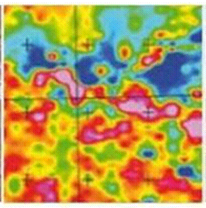
A REVIEW OF THE COPPER PROSPECTIVITY OF THE TETHYAN METALLOGENIC BELT


Report Prepared for:

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Report Prepared for:
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Executive Summary

SRK Exploration Services (SRK ES) has been requested by Metals and Minerals Group (MMG), to undertake a prospectivity review of the Tethyan Metallogenic Belt with the aim of identifying regions with the potential to host 'Tier 1' copper deposits (containing the equivalent of >500 Mt at 1% Cu). MMG have expressed a primary interest in identifying large porphyry copper deposits at any stage of development, but area also interested in the potential of high sulphidation epithermal, sedimentary and IOCG (iron-oxide-copper-gold), polymetallic VHMS (volcanic hosted massive sulphide) and sediment-hosted Pb-Zn prospects. This review has examined the potential for these types of deposit across 20 individual countries from Poland through to Pakistan.

SRK ES has reviewed a large amount of publically available data including academic papers/journals, company websites and press releases and national geological organisation reports. In brief, the following conclusions can be drawn about each deposit type in the TMB;

Porphyry copper deposits

Tethyan porphyry deposits are generally low grade deposits with limited supergene enrichment, either due to erosion of much of the deposit or a lack of supergene forming weathering. However there is particular support for the existence of undiscovered porphyries below and adjacent to epithermal gold and copper mineralisation, as seen in a number of smaller porphyries in Turkey and Romania. It is thought that the specific crustal structural processes that have occurred in South America, forming the numerous very large and high grade porphyry systems in Chile, have not been replicated on a similar scale in the Tethan Metallogenic Belt. It is evident that in localised areas such as southeastern Iran-southwest Pakistan, that tectonic history has caused the formation of a cluster of large porphyries (Saindak, Sarcheshmeh and Reko Diq), but it is unlikely that these conditions extend over the rest of the TMB. Potential for "Tier 1" porphyries is therefore limited to this southeastern part of the TMB, the area in northwest Iran and Lesser Caucasus region and possibly parts of Serbia and Bulgaria.

Sediment-hosted copper deposits

The sedimentary copper deposits found at Aynak, Afghanistan and across Poland contain significant amounts of copper mineralisation. Those in Afghanistan occur over a limited area in a complex zone of microcontinent suturing and structural deformation. All of the listed occurrences in this region are also all thought to have recently been acquired by the China Metallurgical Group Corporation (MCC). The Polish Kupferschiefer deposits occur over a large area with largest mineralised area covering about 350 km². KGHM (Polska Miedz) currently produce from the most prospective zones found to date, however some other companies are currently exploring for extensions to mineralisation on the periphery of these known areas.

Volcanic-hosted massive sulphide deposits

Although VHMS deposits do exist in the Tethyan belt, none are of significant size and dominated by copper mineralisation, the largest being Madneuli in southern Georgia which contains just over 1.3Mt of copper metal (Galley et al, 2007). It is not thought that extensional environments were long lived or widespread during the formation of the TMB. VHMS deposits generally form at ocean spreading centres and in back-arc extensional basins. In the TMB, compression and uplift of the overriding plates dominated, with only minor upwelling of mafic magmas that may form VHMS mineralisation. Some small deposits associated with ophiolite complexes are known (Cyprus, Afghanistan), though again, do not contain large tonnages of mineralisation. VHMS deposits within Europe are mainly held within the Triassic rifting terranes of Cyprus. Cyprus has moderately sized deposits of VHMS but not of the size within the terms of MMG's criteria. There are also a few smaller deposits dotted within the sutures of the Dinaric-Hellenides; again these are of little significance.

Clastic-dominated lead-zinc deposits

Of the world's largest Mississippi Valley and CD-type (clastic dominated) lead-zinc deposits, containing more than 2 Mt of combined Pb-Zn metal, only the Mehdiabad (Iran), Filizchai (Azerbaijan), Boleslaw (within the Krakow-Silesian mining district, Poland) deposits are found to lie in the TMB. A limited number of smaller Pb-Zn deposits, mostly Mississippi Valley type, are found along the northern boundary of the Central Iranian Volcanic Belt. Pb-Zn mineralisation is recorded as vein-hosted occurrences throughout the TMB, deposits in Europe are defined within the Serbo-Macedonian metallogenic province and the Rhodope Massif, these deposits are not of higher tier deposits and will not be interest to MMG.

Highly prospective target regions

SRK ES has selected a number of target regions which are thought to hold significant potential for undiscovered copper mineralisation, forming deposits at a scale of interest to MMG. These selections have been based on the past success of mineral exploration and mining, regional geology and position within the TMB. SRK ES recommends that each of these could host significant undiscovered/underexplored deposits and that, dependant on socio-political risk and MMG's company strategy, any of these regions would be worth pursuing.

- **Chagai Hills, SW Pakistan and southern Afghanistan** – greenfield porphyry Cu-Au and VMS potential.
- **Central Iranian Volcanic Belt, Iran** – greenfield porphyry Cu-Au, VMS and Pb-Zn potential.
- **Alborz Volcanic Belt, NW Iran, and southern Azerbaijan/Armenia**, greenfield porphyry Cu-Au-Mo and VMS potential.
- **Eastern Turkey and Southern Georgia** – greenfield porphyry Cu-Au, VMS and epithermal deposit potential.
- **Panagyrishte District, Bulgaria** – porphyry Cu and epithermal potential.
- **Bor Basin, Serbia and Western Romania and the Apuseni Mountains** – brownfield potential for porphyry Cu-Au deposits.
- **Slovakia/Northern Hungary** – potential for porphyry Cu deposits, possibly below existing epithermal mineralisation
- **South central Poland** – potential lies in extensions of the Krakow-Silesian Pb-Zn mining district and Mo-Cu porphyries along strike of the Myszkow project.
- **Kupfershiefer** – further sedimentary copper potential on the peripheries of the Kupfershiefer in south west Poland.

MMG also posed some specific questions as part of the scope of this review, the answers to which act as a useful summary of this report in addition to the definition of prospective target regions;

1. **Which regions are more fertile, in terms of copper porphyries, than others and why? Why does there seem to be a greater contained copper volume in certain countries?**

Major porphyries have already been discovered and exploited in western Romania, southern Poland, eastern Serbia, throughout Turkey, in southern Armenia, North-eastern and Central Iran and south-western Pakistan. The largest porphyries tend to form clusters of 2-3 large deposits within a 50km radius, reflecting geological factors/triggers that caused voluminous porphyry mineralisation and the results of more intensive near-mine exploration.

The subduction processes involved in the Tethyan orogeny were far more complex than seen in the Andes of South America, and therefore a simple model of porphyry formation cannot be applied to the entire TMB. Certain areas have seen more voluminous intrusive and volcanic activity during the Tertiary that is key to porphyry mineralisation, and other areas have seen increased uplift and erosion, leading to the removal and destruction of any supergene mineralisation, as well as the hypogene porphyry core.

2. **Which areas hold greatest potential for VHMS deposits?**

It is not thought that there is potential for world-class VHMS deposits within the TMB. A significant number of deposits of this type are found in northeast Turkey, though the largest (Madenkoy) contains only 0.8 Mt Cu and 1.3Mt Zn. Further undiscovered deposits are likely to be found beneath the recent volcanics covering much of far north-eastern Turkey and across into southern Georgia and northern Armenia.

3. **Is the IOCG deposit model prospective in the TMB?**

Although some occurrences of copper mineralisation have been attributed to IOCG deposit types, it is not thought that IOCGs constitute a primary target for exploration. The presence of small deposits is likely in areas of magmatic activity and may be used as a guide in porphyry exploration in a similar targeting role as epithermal and skarn mineralisation proximal to porphyry centres.

4. **What potential exists for Kupferschiefer style sedimentary copper deposits?**

The Sedimentary copper deposits in Poland are extensive, containing millions of tonnes of metal. The Polish mining company KGHM currently produce approximately 30 Mt of ore a year from the Lubin, Polkowice-Sieroszowice and Rudna mines and they also hold licences for much of the known deposit area. Some smaller exploration companies are currently running drilling programmes the delineate extensions to currently known mineralisation. The Afghan deposits south of Kabul are also very prospective, though not as extensive in aerial extent. It is also thought that a tender for the development of all the sedimentary prospects in this region has recently been awarded. No further suggestion of basins containing large sedimentary deposits in the TMB has been found.

5. **What potential exists for clastic-dominated (CD) zinc (± lead) deposits?**

There are a limited number of Pb-Zn deposits of note in the TMB, the largest being Mississippi Valley-type deposits in the Central Iranian Volcanic Belt proximal to significant porphyry deposits and south *central Poland. Pb-Zn deposits are not as numerous as copper occurrences and are of much smaller scale. For this reason, their discovery is more difficult, though the regions immediately on the continental side (back-arc basins) of porphyry-bearing volcanic belts, hold potential for sedimentary base metals, e.g. Iran, Poland and Ukraine.*

6. What potential exists for nickel (± copper) deposits, but not lateritic nickel?

The major sources of nickel are found in lateritic weathering profiles, or from magmatic intrusions in which sulphides precipitate out of a fractionating melt. This latter deposit model is associated with (1) deformed greenstone belts and calc-alkaline batholiths associated with convergent plate margins, (2) ophiolite complexes that formed at constructive plate margins, (3) intraplate magmatic provinces associated with flood-basalt type magmatism, and (4) passively rifted, continental margins. Of these only ophiolitic sequences are present in the TMB and these are limited in extent and are not thought to have significant potential for large deposits (Cyprus and sections of Iran, Afghanistan and Pakistan).

7. Which areas are most prospective for greenfield exploration?

The areas selected in Table 25-1*cover both regions of moderate historical exploration activity, as well as regions where minimal commercial exploration has been conducted. Those areas that are most amenable to greenfield exploration of under investigated geology lie mostly in states where access has been restricted in the past. This may be due to the physical terrain of certain mountainous regions being too rough, because of political restrictions effectively closing off countries during times of conflict, or due to a nationalist hostility to foreign investment and exploration projects.*

For this reason SRK ES suggests that south-easternand eastern Turkey, Iran, Azerbaijan, Armenia, Georgia and south-eastern Pakistan possess the greatest scope for picking up licences in prospective areas and beginning mineral exploration from the very basics of geological mapping, GIS interpretation and surface sampling.

Although not specific to the TMB Sillitoe (2010) also gives a good summary of implications of target selection and exploration for porphyry deposits in greenfield and brownfield terranes

8. Do any known porphyry deposits have potential for an unidentified/untested deep hypogene core?

The majority of deposits in the TMB have little or no supergene enriched blanket overlying hypogene mineralisation. Most existing and planned mines exploit low grade hypogene mineralisation, often with copper production supplemented by gold or molybdenum by products. The use of epithermal and skarn deposits as vectoring tools to locate porphyry mineralisation has been proven in Turkey and is expected to be an important factor in the target regions suggested.

The geology of specific mines has not been thoroughly assessed due to the sheer number of deposits present in the TMB. This would, however, be a priority when comprehensively assessing any selected target region/country and the existing deposits/occurrences in more detail at a district, rather than global scale.

9. How does each country rank in terms of political risk

The mining legislation and governmental attitude towards the mining sector has not been evaluated for the countries in this review. It is however evident that in some target countries, such as in the Caucasus region and Iran, investment from international organisations may be more difficult. Pakistan and Afghanistan are becoming much more geared towards international investment in their developing mineral sectors, though the threat from terrorism and organised crime pose a significant threat to operations on the ground.

The prospective regions in the Caucasus are also disputed territories, with Azerbaijan and Armenia, as well as autonomous republics, claiming rights to the land. How mineral licences issued by respective governments would be viewed or respected by these parties is likely to cause some issues.

The prospective regions in Europe are all relatively stable and have no major issues. Difficulties faced by MMG would be minor corruption or petty crime within the government and law. In many of the prospective countries foreign companies are already operating in the minerals sector, indicating a suitable working environment. Ease of obtaining licences and development of mining polices will vary from country to country, however many of them have got established mining sectors.

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May 2012

A REVIEW OF THE COPPER PROSPECTIVITY OF THE TETHYAN METALLOGENIC BELT

1 Introduction

1.1 Background

SRK Exploration Services (SRK ES) has been requested by James Patterson, Exploration Manager for the Metals and Minerals Group (MMG), to undertake a prospectivity review of the Tethyan Metallogenic Belt with the aim of identifying regions with the potential to host "Tier 1" copper deposits. It is understood that this regional review will act as a basis on which MMG may plan further target generation and exploration work.

1.2 Terms of Reference

MMG has provided a detailed scope of work that can be summarised as follows;

MMG Exploration is primarily looking for large porphyry copper (± gold and molybdenum) deposits capable of providing "Tier 1" level resources, (greater than 500 Mt @ 1% Cu equivalent). Other deposit types that are of interest include high-sulphidation epithermal (Cu dominant), Iron-Oxide-Copper-Gold (IOCG), sedimentary copper, polymetallic volcanic-hosted massive sulphide (VHMS) systems, sediment hosted lead-zinc deposits and magmatic nickel deposits.

The map in Figure 1-1 shows the countries which MMG have requested are reviewed. The area of interest covers the entire Tethyan Metallogenic Belt (TMB) and includes Slovakia, Hungary, Romania, Serbia, Kosovo, Bulgaria, Macedonia, Greece, Turkey, Armenia, Azerbaijan, Iran and Pakistan as well as portions of Poland, Czech Republic, Ukraine, Montenegro, Bosnia and Albania. SRK ES also suggests that certain regions of Georgia and Afghanistan (highlighted in orange) also be reviewed for completeness of the objectives of this commission.

SRK ESs brief was to focus primarily on the geological prospectivity of the entire region, aiming to highlight areas most likely to host the required type and size of deposit. It will not be necessary to define specific targets/anomalies or review exploration and mining licences within prospective regions.

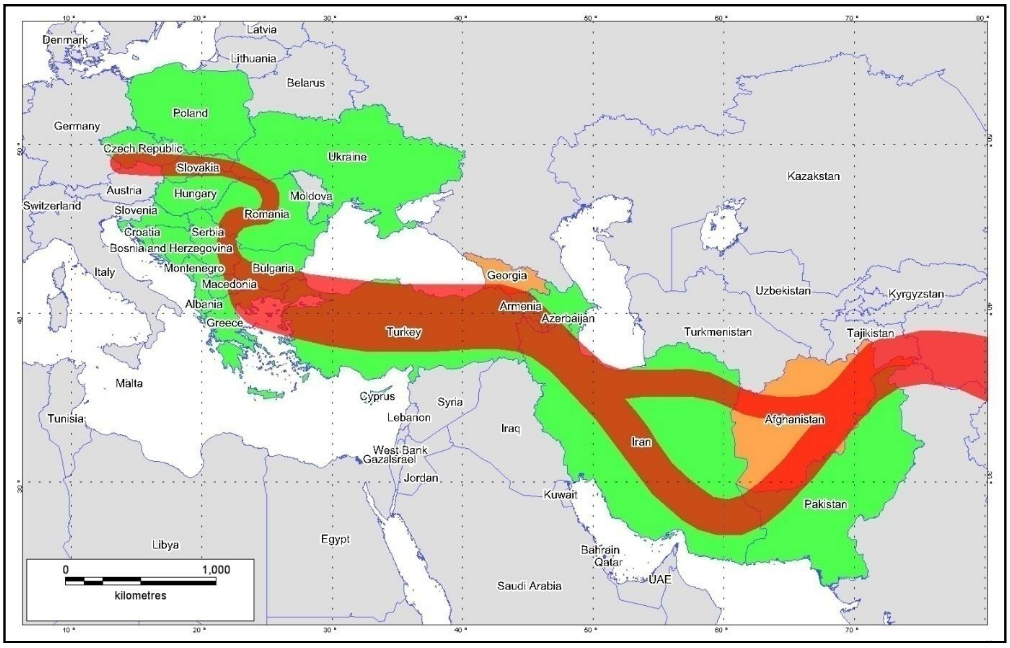

Figure 1-1 Map showing the approximate extent of the Tethyan Metallogenic Belt (red). Countries coloured green are investigated in this review. SRK ES recommends that parts of the orange coloured countries are prospective and should also be reviewed.

MMG have requested that this review addresses the following questions;

1. Which regions are more fertile, in terms of copper porphyries, than others and why? Why does there seem to be a greater contained copper volume in certain countries?
2. Which areas hold greatest potential for VHMS deposits?
3. Is the IOCG deposit model relevant and prospective in the TMB?
4. What potential exists for Kupferschiefer style sedimentary copper deposits?
5. What potential exists for clastic-dominated (CD) zinc (± zinc) deposits?
6. What potential exists for nickel (± copper) deposits, but not lateritic nickel?
7. Which areas are most prospective for greenfield exploration?
8. Do any known porphyry deposits have potential for an unidentified/untested deep hypogene core?
9. How does each country rank in terms of political risk?

Provided with this report is a digital dataset containing most data sources that have been reviewed during this commission. This includes geological maps at various scales, certain company reports found on the websites of exploration/mining companies and reports from national geological survey organisations. Due to the legal implications of distributing materials from subscription sites in a commercial context, references for journal articles and papers reviewed are listed in the Appendix of this report.

Although geophysical and geochemical datasets have been reviewed, it has not been deemed necessary to thoroughly interrogate such data. This has mostly been due to the unavailability of national-scale datasets. Countrywide geochemical and geophysical surveys may be commissioned by the government of each respective country and are often only released for a fee. A complete interpretation of these datasets would constitute a significant targeting exercise in itself and beyond the scope of this review. It would be a priority however, once target generation exercises begin, to acquire any geophysical or geochemical datasets pertaining to the country/region of interest and perform a complete interpretation of these results to identify potential porphyry systems.

Also accompanying this report is a spreadsheet of known copper deposits across the TMB. This has been compiled from a number of United States Geological Survey (USGS) databases as well as from the Metals Economics Group (MEG), Intierra and Infomine web services. SRK ES has attempted to confirm and validate the data in this database, but it must be noted that many occurrences and early-stage exploration projects are not widely publicised, with few (if any) announcements of project status, grade, or even ownership made in the public domain. Any estimates quoted for contained metal or deposit tonnages have not been independently verified, merely transcribed from websites or reports relating to the deposits. It is also not practical to list or illustrate every occurrence of copper mineralisation across the TMB, but the distribution of the largest deposits so far discovered and investigated will provide enough guidance for estimation of prospectivity.

This report has been constructed in a geographical manner, beginning in the north-western region of the TMB and moving progressively further southeast on a country-by-country basis. The review of certain nations has been grouped because of the similar geological history and prospectivity of each being intricately linked. The scarcity of research in certain underexplored or newly accessible regions is also reflected in the number of known deposits in these countries, as well as the ability to comprehensively review their prospectivity.

2 Tethyan Metallogenic Belt

2.1 Definition/Extent

The Tethyan Metallogenic Belt (TMB), also referred to in literature as the Tethyan Eurasian Metallogenic Belt (TEMB), represents a global metallogenic province formed by numerous orogenic processes during Mesozoic and post-Mesozoic times. The belt stretches for almost 10,000km from Western Europe, across southern Asia to the Pacific, between the Afro-Arabian and Indian plates in the south and Eurasian plate to the north, along the line of the ancient Tethys Ocean. Major regions of structural importance, such as the European Alps, the Eastern Pontides, Lesser Caucasus, the Hindu Kush and the Tibetan Plateau (Figure 1-1 and Figure 2-1).

The belt is of significant economic importance for its world-class deposits of gold, copper, lead, zinc, molybdenum and silver. These are distributed along the entire length of the TMB, though different types of deposit can be identified and spatially grouped by the timing and style of formation.

2.2 Tectonic History/Formation

The general geotectonic evolution of the domain where the TMB was formed is closely connected with the history of the former Tethys Ocean; its opening, the development of island arcs and microplates, its closure, the suturing of microplates with Eurasia and the collision/subduction of oceanic and continental crust. The formation of the Tethys seas, breakup of the Pangean supercontinent and subsequent closure of the Tethys over the last 200Ma is well documented. Only a summary of this structural development is presented here.

Around 200 Ma during the Early Jurassic, the Cimmerian Plate (previously detached from southern Pangea/Gondwana) moved northwards and collided with Laurasia in the Cimmerian Orogeny which created the large mountains ranges seen across much of present-day Turkey, Iran and Tibet. A stalling of Cimmeria's northward movement caused buckling and subsequent subduction along its southern edge, forming the Tethyan Trench. A shallow Neo-Tethys sea opened up in this trench covering significant portions of present-day Europe. Between 150-100 Ma rifting in the young Atlantic Ocean began to separate Gondwana and Laurasia resulting in the Tethys to stretching around the entire Equator.

Contemporaneous continental rifting within Gondwana began to break up the supercontinent. India and Africa-Arabia began to drift north towards Laurasia, of which Cimmeria now formed the southern coast, eventually colliding with Asia c. 30 Ma. It was at this point the Alpine Orogeny formed the mountain ranges of the Alps, Caucasus, Zagros Mountains, Hindu Kush, Parmirs, Sulaiman, the Iranian plateau, the Himalayas, the Tibetan Plateau, and the Burmese highlands.

The Tethys continued to close until about 15 Ma, with the majority of the oceanic plate subducting under the continental plates to the north. The Tethys was not technically a single oceanic plate, but a compilation of smaller microplates and subcontinents, oceanic crust, island arcs and remnant thinned continental crust covered by a shallow sea. It is thought that the present Caspian Sea and Aral Sea are crustal remains of the Western Tethys Sea, with the Black Sea possibly representing the remains of the older Paleotethys Ocean. A useful animation depicting these movements has been created from images produced by Dr Ron Blakey, and can be viewed at the following web address, http://vimeo.com/14507389.

2.3 Metallogenesis of the TMB

The formation of different types of mineral deposits in the TMB can be broadly attributed to the different stages of tectonic development and large scale structural processes. Four main settings are described that account for the formation of significant mineral deposits across the TMB (Jankovic, 1997);

- Intracontinental rifting;
- Ocean floor spreading;
- Subduction zone processes; and,
- Post-collisional continent-continent magmatism.

2.3.1 Intracontinental rifting

During the intracontinental rifting of Gondwana lateral spreading and crustal thinning occurred creating graben floors. These largely failed to progress to the formation of ocean floor. Rifting was accompanied by the emplacement of calc-alkaline igneous plutonic complexes that, along with other mafic and intermediate intrusives, provided a source of ore metals, fluids and heat to power hydrothermal metallogenesis. The three principle morphogenetic types of deposit associated with this phase of the TMB formation are;

- Rare iron oxide skarn deposits associated with subvolcanic hypabyssal intrusions.
- Volcanogenic hydrothermal and volcanogenic sedimentary close to or at the sea floor. Small ore deposits can be associated with shallow intrusives, but the general absence of large copper deposits is characteristic.
- Low temperature carbonate-hosted lead-zinc sulphide deposits located along continental margins.

2.3.2 Ocean floor spreading

A number of tectonic regions of the Tethys Ocean floor, e.g. active spreading centres and hot spots, which developed after extensive continental rifting, are thought to host mineral deposits. These ophiolite-related deposits include;

- Podiform chromite deposits are widespread across the Dinarides and Albanides of south-eastern Europe and across Turkey, forming at multiple levels in the ophiolite sequence.
- Ni-Cu-Co sulphides found locally in serpentinites
- Titaniferous magnetite veins and lenses forming sporadically throughout gabbros.
- Volcano-sedimentary seafloor (VHMS) Cyprus-type pyritic copper-sulphides and bedded ferromanganese deposits associated with pillow lavas are also found sporadically.

2.3.3 Subduction zone processes

As part of the process of the closure of the Tethys, oceanic crust began to subduct below the European/Asian continental crust causing the formation of numerous multiphase/composite calc-alkaline and alkaline volcanic intrusive complexes. The emplacement of mid-crustal, subvolcanic granite, granodiorite, quartz-diorite porphyries was common. The most important types of mineral deposits include;

- Copper porphyries. A number of major copper deposits have been identified in the recent past, often with distinct vertical and horizontal zoning of mineralisation due to the hydrothermal processes during formation. The Cu-Mo concentrations are often related to the deeper cores of depositsand can be overlain by Pb-Zn and/or gold mineralisation.

- Skarn deposits commonly form in the contact zone between intrusions and their host rocks. Dominant ore components include iron, base metals, and locally molybdenum and boron.

- Volcanogenic hydrothermal deposits are commonly found at sub-volcanic levels, genetically related to deep-seated magmatic sources. The spatial distribution of these deposits is often defined by volcanic structures and deposit types can be divided as follows;

    - cupriferous pyrite deposits

    - replacement type deposits formed sporadically above porphyry copper systems,

    - polymetallic massive sulphides with high gold contents; and

    - conglomerate hosted copper deposits.

- Lead-zinc deposits closely associated with fracture systems within andesite-dacite volcanics, often close to caldera structures.

- Epithermal Au-Ag vein and stockwork deposits at subvolcanic levels.

2.3.4 Post-collisional continent-continent magmatism

It is thought that some deposits are related to later re-melting of continental crust near suture zones, particularly in the western parts of the TMB, causing the formation of a range of mineralisation styles. Lead-zinc and antimony are the dominant metals, though porphyry copper deposits can occur at the contact zone between two tectonic blocks, e.g. in Serbia. Molybdenum vein deposits can occur sporadically in association with porphyry systems, sometimes in large volumes, but are often low grade. Hydrothermal magnesite and boron are also common in Neogene basins proximal to volcanic centres.

2.4 Geology

Whilst the geology across the Tethyan is highly variable, though often the same sequential or concurrent cycle of tectonic and orogenic history can often be observed in multiple countries. For this reason, the geology of the Carpathian Mountain Belt and the Apuseni-Banat-Timok-Srednogorie Belt in Eastern Europe, which cover multiple countries, are described separately prior to discussing the prospectivity of individual states.

Due to the association of large scale copper mineralisation with back-arc areas behind subduction zones, as described in the third metallogenic setting above, those areas in the TMB containing volcanic and intrusive igneous lithologies that are of late Proterozoic and Tertiary age are of particular interest in this review.

The geology used as a base map in all deposit/occurrence maps (found in Appendix 1Appendix 1: Regional copper deposit distribution maps) has been compiled and simplified from various USGS regional maps and is colour coded by generic rock type (sedimentary, metamorphic, volcanic, igneous intrusive etc). It is clear that the volcanic lithologies (red) follow linear trends parallel to subduction fronts where various crustal blocks have collided. It is also clear in Iran, for example, that multiple linear regions of volcanism have formed due to the complex interaction of multiple subduction zones between microcontinents. These generalised regional geological maps have been included as A3 reference maps in the appendix rather than within the report itself.

2.5 Deposit Models

It is important to understand the different types of deposit when considering targeted exploration so that certain targets can be quickly dismissed from further consideration and other more prospective targets can be pursued. The following deposit models summarise the main characteristics of the most significant styles of copper mineralisation and highlight key features which may help in identifying new geologic regions with potential to host each major deposit type.

Figure 2-1 shows the distribution of the 83 largest copper deposits as defined in the USGS deposit databases, all containing greater than 5Mt of copper metal. The dominance of large porphyry systems along the western margins of North and South America and in the Philippines is evident. Within the Tethyan belt countries, only the sedimentary deposits of Poland, the Bor Basin region in Serbia and the large porphyries in Iran and Pakistan are large enough to be included in this map.

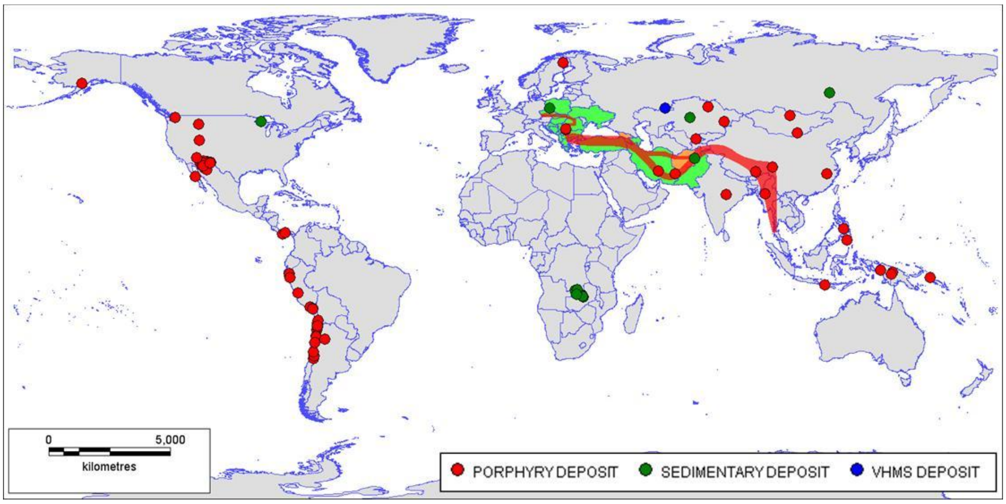

Figure 2-1 Global distribution of copper deposits containing >5Mt of copper metal. Approximate extent of the TMB defined by the red band and countries coloured green and orange are to be covered in this review.

2.5.1 Porphyry Copper Deposits

Porphyry copper deposits are the world's most important source of copper metal, accounting for almost 60% of production, as well as considerable resources of molybdenum, gold and silver. They often form very large deposits (>100Mt) of low grade copper mineralisation (2008 average of 0.44% Cu), resulting in large, long-life, typically open-pit mining operations (John et al., 2010).

Deposits are widespread but are generally localised in time and space within the evolution of island arcs in a convergent plate subduction setting (Figure 2-2). Upon subduction of oceanic crust, partial melting of hydrous lithosphere creates large, buoyant volumes of intermediate to silicic magmas that rise up into the overlying crust and emplace at 5-10km depth where density contrasts decrease, to form subvolcanic batholiths and plutons. Early exsolution of hydrous fluids occurs as the magmas cool and crystallise, partitioning metals into a chloride-rich vapour phase. Garson and Mitchell (1977), suggest that the largest deposits of the Andes formed along strike-slip faults that extended throughout the crust during intrusive magmatism parallel to the subduction zone. These faults extended down to the zone of partial melting and provided pathways for dykes and intrusives to migrate upwards and begin the formation of porphyry mineralisation higher in the crust.

Porphyry deposits are often centred on a small cylindrical porphyry stock or swarm of dykes often referred to as a "barren" core due to the low metal grades present. Concentric shells, identified by varying intensities of hydrothermal alteration, surround this core with Cu grades generally decreasing with distance outwards. Ideal porphyries may appear to be "plug-like" intrusions surrounded by concentric rings of shallow dipping and radial steeply dipping faults and fractures. However, due to differential principal horizontal stresses, they are often characterised by steeply dipping, sheeted and parallel veins surrounding a dyke like porphyry core.

Undeformed deposits often have a circular to elliptical shape in plan view with a diameter of 0.1-1km and a vertical extent of 1-1.5km in section (Figure 2-3). However, mineralised rock can continue several kilometres further below and outwards from the primary hypogene zone and alteration haloes much wider and deeper still. It is for this reason that the limits of any given deposit are defined by assay, copper grade and the economics of mining decreasing grade ore at increasing depth.

Larger porphyry deposits may comprise several adjacent porphyry cores with overlapping and integrated alteration zones. Sequential or concurrent emplacement of porphyry cores can lead to multiple phases of mineral enrichment and/or depleation within these larger systems. The Pakistani Reko Diq project is an excellent example of multiple porphyry cores where the current published resource is based on only around four of over a dozen identified porphyries in close proximity to one and other.

The hypogene mineralisation (primary mineralisation) in porphyry copper ore is predominantly chalcopyrite, which occurs in almost all deposits, and bornite, which is found in about 75% of them. Molybdenite is the only molybdenum mineral and is found in about 70% of deposits and is found in grades from 0.001-0.1% (2008 average of 0.018%). Gold and silver occur in about 30% of deposits within the bornite and chalcopyrite crystals. Average grades in 2008 were 0.16 g/t and 2.67 g/t respectively. Other hypogene minerals are quartz, pyrite, sericite (muscovite; potassium mica), chlorite, epidote, biotite, potassium feldspar, magnetite, and anhydrite. Hypogene copper can be found as disseminated anhedral-subhedral crystals in host rock that replace feldspars, in veins up to several centimetres wide with quartz, pyrite and other hypogene minerals, and in breccia matrices with millimetre to centimetre quartz grains and variably composed clasts.

Supergene processes may create a further zone of secondary copper enrichment overlying the primary hypogene ore. Descending oxidised acidic groundwaters dissolve hypogene mineralisation and redeposit copper minerals in low-temperature, reducing environments, i.e. just below the water table. The results in a leached gossanous cap overlying supergene mineralisation and primary hypogene ore below that. It is not uncommon to find polymetallic replacement type deposits some distance from the main porphyry (as seen in Figure 2-3 and Figure 2-4) or skarn deposits proximal to the porphyry stock where interaction with host rocks has occurred.

Many porphyry deposits are rich in gold, as well as or dominant over copper mineralisation. For this reason, many deposits are exploited for gold as a primary commodity with copper only classified as a by-product, despite in some cases the copper content being significant itself. Gold concentration is often higher in the peripheral alteration zones surrounding a porphyry core, in near-by epithermal deposits and in distal skarn or polymetallic replacement deposits. Though this association is not always present, these “satellite” deposit types may be used as indicators of the existence of a porphyry centre near-by during exploration.

Extensive detail regarding the formation and characteristics of this type of deposit is presented in John et al. (2010) in their USGS report titled “Porphyry Copper Deposit Model”.

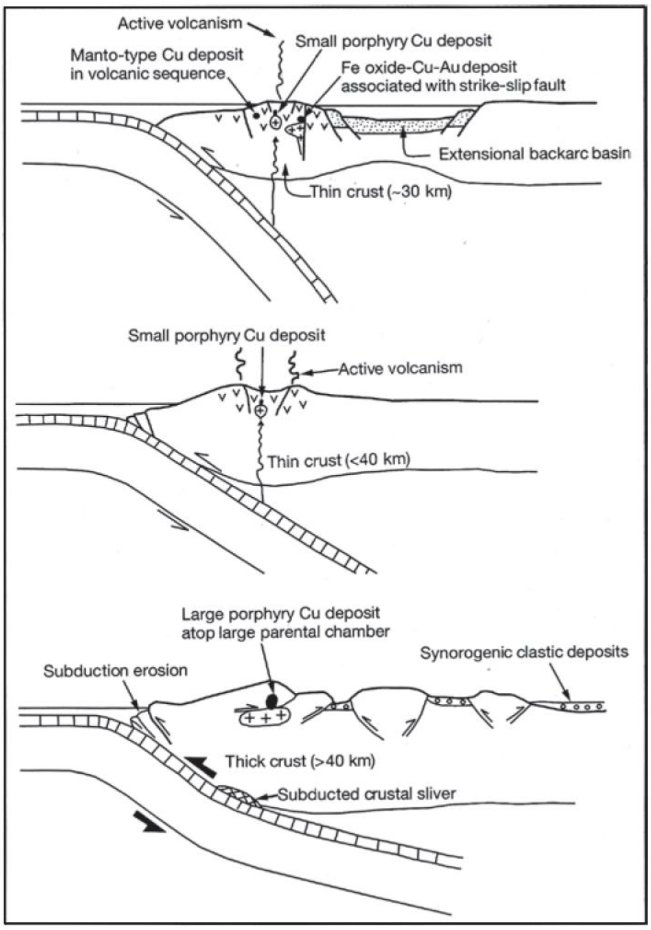

Figure 2-2 Generalised tectonic conditions required for the formation of giant porphyry systems (from Sillitoe and Parelló, 2005)

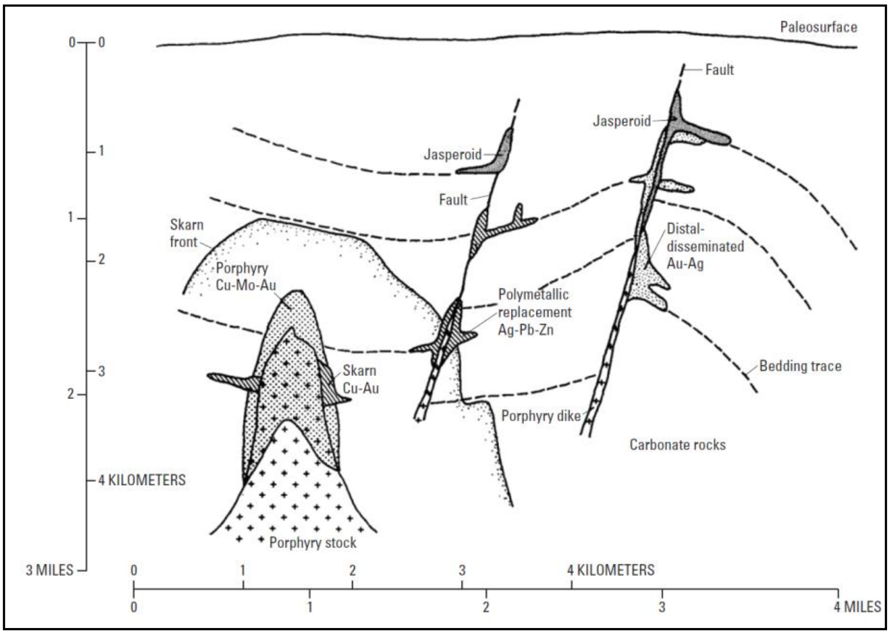

Figure 2-3 General setting of porphyry copper and associated deposit types (from John et al., 2010). Erosion may result in removal of some or all of the upper 3km, including mineralisation.

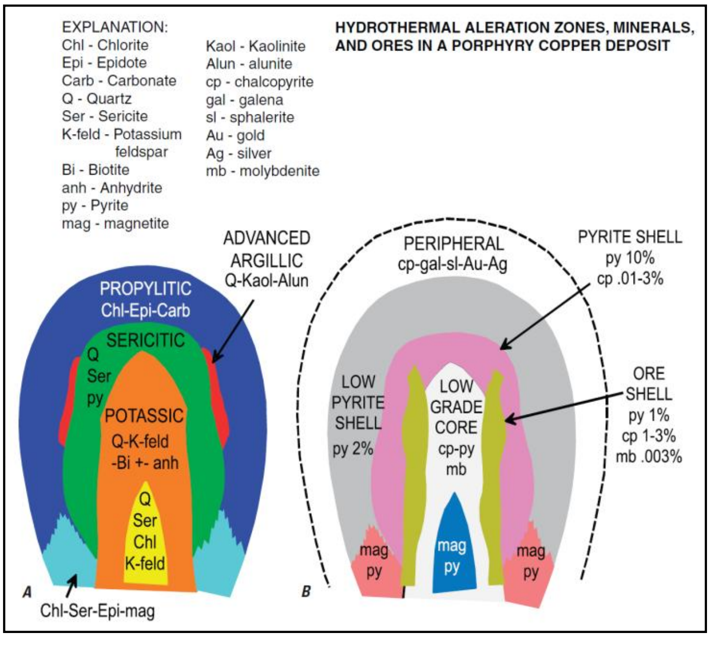

Figure 2-4: ***Simplified deposit porphyry copper deposit model (from John et al., 2010). (A) Schematic cross section of hydrothermal alteration minerals and types. (B) Schematic cross section of mineral ores associated with each zone of alteration. (This is referred to as the Lowell-Guilbert style model at times in this report)***

2.5.2 VHMS Deposits

Volcanogenic Massive Sulphide (VHMS) deposits typically occur as lenses or stratiform bodies of polymetallic massive sulphide that formed at or near the sea floor in submarine volcanic environments. They occur in extensional tectonic settings, typically mid-ocean ridges and back-arcs, where thinning of the oceanic crust leads to upwelling and intrusion of felsic to mafic magmas, frequently through a number of phases, and the establishment of hydrothermal convection at and below the seafloor. Massive sulphide precipitation forms globally significant deposits of copper, lead-zinc, gold and silver, often with by-products of Fe, S, Co, Sn, Ba, Se, Mn, Cd, In, Bi, Te, Ga, Ge and Hg (Shanks et al., 2009).

Most VHMS deposits have two components to their structure. Primarily there is a mound-like to tabular body of massive sulphide (40%), quartz and subordinate phyllosilicates and iron oxides, and altered host lithologies. Below this typically lay stockwork-like arrangements of veins and disseminated sulphides. Surrounding this there is a series of distinctive alteration haloes that may stretch laterally for many kilometres. Below the stockwork can be found a high-level, sill-like magma source that provided the heat necessary for hydrothermal circulation. This may even take the form of a composite intrusion up to 2000m thick and over 15km in length. Typically however, VHMS deposits extend 100-500m laterally are up to 100m thick and have down-dip extensions of over 2000m.

Most authors now use a classification of VHMS deposits similar to that seen in Figure 2-5 (Galley et al., 2007), which discriminates deposits based on host-rock lithology extending 3000m below the deposit and up to 5000m horizontally. VHMS deposits that form in mafic dominated settings (upper and middle left) tend to have higher copper contents, whereas those with felsic successions appear to be more Pb-Zn rich. Where sedimentary successions are found to host VHMS deposits, the mineralisation is much more enriched with lead and silver. Extensive iron formations and other hydrothermally precipitated chemical sediments are also common surrounding deposits where sedimentary clastic lithologies are present, e.g. chert, jasper and Fe-Mn formations in the lower right diagram.

The distribution of existing VHMS deposits suggests that they are found in districts related to a volcanic source at depth and to a regional alteration system. The distribution of individual deposits within this district is dependent on the synvolcanic faulting of the district relative to the underlying intrusion as these will have acted as conduits for mineralising fluid flow. Continued activation of these faults throughout multiple phases of magmatic and hydrothermal activity may produce deposits with multiple stratigraphic levels of mineralisation.

VHMS deposits, as with porphyry systems, can exhibit a supergene cap of increased grade mineralisation caused by remobilisation of metals under REDOX (variable reduction-oxidation) conditions. This is again overlain by an intensively leached, iron-oxide rich gossan that extends upwards to the paleosurface.

Principle exploration guides for finding new VHMS deposits include, on a regional scale, identification of potential “districts” with known deposits and favourable volcano-sedimentary lithologies, identification of large subvolcanic sills and/or dykes and the presence of iron-rich exhalites. On a small deposit-scale, identification of alteration haloes in country rocks, geochemical signatures and strong electrical, magnetic and gravitational geophysical anomalies will further direct exploration activities.

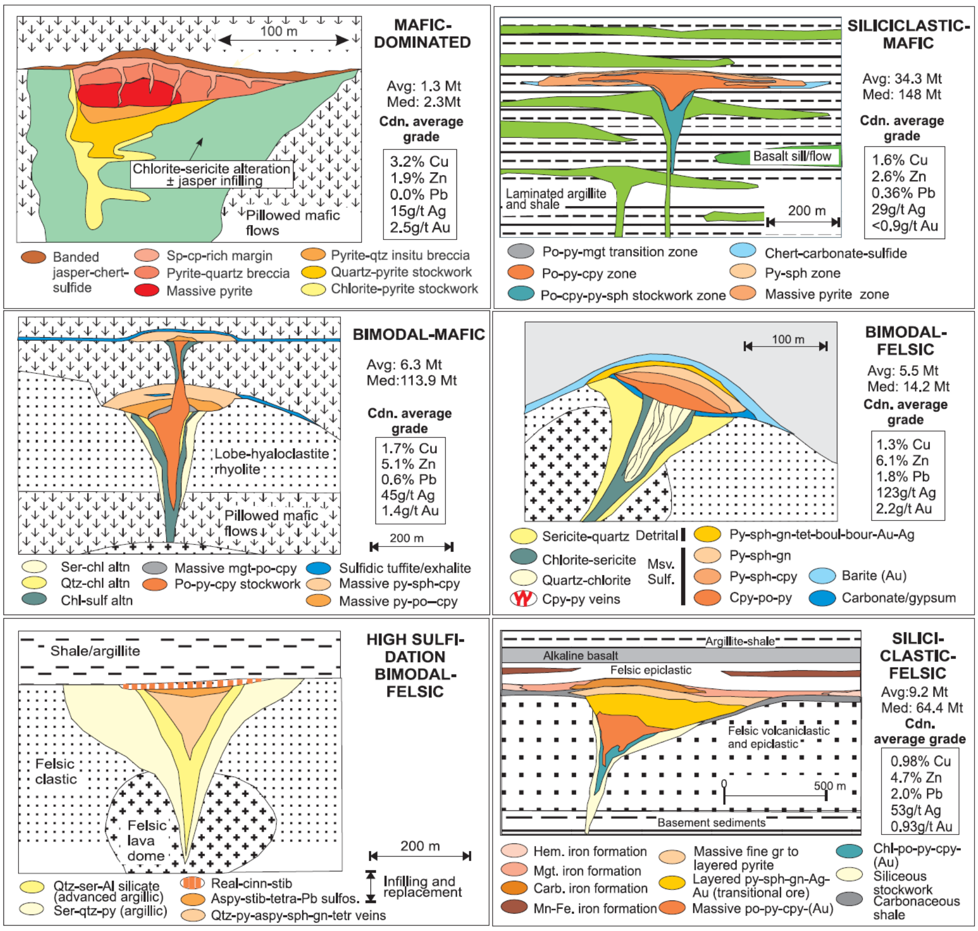

Figure 2-5 Lithological classification for VHMS deposits, with "high-sulphidation" type an added sub-type of the bimodal-felsic group. Average sizes and grades stated are for Canadian deposits. (Galley et al., 2007)

2.5.3 Sediment Hosted Copper Deposits

Sediment-hosted stratiform copper deposits comprise of disseminated and vein-hosted copper and copper-iron sulphides in siliciclastic or dolomitic sedimentary rocks and account for some 23% of global copper production and resources. They are common in occurrence, but rarely economical. Formed throughout the evolution of basins of varying size, unlike other hydrothermal porphyry and VHMS deposits, require no magmatic component to provide fluids or a source of metals, but instead are dependent on intrabasinal fluid movement. This source is invariably red-bed sedimentary rocks containing Fe-oxyhydroxides capable of weakly binding metals. Sulphur from evaporites or hydrogen sulphide-bearing hydrocarbons, along with moderately saline fluids at moderate temperatures, causes the redistribution of metals and deposition in areas of reducing conditions. Deposits form best in areas of high fluid throughput such as at basin margins, a constriction in the thickness of the red-beds, variations in paleotopography or where permeability contrasts occur. The largest deposits have formed where prolonged fluid flow has allowed significant build-up of metal bearing fluids, reduced sulphur and large amounts of reductants.

Three “supergiant” deposits (the Permian Kupferschiefer of central Europe, Neoproterozoic Katangan basin in the Central African Copperbelt and the Paleoproterozoic Kodaro-Udokan basin in Siberia) exist, each containing more than 24Mt of copper metal. As well as these, three “giant” deposits each contain >2Mt of copper (the Devonian-carboniferous Chu-Sarysu basin in Kazakhstan, the Middle Proterozoic Mid-Continental Rift in the United States and a Neoproterozoic-Cambrian basin in Afghanistan). Mineralisation generally forms parallel to the host-rock layering, hence the stratiform designation, in beds ranging up to 30m in thickness, but commonly <3m. The lateral extent of mineralisation is variable, up to 800,000km² in the case of the European Kupferschiefer deposit, though zones of economic grades are more restricted to less than 0.1% of this. Figure 2-6 shows the distribution of selected major deposits with geologic age.

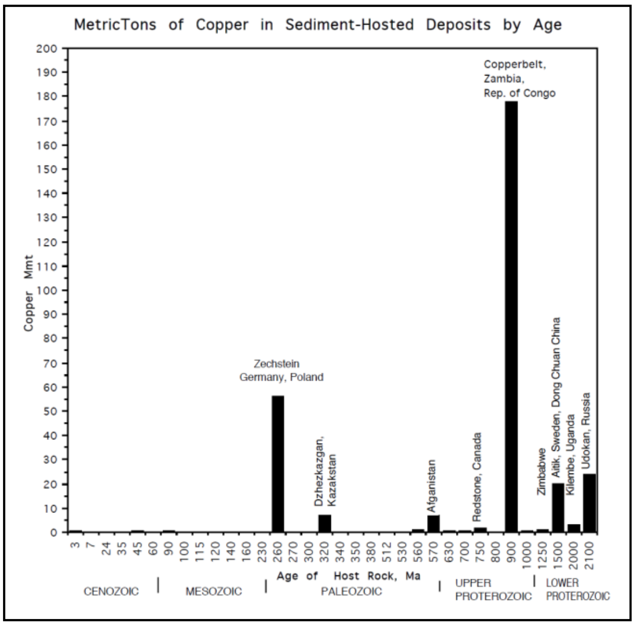

Figure 2-6 Distribution of copper across sedimentary deposits of varying age, (from USGS, 2007).

Figure 2-7 shows the key stages in formation of sediment-hosted copper mineralisation within an evolving basin;

1. Following a major marine transgression, carbonaceous sediments begin to be deposited in a basin already containing a thick sequence of continental redbeds overlying impermeable basement rocks. Fluid movement under gravity and compaction produces low temperature saline brines that are capable of mobilising copper minerals and forming disseminated mineralisation within the redbed sequence, below trapped hydrocarbons or within the carbonaceous sediments.

2. A significant thickness of marine sediments and evaporites forms in the basin. Brines developed from evaporite dissolution enter the redbed sequence and contribute to the fluid convection already established. Focused mainly by the basin-edge structures, these fluids form diagenetic copper-iron sulphide deposits adjacent to hydrocarbon traps and along the base of the marine sediment sequence.

3. The basin now undergoes compression and local inversion. The evaporites have largely disappeared through dissolution and salt tectonism, entering the redbed fluid convection system through basin-bounding faults. At this later stage of evolution the fluid temperature (50-400°C) and salinity within the basin could be expected to be higher, assisting further with metal transport. Sediment-hosted stratiform copper deposits form at various levels upon interaction with hydrocarbons or where fluids meet reductants in carbonaceous shales and fractures higher in the basin stratigraphy.

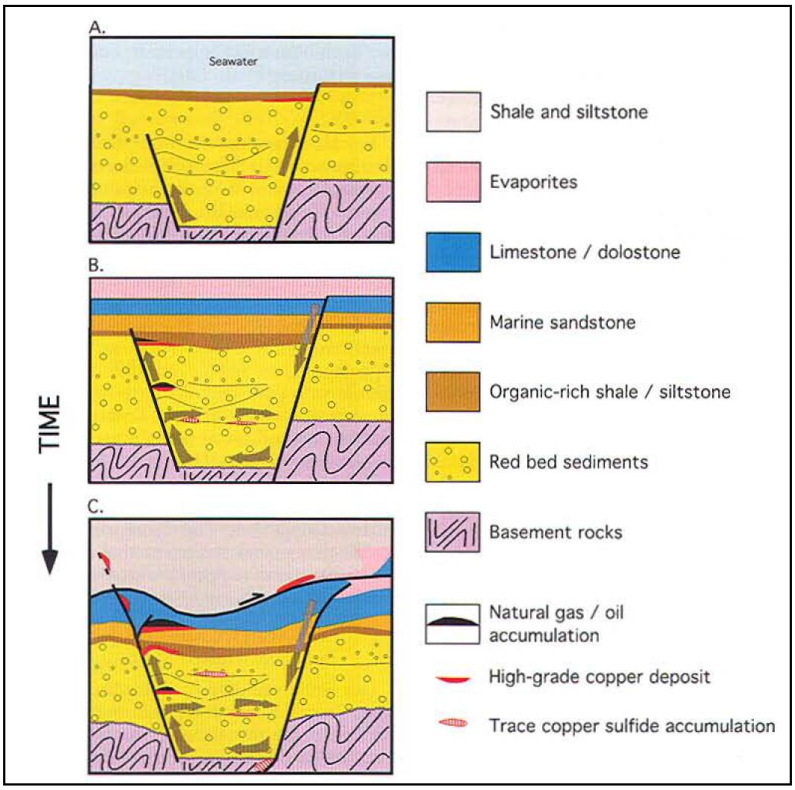

Figure 2-7 Schematic model for the formation of sediment-hosted stratiform copper deposits in an evolving basin (Hitzman et al., 2005). See text for description.

In terms of exploration for model sedimentary copper deposits, large basins with extensive thicknesses of oxidised siliciclastic sediments are needed. An overlying succession of reductant-bearing organic-rich or carbonaceous sediments are favourable, as is the presence of evaporite sequences or proximal sources of brines. There will be a distinctive regional and basin scale alteration patterns associated with regional flow of evaporitic brines (hematitic, sodic, potassic and magnesian), as well as evidence of zone of sub-economic copper mineralisation. These may be at different stratigraphic levels to the high grade mineralisation elsewhere in the basin.

2.5.4 Cu-dominated High-Sulphidation Epithermal Deposits

Epithermal deposits are Au-Ag-(Cu) deposits which form due to magmatic hydrothermal action at shallow depths in the earth's crust (50-1000m) and at low temperatures (160 and 270°C). There are two contrasting styles of mineralisation, termed high-sulphidation (HS) and low-sulphidation (LS), relating to the oxidation state of sulphur in the ore carrying fluids. HS epithermal deposits are of interest in this case. LS epithermal deposits are more enriched in silver, but less so in copper.

Magmatic fluids, derived from the deeper porphyry stock, ascend through the volcanic arc, boiling on ascent and becoming highly acidic/oxidised (pH 1-3) as SO_2 and CO_2 partition into the vapour phase (Figure 2-8). The acidic fluids leach metals from the volcanic host rocks, resulting in a vuggy, quartz-rich texture and advanced argillic alteration (hydrothermal alteration of wall rock which introduces clay minerals including kaolinite, smectite and illite). As the fluids rise up through the crust, the pressure and temperatures drop until the volatiles condense and the hydrothermal fluids precipitate copper (and gold) as massive mineralisation in dilatational structures, grading upwards to disseminated mineralisation in which copper decreases and gold becomes dominant. Mineralisation in HS epithermal deposits comprises pyrite-rich sulphide assemblages including minerals like enargite, luzonite and covellite.

It has been shown that HS epithermal deposits are therefore related to the intrusive porphyry stocks responsible for forming porphyry copper deposits. It is not uncommon for HS epithermal deposits to track downwards, with increasing copper grade, into true porphyry deposits. This should be considered as an exploration tool in the identification of potentially much large undiscovered porphyries under known epithermal deposits (Figure 2-8). One such example is the Lepanto epithermal Au-Cu and Far Southeast porphyry Cu-Au deposits on Luzon in the Philippines. This relationship is rarely recorded, possibly due to the part-erosion of many pairs, leaving only the deeper porphyry, or classifying the HS epithermal mineralisation as distal or hypogene porphyry with low Cu grade.

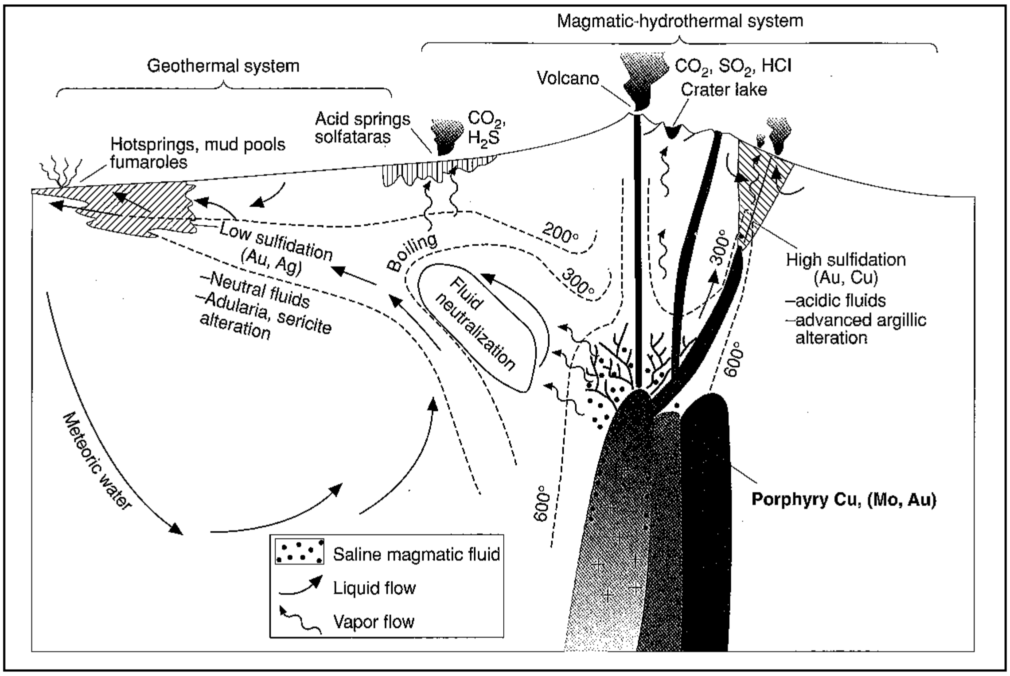

Figure 2-8 The geological setting and characteristics of high-sulphidation epithermal deposits. Note the genetic and spatial relationship with porphyry copper mineralisation and Au-Ag low-sulphidation epithermal mineralisation. (From Robb, 2008)

2.5.5 IOCG Deposits

The term Iron Oxide Copper-Gold (IOCG) deposit was first introduced by Hitzman (1992) when attempting to characterise Proterozoic iron oxide (Cu-U-Au-REE) deposits. The exact definition and form of IOCG deposits has been contested for some time now since the discovery of the giant Olympic Dam Cu-U-Au deposit in 1975 by Western Mining Corporation in Australia. A wide variety of deposits have since been classified as IOCGs, despite showing a wide diversity of age, geochemical signature, mineralogy, host rock and geological setting. Groves et al. (2010) suggest that until now a number of the previously defined IOCGs have in fact been misclassified and in fact represent porphyry, skarn, epithermal or carbonatite related deposits with or without economic grades of copper and/or gold.

An IOCG deposit is defined by Groves et al. (2010) as having the following characteristics;

- a magmatic-hydrothermal deposit that contains economic copper and gold grades,
- is structurally controlled and commonly contains significant volumes of breccia,
- is commonly associated with pre-sulphide sodic or sodic-calcic alteration and shows alteration and/or brecciation zones on a large, commonly regional scale relative to mineralisation,
- has abundant low-Ti iron oxides and/or iron silicates intimately associated with, but generally paragenetically older than Fe-Cu sulphides,

- is enriched in Light Rare Earth Elements (LREE) and has low sulphides (i.e. lacking abundant pyrite),
- lacks widespread quartz veining or silicification,
- and shows a temporal, but not close special, relationship with major magmatic intrusions.

This definition distinguishes IOCGs from most other hydrothermal Cu-Au deposits where pyrite dominates, other copper sulphides and gold are subordinate and quartz veining and silicification are commonly found alongside iron oxides.

These IOCG deposits fall into just five provinces found mostly in stable Archean craton or areas of Phanerozoic crustal extension/reassembly. Very few contain resources of greater than 500Mt @1% Cu equivalent, a target resource value set by MMG as a benchmark for this review (Figure 2-9).

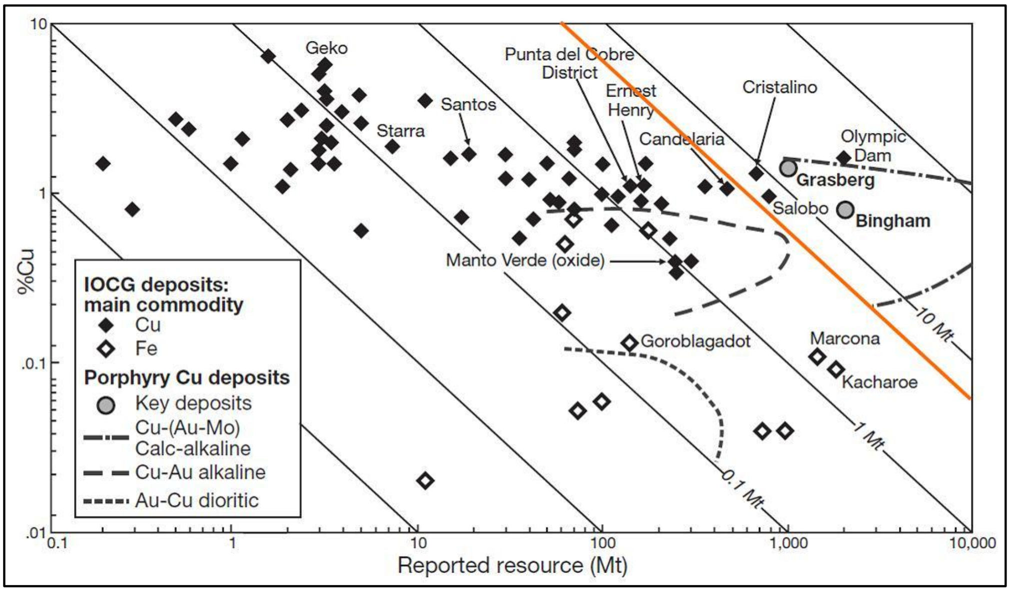

Figure 2-9 Grade-tonnage data for IOCG and related Fe-oxide hydrothermal systems. Two key porphyry deposits are shown, as are envelopes for porphyry types. To the right of the orange line lie deposits holding >5Mt of contained Cu (after Williams et al., 2005)

The tectonic, magmatic and hydrothermal processes involved in the formation of IOCGs is equally as debated as the decription of the deposit model itself. Groves et al. (2010) suggest that partial melting of subcontinental lithospheric mantle (SCLM) produces basic and ultrabasic melts, enriched in volatiles, Cu and Au (Figure 2-10). This melt ponds at the lithoshphere-crust boundary and creates felsic magmas by melting the continental crust. These rise first creating mid-crustal plutons, followed by mafic magmas, forming multiple phases of intrusion. Large volume volatile exsolution at depth creates giant breccia pipes with silicate rocks being replaced by Fe-oxides, followed by Cu, Au, U and other enriched elements. This applies in the case of intracratonic deposits, particularly those related to old Archean crust. It is thought that these deposits formed 100-200 m.y. after supercontinent assembly, likely related to underplating of the continental lithosphere.

Figure 2-11 shows the global distribution of iron-rich copper-gold deposits. IOCGs are seen to occur at the boundaries between Archean and Paleozoic lithologies, whereas skarns show no definitive association. Although skarn deposits, forming at the contact between magmatic intrusions and carbonate sequences, can host copper-gold mineralisation, rarely do they form world-class economic deposits.

It should also be noted that it is now generally accepted the the Palabora deposit/mine in South Africa is a mineralised carbonatite pipe hosted within an alkaline igneous complex rather than part of the IOCG continum of deposits.

It is not thought that IOCGs, in their true form defined above, are likely to be present in the TMB. This is not to say however that Fe-oxide deposits are not to be found, particularly as a number of previously identified economic deposits have been located proximal to larger porphyry and skarn deposits related to shallower magmatic intrusions. It is not thought that any such Tethyan Fe-oxide, Cu-Au related deposits are capable of hosting the quantity of mineralisation specified by MMG.

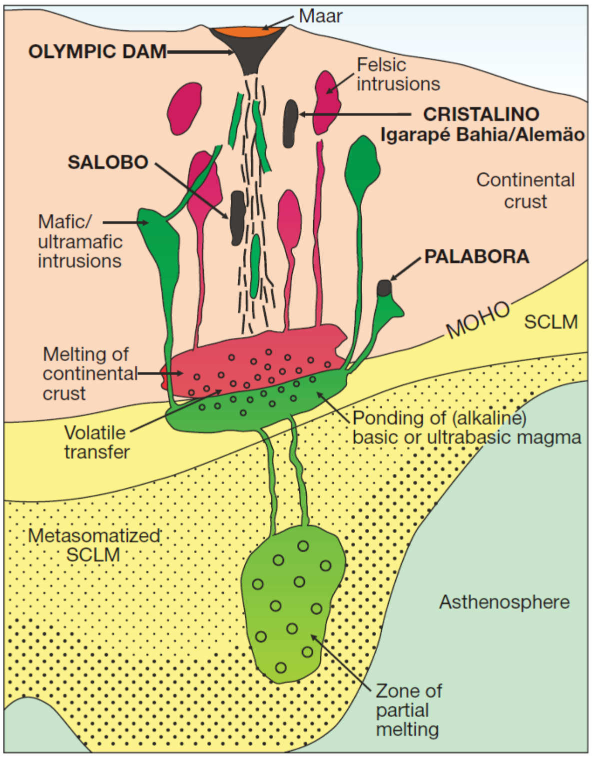

Figure 2-10 The formation of IOCG deposits (Groves et al., 2010). See text for description.

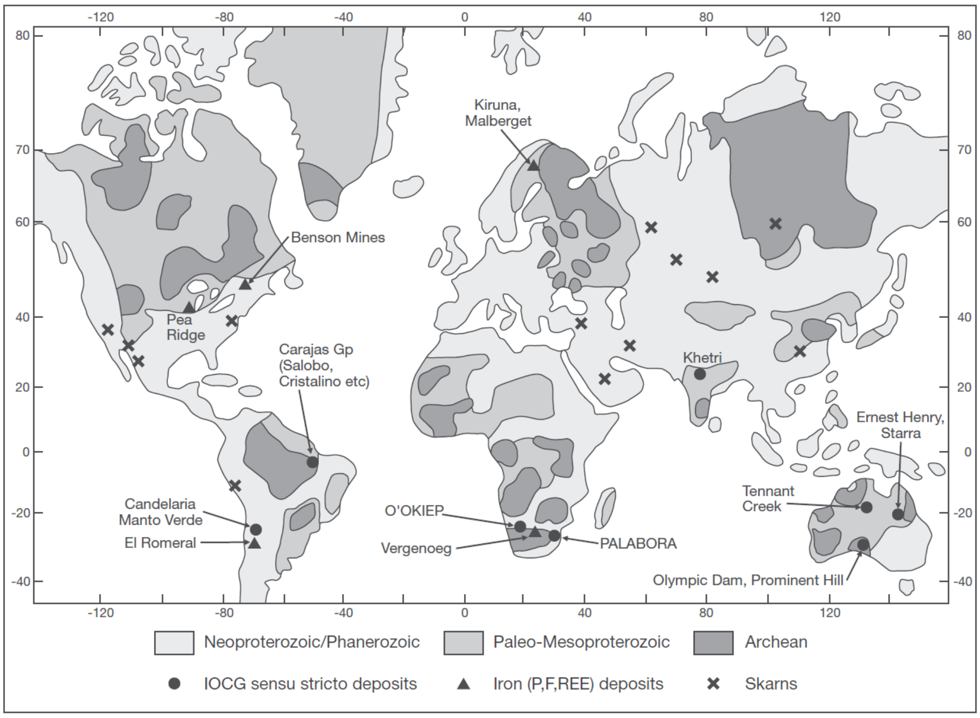

Figure 2-11 Geographical distribution of major IOCG deposits, P-F-REE iron oxide deposits and Fe-skarns, as described in Groves et al., (2005). Most IOCGs form near Archean cratonic margins, except some yonger deposits in S. America. Fe-skarns show no association.

2.6 Clastic-Dominated Sediment-Hosted Lead-Zinc Deposits

Traditionally called sedimentary exhalative (SEDEX) deposits, clastic dominated (CD) Pb-Zn deposits contribute significantly to the global production of lead and zinc. Leach et al (2005) avoids genetic influences on classification of sedimentary Pb-Zn deposits, instead basing classification on the type of sedimentary host rocks present. CD deposits therefore form in CD sedimentary sequences in mainly passive margins, continental rifts and sag basins, and are often hosted in shales, sandstones siltstones, mixed clastic units, or as carbonate replacement ores within a CD sequence. They are classified separately from Mississippi Valley-type (MVT) Pb-Zn deposits which form in carbonate-dominated sequences under different depositional and mineralising environments.

The metals in CD deposits were precipitated through a variety of processes that include synsedimentary deposition on the seafloor (SEDEX) forming stratified mineralisation parallel with bedding, diagenesis, and epigenetic replacement or during low grade metamorphism. These deposits are often dominated by sphalerite and galena with silver as an important co-product and copper as a minor, but economically important secondary mineral.

The tectonic environment present at the time of formation is key to the formation of CD Pb-Zn deposits. In the case of passive margins, continental rifts and back-arc extensional sag basins, there must be sufficient subsidence below sea-level to allow sedimentation. It is generally accepted that hot, highly saline metalliferous brines were the principal fluids responsible for the transport of lead and zinc. Precipitation and mineralisation occurs in both syngenetic and early diagenetic environments within immature sediments with high primary porosities. MVT mineralisation on the other hand occurs in shallower basin flanks where platform carbonate sequences dominate. CD deposits are generally of Proterozoic or Paleozoic age, with the few examples found in the TMB, belonging to this older group. MVT deposits however, are generally younger, having formed in the late Paleozoic and Mesozoic.

3 Deposit Databases

The basis for the master deposit database presented in this report is a number of separate deposit databases created by the USGS over the last decade. These cover porphyry copper deposits, sediment-hosted copper deposits and VHMS copper deposits respectively. The data for individual deposits of each model type have been extracted for the countries relevant to this review and composited to form a single TMB copper deposits database. This has then be verified and supplemented with information from sources including Infomine[1], Intierra[2] and the Minerals Economic Group[3] online databases which are updated regularly with news and public press releases.

Although best efforts have been made to validate data, many deposits have not been publically detailed in recent years and the data presented here should only be taken as approximate. Some deposits also contain missing data relating to grade and tonnage, particularly in those at an early stage of exploration, mined out historic sites or those where reporting is not made public. It would also be impractical and inappropriate to try and locate and list all copper occurrences across the TMB countries. Once the target region has been narrowed down by MMG, a more in-depth investigation of occurrences and historic deposits would be warranted, but at present, individual mineral occurrences are not material in identification of “Tier 1” deposit potential.

The database itself is provided in Excel (.xls) format in a single worksheet that can be filtered and ordered to highlight deposits of specific type, country, size etc. This database has also been used to create the deposit location symbols seen in various figures throughout this report that identify depost type or estimated contained tonnages of copper metal. All maps of deposit distribution or type, and those graphs not attributed to other authors, that are presented in this report have been created from this composite dataset.

Also accompanying this report are a number of georeferenced maps, grids and documents that have been utilised during the review. Due to copyright laws, we are unable to provide any of the journal articles reviewed for this report, but a list of papers is provided in the References section at the end of the report, should MMG wish to locate and personally review literature. However, a number of comprehensive USGS reports are provided as these are considered part of the “public domain”.

The following sections of this report have been subdivided by country, starting in the west of the TMB in Europe, and moving methodically west to Afghanistan and Pakistan. This makes it easier to review and understand the geology, structural history, deposits, prospectivity and socio-political conditions of each state in logical progression. As metallogeny is not confined to geopolitical boundaries, cross-border mineral potential interpretations of defined zones are then presented. These zones constitute a western European region, a Turkey and Caucasus central region and an eastern Middle East and Asian region of the TMB.

[1] http://www.infomine.com/
[2] http://www.intierra.com/
[3] http://www.metalseconomics.com/

4 The Carpathians

The first 10 countries reviewed in this report are represented in the European regional maps of deposit type and deposit size seen in Appendix 1

The Carpathian Mountains (Carpathians) are a range of mountains forming an arc roughly 1,500 km long across Central and Eastern Europe from the Czech Republic in the northwest through Slovakia, Poland, Hungary and though the Ukraine and Romania in the east. The Carpathians then continue to the south joining with the Apuseni-Banat-Timok-Srednogorie belt in Romania. This continuous mountain range constitutes the European section of the TMB where closure of the western Tethys ocean lead to subduction and uplift.

As the Carpathians constitute the majority of the eastern European region of the study they are examined in general detail over the following section before detailed country-by-country reviews.

4.1 Geology and Tectonics

The geological structure of the Carpathian Mountains consists of five generally crescent-shaped zones: (i) the Carpathian Foredeep and (ii) the Flysch Belt along the northern margin of the Carpathians, (iii) the central mountain ranges of the Carpathian arc, (iv) several Tertiary volcanic provinces along the southern periphery of the Carpathians and (v) the inner extensional Pannonian, East Slovakian and Transylvanian Basins, (Figure 4-1).

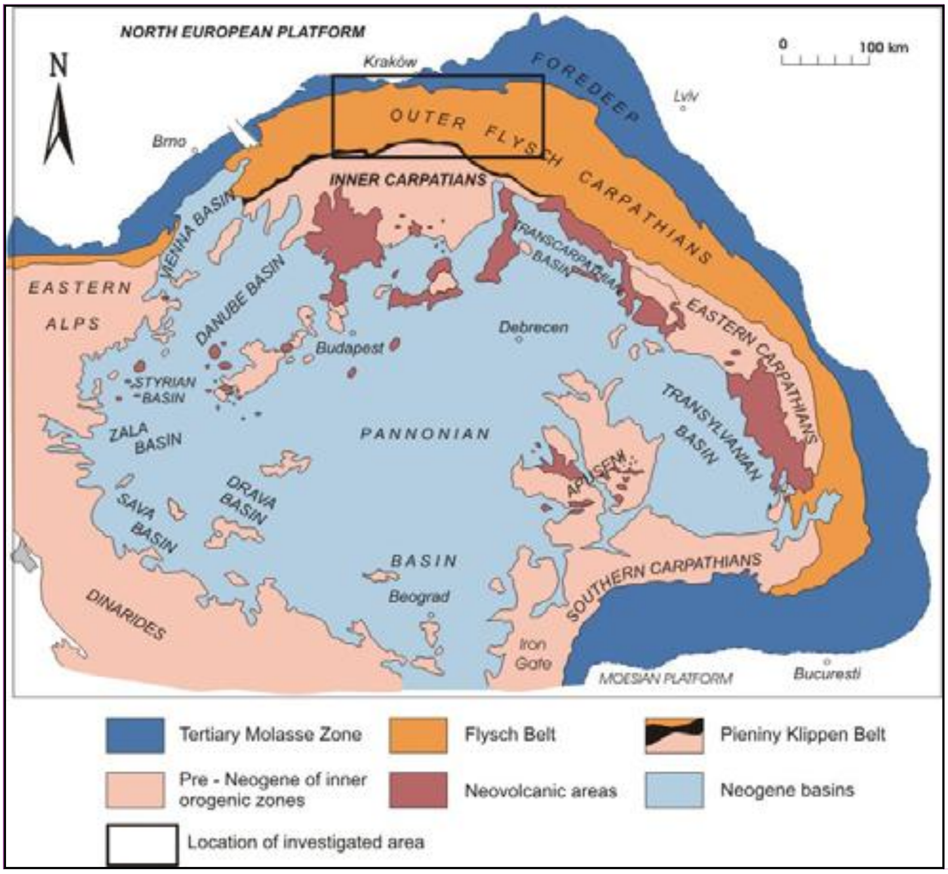

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Figure 4-1 Geological Map of the Carpathians, Galonka et al (2011)

The **Carpathian Foredeep**, which, along with the outer Flysch Belt, makes up the majority of the TMB found in eastern Czech Republic, southern Poland, south-western Ukraine, north-western Romania and Moldova, are thick deposits of molasse, marl, sandstones and conglomerates that were formed as a result of erosive periods within the Carpathian Mountains to the south and east.

The **Outer Carpathian Flysch Belt** consists of several units which were repeatedly thrust during the Tertiary to form a complex stack of relatively horizontal, un-rooted nappes, within which, layers of resistant sandstone rhythmically alternate with softer, less resistant siltstones. These complexes formed as horizontal nappes thrust over the Precambrian basement and its sedimentary cover over a distance of tens of kilometres. In general, the topographic relief of the Flysch Belt is one of smooth and rounded hills, with the sandstones forming the peaks and ridges with the less resistant clays forming the valleys.

A narrow Klippen Belt, 600 km in length and varying from a few hundred metres to a few kilometres wide, extends along the southern edge of the flysch zone and forms the most conspicuous geological feature of the Carpathians. It is a tectonic melange of oceanic rocks that were folded and fractured along a thrust plane.

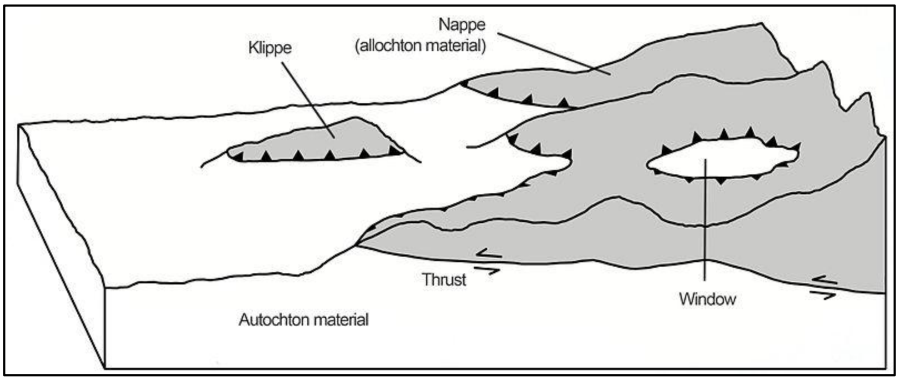

Figure 4-2: Sketch diagram of Klippen-thrust structure

The **central mountain ranges of the Carpathians** generally comprise an overthrust nappe structure and are composed of Palaeozoic crystalline granitoid rocks and meta-sediments that are overlain by late Palaeozoic and Mesozoic sediments.

During late early Miocene, the **Pannonian Basin** began to subside under a transtensional setting on top of the Carpathians and East Alpine nappes. Following Oligocene-early Miocene deformation of the northern Carpathians and the Dinarides, the area of the Pannonian Basin was uplifted, and its central and north-eastern parts became sites of extensive silicic volcanism of high-potassium calc-alkaline type, giving rise to extensive dacitic to rhyolitic ignimbrite, tuffs and reworked tuffs, which were subsequently covered by younger sedimentary rocks (Plant et al., 2005).

Tertiary to Quaternary volcanism is closely connected to the structural evolution of the Carpathian arc and Pannonian Basin. Subduction of the flysch basin floor in the convex Carpathian arc commenced in early Miocene in the west, and was concluded during Pliocene to Quaternary in the east.

The **Tertiary volcanic provinces** of Slovakia, Hungary, Romania and small parts of the Ukraine generally consist of alternating andesite lavas and less-resistant pyroclastic rocks that give rise to a subdued hill terrain. Some rhyolitic rocks occur as extrusive domes, lava flows and tuff layers that are frequently altered to bentonite or zeolite. The youngest volcanics are basalts that originally occurred as flows along the river valleys, but because of their relief inversion, now often form elevated ridges.

4.2 Known Deposits and Occurrences

The West Carpathians are characterized by a strong Late Cretaceous metamorphic/deformational overprint, a lack of magmatism and both syn- and late-orogenic formation of metasomatic and metamorphogenic talc, magnesite, siderite and vein- and shear zone-type Cu and As-Au mineralisation due to the exhumation of deep crust exhumed in association with largely amagmatic extension, known as metamorphic core complexes (Neubauer, 2002).

Within the inner Carpathian Orogen, the closure of oceanic sub-basins, the indentation of continental microplates into the evolving orogen along transfer structures, and probably slab break-off and asthenosphere incursion have variably contributed to localised centres and short belts of Oligocene to Recent calc-alkaline to alkaline magmatism in the Inner Carpathians and the Apuseni Mountains.

Miocene mineral occurrences found within the Carpathians are generally related to volcanic activity contemporaneous with the invasion of fault-bounded blocks into the Carpathian arc. These have been related to slab break-off and the cessation of subduction. Mineral deposits include structurally controlled Au-Sb-Cu-Pb-Zn mineralised bodies within shallow volcanic edifices, with a preference for steep tension veins parallel to the motion direction of laterally escaping crustal blocks (Neubauer, 2002)

The main types of mineralisation found within the Carpathians is thought to have occurred during two distinct major orogenic stages between the Late Cretaceous and the Neogene, which therefore suggests a punctuated development of mineralisation rather than a continuous process during the orogeny.

Specific deposits and prospectivity of regions are discussed in their respective country chapters.

5 Czech Republic

The Czech Republic is a landlocked country in Central Europe (Figure 5-1). Its capital and largest city, at 1.3 million inhabitants, is Prague. Historically the Czech Republic was an important Central European producer of heavy industrial goods manufactured by the country's chemical, machine building, and tool making industries. Coal, coke, and steel production were of domestic and regional importance. The production of coal for thermal power plants and the use of nuclear power were important sources of electricity and helped the country maintain a lower level of dependence on imported natural gas for electricity production than many other countries in Central and Eastern Europe.

In recent times there has been a significant decrease in production across a wide range of mineral commodities, owing generally to the reduction in demand for minerals as a result of the world economic crisis (Brininstool, 2009). More recent recoveries in the global market have yet to impact upon the reinvigoration of the Czech mineral sector.

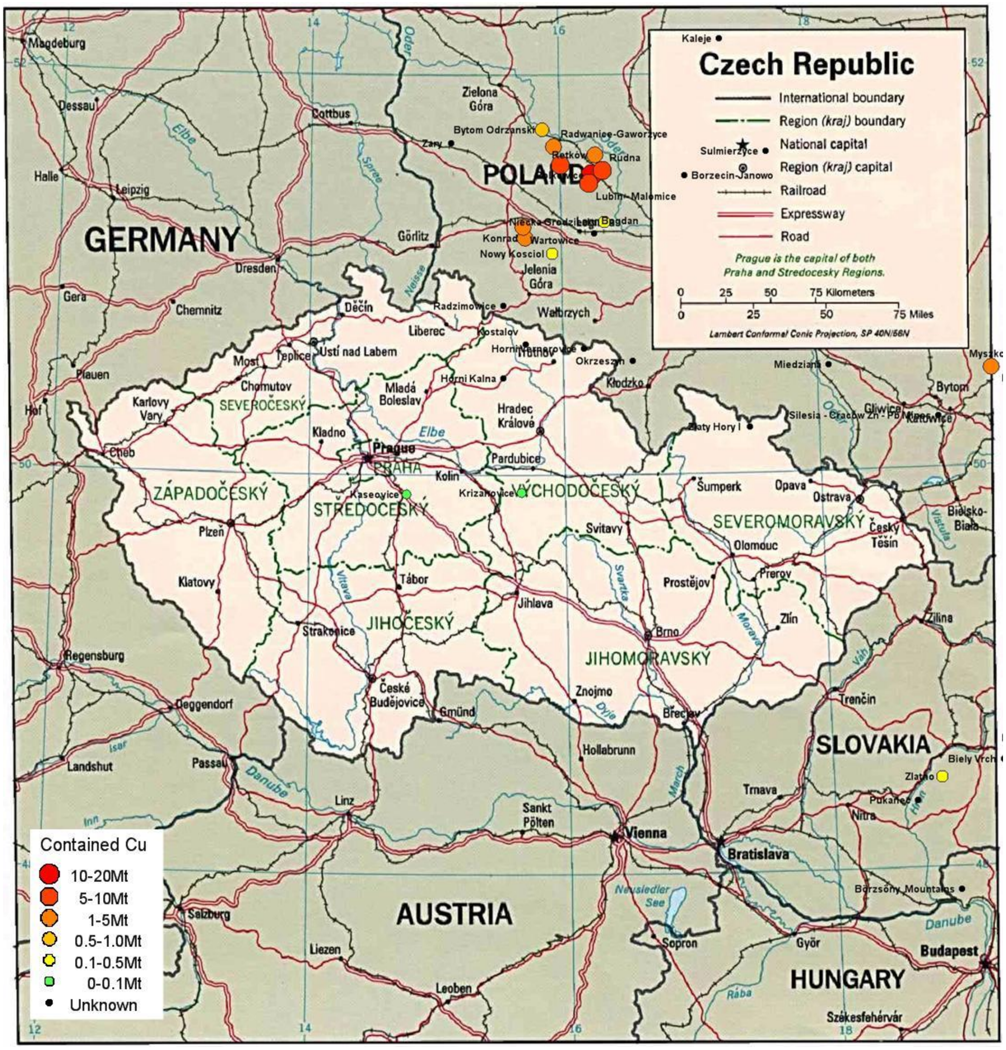

Figure 5-1 Political map of the Czech Republic showing copper deposits by contained copper resources. Adapted from the University of Texas Libraries, The University of Texas at Austin (1994)

5.1 Geology and Tectonics

The Czech Republic is located in the centre of Europe at the boundary between the Hercynian and Carpathian/Tethyan orogenic belts. Three main structural complexes form the geological structure of the Czech territory.

1. The oldest is Precambrian in age and underlies what is the area of Moravia in eastern Czech Republic. This segment of the Earth's crust probably represents an extremity of the East European platform. The influence of the younger Paleozoic and Alpine orogenies was only minor and the Precambrian basement served as a foreland for the nappe structures which were thrust over it.

2. The Hercynian Bohemian Massif, overlapping into Austria, Germany and Poland, forms the majority of the Czech Republic.

3. The Western Carpathians are made up of the Central West Carpathians, Outer Flysch Carpathians and the Carpathian Foredeep. The Central-West Carpathians are formed by pre-Mesozoic volcanosedimentary complexes, mostly metamorphosed and penetrated by late-Hercynian granitoid plutons, and their sedimentary cover.

5.2 Known Deposits and Occurrences

There are currently no known economically exploitable Cu mineral deposits in the Czech Republic although Cu mineralisation of various genetic types occurs and has been historically exploited. Though generally not genetically associated with the TMB, some examples of historic importance have been included here.

Zlaté Hory

The deposit lies within the Bohemian Massif and is hosted by weakly metamorphosed Devonian rocks of the Vrbno Group, which is partly overlain by the Upper Devonian to Lower Carboniferous Andelska Hora Group.

Several types of mineralisation are present, each with a different relationship to the structural and metamorphic history of the area. Copper mineralisation occurs within chloritic quartzites within phyllic host rocks and forms as: i). stratabound lenses of monometallic chalcopyrite; ii) generally massive chalcopyrite within quartz veins; iii) complex stratabound galena-sphalerite-pyrite-chalcopyrite mineralisation partially within chloritic quartzites and partly within limestones; and iv) chalcopyrite with associated gold within quartzites.

Mining at Zlaté Hory ceased in 1990 and it has been estimated that 5,808 Kt of mineralisation containing 34,741 t of copper was mined from 1965–1990. During production it is thought that grades ranged between 0.4 % and 0.7 % Cu. (Stary *et al*, 2010). The total deposit is estimated to have been 50 Mt @ 0.34% Cu, 0.29% Pb and 1.19% Zn, incorporating higher grade lenses.

Kostalov

Copper mineralisation at Kostalov occurs within continental redbeds, in siltstones with associated with plant remains. Recent investigation of a basaltic quarry has also uncovered what is thought to be re-mobilised Cu mineralisation from underlying Upper Carboniferous sediments (Paulis & Malec, 2010).

Other areas

Stratabound Cu mineralisation, occurring within low-grade metamorphic volcano-sedimentary formations has been exploited at Tisová near Kraslice. Historical production grades were in the region of 1% Cu, and mining ceased in 1973. A mineral exploration project was then executed in the area in the 1980’s although no information is publically available as to the findings of this.

Cu mineralisation and/or Cu-Zn-Pb mineralisation of stratabound type is also known to occur at numerous localities within the Bohemian Massif (e.g. Staré Ransko, Křižanovice, Svržno).

Hydrothermal vein Cu deposits (Rybnice, Rožany, Tři Sekery) and sedimentary Cu ores (Krkonoše Mts. Piedmont Basin) have been of historical importance, but are no longer thought to be economic.

Mining of Cu in the Czech Republic ceased in 1990 and historic, Soviet era, deposits have gradually been eliminated from The Register.

5.3 Political Considerations

The Czech Republic is part of the EU single market and the Schengen Area. It possesses a developed, high-income economy with a GDP per capita of 80% of the European Union average.

As one of the most stable and prosperous of the post-Communist states the Czech Republic saw growth of over 6% annually in the three years before the outbreak of the recent global economic crisis. As the global financial crisis began to impact, growth dipped to 3.5% in 2008 and was minus 4.1% in 2009. A centre-right coalition led by Prime Minister Petr Necas was formed in July 2010 with stated priorities include "budgetary responsibility" and cutting the budget deficit to 4.8% of GDP in 2011 and to 3% by 2013.

The growth for 2010 was 2.3% and economists, including the Czech National Bank, are currently estimating growth of about 2% for 2011. Other priorities include reforms to public spending, especially reform to the pension, healthcare, and judicial system, and tackling corruption. Growth has been led by exports to the European Union, especially Germany, and foreign investment, while domestic demand is reviving.

While most foreign companies find the legal-business climate conducive there are wide ranging improvements that are needed, e.g. a speedier judicial process, and greater transparency in public procurement. The amended Commercial Code, allowing company registration within 5 days (compared to the previous average 88 days), and a new Bankruptcy Law, were steps in the right direction. Accession to the EU in May 2004 has driven improvements, and the Czech government acknowledges the need for reform. The main challenge for the economy over the coming years will be structural reform, particularly in the health and pension sectors. The Czech government has not set a target date for joining the Euro[4].

Benchmark assessments indicate that the Czech Republic ranks 64th out of 183 countries for Ease of Doing Business 2011[5] and 57th out of 183 countries for Corruption Perception Index 2011[6].

Within the scope of this report, the Czech Republic ranks 9th out of 24 countries for Ease of Doing Business 2011 and 4th out of 24 countries for Corruption Perception Index 2011.

The Control Risks RiskMap 2012 edition classifies the Political Risk of the Czech Republic as Low[7].

5.1 Security Considerations

The Control Risks RiskMap 2012 edition classifies the Security Risk of the Czech Republic as Low. This is supported by other online resources such as the FCO travel advice pages[8].

[4] http://www.ukti.gov.uk/export/countries/europe/centraleurope/czechrepublic/overseasbusinessrisk.html
[5] http://www.doingbusiness.org/rankings
[6] http://cpi.transparency.org/cpi2011/results/
[7] http://www.control-risks.com/Riskmap/Pages/Home.aspx
[8] http://www.fco.gov.uk/en/travel-and-living-abroad/travel-advice-by-country/europe/czech-republic

It is therefore likely that access might be made to all areas within the country and that standard security measures would not need to be augmented to protect company staff and assets during exploration and development.

5.2 Prospectivity

There is a low probability that the Czech Republic contains any deposits that would meet the criteria set by MMG in relation to grade and tonnage as the country has undertaken extensive historical mining, none of which is thought to have reached this scale. However the country does host some potential for several types of Cu and Pb-Zn mineralisation that may not have been explored for using modern exploration methodologies within its borders.

Mineralisation could include a continuation of Permo-Carboniferous sediment hosted redbeds (Near Kostalov) similar to those found in the Kupferschiefer of Poland. However it is highly unlikely that any potential deposit would be more than a small fraction of the size of the deposit in Poland. Potential for mineralisation may also be associated with rifting during the Carpathian orogeny plus the intense volcanic activity and possible carbonatite intrusives that accompanied this in the Doupovské Hory Volcanic Complex and České Středohoří Volcanic Complex (Holub et al., 2010).

6 Poland

Poland's location in Central Europe is shown in Figure 6-1. The total area of Poland is 312,679 km^2.

Since the end of the communist period, Poland has achieved a "very high" ranking in terms of human development and is a member of numerous international trade, economic and security organisations.

Poland has significant reserves of several mineral commodities and also has important mineral processing facilities. In 2009, Poland was estimated to be the world's 9th ranked producer of silver, the 10th ranked producer of mined copper, and a significant producer of rhenium. Industrial minerals, such as aggregates, feldspar, gypsum, lime, salt, and sulphur were also produced in significant quantities. For mineral fuels, Poland was the 9th ranked producer of bituminous coal but was mostly dependent on imports of oil and gas.

Although Poland's economy performed well in 2009 relative to other EU countries, the slowdown in economic growth seemed to affect the volume of mineral production. Production of most metals was reported to have decreased significantly with the exception of copper and silver mine production, each of which increased slightly. Future economic growth and an accompanying increase in domestic demand could lead to increased mineral commodity production, but much of the growth in demand for mineral products could depend on demand by Poland's trade partners, especially those in the EU. Dependence on imports of mineral fuels is expected to remain one of Poland's biggest challenges, and Poland is expected to continue to investigate other potential sources of supply (Brininstool, 2011-1).

The Polish Government (through ownership of shares by the Polish Ministry of Treasury) owned shares in a number of important producers of mineral products but planned to privatize many of its holdings. One of the Government's most important holdings was a 41.79% stake in Poland's sole copper producer, Kombinat Gorniczo Hutniczy Miedzi Polska Miedz S.A. (KGHM). No other shareholders owned more than 5% of the company. In January 2010, the Government sold 20 million shares of KGHM to bring its ownership down to 31.79%.

Figure 6-1 Political map of Poland showing copper deposits by contained copper resources. Adapted from the University of Texas Libraries, The University of Texas at Austin (2000)

6.1 Geology and Tectonics

The geology of Poland is well summarised by Lczka et al., 2006.

The geological structure of Poland has been shaped by the continental collision of Europe and Africa over the past 60 million years, on the one hand, and the Quaternary glaciations of northern Europe, on the other. Both processes shaped the Sudetes and the Carpathian Mountains. The moraine landscape of northern Poland contains soils made up mostly of sand or loam, while the ice age river valleys of the south often contain loess. The Cracow-Częstochowa Upland, the Pieniny, and the Western Tatras consist of limestone, while the High Tatras, the Beskids, and the Karkonosze are made up mainly of granite and basalts. The Polish Jura Chain is one of the oldest mountain ranges on earth.

The Polish Tatras Mountains, which consist of the High Tatras and the Western Tatras, is the highest mountain group of Poland and of the entire Carpathian range.

The Polish and Ukrainian Outer Carpathians form the north and north-eastern part of the Carpathians that expand from the Olza River on the Polish Czech border to the Ukrainian-Romanian border. Traditionally, the Northern Carpathians are subdivided into an older range, known as the Inner Carpathians, and the younger ones, known as the Outer Carpathians. These ranges are separated by a narrow, strongly tectonised belt, the Pieniny Klippen Belt. The Outer Carpathians are made up of a stack of nappes and thrust sheets showing different lithostratigraphic and tectonic structures. Generally, each Outer Carpathian nappe represented separate or partly separate sedimentary sub-basins.

In these sub-basins, enormous continuous sequences of flysch-type sediments were deposited; their thickness locally exceeds 6 km. The sedimentation spanned between the Late Jurassic and early Miocene. During the folding and over thrusting, sedimentary sequences were uprooted, and generally, only sediments from the central parts of basins are preserved.

The Outer Carpathian nappes are overthrust on each other and on the North European platform and its Miocene-Palaeocene cover. In the western part, overthrust plane is relatively flat and becomes more and steeper eastward. The evolution of the Northern Outer Carpathian Flysch basins shows several tectonostratigraphic stages. The first period (Early Jurassic Kimmeridgian) began from the incipient stage of rifting and formation of local basins. The next stage (Tithonian Early Cretaceous) is characterized by rapid subsidence of local basins where calcareous flysch sedimentation started. The third period (Late Cretaceous early Miocene) is characterized by compression movements, appearance of intensive turbiditic sedimentation, and increased rate of subsidence in the basins.

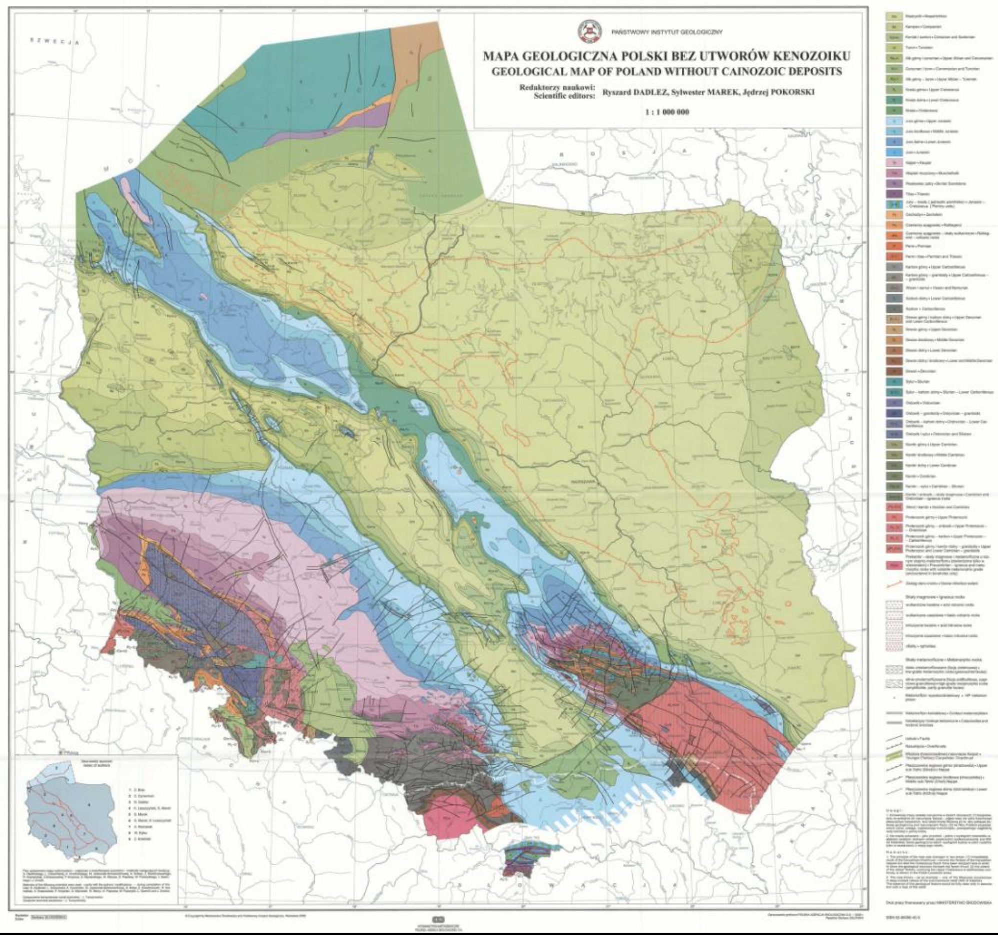

Figure 6-2 Geological map of Poland courtesy of the Polish Geological Survey (2000). Pink lithologies are Precambrian and Proterozoic age, olive lithologies are Cambrian age, dark purple lithologies are Silurian and Ordovician age, brown litholiges are Devonian age, grey lithologies are Carboniferous age, orange lithologies are Permian and Jurassic age, light blue lithologies are Jurassic, and pale green lithologies are Cretaceous age. Cenozoic lithologies are not represented in this map.

6.2 Known Deposits and Occurrences

Kupferschiefer

The Kupferschiefer is a major base metal district in Europe located mainly within south-western Poland and is a Permian copper-bearing shale formation. Stratigraphically it constitutes the boundary between the Rotliegendes of the Lower Permian, and the Zechstein of the Upper Permian.

Within the formation there are three layers mineralised with copper sulphides: the Weissliegendes or White Sandstone formation at the base, with decimetre to metre thickness; its upper portion contains 0.2 to 2% Cu in sulphides. Above it, the copper-bearing shale (Kupferschiefer) is the principal ore level, with 2 to 10% Cu content, and a thickness up to 20 m. The shale is usually bituminous, and always contains Cu and less frequently Pb and Zn sulphides.

Carbonate rocks rest upon the copper-bearing shales; these contain Cu sulphides, and also small clay layers containing lead sulphides. The ore bearing stratigraphic layers are mineralised in a reducing facies, which occurs in large patches, whereas in areas with oxidised facies in the same stratigraphic levels, ore is absent. The largest mineralised area covers about 350 km² in the region around Lubin, Rudna, Polkowice and Sieroszowice, which are at present the main mining centres. The richest part of the Kupferschiefer is situated structurally in the Fore Sudetic monocline to the NW of Wroclaw and extends from NW to SE dipping gently (less than 12°) towards the northeast. Active mines currently reach a maximum depth of 1200 m. Polska Miedź (Polish Copper) produced 486,000 tonnes of copper in the year 2000, representing 3.3% of world copper production; silver production was 1119 tonnes, and there is also some recovery of Pb, Au, Ni, Co and Mo (De Vos et al., 2005).

Even after some 40 years of exploitation, today's unexploited resources are estimated at 1.5 billion tons at 2% Cu and 56g/t Ag. As a result of the size of the documented copper ore resources in the region, Poland holds 8th place globally in terms of copper resources, and 1st place in terms of silver (based on the U.S. Geological Survey-2007)

Krakow-Silesian Pb-Zn (MVT)

The Upper Silesian MVT deposit in south-central Poland is an important producer of zinc (Zn), lead (Pb) and silver (Ag), with mining dating back to at least to the eleventh century for silver and lead. Mining activity developed in several areas around the towns Bytom, Tarnowskie Góry, Chrzanów and Olkusz.

The stratabound deposits occur to the north and north-east of the Upper Silesian Coal Basin, where Permian to Mesozoic rocks lie monoclinally on a Variscan Palaeozoic substrate. Mineralisation occurs mainly within the Muschelkalk series of the Middle Triassic, hosted by carbonate rocks, generally dolomites. The mineralisation forms as replacements, cavity fillings, linings, veins and mineralized breccias (Szuwarzyński, 1996) and is controlled by steeply dipping faults and fracture zones related to the Krakow-Myszkow tectonic zone.

Recent production is from Zn-Pb sulphide ores hosted in a 200 m thick sequence of flat-lying shallow-marine Triassic carbonates, where the lower and upper units of the sequence enclosing the mineralised formations are marly or argillaceous sediments of lower permeability (De Vos et al., 2005).

The main ore minerals include sphalerite galena, pyrite and marcasite, accompanied by the gangue minerals dolomite, calcite, barite, chalcedony and quartz. Of secondary importance are lead-arsenic complex sulphides such as jordanite and gratonite. In part of the region, Middle Triassic dolomites form outcrops, and zinc carbonates and silicates appear frequently in karst pockets.

This area includes the Boleslaw mine (ZGH Boleslaw Mines) near Katowice, which has been in production since 1955 and has a reported total resource of 200Mt @ 3.9% Zn & 1.8% Pb, (7.8 Mt contained zinc and 3.6 Mt contained lead respectively).

Myszkow porphyry Mo/Cu project

The Myszkow Mo/Cu project is located in South-West Poland near the towns of Myszkow and Zarki, some 80 km to the north-west of the city of Krakow. Mineralisation in the area was identified by the Polish Geological Institute in the late 1960's. Follow up drilling by Polish Government institutions identified the Myszkow Mo-Cu-W deposit. Geologically, the concession area is located within the Malopolska Block, which is a major geological unit of Southern Poland. The Myszkow deposit itself developed along a major NW-SE trending fault system of the Malopolska Block. This structure is a part of a major, central Europe scale NW-SE trending lineament/tectonic zone known as the Hamburg-Krakow Fault Zone (HKFZ).

The Myszków porphyry molybdenum-copper-tungsten deposit is one of several porphyry copper-type deposits that have been identified within a poorly defined belt of Precambrian to Palaeozoic rocks in south-central Poland. It is in a complex of Proterozoic to early Palaeozoic-aged metasedimentary rocks that was intruded by a predominantly granodioritic pluton. The chemistry, mineralogy, and vein morphology of the Myszków mineralisation are similar to calc-alkaline-associated porphyry copper deposits.

The geology of the tenement area is dominated by clastic rocks of a pre-Cambrian age, which have undergone low grade metamorphism. These rocks were intruded intensely by magmatic bodies, particularly porphyritic granitoids to which most of the metalliferous mineralisation is confined. Locally, these clastic rocks are covered by lower Palaeozoic sediments with limited thickness.

The Myszków deposit is strongly enriched in Cu and Mo but contains very little gold. In comparison to other calc-alkaline-type porphyry Cu deposits, this deposit also contains an unusually high concentration of tungsten, particularly in the mineralised part of the stock.

Overall, the mineralisation at Myszków exhibits typical mineralogy for the deeper parts of a porphyry Cu system.

The area of known Mo-Cu-W mineralisation is associated with rocks extending over approximately 700 km^2 in which several areas with increased concentration of metalliferous mineralisation have been identified.

The Myszków porphyry has been estimated to contain 700Mt of mineralisation grading 2.2g/t Ag, 0.12% Cu & 0.06% Mo (49.5 Moz contained Ag, 0.8 Mt copper metal and 0.4 Mt molybdenum), however this project is still at a very early stage of development. Strzelecki Metals Limited is currently undertaking drilling to fully understand the distribution and extent of mineralisation with the intention of undertaking a mining scoping study.

6.3 Political Considerations

Since emerging onto the global market place 20 years ago, Poland has transformed itself from a command economy into a free market. The private sector, almost 80% of GDP, is now the main driver of economic activity.

Poland is a democracy with strong institutions, and the risk of any sudden regime change is insignificant. Despite problems with forming stable and effective majority governments, successive administrations have aligned the country's legal and regulatory framework with EU standards. Although the government is generally pro-market, the current coalition has failed to deliver on its promises to enact structural reforms and improve conditions for business.

The main driver for Foreign Direct Investment in Poland, according to investors, is still a well-qualified and relatively low cost labour force[9].

[9] *http://www.fco.gov.uk/en/travel-and-living-abroad/travel-advice-by-country/country-profile/europe/poland?profile=economy*

Benchmark assessments indicate that Poland ranks 62nd out of 183 countries for Ease of Doing Business 2011[10] and 41st out of 183 countries for Corruption Perception Index 2011[11].

Within the scope of this report, Poland ranks 8th out of 24 countries for Ease of Doing Business 2011 and 2nd out of 24 countries for Corruption Perception Index 2011.

The Control Risks RiskMap 2012 edition classifies the Political Risk of Poland as Low[12].

6.4 Security Considerations

The Control Risks RiskMap 2012 edition classifies the Security Risk of Poland as Low. This is supported by other online resources such as the FCO travel advice pages[13].

It is therefore likely that access might be made to all areas within the country and that standard security measures would not need to be augmented to protect company staff and assets during exploration and development.

6.5 Prospectivity

Poland is already known to contain major Cu and Pb-Zn deposits which have been mined extensively, however exploration of surrounding area extensions to the deposits has been generally limited and potential for deep lying extensions of the Kupferschiefer and Krakow-Silesian Pb-Zn (MVT) deposits are thought to exist.

[10] http://www.doingbusiness.org/rankings
[11] http://cpi.transparency.org/cpi2011/results/
[12] http://www.control-risks.com/Riskmap/Pages/Home.aspx
[13] http://www.fco.gov.uk/en/travel-and-living-abroad/travel-advice-by-country/europe/poland

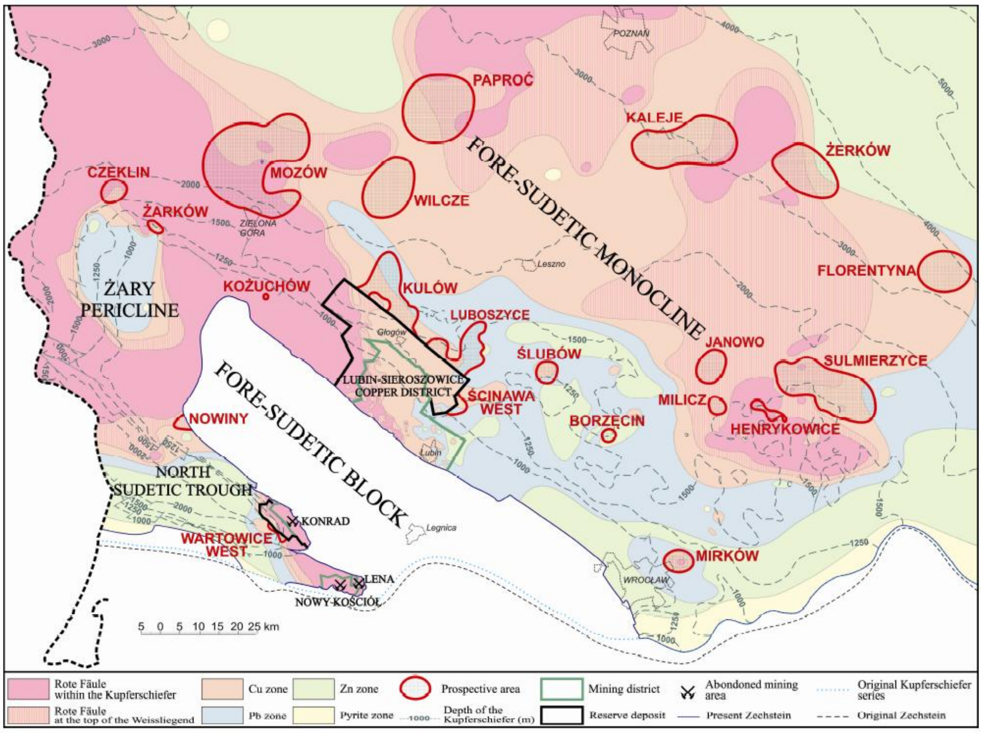

Figure 6-3 Cu-Ag prospectivity of SW Poland (Oszczepalski & Speczik, 2011)

Recent studies of historic exploration data and drill core by the Polish Geological Institute has allowed for the construction of a prospectivity map (Figure 6-3) that confines the limits of the oxidized (Rote Fäule) areas, metalliferous zones and Cu resources in south west Poland (Oszczepalski & Speczik, 2011). No known compliant Mineral Resource Estimate has been made on these exploration areas and due to the scarcity of the drilling and uncertainty of exploration methods, it is unclear how accurate the following estimated resources are.

The greatest potential prospectivity in the Fore-Sudetic Monocline is confined to Kulów, Luboszyce and Ścinawa West areas, directly adjoining the Lubin-Sieroszowice District. These areas cover 239 km^2 and are thought to contain about 21.7 Mt Cu at depths ranging between 450 and 2000 m. Several areas located slightly farther from the Lubin-Sieroszowice deposit (Kożuchów, Borzęcin, Ślubów, Mirków) cover 70 km^2 and is thought to contain 4.0 Mt Cu between 800-1500 m depth. Four other areas in the eastern part of the Fore-Sudetic Monocline (Henrykowice, Janowo, Milicz, Sulmierzyce) have total area of 343 km^2 and resources of approximately 40.8 Mt Cu at depths that range from 1450 to 2000 m.

At the Żary Pericline two areas: Żarków and Czeklin have been delineated, with a size of about 40 km^2 and estimated resources of 1.7 Mt at depth from 1350 to1800 m. Close to the Konrad Copper District, two small areas (Wartowice Zachód and Nowiny) at depth to 1500 m have been located.

Potential also exists for similar unknown MVT deposits along the edge of the Carpathian Foredeep that spans from the Czech Republic to Moldova. The study of dolomitic boundaries found within the extensive oil and gas exploration of the area may provide a starting point for further exploration of MVT deposits in this region.

Large Mo-Cu-W porphyry systems (Myszków) are known to exist within the poorly defined belt of Precambrian to Palaeozoic rocks of the Hamburg-Krakow Fault Zone and potential exists for other porphyries along strike of the HKFZ.

7 Slovakia

The Slovak Republic is a landlocked state in Central Europe shown in Figure 7-1. It has a population of over five million and an area of about 49,000 km^2. The largest city is the capital, Bratislava. Slovakia is a member state of the European Union, NATO, United Nations, OECD and the WTO.

Slovakia is a high-income advanced economy with one of the fastest growth rates in the European Union and the OECD. The country joined the European Union in 2004 and the Euro zone on 1 January 2009. Slovakia together with Slovenia and Estonia are the only former Communist nations to be part of the European Union, Euro zone, Schengen Area and NATO simultaneously.

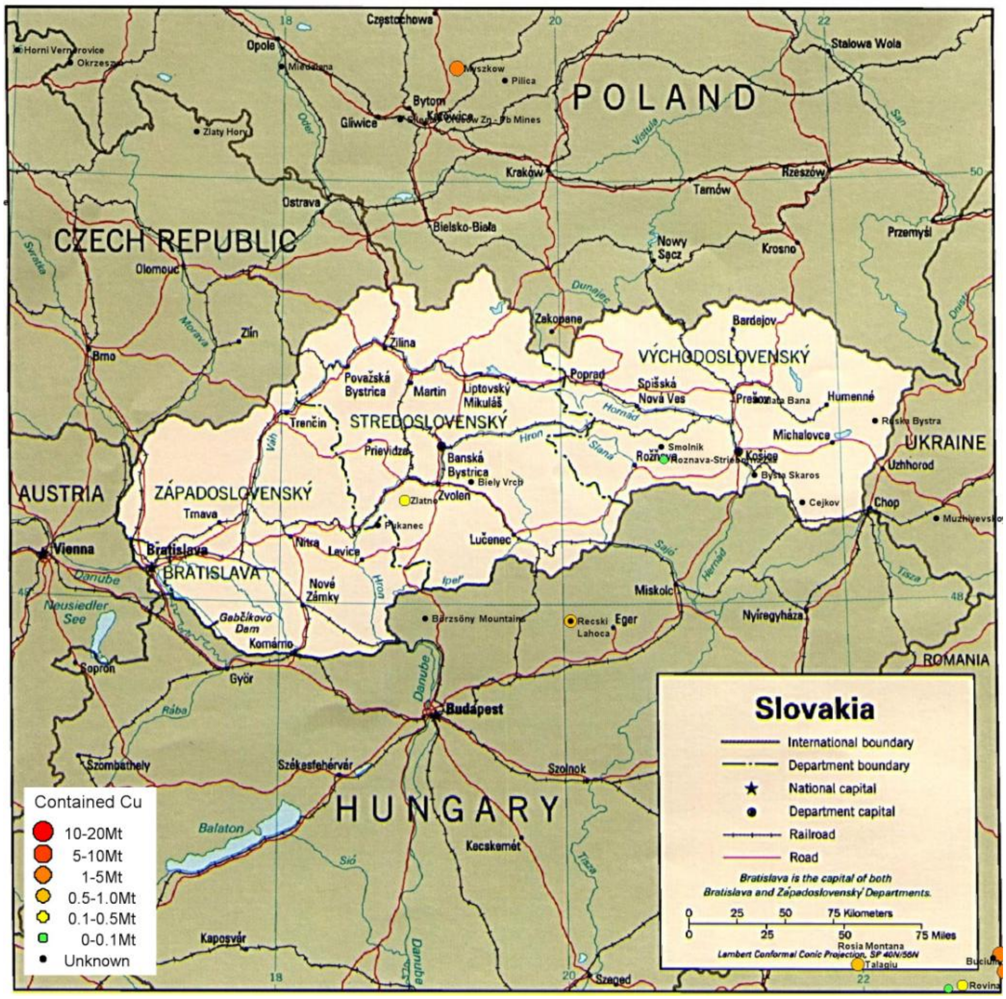

Figure 7-1Political map of Slovakia showing copper deposits by contained copper resources. Adapted from the University of Texas Libraries, The University of Texas at Austin (1994)

Slovakia produces a modest range of mineral products but is not a significant world or regional producer of any minerals. In 2009, Slovakia's real gross domestic product (GDP) decreased by 4.7% compared with that of 2008. In 2008, mining and quarrying made up about 0.6% of the nominal GDP.

In 2009, production of mineral commodities generally decreased, mainly owing to lower market demand for mineral commodities as a result of the world financial crisis. Compared with 2008, production of ferrosilicon decreased by 20%; steel, by 16%; pig iron, by 14%; and primary aluminium, by 8%. Secondary copper smelter production increased by 26%.

In late 2008, Kovohuty, which was Slovakia's only copper producer, began operating a new 60,000-metric-ton-per-year (t/yr) copper smelter that would process secondary scrap materials. Anode production capacity was increased to 90,000 t/yr (from 30,000 t/yr in 2008).

Slovakia will likely continue to produce modest amounts of mineral commodities, but no major increases in production are expected and decreased coal production is expected during the next several decades. The country is likely to continue to import the majority of its metallic ores and concentrates and mineral fuels (Brininstool, 2011-3).

7.1 Geology and Tectonics

The geological structure of Slovakia consists of three crescent-shaped zones that form the Carpathian Mountains: (i) the Flysch Belt along the northern margin of the Carpathians, (ii) the central mountain ranges of the Carpathian arc, and (iii) several Tertiary volcanic provinces along the southern periphery of the Carpathians (Figure 4-1).

The outer Carpathian Flysch belt consists of several units which were thrust during the Tertiary to form a huge pile of relatively flat, un-rooted nappes, within which, layers of resistant sandstone rhythmically alternate with softer, less resistant siltstones. A narrow Klippen Belt, 600 kilometres in length and varying from a few hundred metres to a few kilometres wide, extends along the southern edge of the flysch zone and forms the most conspicuous geological feature of the Carpathians. It is a tectonic melange of oceanic rocks that were folded and fractured along the thrust plane.

The central mountain ranges of the West Carpathians comprise an overthrust nappe structure that forms the highest mountain ranges in Slovakia - the High and the Low Tatra mountains. These are composed of Palaeozoic crystalline granitoid rocks and meta-sediments that are overlain by late Palaeozoic and Mesozoic sediments

The Tertiary volcanic provinces of Slovakia consist of alternating andesite lavas and less-resistant pyroclastic rocks that give rise to a subdued hill terrain. Some rhyolitic rocks occur as extrusive domes, lava flows and tuff layers that are frequently altered to bentonite or zeolite. The youngest volcanics are basalts that originally occurred as flows along the river valleys, but because of their relief inversion, now often form elevated ridges.

During the Early Palaeozoic, there was a sedimentary trough or a rift basin in the region of the present Carpathians. The Late Palaeozoic Variscan orogeny caused convergence of the basin, deformed the sediments and emplaced orogenic granitoids. After a short period of epicontinental sedimentation, the Carpathian area was submerged again and marine, mainly calcareous, sediments were deposited from the Early Triassic through the Early Cretaceous, as the Tethys Sea occupied the general position of the Alpides. The main Mid-Cretaceous pulse of the Alpine orogeny caused convergence of the Tethys basin, including strong deformation, nappe overthrusting, igneous intrusions and volcanism. In the Miocene, there was subsequent magmatism and further pulses of Alpine orogenic movements in the Carpathians (Jakubiak, 2008).

7.2 Known Deposits and Occurrences

The metamorphosed Early Palaeozoic volcanosedimentary complex of the Spišsko-gemerské rudohorie mountain range harbours an extensive mineralised district with gold, antimony, copper (Smolník), replacement siderite (Nižná Slaná, Železník), magnesite (Jelšava – Dúbrava, Košice), vein type siderite/sulphide (Rudňany, Slovinky, Gelnica, Rožňava) and vein type Sb-Au (antimonite - Čučma, Poproč) deposits. According to a rough estimate 15,000 t Sb, 0.5 Mt Cu and 45 Mt Fe has been produced in the district.

Comment [DM2]: +Locate on map

Volcanic hosted precious and base metal deposits of the Western Carpathians Neogene volcano-plutonic complexes host porphyry, skarn, replacement and epithermal mineralisation (De Vos et al., 2005).

Smolnik

The Smolnik area is one of historic mining for antimony from the 16th Century to 1962, using adits as the principal means of underground access. With the successful development of flotation technique, gold began to be recovered as a by-product after World War I.

There are 12 narrow, steeply dipping, sub-parallel quartz-stibnite veins in the licence area, some having payable lengths of 150-250m within structures of up to 1,500m in strike length. Vein thickness is reported to be typically around 0.5-0.8m with down-dip persistence of the order of 100-200m. The host rocks are Early Palaeozoic metasediments and pyroclastics and the quartz-stibnite mineralisation is related to granitic intrusives.

The most recent exploration in the area was carried out for Ortac from 2007-08. This involved geological and structural mapping, the collection and chemical analysis of 56 specimens collected from old mine dumps and outcrops, and a geophysical (induced polarisation, magnetic, resistivity and self potential) survey of 10 line km over two areas in the central part of the licence area. Five of the specimens sent for analysis returned high gold values in the range 21.6 to 58g/t Au, but these should only be seen as being indicative of the highest grade of the mineralisation. The average grade of mineralisation is reported to be 5-10g/t Au over 0.5m, presumably based on adit sampling and historic data.

The historic mining was largely confined to elevations above the valley floor level so that some potential exists for discovering mineralisation at greater depth, particularly in the western part of the licence area, which appears to be the most prospective.

Roznava-Strieborna

The Strieborná Project in the Banská Štiavnica region is an advanced exploration property (and historic mine) centred on a silver-copper-antimony-bearing siderite-quartz vein, in which tetrahedrite is the main silver, copper and antimony mineral. Operated by Global Minerals Ltd[14]

Pukanec

Mineralisation at Pukanec is found within a 2 x 1 km area of gold-silver mineralisation, known as Agras-Biela Bana, located in the near surface halo of a deep copper porphyry system owned by Argosy Mining Corp. The system includes a central granodioritic stock and numerous porphyry and rhyolite dikes that intrude andesites. At surface, the gold-silver mineralization is marked by

[14] http://www.globalminerals.com/

hundreds of old, now inaccessible, near-surface mine workings. The dumps at these workings contain hydrothermally altered host rock and quartz vein material that averages 1 to 2 g/t gold with high silver credits. Argosy completed 66 trenches totalling about 7,200 metres across the areas of old surface workings. A number of linear gold-bearing zones were defined indicating potential for the discovery of porphyry-type mineralization.

Biely Vrch

Varying degrees of alteration in the licence area indicate hydrothermal activity. A high-sulphidation alteration system extends over a 2 x 2 km area in the northern portion of the area. No exploration of this prospect has been carried out except for 14 surface samples of float which returned gold grades up to 1.1 g/t gold. These results, together with the presence of kaolin at surface, suggest the potential for a high-sulphidation epithermal system and the potential for associated porphyry mineralisation at depth below the surface alteration.

7.3 Political Considerations

Overall, the country is politically and institutionally stable. Following successful EU and NATO accessions in 2004, it adopted the euro currency in 2009.

Having taken office in 2010, the centre-right coalition government began to roll back the previous administration's market-unfriendly measures. However, the coalition lost a confidence vote in October 2011, leaving it to rule as a weak interim administration. This is likely to undermine its ability to take resolute policy decisions before early elections are held in March 2012.

The Slovakia economy grew by 3% in 2011, down from 4.1% in 2010 due to the implementation of an austerity package worth of 2.5% of GDP and weaker foreign demand (exports create 84% of the Slovak GDP). Growth for 2012 is predicted to be around 1.2%.

Red tape and corruption may occasionally create obstacles for investors, but the general business environment is deemed to be good.

Benchmark assessments indicate that Slovakia ranks 48th out of 183 countries for Ease of Doing Business 2011[15] and 66th out of 183 countries for Corruption Perception Index 2011[16].

Within the scope of this report, Slovakia ranks 4th out of 24 countries for Ease of Doing Business 2011 and 7th out of 24 countries for Corruption Perception Index 2011.

The Control Risks RiskMap 2012 edition classifies the Political Risk of Slovakia as Medium[17].

7.4 Security Considerations

The Control Risks RiskMap 2012 edition classifies the Security Risk of Slovakia as Low. This is supported by other online resources such as the FCO travel advice pages[18].

[15] http://www.doingbusiness.org/rankings
[16] http://cpi.transparency.org/cpi2011/results/
[17] http://www.control-risks.com/Riskmap/Pages/Home.aspx
[18] http://www.fco.gov.uk/en/travel-and-living-abroad/travel-advice-by-country/europe/slovakia

It is therefore likely that access might be made to all areas within the country and that standard security measures would not need to be augmented to protect company staff and assets during exploration and development.

7.5 Prospectivity

Slovakia has a rich history of mining polymetallic vein deposits and only minor porphyry exploration and exploitation having taken place. The spatial and kindred association between copper porphyry and these polymetallic vein deposits being well defined and the discovery of deep porphyry style mineralisation at Pukanec and Biely Vrch, it can be expected that more porphyry deposits could be found within the Slovakian Volcanic Field in the vicinity of other known and historic epithermal vein occurrences in this region.

The volcanosedimentary complex of the Spišsko-gemerské rudohorie mountain range also harbours an extensive mineralised district generally of high sulphidation epithermal vein deposits. Potential exists for the discovery of deep lying porphyry systems in the vicinity of the Ruska Bystra and Smolnik properties held by Ortac Resources near Kosice.

The similarities of Slovak geology and the setting in which the world class deposits of Romania were emplaced means that the potential to find similar ‘blind’ porphyries is relatively high.

8 Hungary

Hungary is a landlocked country in Central Europe, situated in the Carpathian Basin (Figure 8-1). The capital and largest city is Budapest. Hungary is a member of the European Union, NATO, the OECD, the Visegrád Group, and is a Schengen state. The official language is Hungarian, also known as Magyar, which is part of the Finno-Ugric group and is the most widely spoken non-Indo-European language in Europe.

Figure 8-1 Political map of Hungary showing copper deposits by contained copper resources. Adapted from the University of Texas Libraries, The University of Texas at Austin (1994)

Hungary is a modest producer of minerals, and mining and mineral processing activities make up only a small part of the country's economy. In 2009, Hungary's gross domestic product (GDP) decreased by 6.3% compared with the GDP in 2008. Mining and quarrying made up only about 0.2% of the GDP in 2008. Production decreases were seen for most minerals in 2009 owing to the world economic crisis and the resulting decrease in demand for mineral commodities. Production of bauxite and alumina decreased by 38% each; gallium by 33%; pig iron by 19%; crude steel by 35%; and steel by an estimated 36% (Brininstool, 2010).

8.1 Geology and Tectonics

Comment [DM3]: Needs a map that shows all that you have mentioned here. The Carpathians map isn't detailed enough

Hungary is located in the central part of the Pannonian basin system. The basin was formed by stretching of continental lithosphere during the Neogene, synchronously with the compressional deformation of the Outer Carpathian flysch nappes. The external units are composed of a Late Cretaceous-Early Neogene flysch wedge, deformed during the Tertiary and thrust on their foredeep and foreland. The internal units are made up of less continuous exposures of Mesozoic rocks and their crystalline basement, deformed during different periods of the Jurassic and Cretaceous. A narrow, strongly deformed zone of Mesozoic rocks, the Pieniny Klippen Belt is situated between the Inner West Carpathians and the Flysch belt (Birkenmajer, 1974; Birkenmajer, 2007).

The Neogene volcanic belt follows the outlines of the chains on their internal side and a large volume of volcanic rocks are thought to be buried beneath sediments of the Pannonian Basin. Modern seismic and borehole investigations revealed that the substrata of the Neogene Basins is composed of Alpine nappes (Tari, 1994), which are the continuations of outcropping units around the basin system.

It has been implied that that the substratum of the Pannonian Basin is not uniform and is composed of at two microplates. These continental microplates are called the Alcapa and Tisza-Dacia units (Fodor, 2006) and had significantly different Mesozoic position and were juxtaposed in the late Tertiary. The boundary between the two units is a tectonic zone, the Mid-Hungarian fault system, which is buried for most of its length below the Neogene volcanic and sedimentary rocks of the Pannonian Basin.

The Alcapa block is located north of the Mid-Hungarian fault system. Its original northern limit is the Pieniny Klippen belt. This northern limit gradually shifted to more external nappe boundaries, as during the evolution of the Alcapa, more and more Outer Carpathian flysch nappes were accreted to the internal Mesozoic unit.

The western boundary of the Alcapa can be found in the Eastern Alps along the low-angle normal fault at the eastern limit of the Tauern window.

Due to intra-plate compression, the Pannonian lithosphere exhibits large-scale flexure, manifested in Quaternary subsidence and uplift that largely control the recent morphological features of the basin. The extended, hot, and hence weak lithosphere underlying sedimentary basins is prone to reactivation under relatively low compressional stresses.

8.2 Known Deposits and Occurrences

Recsk-Lahoca

The large porphyry copper-skarn-epithermal deposit Recsk is associated with Paleogene volcanics in the Hungarian Central Mountains. The current resource estimate from the MEG website is 45Mt at 1.6% Cu and 1.2 %Zn, (0.7 Mt contained copper and 0.5 Mt contained zinc)[19].

Mineralisation is associated with andesitic subvolcanic bodies, and subaerial and submarine strato-volcanic rocks that formed in the thrust-subduction zones of the inner Carpathian volcanic arc.

[19] http://www.metalseconomics.com/

The porphyry copper, Cu-Zn skarn, vein and replacement mineralisation is found at deeper levels. The near surface Au-Cu epithermal deposits are hosted by the uppermost Eocene calc-alkaline andesitic stratovolcanic sequences.

In the 1960's a large, complex, porphyry copper and polymetallic, deep-seated ore deposit (Recsk Deep) was discovered. Detailed explorations resulted in 130 deep (>1,000 m) diamond boreholes, two deep shafts (to 1,200 m depth), tunnels and numerous crosscuts at two levels, and a total of 75,000 m of underground drillholes. After decades Recsk Deep still awaits exploitation and is in the state of long-term suspension (Kovacs et al., 2007). The mine development and historical workings are currently thought to be flooded.

Base and precious metal mining in the Recsk-Lahóca area started about 200 years ago and several ancient adits exist in the area. Major mining activities took place mainly between the 1950s and 1997. It is unclear why mining ceased at Recsk, however it is thought to be a large copper/gold porphyry that is deep, irregular, broken up, and difficult and expensive to mine and the majority of mineralisation lies at a depth of between 900 meters and 1,000 meters.

8.3 Political Considerations

The country is generally politically stable, and the risk of any major political upheaval is insignificant. However, recent government initiatives have curtailed the democratic functioning of nominally independent institutions, hindering transparency and creating a degree of uncertainty about the government's actions. The current government frequently adopts anti-capitalist rhetoric and has passed legislation that disproportionately affects foreign investors and increases the state's role in the economy. Social tensions have increased over the past few years as the poor economic situation and disaffection with leading political parties have resulted in a shift in support towards the right-wing, in some cases fuelling extreme nationalism.

Hungary's economic growth forecast for 2012 was recently corrected downward to 0.5% and its sovereign debt rating has recently been downgraded to speculative levels by all three major credit rating agencies. However, as Hungary has a very open economy and is greatly dependent on its export partners, its economic outlook is very much dependent on international events (UKTI, 2012).

In terms of business, Hungary has many advantages but lack of transparency and over-regulation are some of the problems doing business in the country (FCO, 2012).

Benchmark assessments indicate that Hungary ranks 51st out of 183 countries for Ease of Doing Business 2011[20] and 54th out of 183 countries for Corruption Perception Index 2011[21].

Within the scope of this report, Hungary ranks 5th out of 24 countries for Ease of Doing Business 2011 and 3rd out of 24 countries for Corruption Perception Index 2011.

The Control Risks RiskMap 2012 edition classifies the Political Risk of Hungary as Medium[22].

[20] http://www.doingbusiness.org/rankings
[21] http://cpi.transparency.org/cpi2011/results/
[22] http://www.control-risks.com/Riskmap/Pages/Home.aspx

8.4 Security Considerations

The Control Risks RiskMap 2012 edition classifies the Security Risk of Hungary as Low. This is supported by other online resources such as the FCO travel advice pages[23].

It is therefore likely that access might be made to all areas within the country and that standard security measures would not need to be augmented to protect company staff and assets during exploration and development.

8.5 Prospectivity

The historically reported resources at the large Recsk copper porphyry and the Lahoca near surface high sulphidation epithermal deposits is promising. The level of exploration and development of the project and mine infrastructure is also a plus for the deposit. Following a detailed due diligence study into the historical work on the deposit it may be possible, with a limited amount of work, to bring this deposit to an advanced stage.

It has however been stated that the mineralisation is irregular and thereby difficult to mine. In 2008 the Hungarian government were looking for a buyer to purchase the mine, however no buyer seems to have been found and the workings are currently thought to be flooded.

As Cu porphyry deposits are generally found in clusters and the large porphyry copper deposit at Recsk currently seems to be the only known deposit within northern Hungary there is a likelihood that more porphyry deposits could be found within this region.

The Mid-Hungarian fault system, which is buried for most of its length below the Neogene volcanic and sedimentary rocks of the Pannonian Basin holds the potential to confine structurally controlled mineralisation, however the depth of sediment cover within the basin would make indentifying potential zones of mineralisation very difficult.

[23] http://www.fco.gov.uk/en/travel-and-living-abroad/travel-advice-by-country/europe/hungary

9 Ukraine

Ukraine is a country that straddles Central and Eastern Europe. It has an area of 603,628 km², making it the second largest contiguous country on the European continent, after Russia (Figure 9-1).

Figure 9-1 Political map of Ukraine showing copper deposits by contained copper resources. Adapted from the University of Texas Libraries, The University of Texas at Austin (1993)

Ukraine is a major world producer of such minerals as bromine, gallium, graphite, iron ore, manganese ore, pig iron, steel, titanium concentrates (ilmenite and rutile), and titanium. The country has large coal reserves, but is dependent on imports to satisfy most of its petroleum and natural gas demand. Ukraine is also an important transit country for natural gas and petroleum from Central Asia and Russia to Europe.

In 2009, Ukraine's real gross domestic product (GDP) decreased by 15.1% compared with that of 2008. The State Statistics Committee of Ukraine reported that, in 2009, mining and quarrying activities accounted for about 3.87% of the GDP, and manufacturing, 15.85%. The value of minerals and metals processing activities as a percentage of the GDP was not reported by the State Statistics

Committee, but news reports stated, that in 2007, the mining and metals industry accounted for 27% of the GDP. It was not known if this figure included the value of finished products or other items not included in this report, but the figure acts as a good general indicator of the importance of Ukraine's mineral industry for the country's economy.

9.1 Geology and Tectonics

The Ukrainian section of the TMB is represented by part of the Carpathian Mountains which lie on the border of the Eastern European Platform and the Mediterranean Geosynclinal Province. Their geological structure is the result of successive periods of sedimentation, orogenesis, and denudation. The basic pattern in the structure of the Ukrainian Carpathians is their distinct division into longitudinal structural-lithological zones. The mountains were principally formed in the Tertiary period. Older Paleozoic and Precambrian rocks are quite rare and are found mostly in the RakhivMountains and the Chyvchyn Mountains, which are part of the Maramureş-Bukovynian Upland. Upper Cretaceous and Paleogene deposits appear in dislocated layers of flysch—interbedded sandstones, marls, and schist. Late Tertiary strata are common in Subcarpathia and Transcarpathia. Quaternary formations such as glacial deposits, alluvial deposits, and loess in the depressions are widespread.

Comment [DM4]: These need to be on one of the maps

Zonation is characteristic of the tectonic structure of the Ukrainian Carpathians. They consist of four longitudinal structural zones, which extend from the northwest to the southeast (Figure 4-1):

(1) The outer or overthrust fold zone, 40 km wide, built of Cretaceous and Paleogene flysch (mostly sandstone) formed into anticlinal folds that were broken and thrust towards the southeast (at the edge of the Carpathians they often cover the Miocene strata of Subcarpathia).

(2) The central synclinal zone, 30–40 km wide: at its surface intensely folded Upper Oligocene strata of soft, sand-clay sediment are most common.

(3) The core of the inner anticlinal zone, consisting primarily of crystalline rock formations—crystalline schist, gneiss, quartzite, and crystalline limestones—and, to a lesser extent, of Triassic and Jurassic strata—limestones, sandstones, porphyrites, and conglomerates—which emerge to the surface only in the Maramureş-Bukovynian Upland; however, this basic core is often overthrust with flysch strata from the Cretaceous and Lower Paleogene periods, folded, frequently dissected, and in places pushed towards the north.

(4) A zone of volcanic deposits—trachytes, andesites, rhyolites, and tuffs—separated from the rest of the Carpathians by the Inner Carpathian Valley and the Maramureş Basin, which are covered by horizontal layers from the Miocene period.

The most southwesterly belt of the Carpathian Mountains is located between the Tysa Lowland and the Polonynian Beskyd and Inner Carpathian Valley. The mountains rise steeply for 600–900 m above the Tysa Lowland to an elevation of 900–1,100 m. They consist mostly of effusive centres joined by lava streams that were created during the sinking of the Inner Carpathians during the Miocene epoch. The volcanic deposits include trachytes, andesites, rhyolites, and tuffs.

9.2 Known Deposits and Occurrences

There are a number of known Permian/Carboniferous sediment hosted deposits found within the Ukraine, however little is known about the extent or grade of the mineralisation at these locations. Despite considerable time spent researching through publically available resources, very little useful information ahs been found regarding the extractive minerals industry in Ukraine.

9.3 Political Considerations

The Ukraine is a member of the European Bank for Reconstruction and Development (EBRD) and joined the World Trade Organisation (WTO) in May 2008. It has a major ferrous metal industry, producing cast iron, steel and steel pipe, and its chemical industry produces coke, mineral fertilisers, and sulphuric acid. Manufactured goods include airplanes, turbines, metallurgical equipment, diesel locomotives and tractors. The Ukraine is also a major producer of grain, sunflower seeds, and sugar beet. It has a broad industrial base, including much of the former USSR's space and rocket industry[24].

The Ukraine has significant economic potential as a result of its well educated labour force, large domestic market, access to a variety of resources including some of Europe's best agricultural land, significant coal and some oil and gas reserves, and a strategic location connecting Europe, Russia and Asian markets.

Ukraine also still has relatively poor infrastructure, making road and rail links a particular challenge for investors.

Political wranglings in the Ukraine are well documented in the media and whilst the current government appears to be handling the current economic difficulties there have been several rollbacks in the constitution that have lacked transparency and are widely seen as a backward step by the Ukraine's European neighbours. More recently, political reprisals have led to several high profile court cases where observers have recorded numerous and serious violations of fundamental legal principles, in direct contradiction of common European values[25].

Benchmark assessments indicate that the Ukraine ranks 152nd out of 183 countries for Ease of Doing Business 2011[26] and 152nd out of 183 countries for Corruption Perception Index 2011[27].

Within the scope of this report, the Ukraine ranks 22nd out of 24 countries for Ease of Doing Business 2011 and 22nd out of 24 countries for Corruption Perception Index 2011.

The Control Risks RiskMap 2012 edition classifies the Political Risk of the Ukraine as Medium[28].

9.4 Security Considerations

Poor socio-economic conditions and high levels of alcohol and drug abuse fuel both petty and violent crime. The police force has often been accused of excessive use of force and corruption. Violence associated with organised crime, such as contract killings and bombings, is on the rise. Foreign

[24] http://www.ukti.gov.uk/export/countries/europe/easterneurope/ukraine/overseasbusinessrisk.html
[25] http://www.fco.gov.uk/en/travel-and-living-abroad/travel-advice-by-country/country-profile/europe/ukraine?profile=politics
[26] http://www.doingbusiness.org/rankings
[27] http://cpi.transparency.org/cpi2011/results/
[28] http://www.control-risks.com/Riskmap/Pages/Home.aspx

companies may be vulnerable to occasional extortion or other threats, but organised crime is usually confined to local or Russian business or criminal groups.

The Control Risks RiskMap 2012 edition classifies the Security Risk of the Ukraine as Low. This is supported by other online resources such as the FCO travel advice pages[29].

It is therefore likely that access might be made to all areas within the country and that standard security measures would not need to be augmented to protect company staff and assets during exploration and development.

9.5 Prospectivity

Very little is known about the copper deposits in Ukraine.. There is some potential for Pb-Zn MVT deposits similar to those found in Poland along the Carpathian Foredeep and deposits similar to those found within Slovakia and Romania although the size of these deposits is expected to be small, if they exist at all. Potential also exists for Cu porphyry and vein deposits within the Volcanic Carpathians, similar to those found within Slovakia and Romania.

It is not recommended that MMG persue exploration for copper further in Ukraine due to the unfavourable geology and lack of known deposits.

[29] *http://www.fco.gov.uk/en/travel-and-living-abroad/travel-advice-by-country/europe/hungary*

10 Central Europe: The Apuseni-Banat-Timok-Srednogorie Belt

Central Europe's mineral wealth and in particular copper potential is concentrated in the Apuseni-Banat-Timok-Srednogorie belt (ABTS belt) which is largely the 'Balkan' sub segment of the larger Alpine-Balkan-Carpathian-Dinaride system (ABCD) (Figure 10-1). The sub division of the ABTS belt can be grouped largely into country related zones, the Apuseni and Banat segments are confined mostly to Romania, Timok to north and eastern Serbia and the Srednogorie portion to Bulgaria. Each of these segments or countries host potential mineral wealth of interest to MMG with slight variations in deposits styles, settings and dominant mineralisation.

The Alpine-Balkan-Carpathian-Dinaride (ABCD) orogen displays fundamentally different ore deposits along strike in three temporally and spatially distinct belts, the Alps, Balkan-Carpathians and the Dinarides (Neubauer 2002). These were formed through short lived episodes though in the later stages of orogenesis.

The particular focus for this section of the TMB is 1) the ABTS is the 'Balkan' portion of the Alpine-Balkan-Carpathian-Dinaride orogen arcing through Bulgaria, Serbia and Romania and 2) the Serbo Macedonian-Rhodope metallogenic zone in southern Bulgaria and northern Greece. Other regions such as the Dinaric Hellenides will be discussed with the associated countries but in less detail as the geology and current known deposits are less prospective especially in context of MMG's requirements in these regions.

The formation of the ABTS belt has been largely attributed to the Alpine orogeny (Late Mesozoic-Tertiary) and subduction induced magmatism during the late Cretaceous to early Paleocene has calc alkaline affinities favourable to porphyry stock formation .

The tectonic history of this period becomes increasingly complex from the late Cretaceous into the Tertiary. The interaction and trajectories of multiple plates produced a network of compressional and extensional environments.

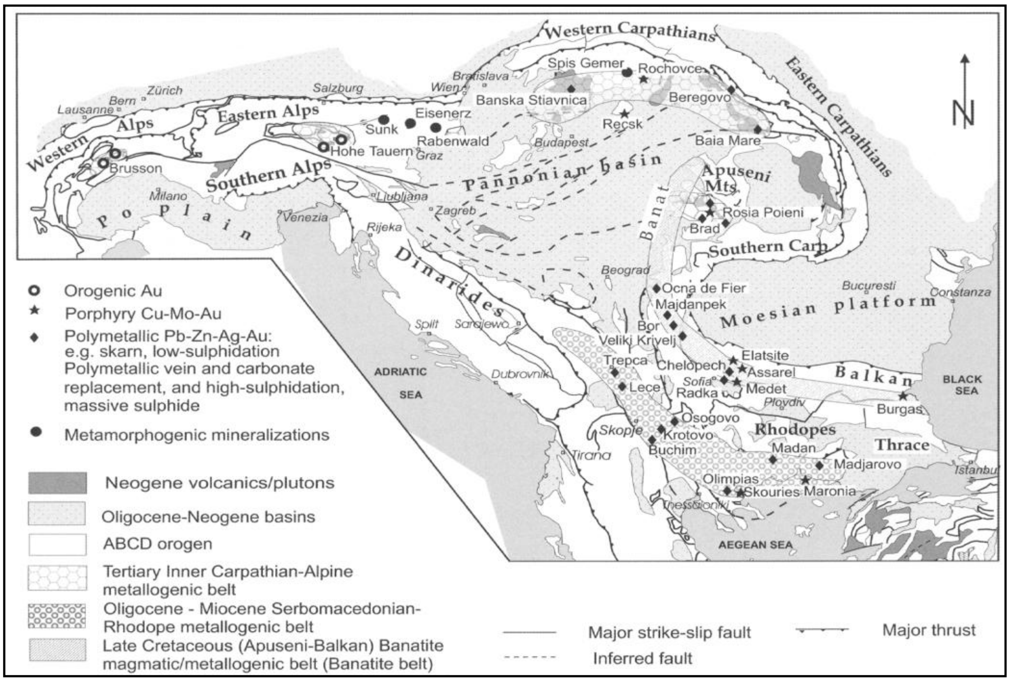

Figure 10-1 Map to show the main domains of the ABTS belt (Von Quandt, modified from Henrich and Neubauer, 2002)

10.1.1Geology and Tectonics

The Early Palaeozoic to Carboniferous was characterised by a period of convergence of multiple microplates and continental units leading to the accretion and construction of larger terranes. Tethyan terranes (i.e. the Vardar Ocean) were transported north to a near-equatorial latitude before docking during the Carboniferous to the Moesian platform. Simultaneously, a series of microcontinents and terranes were transported south-east along transcurrent faults situated on the margin of Adria (Marroni 2009). Today Adria constitutes an accreted group of microplates between the Dinarides and the Apennines margin under the Adriatic Sea.

Through the Permian to the Jurassic-Cretaceous boundary the Vardar Ocean (i.e. north-western part of Tethys) began to close as the north-east convergence of Eurasian and the Adria continental plates commenced. New marginal seas formed at its south-west margin during the Triassic, first the Dinaridic - Mirdita-Pindos basin and later the Western basin of the Vardar Ocean. These marginal basins began until the Vardar Basin completely closed in the late Jurassic.

During the Cretaceous the convergence of Adria and Eurasia continued and the long and complex closure of the Western basin of the Vardar Ocean took place until final the collision of Adria and Eurasia occurred during the Maastrichtian. It was during this final period of convergence that the subducting Vardar crust is thought to have stalled and caused either slab break off or roll back. A back-arc extensional environment was developed and concomitant calcalkaline intrusive complexes manifested themselves in the forming ABTS belt accompanied by mineralisation of an economic nature.

During the Cenozoic all of the continental units exhibited an interrelated development, which finally produced the present geological framework of the Balkan Peninsula (Figure 10-1).The impact of Adria resulted in transcurrent movements along some faults and boundaries of geological units, the rotation of units, and over thrusting as a result of escape tectonics. The location of the ABTS belt has already been discussed in the earlier stages of this chapter. Other significant terranes are discussed in the text below.

The Serbomacedonian-Rhodope Massif

The Serbomacedonian-Rhodope massif metallogenic zone is of Oligocene to Miocene age and encompasses many structurally differing zones from the Bosnian Dinarides to the Rhodope Massif in N-E Greece.

Various styles of mineralisation have been identified in the Serbomacedonian-Rhodope Massif, including a belt of volcanic hosted and vein type Pb-Zn type deposits and another of porphyry Cu-Au-Mo with epithermal Au mineralisation. The unit can be looked at as two separate subsections termed the Serbo-Macedonian Massif and the Rhodopes Massif.

The Serbo-Macedonian Massif/province is strongly associated with tertiary volcano plutonic complexes, which cross Serbia from the borders of Macedonia and Bulgaria in the south-southeast to the borders of Bosnia and Herzegovina and Croatia in the north-northwest. The massif begins with a metamorphic sequence of marbles and gneisses, penetrated by granitic intrusions, unconformably overlain by a sedimentary sequence of Upper Palaeozoic to lower Cretaceous units. The Alpine orogen in the middle Jurassic deformed all pre existing rocks, and then in the Tertiary the western margin was intruded by granitic bodies.

The Rhodope Massif occupies the N-E segment of mainland Greece and extends northwards into southern Bulgaria. The Massif contains metamorphic rocks of two distinctions. The lower group includes gneisses and amphibolitic schist, and the upper is of Middle Eocene rocks which unconformably overlie the older formations. The homogeneity of the structures in the southern part of the massif identifies the metamorphism and deformation as Jurassic and are assumed to be of Alpine influence (Marchev, 2005).

The massif is locally subdivided into two northwest-trending lithostratigraphic-tectonic units, namely the Vertiskos Formation to the west, which includes amphibolite gneiss flanking biotite schist and interbedded amphibolites, and to the east the underlying Kerdilla Formation, consisting of granitised and migmatised mica gneiss with amphibolite and marble horizons. The units have been intruded by Oligocene sub-alkaline porphyry stocks which include the body that hosts the Skouries copper-gold deposit in Greece, and are separated by the arcuate Stratoni Fault. Foliated leucocratic migmatites occur within the Kerdilla Formation. The most significant deposits are of lead/zinc, and to some extent copper and antimony. Amongst other mineralised areas the copper bearing zone hosts hydrothermal replacement and vein types of lead-zinc mineralisation.

The Vardar zone

The Ophiolitic terrane is a NW-SE striking assemblage of oceanic and continental units, each showing different metamorphic grades and metamorphic features. (Zelic 2010)

The Vardar Ocean units are represented by obducted ophiolitic sequences found in the Hellenides and Dinarides which were obducted during the subduction period of the Meliata Ocean. During the slab rebound a segment was obducted on the Pelagonian margin in Late Jurassic, then partially subducted under the Rhodope Massif in Cretaceous times.

The Pannonian Basin

The Pannonian Basin occupies a northern portion of Serbia extending across much of central Europe into Hungary, Romania and Croatia. The basin, which is encircled by the Carpatho-Balkan mountain range (east) and the Dinaric Alps (west), formed during the Neogene when back-arc extension took place behind the Carpathian thrust fold-belt. It subsequently filled with Palaeogene, Neogene and Quaternary sediments, mainly of molasse-type facies with a total maximum thickness of approximately 4000 meters. The thickness of the sediments and the structural style setting of the Pannonian basin has made it increasingly prospective for petroleum resources.

10.1.2Hellenic-Dinarides

This is a particularly broad overview of the Dinaric-Hellenides, but for the purposes of this report and given the complex nature of the Hellenides it is not necessary to detail all of the tectonic intricacies as the Hellenides do not host known mineralisation of the style MMG are interested in or indeed the geology to have the potential to do so (Figure 10-2)

The Dinarides extend south from the Southern Alps, along the east coast of the Adriatic and Ionian Seas and into the Agean to meet the Taurides and form the Dinaro-Tauride arc. The Dinarides are cut by the SE-NW Shkodra-Peja transversal fault zone in northern Albania which sub-divides the belt into the Dinarides and Hellenides, The northern Hellenides and southern Hellenides have geological and geophysical features which resemble those of island arcs (Pinter et al., 2004)

The Dinarides consist of highly complex folded, thrusted and imbricated belts that merge from the Southern Alps down to the Hellenides. The north-western Dinaric Mountains consist of collision to syn-collisional granitoids of Early-Middle Eocene age. The mountains are mainly covered by tertiary Pannonian basin sediments.

The Outer Dinarides are composed broadly of the Adriatic carbonate Platform and carbonate clastic formations. The thick deposits of the Adriatic carbonate platform existed throughout the entire Mesozoic until its final submergence in the Mid-Eocene. Structurally the platform consists of two parts: the lower portion corresponds to autochthonous Apulia, while the upper portion forms a broad ~100km wide zone made up of Dinaric nappes and imbricate thrust sheets. These units are composed of Cretaceous and Eocene limestone, marls and tertiary flysch that intermittently interbed with shallow marine and continental clastics below. The carbonate nappes are thrust and folded with Mesozoic Bosnian flysch and its low grade metamorphic Palaeozoic basement, the Bosnian Schist Mountains. Metamorphism occurred through the Early Cretaceous and the Bosnian Schist Mountains were exhumed during the Eocene-Oligocene. (Mikes et al., 2008)

The Internal Dinarides are largely composed of the Dinaric ophiolites and units active continental margin units; the Bosnian flysch, Dinaric ophiolitic melange zone, and the Sava-Vardar zone.

The Bosnian Flysch is approximately 2000m thick and is composed of two main units. The Vranduk group of Jurassic to Berriasian age, consisting of flysch sequences interlayered with radiolarites, the second group being the Ugar group, a typical carbonate flysch sequence; and is to Santonian / Early Palaeogene in age (Pamic et al., 2002)

The Dinaric Melange Ophiolite Zone includes a variety of units. Pamic (1982), briefly describes them as Middle/late Triassic to Early Cretaceous age radiolarite formations. The Olistrome ophiolite melange contains limestone exotics of Middle to late Triassic and a Cretaceous carbonate overstep in which ophiolites are re-deposited.

The Sava-Vadar Zone consists of a variety of sedimentary, metamorphic and igneous rocks. The Cretaceous-Early Palaeogene flysch sequences are interlayered by coeval basalts rhyolites and granites. In the Palaeogene the clastics and carbonates became progressively more metamorphosed to medium grade P-T conditions.

The Hellenides

The Hellenides are several sub-parallel zones which are interpreted as terranes separated by sutures e.g. the Pindos and Vardar sutures caused by the amalgamation of crustal segments during the subduction of the Tethyan basin, (Himmerkus 2007).

The external Hellenides are of low grade metamorphism and are composed of Tertiary nappe piles which include within them a detached slice of medial belt blueschist, known as the Arna Unit.

The medial Central Hellenides consist of pre-late Eocene metamorphic units formed by the subduction of a group of units originally located between the external platform of the Hellenides and the Pindos Ocean together with ophiolites and basement rocks,(Papnikolaou 1984).

The internal Hellenide metamorphic belt has resulted from Hercynian and early Alpine imbrications of fragments of continental crust with ophiolitic rocks followed by a considerable intraplate shortening during Eocene-Oligocene times. (Papnikolaou 1984)

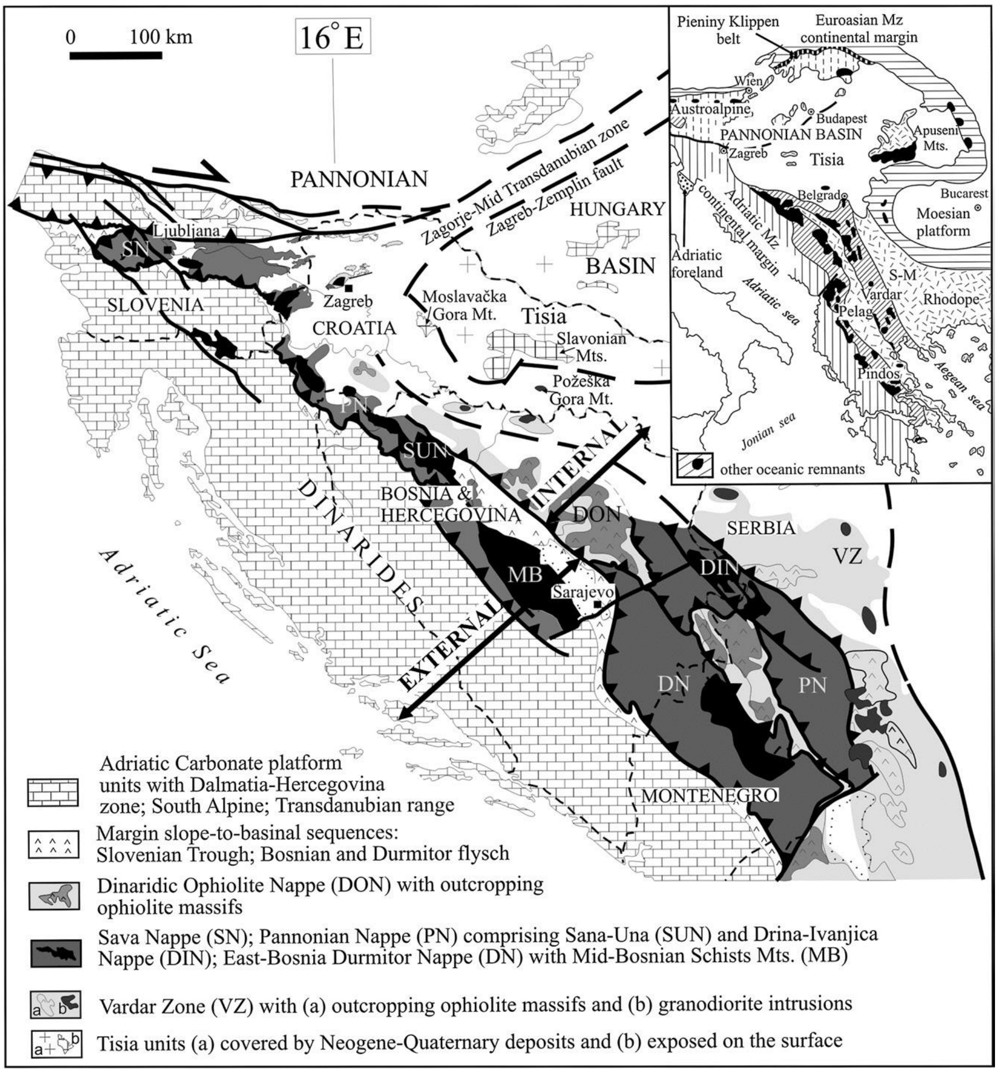

Figure 10-2: Summary map of the Dinarides(Ladislav 2008)

11 Romania

Romania is a country located at the crossroads of central and south-eastern Europe, on the Lower Danube, within and outside the Carpathian arch and bordering the Black Sea (Figure 11-1). At 238,400 km^2 Romania is the ninth largest country of the European Union by area, and has the seventh largest population with 21.9 million people. Its capital and largest city is Bucharest and is the sixth largest city in the EU with approximately two million inhabitants.

With the fall of the Iron Curtain and the 1989 Revolution, Romania began its transition towards democracy and a capitalist market economy. After a decade of post-revolution economic problems, extensive reforms fostered economic recovery making Romania now an upper middle-income country with high human development.

Romania is currentlya unitary, semi-presidential republic, in which the executive branch consists of the President and the Government. It is also a member of NATO. In 2009, Romania's GDP decreased by 7.1% in real terms compared with 2008. Industrial production made up about 24% of the nominal GDP at current prices, but it was not reported what percentage of this amount was from mining and quarrying and metal production activities.

Romania's mineral production is not significant in terms of world rankings, and industry is dependent on imports of mineral ores and concentrates to produce refined metals. EU membership was achieved in 2007 which prompted the steep decline of mining activities for copper, iron ore, lead, and zinc. This was a result of the necessity for production facilities to either modernize to meet EU standards or to close.

Romania's mineral production was negatively affected by the world economic crisis, and increased production will most likely depend on the improvement of the European economy. Production of metals is expected to continue, even though producers are likely to be under pressure to continue the modernisation of facilities to meet EU standards (Brininstool, 2011-2).

Figure 11-1 Political map of Romania showing copper deposits by contained copper resources. Adapted from the University of Texas Libraries, The University of Texas at Austin (1996)

11.1 Geology and Tectonics

Romania includes four major Alpine and older orogens, namely the Carpathian chain that comprises the Southern and Eastern segments of the Carpathians, the Apuseni Mountains and the Northern Dobrogea.

Tertiary sediments were deposited in the intervening Pannonian and Transylvanian Basins, as well as on the Scythian and Moesian Platforms.

Two principal areas of Tertiary volcanic rocks, predominantly of calcalkaline affinity, intrude and overlie these sequences. The first one spreads in the Eastern Carpathians from the north in the Baia Mare area (Oas-Gutai mountains) to the south (Calimani-Gurghiu-Harghita mountains), containing also a subvolcanic median sector (Tibles-Toroiaga- Rodna- Bargau mountains). The second area with Tertiary volcanic rocks is the Apuseni Mountains in central-western Romania. The famous mining districts of the Metaliferi Mountains of Transylvania, which represent the southern part of the Apuseni Mountains, comprise a 900 km^2 region, immediately to the north of the city of Deva and are commonly referred to as the Golden Quadrilateral.

The Banatic area in Romania is a segment of the Late Cretaceous calc-alkaline affinity Apuseni-Banat-Timok-Srednogorie belt. The Banat region consists of a north-trending corridor on the western edge of the Permian to Upper Cretaceous Getic Nappe complex which consists of substantial amounts of limestone (Lawrence 2005).The area is associated with porphyry and polymetallic mineralisation in the form of small stocks and dikes of Late Cretaceous to Paleocene age. The limestone host rock in which the intrusives are emplaced hosts numerous pods of discontinuous skarn and is one of the most prospective regions in Romania

The Golden Quadrilateral lies within the Apuseni Mountains(Figure 11-1), which consist of Mesozoic, shallow marine and non-marine sedimentary rocks overlying Palaeozoic and Precambrian sedimentary and metamorphic basement. North-directed thrust faulting during the late Cretaceous resulted in a series of nappes that are unconformably overlain, and intruded, by Tertiary volcanics that are associated with high-level gold-silver mineralization and porphyry copper deposits.

According to available K-Ar dating, the main volcanic activity from the Apuseni Mountains ranges between 14.7 and 7.3 Ma, and ended in the Quaternary (1.6 Ma). Three major northwest-trending belts of volcanism (Brad-Sacaramb, Zlatna-Stanija, and Rosia Montana-Bucium) and associated mineralisation are identified within the Golden Quadrilateral. The Rosia Montana Complex represents part of the northernmost belt.

11.2 Known Deposits and Occurrences

The Banat district and Apuseni Mountains.form the two segments of the ABTS belt that run through Romania. Key copper deposits are discussed here based on this separation.

11.2.1Apuseni Mountains

The calc-alkaline Miocene magmatism in the South Apuseni Mountains was related to transtensional and rotational tectonics. Magmatic activity was focused within NW-SE oriented extensional basins and developed mainly between 14.7 and 7.4 Ma (Rosu et al, 2004). These structures host some of Europe’s largest porphyry Cu-Au and epithermal Au-Ag deposits, both associated with shallow subvolcanic intrusions, (Kouzmanov, 2005).

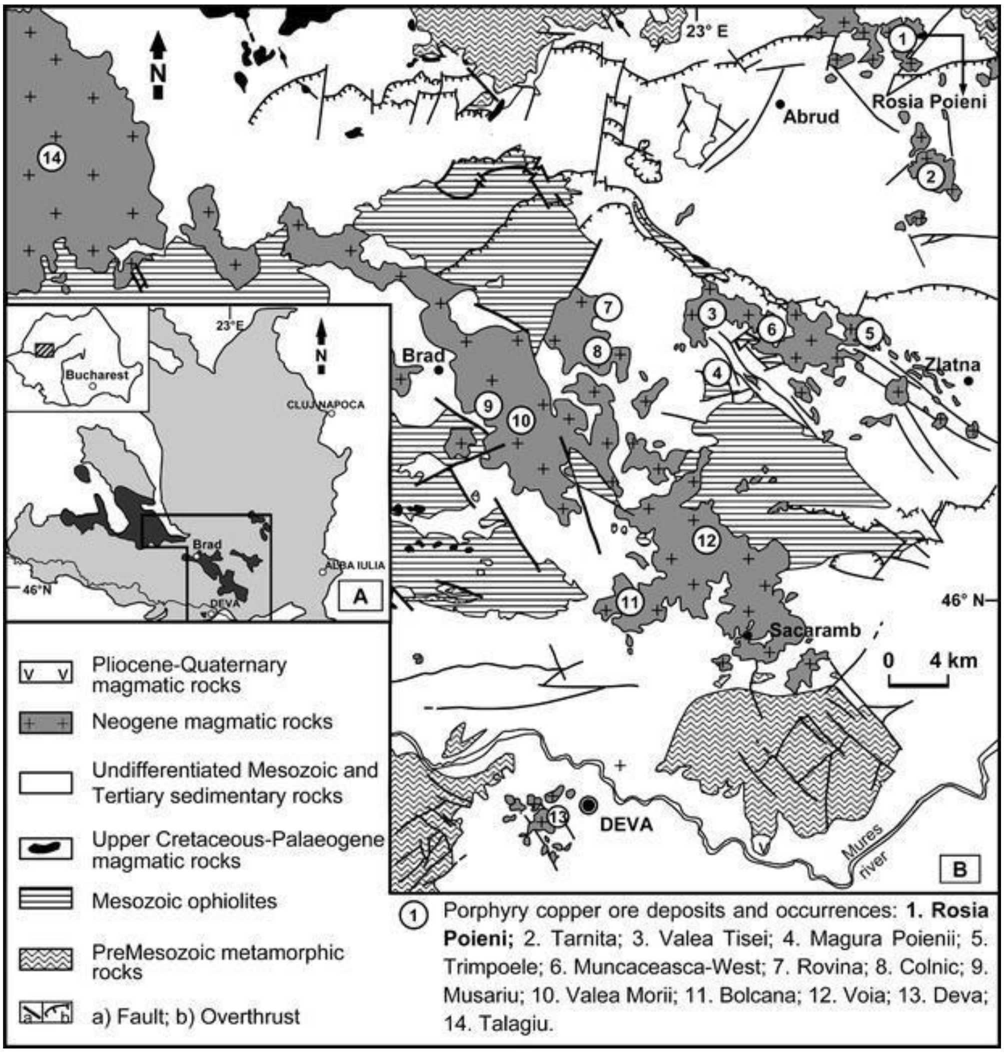

Figure 11-2 Simplified geological map of South Apuseni Mts. showing the location of porphyry Cu (Mo, Au) ore deposit occurrences (after Dumitrescu et al., 1978 and Bostinescu, 1984 in Milu et al., 2002)

Rosia Montana

The Rosia Montana is a breccia-hosted low to intermediate sulphidation epithermal system, operated by Gabriel Resources Ltd. Rosia Montana was previously closed in 1985 due to environment issues. Gabriel Resources are redeveloping an open pit and conducting further exploration of the site focusing on Au and Ag. Resources are noted as 14.6 Moz of gold and 64.9m oz of silver (measured and indicated), including reserves of 10.1 Moz of gold and 47.6 Moz of silver (proven and probable).[30]

Rosia Poieni

Rosia Poieni, a porphyry copper system is approximately 4 km NE of Rosia Montana, and has a high sulphidation epithermal overprint. These two deposits make up the largest Cu-Au deposits in

[30] http://www.gabrielresources.com/site/rosiamontana.aspx

Romania. Porter GeoConsultancy[31] quotes a total measured, indicated and inferred resource for Rosia Poieni of 350 Mt @ 0.36% Cu (1.26 Mt contained Cu) and 0.29 g/t Au (3.2 Moz contained Au).The deposit and mine processing complex are currently operated by CupruMin[32]. The future ownership of the deposit is unclear due to CupruMin opening auction for the deposit. In late March 2012 four companies bid for the deposit, BayFront Capital Partners[33] and its wholly-owned subsidiary Roman Copper Corp won the bidding but the sales agreement failed to finalise following the government and Roman Copper Corp. being unable to agree on terms. The current situation of the Rosia Poieni and Rosia Montana are further discussed in the political considerations section.

Rovina

Rovina is situated within the Golden Quadrilateral of the southern Apuseni Mountains. Rovina hosts three copper-gold porphyry systems: Rovina, Colnic and Ciresata. The Colnic porphyry is located approximately 2.5 km south of the Rovina porphyry and the Ciresata porphyry is approximately 4 km south of the Colnic porphyry. Copper gold mineralisation at Rovina and Colnic prospects is hosted in altered porphyritic microdioritie, containing magnetite in thin vienlets and as disseminated granular agglomerates and secondary biotite consistent with potassic alteration at the core of gold rich-porphyry hydrothermal systems. This alteration is cut by quartz-chalcopyrite-pyrite stockwork vienlets. The porphyry style is said to be of the same type as the Rosia Montana deposit.

The deposits are being developed by Carpathian Gold Inc. who have realised a JORC compliant total measured and indicted resource for the three combined projects of 193.1Mt at 0.49 g/t Au (3.04 Moz contained Au) and 0.18% Cu (347,000 t contained Cu).[34]

Bucium Tarnita

The three main styles of mineralisation that have been identified to date in the Bucium project are epithermal, epithermal-mesothermal gold-silver mineralisation and mesothermal copper-gold mineralisation. The predominant style for gold-silver mineralisation hosted within the andesitic units at the property is a series of sub-parallel quartz-sulphide veins separated by strong to intensely altered wall rock. These predominantly occur in the southern part of the licence area. Porphyry copper-gold mineralisation has been identified at Bucium Tarnita where drilling of a subvertical micro-dioritic plug has returned broad zones of copper and gold mineralisation (Gabriel Resouorces)[35]Although there is copper present in the deposit the company's focus is predominantly on Au and Ag.

Deva

European Goldfields Ltd.36 has acquired an exploration licence around the Deva copper gold porphyry and the Muncel-Vetel massive sulphide deposits. The Deva porphyry was previously operated by the Romanian state and reportedly contained an estimated 19.2 Mt of mineralisation containing 0.5g/t Au and 0.7% Cu (0.3 Moz contained Au and 0.13 Mt contained Cu).

11.2.2Banat district

Moldova Nouă

The Moldova Nouă deposit is the second largest mine in Romania having estimated reserves of 500 Mt at 0.35% Cu (1.75 Mt contained Cu). The deposit comprises a quartz diorite stock intruded

[31] http://www.portergeo.com.au/
[32] http://www.cuprumin.ro
[33] http://www.bayfrontcp.com
[34] www.carpathiangold.com
[35] http://www.gabrielresources.com
[36] www.egoldfields.com

into the limestones in the Getic nappe complex. Mineralisation is hosted within a skarn alteration body. The Romanian national company of copper gold and iron "MINVEST" Deva[37] is a state owned company whose business is focused on the mining and processing of copper, ferrous and polymetallic deposits and gravel and operates Moldova Nouă.

Oravita

Oravita is an exploration licence the Serbia border.held by Carpathian Gold Inc and covers a 32km stretch of the Banat porphyry belt. The licence is currently under exploration for gold and gold-copper mineralisation in a favourable setting for sediment-hosted skarn and porphyry deposits.

11.3 Political Considerations

Romania is a member of the EU and NATO, and is politically stable. Democratic institutions are entrenched, though law enforcement and political accountability are weaker than in more established Western democracies. Occasional disputes between ruling coalition partners may induce regulatory uncertainty, but all governments have served full terms since the fall of the communist regime in 1989.

Romania’s public finances have been improving, thanks to efforts to hold the government to an IMF funded programme. This has secured Romania's credibility – more recently reflected in Fitch's upgraded rating - and protected the country from the worst of the economic crisis. However, the government's political as well as economic calculations were based on a return to strong growth in 2012, an election year. This is looking less likely, with a lack of domestic consumption, flagging exports and slow spending of EU funds. The government is deemed to need to offer better prospects for growth, and may ultimately be tempted to reverse elements of the austerity programme. How this might affect the Government’s intent to join the Euro by 2015 has yet to become apparent[38].

Benchmark assessments indicate that Romania ranks 72nd out of 183 countries for Ease of Doing Business 2011[39] and 75th out of 183 countries for Corruption Perception Index 2011[40].

Within the scope of this report, Romania ranks 12th out of 24 countries for Ease of Doing Business 2011 and 10th out of 24 countries for Corruption Perception Index 2011.

The Control Risks RiskMap 2012 edition classifies the Political Risk of Romania as Medium[41].

There political developments within recent months with two of Romania's largest copper gold deposits. Rosia Montana currently operated by Canada's Gabriel Resources faces difficulties following the announcement of a proposed mine development project, that includes cyanide heap leach gold extraction methods, which has caused controversy among environmental groups and politicians. The media have covered the resignation of Laszlo Tokes claiming a factor of his resignation is over the use of cyanide in the gold extraction processes. These developments and the negative coverage in the media have seen Gabriel Resources' shares fall nearly 3% in the Toronto Stock

[37] http://minvest.hd.ro/
[38] http://www.fco.gov.uk/en/travel-and-living-abroad/travel-advice-by-country/country-profile/europe/romania?profile=economy
[39] http://www.doingbusiness.org/rankings
[40] http://cpi.transparency.org/cpi2011/results/
[41] http://www.control-risks.com/Riskmap/Pages/Home.aspx

Exchange[42].Historically Rosia Montana has been in the spot light for environmental and social issues, however, Romania's prime minister appears in favour of developments at the site.

The Rosia Poieni deposit was recently put for auction by the owners CupruMin. Despite Roman Copper Corp (a wholly owned subsidiary of BayFront Capital Partners[43]) winning the auction with a sum of 200.8 million euros[44], the deal fell through after the government pulled out subsequent to terms and conditions not being agreed upon.

The political factors and 'ease of working' in Romania following the developments of the two deposits maybe be regarded less highly than when Romania was initially reviewed. However, it must also be considered that these are high profile deposits in Romania and have been the focus of environmental and socio-economic issues previously. Rosia Montana in particular has had negative environmental coverage in the past, and will therefore naturally come under more political scrutiny and media coverage than many other deposits or projects in the country.

11.4 Security Considerations

The security environment is good, with petty crime posing the most significant threat for business personnel in the main cities. The government continues to support the US-led war against terrorism. Romanian troops served in Iraq and remain in Afghanistan. US troops have been stationed in Romanian airbases on a permanent basis since 2007. However, there are no active terrorist organisations operating in the country, nor have there been any previous terrorist attacks.

The Control Risks RiskMap 2012 edition classifies the Security Risk of Romania as Low. This is supported by other online resources such as the FCO travel advice pages[45].

It is therefore likely that access might be made to all areas within the country and that standard security measures would not need to be augmented to protect company staff and assets during exploration and development.

11.5 Prospectivity

SRK ES considers Romaina as on of the more prospective countires in the revieiw. The Banat region of Romania close to the Serbian border, hosts porphyry copper deposits of large enough size to be of some interest to MMG, the surrounding country and host rocks are made up of Cretaceous limestone, which combined with porphry magamatism gives favourable conditions for skarn formation.

The southern half of the Apuseni Mountains are particularly prospective and the clsuter of gold bearing copper porphries and HS deposits have been dubbed the golden quadrilateral in Apuseni Mountain range, Figure 11-1. The large deposits of this area are not primarily mined for copper due to the high gold grades. Many of the porphyry deposits carry a high sulphidation epithermal overprint, or there are adjacent associated HS epithermal deposits which make the area particularly prospective when considering reasonable gold grades in conjunction with copper.

[42] *http://www.mining.com*
[43] *http://www.bayfrontcp.com*
[44] *www.mining-journal.com*
[45] *http://www.fco.gov.uk/en/travel-and-living-abroad/travel-advice-by-country/europe/hungary*

Given the mining history of Romania, and considering that many of the historically larger deposits are being reinstated, there is significant merit for reinvestigation of copper deposits that have been overlooked in the past or primarily exploited for gold. Greenfield exploration would appear equally prospective in Romania. Given Romania's turbulent political and economic past it is possible that industrial development has been hindered, and with it the exploration and development of the minerals sector.

12 Serbia

Serbia is land locked in the central region of the Balkans. Kosovo, although reviewed here with Serbiafor simplicity, is not recognised by Serbia as a separate nation, despite Kosovo's acceptance of independence by 22 of the 27 EU member nations. Serbia has a population of just over 7.1 million, the capital Belgrade is one is the largest in southeast Europe. Serbia is one of the major copper producers Europe, though production is modest on a global scale. It is thought that in the northwest Serbia contains one tenth of the world's antimony supply, however the nation lacks fuels mineral resources.

Figure 12-1 Political map of Serbia and Montenegro showing copper deposits by contained copper resources. Adapted from the University of Texas Libraries, The University of Texas at Austin (2005)

12.1 Geology and Tectonics

Serbia's prospectivity for porphyry copper is focused within the Timok region of the Apuseni-Banat-Timok-Srednogorie belt. The Timok portion of the belt in east Serbia host's the Bor district which contains much of Serbia's copper mineralisation.

Broadly, Serbia can be subdivided into metallogenic provinces of varying genesis in the Alpine orogenic system, as shown in Figure 12-2:

- The **Pannonian Basin** occupies a northern portion of Serbia and extends across much of central Europe into Hungary, Romania and Croatia. It is the largest extensional basin that formed in a back arc setting during the Miocene in the Central Alps. The typical sedimentary succession of the southern Pannonian Basin consists of continental, alluvial and laustrine sediments unconformably overlying a strongly tectonised basement.

- The **Dinaric Province** covers a western portion of Serbia, despite the Dinaric Alps having been identified as mineralogically wealthy in some other European countries mineralisation of this region in Serbia is not economically significant .The Dinarides are Mesozoic in age, with the principal units being of thick deposits of karstified Triassic limestones and dolomites, Jurassic ophiolitic melange and Cretaceous flysch deposits. Mineralisation is associated with Triassic intercontinental rifted units. None are known to contain significantly economic mineralisation of Cu.

- The **Vardar Zone** is a belt east of the Dinaric Alps continuing into central Macedonia. It consists of three blocks separated by ophiolitic fractures. The ultra basic rock massifs are characterised by Triassic-Jurassic ophiolitic paleo-rifts and sutures.

- The **Serbian-Macedonian Province** is a belt trending north-south along the Great and South Morava valleys forming the Rhodope Mountains. It is strongly associated with tertiary volcano plutonic complexes which cross Serbia from the borders of Macedonia and Bulgaria in the south-southeast to the borders of Bosnia Herzegovina and Croatia in the north-northwest. The metallogenic zone consists of Oligocene-Miocene and locally Pliocene volcano-intrusive complexes of calc alkaline composition.

- The **Carpatho-Balkan Province** arc covers Eastern Serbia. Its northern part, the Serbian Carpathians, is an extension of the Carpathian range which joins the western parts of the Balkan Mountains whose main massif is in Bulgaria. This unit is primarily composed of Triassic, Jurassic, and Cretaceous limestones and U. Cretaceous plutonics. The Upper Cretaceous volcanic and volcano-plutonic complexes gave rise to copper mineralisation particularly in the 'Timok' region which encompasses this portion of the Carpatho-Balkans belt. Magmatic hydrothermal systems (Cu-Au) with polymetallic mineralisation are relatively common to the south-west part of the Carpatho-Balkanides, and most notably in three metallogenic sub provinces that consist of volcanic rocks of differing age. Two of these sub provinces are of Cretaceous magmatism and the third sub-province is of numerous Neogene intrusive complexes. They are named the Ridanj-Krepoljin, Bor-Donje and Lece-Chalkidiki metallogenic zones respectively.

Separate intrusive granites, of which the oldest have been dated as Permo-Carboniferous and the youngest as Tertiary, are located within the Dinaric Alps, Vardar Zone and Serbian-Macedonian Massif.

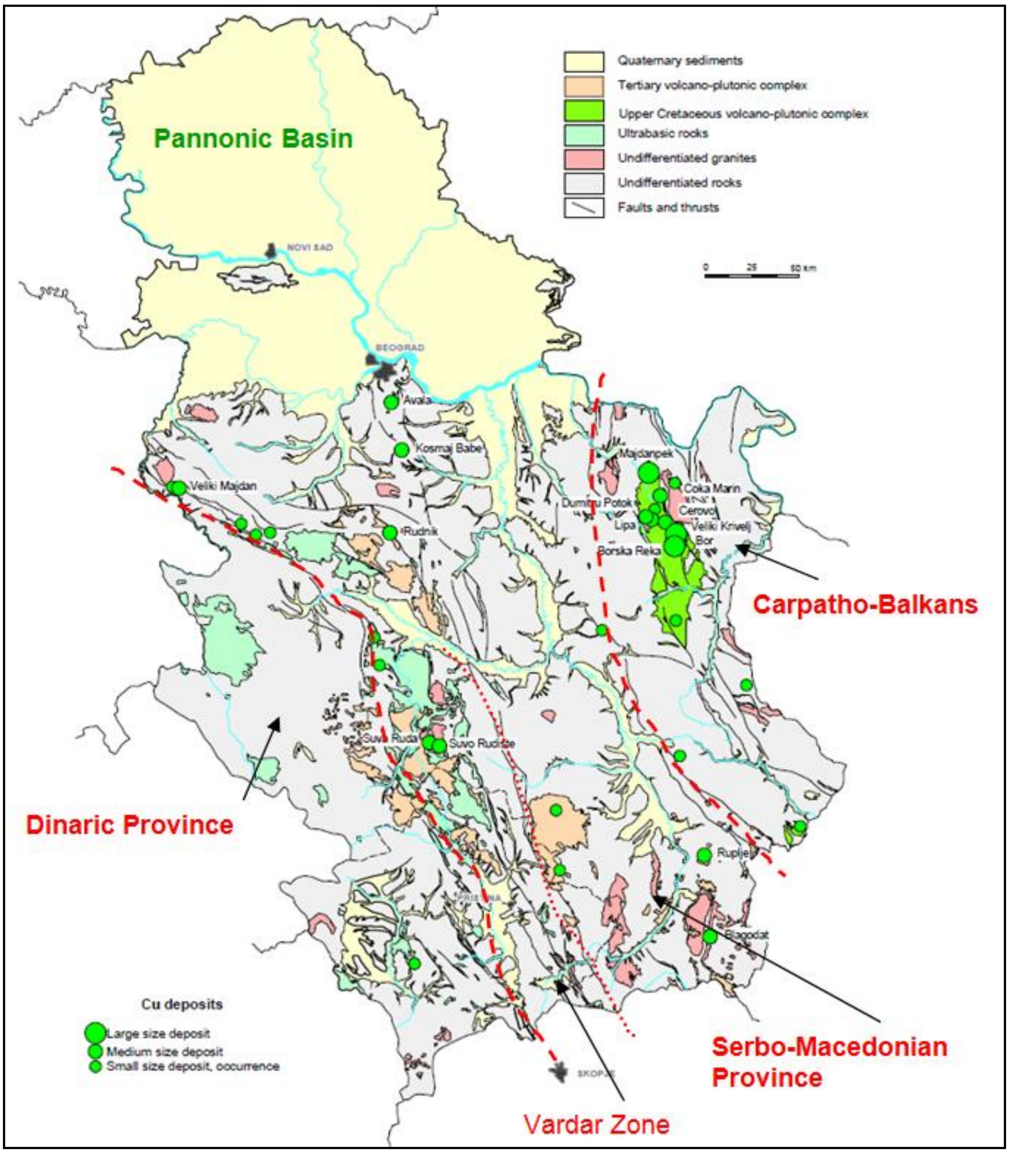

Figure 12-2: Metallurgical province overview map of Serbia. (Monthel et al. 2002)

12.2 Known Deposits and Occurrences

Pb-Zn mineralisation is concentrated in a north-west, south-east trending belt in northern Kosovo through the Vardar Zone forming the backbone of the Trepca Mining and Metallurgical Complex: Stari Trg, Belo Brdo, Novo Brdo Ajvalija. These deposits contain replacement mineralisation related to Tertiary volcano-plutonic events and are generally hosted by carbonates in contact with andesitic intrusions.

12.2.1 Trepca Mining and Metallurgical Complex

The Trepca Mining and metallurgical complex encompasses much of Kosovo's mineral wealth, including a number of major deposits. The Trepca complex is located in the Mitrovica province in Kosovo. The Stari Trg deposit, mined industrially since 1931, has produced 2000 t of Pb, 1400 t of Zn and 2500 t of Ag. Historic production totalled 60.5 Mt of mineralisation grading 8% Pb+Zn. Other deposits of average size, such as Veliki Majdan, Rudnik and Blagodat, are dispersed through the Trepca area to the Kosovo boarders. There are also replacement-type skarn-type deposits related to Tertiary volcano-plutonic events.

Apart from silver, the major by-products from these deposits are copper, bismuth, cadmium and gold. Belo Brdo and Novo Brdo Ajvalija are Tertiary volcano-plutonic events and are alsogenerally hosted by carbonates in contact with andesitic intrusions, but little information is available on them other than there is drilling underway to delineate the deposits and work towards a resource estimate. The ownership of the various mines within the complex is disputed and has had a turbulent ownership past, along with being the focal point of territory disputes. Currently the UN appears to be heavily involved in calming tensions whilst private investors are sought to fund redevelopment and modernisation of the mines.

12.2.2 Bor Complex

The main Cu-Au resources in the Bor district are found in porphyry copper and high sulphidation epithermal deposits, such as the gold-poor Veliki Krivelji porphyry and the Majdanpek porphyry and its surrounding high-sulphidation deposits. Host lithologies consist of andesitic volcanic rocks and pyroclastic rocks with adakitic affinity. At Bor the epithermal deposit mineralisation is seen to extend into the stock below for some 2000m. Veliki Krivelj is hosted by swarms of porphyry dikes and skarns, whereas at Majdanpek the host andesite dikes cross cut fractured basement gneiss (Jankovic, 1990; Herrington et al, 1998). All the deposits are related to Late Cretaceous calc-alkaline magmatism with the variation on mineralisation style under the influence of geological setting.

The Bor complex covers a total of 29 known deposits and includes high-sulphidation epithermal massive-enargite (gold) sulphide deposits and porphyry Cu-Mo and Mo type deposits. Whilst these are now practically exhausted, porphyry copper continues to be mined from the high tonnage/low-grade (0.3-0.4% Cu) deposits of Majdanpek, Veliki Krivelji, and Cerovo, which are a combination of the Bor style deposits. The Bor complex is operated by the state owned RTB Bor which is a collective of RBB (Copper Mines Bor), RBM (Copper Mine Majdanpek) and TIR smelter and refinery.

12.2.3 Tulare Cluster

The Tulare porphyry cluster lies within the Lece volcanic magmatic arc of the Carpatho Balkans. The deposits are of Late Cretaceous to Neogene age and include major porphyry and massive sulphide mineralisation. Located in central south east Serbia the deposits are 30 km NE of Pristnia. The Kiseljak Cu-Au deposit is typical to the region consisting of calcalkaline magmatism intruding into amphibolite and biotite schist country rock producing a Cu-Au porphyry. There is not yet a compliant resource estimate on the deposit according to Dunav Resources[46], the operators of the project.

12.3 Political Considerations

The Republic of Serbia has had a turbulent political past. The name "Former Yugoslavia" is used to describe the present day states that emerged from the collapse of the Socialist Federal Republic of Yugoslavia, that encompassed present day Slovenia, Macedonia, Central Serbia, Serbia, Kosovo, Montenegro, Croatia, Bosnia and Herzegovina. The unity of these countries was severed by the Yugoslav Wars of the late 20th Century.

The Kosovo region of southern Serbia declared independence on 17th February 2008 and is recognised by 89 UN member states, including four of the former Yugoslav states, however Serbia does not yet recognise its independence. Kosovo has seats at the IMF and World Bank, but is not itself a UN member yet.

Despite Belgrade's stance, it welcomes the 'Dialogue' with Pristina (Kosovo's capital), to discuss 'practical' matters such as border control, telecommunications and customs. Nonetheless, Kosovo remains a highly politically-charged issue, especially since disturbances in the Serb-dominated north of the country in July 2011[47].

Serbia has a mixed economy, dominated by a large and growing services sector. However, the industrial sector is still significant, generating about 25% of GDP, as is the agricultural sector at 12%. Owing to its proximity and good links to EU markets, Serbia is marketing itself as an investment destination for manufacturing and processing industries. Many of Serbia's current exports are intermediary goods, and the country will be looking to import expertise and technology to enable it to add value.

Corruption is widespread in Serbia, and is present at all levels of society. Recently, there have been some legislative moves to combat corruption, including establishment of an Anti-Corruption Agency. However, implementation remains patchy at best, with very few high-profile corruption cases coming to court.

Benchmark assessments indicate that Serbia ranks 92nd out of 183 countries for Ease of Doing Business 2011[48] and 86th out of 183 countries for Corruption Perception Index 2011[49].

Within the scope of this report, Serbia ranks 16th out of 24 countries for Ease of Doing Business 2011 and 13th out of 24 countries for Corruption Perception Index 2011. The Control Risks RiskMap 2012 edition classifies the Political Risk of Serbia as Medium[50].

Benchmark assessments indicate that Kosovo ranks 117th out of 183 countries for Ease of Doing Business 2011 and 112th out of 183 countries for Corruption Perception Index 2011.

[46] www.dunavresources.com
[47] http://www.ukti.gov.uk/export/countries/europe/southerneurope/serbia/overseasbusinessrisk.htm
[48] http://www.doingbusiness.org/rankings
[49] http://cpi.transparency.org/cpi2011/results/
[50] http://www.control-risks.com/Riskmap/Pages/Home.aspx

Within the scope of this report, Kosovo ranks 19th out of 24 countries for Ease of Doing Business 2011 and 17th out of 24 countries for Corruption Perception Index 2011. The Control Risks RiskMap 2012 edition classifies the Political Risk of Kosovo as Medium.

12.4 Security Considerations

The 2011 declaration of independence by Kosovo continues to lead to tensions in the region. Whilst these tensions are largely unnoticeable at present, any deterioration in the relationship between the Serbian and Kosvoan sides may lead to unrest in border areas and large cities including Belgrade.

Travel restrictions are in place for travelling into and out of Kosovo from Serbia.

Despite these tensions, the Control Risks RiskMap 2012 edition classifies the Security Risk of Serbia as Low. This is supported by other online resources such as the FCO travel advice pages[51].

It is therefore likely that access might be made to most areas within the country and that standard security measures would not need to be augmented to protect company staff and assets during exploration and development. Increased security measures should however be applied if travelling to the border region with Kosovo.

The Control Risks RiskMap 2012 edition classifies the Security Risk of Kosovo as Low but the FCO travel advice pages[52] recommend avoiding all but essential travel.

It is therefore likely that access to most areas within the country will be possible, but that standard security measures should be augmented to account for the possibility of unrest.

12.5 Prospectivity

It is thought that Serbia is unlikely to have the potential to host “Tier 1” resources in a single deposit, however clusters of deposits may be combined to constitute large quantities of mineralisation. The most prospective area is that of the Bor district within the Timok portion of the ABTS belt. The porphyry mineralisation is in the Late Cretaceous calcalkaline volcanics and with many of the deposits carrying epithermal style mineralisation potential this could significantly increased grade percentages within the deposits making Serbia a candidate for MMG's further investigations.

Copper Porphyry

The Timok region hosts the Bor complex that encompasses a number of deposits that collectively contain significant amounts of copper mineralisation. The known deposits of the Bor complex are reported to have had the high sulphidation epithermal deposits exploited, leaving the lower grade porphyry copper stocks so far untouched below. This makes the region both prospective for brownfield exploration and greenfield exploration for new sites associated with Late Cretaceous to Neogene magmatism.

It has been suggested in literature and technical reports that porphyry copper deposits of the Lece-Chalkidiki region have relatively higher amounts of gold in association with the porphyry mineralisation. The association with gold could make lower tonnage and grade copper deposits potential more attractive targets.

[51] http://www.fco.gov.uk/en/travel-and-living-abroad/travel-advice-by-country/europe/serbia#safetySecurity
[52] http://www.fco.gov.uk/en/travel-and-living-abroad/travel-advice-by-country/europe/kosovo#safetySecurity

Skarn Deposits*:*

Between the Vardar Zone and the Dinaric Alps is a prospective area for Pb-Zn carbonate hosted skarn deposits. These lie however in Kosovo and are thought to be of limited size.

IOCG, nickel and Kupferschiefer style deposits are not identified within Serbia nor does the geology lend itself favourably to their formation and are therefore not thought prospective.

13 Bulgaria

The Republic of Bulgaria lies in Eastern Europe as shown in Figure 13-1. With a territory of 110,994 km^2 Bulgaria is the 15th largest country in Europe. Bulgaria has a population of 7.36 million and the capital city Sofia has 1.25 million inhabitants. Bulgaria's mineral industry includes outputs of ferrous and non ferrous metals, mineral fuels and industrial minerals. Globally Bulgaria's mineral production is not thought to be of great significance, however regionally it is an important producer of copper, gold, iron, lead, zinc and steel.

The greatest prospectivity of Bulgaria is focused in the Srednogorie region, of the Apuseni-Banat-Timok-Srednogorie belt,(Figure 10-1). This region formsa west-northwest trending corridor through the Sofiya and Plovdiv states. In the Srednogorie region lays the Panagyurishte district, a corridor defined by porphyry copper mineralisation, that bears an affinity to strike slip fault regimes.

Figure 13-1 Political map of Bulgaria showing copper deposits by contained copper resources. Adapted from of the University of Texas Libraries, The University of Texas at Austin (1994)

13.1 Geology and Tectonics

Tectonically the country can be subdivided into areas of east-west morphotectonic units (Figure 13-2);

(1) The **Moesian Platform** of northern Bulgaria and southern Romania is a product of the Hercynian deformation episode. These underlie shelf type Mesozoic and Tertiary sedimentary (mostly carbonate) rocks.

(2) Sandwiched between the Moesian Platform and the Srednogorie Zone is the **Fore-Balkans**. The Fore-Balkans consists of tightly folded and metamorphosed Paleozoic sedimentary rocks that have undergone recurrent deformation from both the Hercynian and Alpine orogenies, causing uplift of 3-4 km and large fault scarps on the south size of the zone.

(3) The **Srednogorie zone**, part of the Apuseni-Banat-Timok-Srednogorie region, is an 80-100km wide east-west orientated zone running through eastern Bulgaria. Along the southern boundary of the Srednogorie Zone are flysch-like deposits, deposited in the foredeep that developed during the Jurassic-Cretaceous delineating the Rhodope Massif.

(4) The **Rhodope Massif** composes the southern and south-western portions of Bulgaria, consisting of a variety of metamorphic, sedimentary and intrusive complexes that reflect the larger orogenic history of the area. The Rhodope Massif identifies the south-verging thrusting and northward dipping subduction, accompanied by back-arc extension (Marchev 2005), in the form of a complex of sedimentary thrust sheet, Palaeogene magmatism, intrusives a medium-high grade metamorphic core complex. As a result the Rhodope Massif hosts largely Pb-Zn vein and replacement type deposits and minor Cu-Mo porphyries.

(5) The fourth morphotectonic zone, the **Kraishtide Zone**, trends northwest through western Bulgaria and into adjacent Serbia. It parallels the better known Vardar zone in Serbia (see Serbia section and central Europe).

(6) To the south east is the **Sakar** batholith, though it remains a point of debate in literature as to its structure and emplacement age. The batholith is composed of the following granitoid units: a) equigranular in the inner parts; b) porphyries with large microcline megacrysts in the outer parts, and c) small aplitoid bodies. Large xenoliths of gneisses and orthoamphibolites occur in the marginal parts of the body. It has little economic significance, (Kamenov et al., 2010)

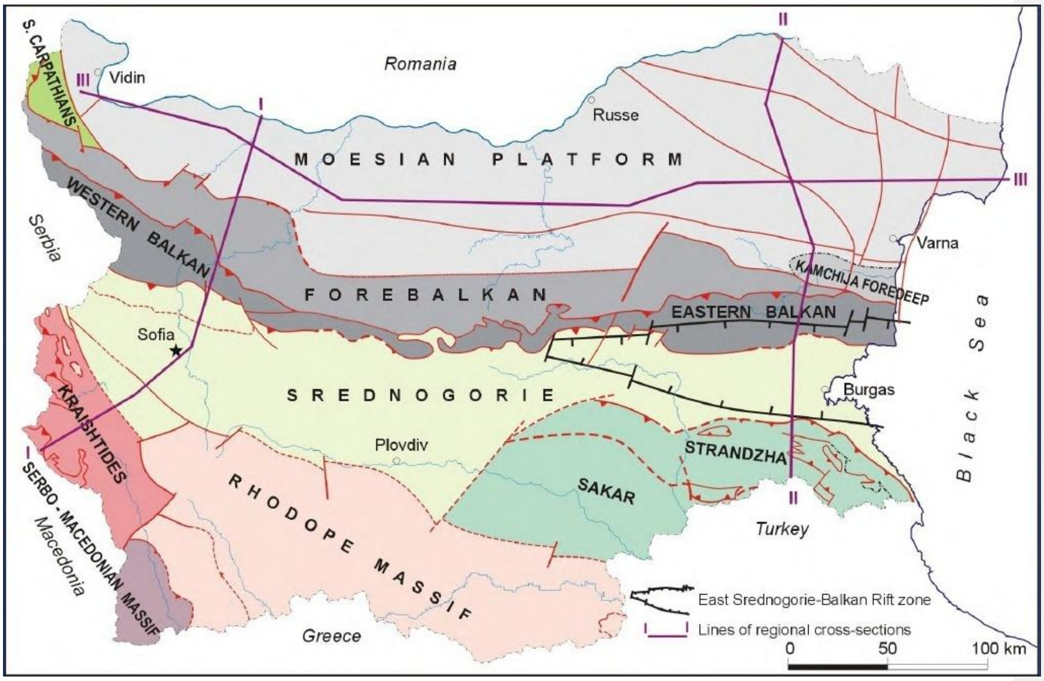

Figure 13-2 Tectonic overview map of Bulgaria, (Georgiev & Dabovski, 1997)

13.2 Known Deposits and Occurrences

Common to many of the central European countries, the Apuseni-Banat-Timok-Srednogorie zone in Bulgaria supports a variety of structures favourable for the emplacement of porphyry stocks and later polymetallic vein style mineralisation.

Like Serbia, Bulgaria's larger porphyries have a close affinity to calc alkaline intrusives. Larger deposits fall into the Panagyurishte mineral district of the Srednogorie region which contains over 150 mineral manifestations of porphyry Cu and massive sulphide copper deposits. As a broad overview the cupriferous massive pyrite deposits are associated with upper cretaceous volcanics of andesitic, dacitic affinity whilst the porphyry deposits are associated with plugs and stocks of monzodioritic and quartz-syenodiorite intrusives. A spatial association of Cu-Au high sulphidation deposits and Cu porphyry deposits is also observed.

The Rhodope Massif within Bulgaria hosts a range of Pb-Zn Ag, Cu-Mo and Au-Ag deposits in high grade metamorphic, continental sedimentary and igneous rocks (Marchev, 2005). The mineralisation found in the Late Cretaceous to Paleogene intrusives is coeval with the domal uplift of the Rhodope massif. The Pb-Zn-Ag-Au mineralisation and minor porphyry Cu-Mo mineralisation are associated with potassic rich, island arc style magmas. The central Rhodope dome is more commonly associated with Pb-Zn carbonate replacement within the dome’s high grade metamorphic core. There are also minor base-metal poor, high grade gold deposits associated with the sedimentary units of continental basin syn-extensional units. These are of medium to low economic significance, but the major deposits are mentioned in the sections below.

The Burgas district in the far east of Bulgaria differs in mineralisation style and has little notable mineralisation of interest to MMG's deposit criteria. This can be largely attributed to the rift style tectonic setting that is found in this region of Bulgaria (Figure 13-2) which does not give rise to large porphyry style deposits and has not hosted VMS deposits of significant size.

13.2.1Porphyry Copper Deposits

The larger porphyry deposits of the Panagyurishte district have some economic significance, but none are "Tier 1" in size.

Elatsite

Elatsite is one of the largest operating porphyry-copper deposits in Eastern Europe, and is also enriched in Au-Ag-Te-Se and PGE. Mineralisation is hosted in Late Cretaceous sub-volcanic quartz-monzonitic to granodioritic intrusions, (Bogdanov, 2005).

The Elatsite deposit is primarily a copper mine, though secondary minerals of economic value include gold and molybdenum. Mineralisation is disseminated and forms a large porphyry stockwork comparable to the Lowell-Gilbert model (Figure 2-4) with exceptions of some alterations styles.

Elatsite-Med JSC operates the Elatsite deposit which reportedly contains reserves of 154 Mt @ 0.33% Cu (0.5 Mt contained Cu) and has extracted in the past approximately 165 Mt of mineralisation containing 0.38% Cu and 0.21 g/t Au (0.6 Mt and 1.1 Moz of contained metal respectively).

Medet

The Medet mine and processing plant complex is approximately 6km from the Elatsite deposit. The mine was in operation between 1965 and 1994, hosting very similar mineralisation in similar lithologies as at Elatsite.

Medet was operated by Assarel Medet JSC between1964-1993 until final closure and rehabilitation in 1994. The estimated mineralisation mined out at Medet during this period of operation amounted to approximatey163 Mt @ 0.32% Cu, 0.1 g/t Au (0.52 Mt and 0.52 Moz of contained metal respectively).

Assarel

The Assarel deposit is partly hosted by volcanics which are coeval with a main intrusive body that is located in the central part of the main Assarel volcano.. The central part of the volcano is occupied by massive and brecciated andesitic and latite-andesitic lava sheets and pyroclastics, while the Assarel granodiorite porphyry is found in the centre of the stratovolcano as two offshoots which join at depth.

It is the only deposit in the district with a well developed 60 to 70 m thick supergene enrichment blanket of chalcocite and covellite, below a remnant 10 to 15 m leached cap. Native gold is rare in the hypogene ore, although it shows elevated concentrations at the contact between the base of oxidation and the zone of secondary enrichment. The deposit is currently operated by Assarel Medet JSC. From 1976-2000 production amounted to 100 Mt at 0.53% Cu (0.5 Mt copper metal) and remaining resources are estimated at 254Mt at 0.41% Cu (1.04 Mt contained copper)).

Tsar Assen

The small Tsar Assen deposit is to the south-east of the Radka ore field in the eastern most section of the Panagyurishte district and occurs in an area of andesitic volcanics (lapilli-agglomerate tuff, lava and lesser ash-flow tuffs and lava breccias) derived from the Elshitsa volcano-plutonic structure. These volcanics are cut by sub-volcanic dacite and granodiorite porphyries. Mineralisation is related to two stock-like bodies of granodiorite porphyry, with a zone of secondary enrichment overlying the hypogene core. The deposit was mined between 1980 and 1995, producing approximately 6.6 Mt of ore at 0.47% Cu (31,000 t contained copper).

Vlaikov Vruh

This small deposit occurs near the southern margin of the Elshitsa graben in the eastern most part of the Panagyurishte district. The deposit area comprises Proterozoic gneisses and overlying andesitic volcanics cut by an E-W trending sub-volcanic dacite dyke. Mineralisation is associated with a small, E-W elongated granodiorite to dacite intrusion, localised in brecciated contacts and at fault intersections. The estimated mined-out resource at Vlaikov Vruh is approximately 9.8 Mt @ 0.46% Cu (45,000 t contained copper).

All of the production and resources figures quoted above have been sourced from *www.geoporter.com*.

13.2.2High Sulphidation Cu-Au deposits

Chelopech

Chelopech is the largest high sulphidation Cu producing deposit in the Panagyurishte district, along with less economically significant porphyry bodies that are also in the vicinity of the main Chelopech deposit. Chelopech ranks amongst some of the largest producing high sulphidation deposits in the world and has been compared to the circum-pacific deposits such as El Indio in Chile, Lepanto in the Philippines and Pierina in Peru (Moritz, 2005).

Moritz (2004) also notes the close spatial association between high sulphidation deposits and the porphyry copper deposits of the Panagyurishte District. The Chelopech deposit includes in its vicinity the Karlievo porphyry occurrence, and the Elatsite deposit, with additional minor vein-type base metal associations.

The mine, owned by Dundee Precious Metals[53], has a measured and indicated mineral resource of approximately 28.5 Mt of mineralisation grading 4.1 g/t gold (3.75 Moz Au) and 1.4% copper (0.4 Mt Cu). The mining operations are currently undergoing expansion from 1 Mt to 2 Mt of ore per year.

Other high sulphidation deposits

The other known deposits are of lesser economic importance and include Krassen, Radka and Elshitsa. Hosted in andesitic and dacitic breccias, volcanics and lava flows, the mineralisation is found in massive sulphide lenses and is disseminated in nature. All three have been historically mined and subsequently closed.

13.2.3Hydrothermal and Replacement Pb-Zn

The Pb-Zn deposits of southern Bulgaria are not related to any major porphyry and alone would be unlikely to form significant sized deposits, though are briefly described below for completeness.

Madan

The ore bodies in the Madan deposits consist of Oligocene mineralised veins, complex stockwork zones and replacement skarn ledges. The veins and stockworks are controlled by six large NNW striking faults in the western slope of the Rhodopian Dome (Dokov & Popov 1963; Kolkovski et al.1996)

[53] *http://www.dundeeprecious.com/*

The Madan deposit is hosted in Paleozoic gneiss, amphibole-mica-schist and marble, with vein and stockwork replacement mineralisation. The whole deposit complex is estimated to contain 95 Mt of mineralisation grading 2.45% Pb and 2.1% Zn (2.37 Mt and 2 Mt of contained metal respectively). Ownership of the deposits is currently unclear. Valentin Zahariev supposedly had financial difficulties, so it now appears that Nikolay Valkanov is controlling operations.

Laki and Davidkovo

The Laki deposit complex is similar to Madan, being hosted in gneiss, schist and marbles and containing vein and replacement type mineralisation. It is estimated to contain approximately 14 Mt of mineralisation grading 2.9% Pb and 2.16% Zn (0.4 Mt and 0.3 Mt contained metal respectively). Resource estimates are not known for Davidkovo and no details regarding ownership have been found.

Madjarovo

Madjarovo is an intermediate type sulphidation deposit, consisting of a network of radial veins. The deposit is again hosted in Paleozoic marbles, schist and gneisses, with mineralisation in association with island arc style potassic andesitic composition igneous bodies. The resource is estimated at 10.8Mt grading 1.27% Pb and 0.66% Zn (0.13 Mt and 71,280 t of contained metal respectively) and 0.3Mt containing 2-3 g/t Au (19,000-30,000 oz contained Au). Details regarding ownership have not been located.

13.3 Political Considerations

Bulgaria is a member of NATO since 2004 and of the European Union - since 2007. This provides for a stable political environment and legislation. A minority government was elected in 2009 on an anticorruption and reformist agenda. Although its determination to do away with corruption and red tape is undeniable, Bulgaria has struggled to deliver and the pursuit of securing successful convictions is an ongoing concern[54]

Since the transition from a communist rule in 1991, Bulgaria has struggled to progress economically; living standards remain low and the previous communist party still have an influential hold.

Following a minor economic boom and a fall in unemployment from 20% in 2007, the country joined the EU. However, in 2008 financial aid form the EU was suspended due to high rate of corruption and crime.

The world economic crisis has had a severe negative effect on Bulgaria’s economy and mineral production. Improvements in the economic situation in Europe and renewed construction activity in Bulgaria could lead to increased production of mineral commodities in Bulgaria, but the country was expected to remain a modest producer in terms of world production. (USGS, 2009)

Obtaining information on the minerals and mining legislations and current licensing across Bulgaria is limited from the public domain and therefore this limits the review. The country’s mining code was updated in 1999.

Benchmark assessments indicate that Bulgaria ranks 59th out of 183 countries for Ease of Doing Business 2011[55] and 86th out of 183 countries for Corruption Perception Index 2011[56]. Within the

[54] http://www.ukti.gov.uk/export/countries/europe/easterneurope/bulgaria/overseasbusinessrisk.html
[55] http://www.doingbusiness.org/rankings
[56] http://cpi.transparency.org/cpi2011/results/

scope of this report, Romania ranks 7th out of 24 countries for Ease of Doing Business 2011 and 12th out of 24 countries for Corruption Perception Index 2011.

The Control Risks RiskMap 2012 edition classifies the Political Risk of Bulgaria as Medium[57].

13.4 Security Considerations

The Control Risks Risk Map 2012 edition classifies the Security Risk of Bulgaria as Low. This is supported by other online resources such as the FCO travel advice pages[58].

It is therefore likely that access may be made to all areas within the country and that standard security measures would not need to be augmented to protect company staff and assets during exploration and development.

13.5 Prospectivity

Bulgaria has the potential to host larger porphyry style deposits with association to high sulphidation epithermal deposits. Some deposits in the area such as Tar Assen, are known to have secondary enrichment of the primary hypogene core. It must also be noted however that Bulgaria has been relatively well geologically documented and thus the possibility of finding shallow/surficial deposits is low. This is not to say however that historic exploration has been exhaustive and potential still remains for discovery of deeper deposits so far unidentified. Exploration in Bulgaria should therefore focus in the north of the Panagyurishte district in correlation with prospective Cretaceous magmatism.

Hydrothermal and replacement type Pb, Zn deposits are found in the Rhodope massif, though are likely to be of little economic significance to MMG. Kupferschiefer and stratiform deposits are not found in Bulgaria due to the geology and tectonic setting of the region.

[57] *http://www.control-risks.com/Riskmap/Pages/Home.aspx*
[58] *http://www.fco.gov.uk/en/travel-and-living-abroad/travel-advice-by-country/europe/slovakia*

14 Bosnia and Herzegovina, and Montenegro

Bosnia and Herzegovina is located in south-eastern Europe as shown in Figure 14-1. The largest city and capital is Sarajevo and the national population totals just 3.9 million persons. Following the breakup of the former Yugoslavia, the country was at unrest with neighbouring peoples still fighting. In March 1994, Bosniaks and Croats reduced the number of warring factions from three to two by signing an agreement creating a joint Bosniak/Croat Federation of Bosnia and Herzegovina. Bosnia and Herzegovina is neither a major world nor regional producer of minerals, the mineral industry accounting for only a small percentage of GDP. Primary outputs are of iron, aluminium, industrial minerals and some mineral fuels, (Brininstool 2010).

Montenegro is situated to the southeast of Bosnia and Herzegovina as shown in Figure 12-1 and Figure 14-1. Its capital and largest city is Podgorica. The country has a population of just over 625,000 people. In May 2006, Montenegro invoked its right under the Constitutional Charter of Serbia and Montenegro to hold a referendum on independence from the state union. Montenegro formally declared its independence on 3 June 2006. Montenegro's mineral industry includes the mining and processing of bauxite, industrial minerals and lignite. Regionally Montenegro is a very minor producer of metals and is likely to remain so with no known new exploration projects underway. (Brininstool, 2010).

Figure 14-1 Political map of Bosnia and Herzegovina showing copper deposits by contained copper resources. Adapted from the University of Texas Libraries, The University of Texas at Austin (2005). Note the incorrect naming of Serbia as Yugoslavia.

14.1 Geology and Tectonics

Bosnia and Herzegovina and Montenegro can be broadly grouped geologically by the NW-SE structurally continuous units along the Dinaric Mountain region, predominantly composed of carbonates and flysch deposits which have been subject to folding and thrusting and are represented in Figure 14-2 as the Dinaride carbonate platform.

The Bosnian Schist Mountains (BSM) also displayed on Figure 14-2, are bounded by faults between the Dinaride carbonate platform and the Dinaride ophiolite units. The BSM are of lower greenschist facies and make up the hinterland of the active compressional fold thrust belt of the Dinarides.

The Dinaride ophiolite belt is found as ophiolitic melanges, remnants of an obducted active continental crustal margin.

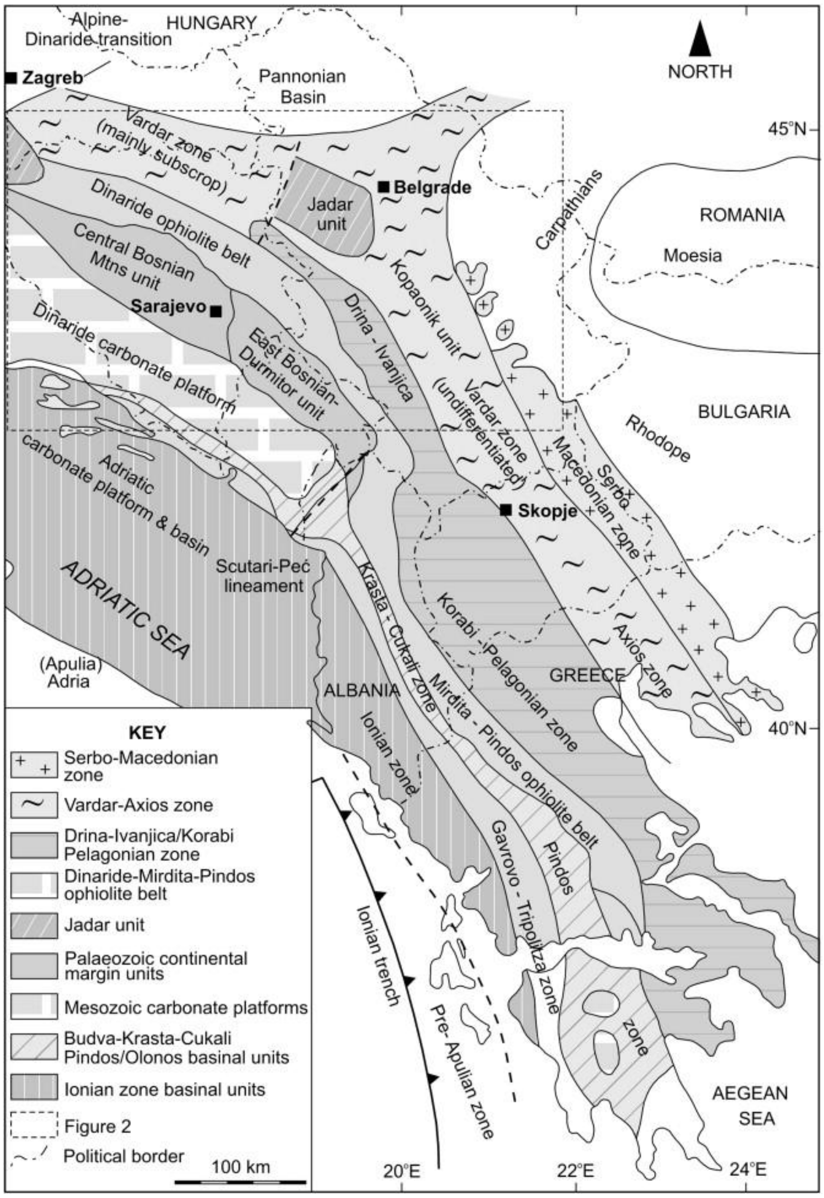

Figure 14-2: Tectonic Map Montenegro, Bosnia and Herzegovina and surrounding Balkan countries (Robertson, Karamata and Šarić, 2009)

14.2 Known Deposits and Occurrences

14.2.1Bosnia and Herzegovina

The USGS 2010 minerals handbook describes Bosnia and Herzegovina as “not a major or regional producer of minerals or mineral products”, however it also goes on to state that minerals will remain one of Bosnia's major exports. The countries primary mineral production is focused around aluminium, iron, steel, lead and zinc along with industrial minerals such as barite, cement, clays and stone.

The Mid-Bosnian Schist Mountains (Figure 14-2) have been mined since prehistoric times. This was once the major gold producing area of the Roman Empire where gold was mined from both primary deposits and placers. The widespread hydrothermal vein deposits were formed by extrusion and intrusion of rhyolitic magma in the Late Carboniferous to Early Permian. Host rocks are Lower Palaeozoic sericite–chlorite–quartz schist, which grade into metasandstones, fossiliferous Devonian carbonates and Lower Carboniferous meta-sediments (Jurković, 1957).

Bosnia and Herzegovina have no major economic Cu, Au or Pb-Zn deposits, despite lead and zinc making up a sizable portion of Bosnia and Herzegovina's mineral industry exports. The geology would also indicate there is no potential for undiscovered large deposits of MMG's commodities. The tectonic regime within Bosnia and Herzegovina does not contain the elements for porphyry formation, magmatism or hydrothermal activity has not been great enough to encourage Pb-Zn formation or any of the other styles of mineralisation that MMG require

14.2.2Montenegro

Montenegro has the same tectonic configuration as Bosnia and Herzegovina, but does not stretch westward enough into the Dinaric ophiolite belt, only covering the Dinaric carbonate platform and the BSM, named the east Durmitor Bosnian unit in Figure 14-2.

Montenegro's main mineral products consist of bauxite, industrial minerals and lignite. Metal production included primary aluminium smelting and crude steel production. Montenegro’s mineral production will most likely remain modest. No major mineral resource exploration projects were known to be underway in 2010, so no important new mineral deposits will likely be developed in the near future. Production of metals will most likely remain small even in terms of regional production (Brininstool 2010).

The Monty Project

The Balamara Resources Ltd’s Monty project encompasses the Brskovo and Sebrenka, Visnjica and the Zuta Prla massive sulphide Pb-Zn-Cu deposits[59]. Exploration is in the advanced stages and has obtained a JORC compliant Inferred Resource of 9.2 Mt grading 3.8% zinc, 1.2% lead and 0.36% copper, containing 350,000 t zinc, 110,400 t lead and 33,120 t copper. This estimate encompasses all of the following smaller deposits.

The ore bodies of the **Brskovo deposit** occur within the Bjelasic metallogenic region which is situated at the contact of an overthrust of Carboniferous and Permian sediments onto the Triassic formations. The mineralised bodies are hosted by Middle Triassic felsic volcaniclastic and carbonate rocks and consist of massive to semi-massive sulphide bodies with sphalerite and galena being the major ore minerals. The footwall complex consists of silicic-sericitic schist, tuffites and sporadic limestone (generally tuffaceous) and chert. The tuffaceous limestone contains disseminated pyrite. At the base of the footwall ‘feeder channels’ hosting stockwork and disseminated mineralization have been recognized. The major sulphides are pyrite, marcasite, sphalerite and galena while there is minor chalcopyrite, tetrahedrite, cinnabar and arsenopyrite. This is also a Balamara Resources property.

[59] *www.balamara.com.au*

Zuta Prla has very similar mineralisation and alteration to Brskovo, but major mineralisation is hosted in middle Triassic dolomites and has higher concentrations of sphalerite and lesser Galena. Specific to Zuta Prla are mineralised conglomerates, containing massive mineralisation mixed with limestone blocks in a tuffaceous limestone matrix.

Visnjica is located approximately 2 km south-east of the Zuta Prla deposit. Mineralisation is associated with two extrusive intermediate bodies that have extensive albite alteration. These bodies are separated by volcano sedimentary sericite schists.

14.3 Political Considerations

Bosnia and Herzegovina has achieved political stability that guarantees security for the foreign capital and businesses following the wars in the 1990s. The main goal of Bosnia and Herzegovina is EU membership and it is a potential candidate country for EU accession. In this respect, it is worth mentioning that Bosnia and Herzegovina has signed the Stabilization and Association Agreement (SAA) with the EU, establishing formal contractual relations between the EU and Bosnia & Herzegovina. The accelerated economic reform process in the country has greatly improved the business climate.

Mounting pressure from the EU at the end of 2011, coupled with the escalating pressures of the European economic crisis, prompted the main parties to compromise on the formation of the council of ministers and the nominee for prime minister. This has resulting in an impasse which had left the country without a federal-level government since elections in October 2010. However, the agreement was born out of necessity, rather than a shared political commitment to respect the national government's authority. As a result, without further constitutional reform, institutional deficiencies and ethnicity-based political structures are likely to continue to hinder the government's ability to function[60].

Benchmark assessments indicate that Bosnia and Herzegovina ranks 125th out of 183 countries for Ease of Doing Business 2011[61] and 91st out of 183 countries for Corruption Perception Index 2011[62].

Within the scope of this report, Bosnia and Herzegovina ranks 20th out of 24 countries for Ease of Doing Business 2011 and 14th out of 24 countries for Corruption Perception Index 2011.

The Control Risks RiskMap 2012 edition classifies the Political Risk of Bosnia and Herzegovina as Medium[63].

14.4 Security Considerations

The Control Risks RiskMap 2012 edition classifies the Security Risk of Bosnia and Herzegovina as Medium on account of the activity of isolated, radical Islamist groups. However, the risk of a major terrorist attack against private interests will remain low. Few other direct security threats will pose any risks to foreign investors and escalation in tension between ethnicity-based political parties is unlikely

[60] http://www.ukti.gov.uk/export/countries/europe/southerneurope/bosniaandherzegovina/overseasbusinessrisk.html
[61] http://www.doingbusiness.org/rankings
[62] http://cpi.transparency.org/cpi2011/results/
[63] http://www.control-risks.com/Riskmap/Pages/Home.aspx

to lead to inter-ethnic or political unrest. This is generally supported by other online resources such as the FCO travel advice pages[64] which recommend no restrictions on travel.

However, a legacy of the recent Balkan conflicts is the persistent threat of the landmines and unexploded ordinance (UXO), particularly in remote and mountainous regions which are obviously more relevant to mineral exploration. It is therefore likely that whilst access might be made to most areas within the country, that there will be areas where standard security measures would need to be augmented to protect company staff and assets during exploration and development. Liaison with local communities, NGOs and the local security services would be essential to enable safe access.

14.5 Prospectivity

Bosnia and Herzegovina and Montenegro have few economic deposits of interest to MMG. This is attributed to the geological setting of the region. Bosnia and Herzegovina and Montenegro have had minimal magmatic activity which is fundamental in porphyry copper formation, not to mention other the tectonic factors required. Other styles of mineralisation that are of interest to MMG are also small or nonexistent in the region for similar reasons of either a lack of magmatic, hydrothermal activity or tectonic regime to promote deposit formation. It is considered by SRK ES that Bosnia and Herzegovina and Montenegro pose no prospectivity for MMG.

[64] *http://www.fco.gov.uk/en/travel-and-living-abroad/travel-advice-by-country/europe/bosnia-herzegovina*

15 Albania

The Republic of Albania is located in the south-western part of the Balkans peninsula, bordering the Adriatic Sea and Ionian Sea, between Greece in the south and Montenegro and Kosovo in the north[65] . Albania has a total population of 2.8 million with Tirana, the largest city and is also the capital, holding a population of approximately 765,000. Agriculture accounts for nearly half the employment in Albania but only a fifth of the GDP, however the government is implementing fiscal and legislative reforms to attract foreign investment to boost the national economy, (Figure 15-1)

Albania is a parliamentary democracy with a transition economy. Free market reforms have opened the country to foreign investment especially in the development of energy and transportation and infrastructure. The country appears keen to promote investment within the natural resources sector. The Agency for Natural Resources has published documents in the public domain promoting the minerals industry at varying degrees of development. Albania's most significant mineral deposits include chromite, copper, limestone and petroleum. Albania has the potential to increase its production with increased investment and is promoting this within the country and the minerals sector. The rate of development however is dependent on the national economy, social stability and the improvement of infrastructure (Brininstool 2010).

15.1 Geology and Tectonics

Albania sits in the Hellenic-Dinaric belt with Gondwanian ophiolitic sequences flanking lithospheric units. The Dinarides and Hellenides are separated and defined by the Shkodra-Peja transverse fault zone through northern Albania.

The Tethyan ophiolites of the Balkan peninsula occur in two NW trending zones bounding the Pelagonian zone which Albania is located over. The Vardar ophiolites to the east of the Pelagonian zone and Pindos zone compose the 'Inner most Hellenic Ophiolite Belt' adjacent to the Serbo-Macedonian Zone (Smith, 1993). The 'Inner Hellenic Ophiolitic Belt' has units representative of the active margin of Eurasia (Figure 15-2).

The Pelagonian continent is a N-W trending continental block sandwiched between the Vardar and Pindos ophiolitic zones and continues into the Tauride platform in Southern Turkey across the Aegean Sea. It consists of sediments, carbonates and bimodal volcanics signifying the onset of rifting that is common to the Tethyan system.

East of the Vardar ophiolite Zone, Middle Jurassic calc-alkaline plutonic and volcanic rocks in the western most part of the Serbo-Macedonian Zone represent a volcanic arc complex (Dilek 2007) that developed at the Eurasian margin.

The Pindos Zone ophiolites to the east of the Pelagonian microcontinent encompass the western Hellenic ophiolites of Greece. The Mirdita ophiolites in northern Albania and their northward continuation into Kosovo and Serbia and the Dinaric ophiolites in Bosnia and Croatia collectively form the Pindos Zone ophiolites of the Balkan Peninsula. The Pindos zone is sandwiched between the Apulian platform in the west and the Pelagonian platform in the east.

[65] *www.cia.gov*

The section of the Apulian platform that manifests itself in Albania is the Ionian zone, best exposed in southern Albania consisting of carbonates, turbidites and siliciclastic units.

Figure 15-1 Political map of Albania showing copper deposits by contained copper resources. Adapted from the University of Texas Libraries, The University of Texas at Austin (2008)

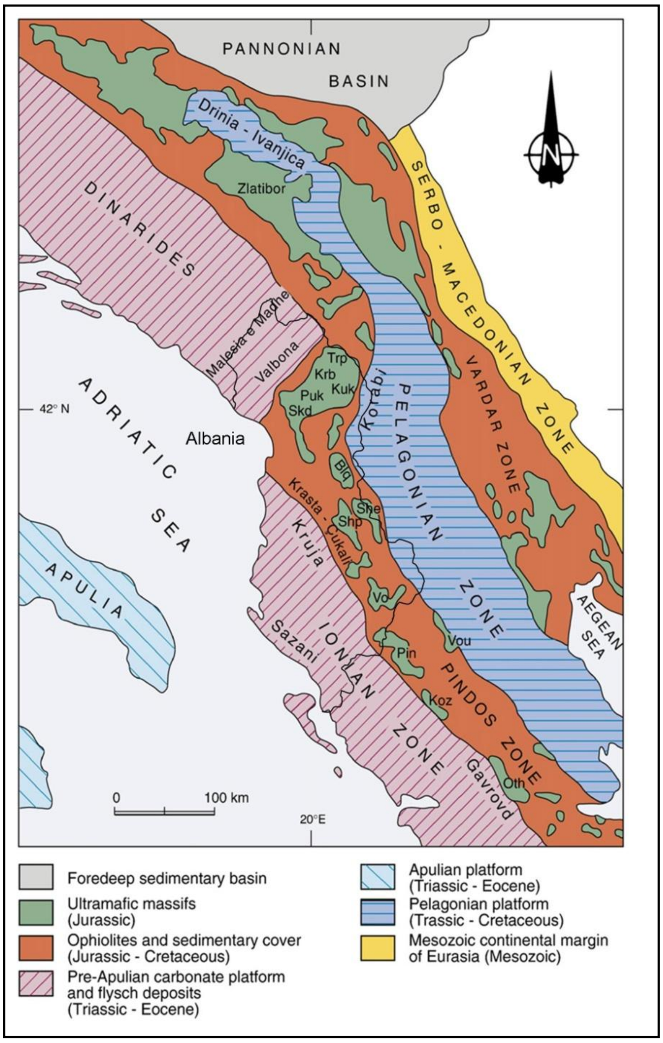

Figure 15-2 Tectonic overview of Albania (Dilek et al. 2007)

15.2 Known Deposits and Occurrences

In general the north-eastern portion of Albania is prospective for minerals such as chromium, copper, zinc, nickel, gold and platinum group metals. The south-west is prospective for oil and gas.

Due to the tectonics and nature of the Albanian geology porphyry copper prospectivity is non-existent, however VHMS and volcano sedimentary deposits are more common across the region, particularly in the north with some containing copper prospects. Mineralisation tends to form high grade, but small deposits.

Mirdita

The Mirdita property encompasses an area of approximately 344km^2 in the Puke district of northern Albania, and has 17 known deposits, 9 of which were former producing mines. Tirex Resources Ltd[66] is developing three of the deposits based on favourable resource estimates made during the 1970's by the Albanian Geological Society (GJEOALBA).

During the 1950's-1960's the soviets carried out extensive exploration programs within the district and discovered many of the currently known deposits. During the 1970's GJEOALBA continued exploration works but found no new deposits. GJEOALBA estimates that 20 Mt of copper mineralisation of varying grades has been mined since the 1970's in Albania and half of this has come from the Mirdita district.

The property is largely underlain by SSZ (supra subduction zone) ophiolite sequences and it is the VHMS deposits that top these sequences that prove most prospective. Two types of VHMS deposit have been identified within the property; Noranda-type and Cyprus-type, hosting copper, zinc, gold and silver mineralisation. The site is only in the exploration stage, however this is becoming more advanced and drilling is due to commence.

Gjegjan

Volcanic Metals Corp[67] is exploring the Gjegjan prospect which covers an area of 200km^2 in northeast Albania. The permit forms a 3- 5 km wide strip that stretches for 65 km through the Surroj, Arre Molla, Pregje Lure and Mbasdeja areas. The property covers a segment of the volcano-sedimentary sequence exposed on the eastern margin of the Mirdita Ophiolite Belt. Also in the area, but not within the licence, is the largest historical VHMS copper mine in Albania, also called Gjegjan. From 1961-1993 the mine produced 4.4Mt at an average of 3.3% Cu. Volcanic Metals are conducting a large scale exploration of the area surrounding this old mine site.

Palaj/Rubik

JAB Resources Ltd[68] is investigating deposits in central-north west Albania. Predominantly mafic submarine volcanic rocks with minor intercalated cherty and silty sediments host Cyprus style copper deposits of massive pyrite, chalcopyrite, sphalerite with minor cobalt and gold. The deposit lies within 100m of a thrust plane between the pillow lavas and the melange. No resource estimate data is available.

Perlati

The Perlati mine was operational in the 1950’s. Balkan Resources Inc[69] has acquired an exploration licence for the area and has a non compliant JORC resource estimate of 10 Mt at 2.2% Cu. The licence area is located in the Mirdita ophiolitic units and the deposit is VHMS style.

15.3 Political Considerations

Albania is one of the poorest countries in Europe. Since 1991, the economy has struggled to recover from the fall of Europe’s harshest communist regime, the impact of the move to a market economy, and the 1997 collapse of pyramid investment schemes. However, Albania’s economy has improved substantially over recent years – albeit from a very low base, (with average annual growth rates of 6%

[66] www.tirexresources.com
[67] www.volcanic metals.com
[68] www.jabresources.com
[69] http://www.objectivecapital.co.uk/ocreports/objective-balkan-sept09.pdf

over the 2004-2008 period) and was only one of two European countries to experience positive growth in 2009.

Although the current government have made the fight against high levels of organised crime and corruption a priority, limited success has been seen in both. Related lack of progress in the rule of law reform agenda continue to present difficulties for the economy[70].

The Albanian government appears to have an established mining industry and is keen to promote further foreign investment As of December 2009, 832 outstanding permits for prospecting, exploration, and mining were reported; 680 of these permits were for mining. Out of the 832 outstanding permits, the largest number were for limestone (282 permits), chromite (262 permits), and iron-nickel and nickel-silicate (37 permits).

Benchmark assessments indicate that Albania ranks 82nd out of 183 countries for Ease of Doing Business 2011[71] and 95th out of 183 countries for Corruption Perception Index 2011[72].

Within the scope of this report, Albania ranks 15th out of 24 countries for Ease of Doing Business 2011 and 15th out of 24 countries for Corruption Perception Index 2011.

The Control Risks RiskMap 2012 edition classifies the Political Risk of Albania as Medium[73].

15.4 Security Considerations

The Control Risks RiskMap 2012 edition classifies the Security Risk of Albania as Low to Medium on account of inadequate law enforcement in the mountainous north, meaning that organised criminal activity will remain entrenched in the region. This is generally supported by other online resources such as the FCO travel advice pages[74] which recommend no restrictions on travel.

It is therefore likely that access might be made to all areas within the country and that standard security measures would not need to be augmented to protect company staff and assets during exploration and development. Travel to the mountainous northern regions might require additional measures and certainly liaison with the local police and security services.

15.5 Prospectivity

Albania has good potential for small to moderately sized copper, base metals and gold prospects, particularly in the VHMS and volcano-sedimentary units most likely to be Triassic in age, relating to the rifting sequences of that period. The deposits already known in Albania are relatively small and high grade, and are not large enough to suit MMG's criteria of deposit. Albania can be likened to both Cyprus and Oman in terms of magmatic style deposits of high grade but low tonnages massive sulphides. It is unlikely given the style of mineralisation and tectonic setting of the known deposits that a deposit large enough to meet MMG's requirements could be discovered.

[70] http://www.fco.gov.uk/en/travel-and-living-abroad/travel-advice-by-country/country-profile/europe/albania?profile=economy
[71] http://www.doingbusiness.org/rankings
[72] http://cpi.transparency.org/cpi2011/results/
[73] http://www.control-risks.com/Riskmap/Pages/Home.aspx
[74] http://www.fco.gov.uk/en/travel-and-living-abroad/travel-advice-by-country/europe/albania

16 Greece

Greece, officially called the Hellenic Republic, is located in south-eastern Europe as shown in Figure 16-1. Eighty percent of Greece consists of mountainous terrain with the highest peak of Mount Olympus at 2,917 m. Athens the capital has 3.25 million of the 11.4 million population.

Mining history goes back to early antiquity. No coordinated exploration or geological investigation was undertaken in Greece until the 19th century when the Institute of Geology and Mining Exploration (IGME) began working mainly in northern Greece with the intention of providing general deposit information to potential investment parties. Greece is currently a major supplier of bauxite and industrial minerals to the international market. Given Greece's recent fragile financial status the government is expected to be involved in planning investment programs to improve the existing installations and lower operating costs. (Newman 2009).

Figure 16-1 Political map of Greece showing copper deposits by contained copper resources. Adapted from the University of Texas Libraries, The University of Texas at Austin (1996)

16.1 Geology and Tectonics

During the collision of the African and Eurasian plates the numerous terranes between the plates collided and accreted to form Greece. This resulted in a patchwork of differing units that have accreted and sutured to form the present geological framework. Pre-Alpine crystalline basement is extensive across much of Greece with the exception of the north-eastern most corner (the Rhodope Massif).

Triassic Tethyan sediments of great thicknesses are deposited throughout Greece and subsequently deformed in the Alpine orogeny to form the Greek Hellenides.

The Hellenide mountain system which comprises most of eastern Greece is a continuation of the Alpine Dinaric zone which runs the length of the eastern Balkan peninsula. The mountains have been further classified into 'internal' or 'external' Hellenides dependant on timing of deformation and location.

The Internal Hellenides were affected by an early phase of orogeny in the late Jurassic and the External Hellenides were deformed at the end of orogenesis in the Tertiary. The boundary between the two Hellenic zones can be broadly divided by a lineation of ophiolitic units, thus creating subzones (Figure 16-2).

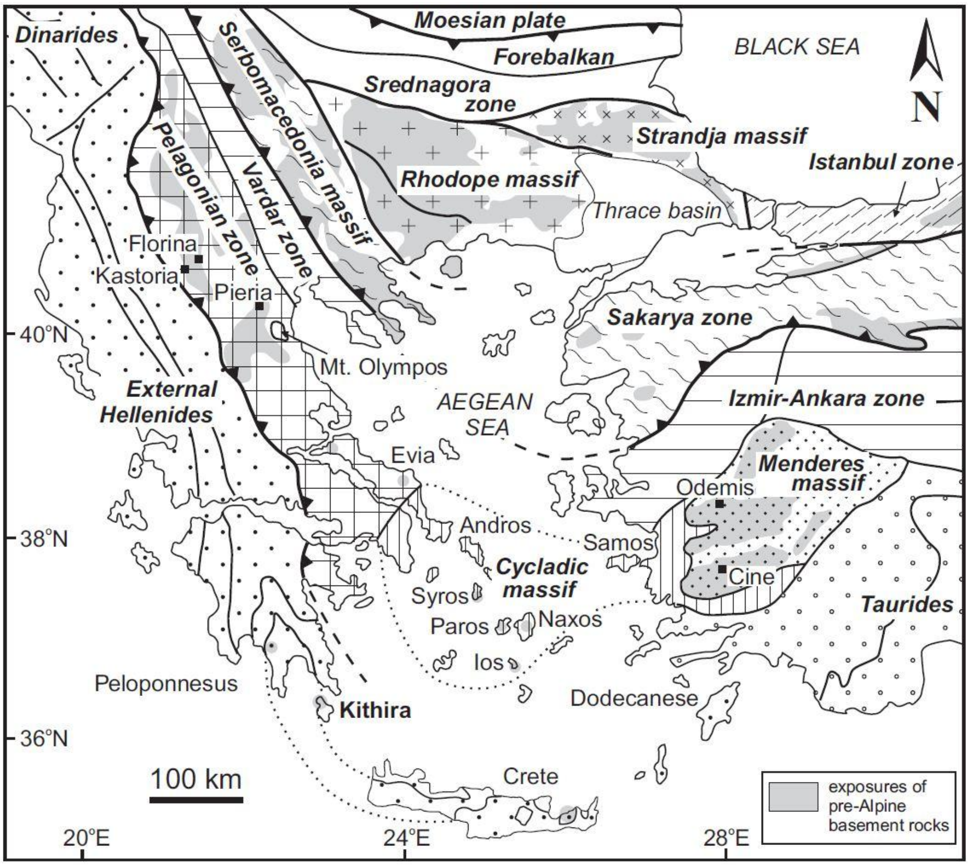

Figure 16-2: Tectonic Domains of Greece (Xypolias et al. 2006)

16.2 Known Deposits and Occurrences

Most of the geologic studies in Greece are conducted by the Institute of Geology and Mining Exploration (IGME) and have focused primarily on bauxite, gold, perlite and base metals.

Skouries

Skouries is a gold-copper porphyry deposit located in the west of the Chalkadiki peninsula. Economic mineralisation occurs within a syenitic porphyry plug and surrounding altered mica schist. The porphyry and schist are cut by a stockwork of thin veins of quartz, chalcopyrite and bornite with rare coarse gold. The stockwork continues into the surrounding schistose metasediments, gradually becoming weaker away from the porphyry contact. The upper portion of the deposit is strongly oxidised with cuprite, chalcocite and fine gold.

The deposit is operated by European Goldfields[75] who also own the Stratoni (Zn + Pb) and Olympias (Au, Zn, Pb and Ag) deposits that lie within the concession. The Skouries deposit total proven and probable reserves stands at 138 Mt grading 0.81 g/t Au and 0.53% Cu (3.6 Moz contained gold and 0.73 Mt copper metal).

All of the European Goldfields deposits that have been discovered are within a 20km radius of one another and lie within the LHMZ (Lece Chalkadiki Metallogenic Zone) zone of the Serbo-Macedonian massif, on the west coast of the Chalkadiki Peninsula.

Stratoni

The European Goldfields Stratoni Mine lies approximately 4km from the coastal town of Stratoni and is exploited for Zn, Pb-Ag. The polymetallic deposit consists of stratabound replacement mineralisation hosted within marble horizons. The mineralisation consists of massive sulphide carbonate and aplite replacement, the most abundant ore minerals being pyrite, sphalerite, and galena. Drilling has commenced to expand the total measured resource that currently stands at 1.69 Mt grading 2.16 g/t Ag,7.7 % Pb and 10.8% Zn (0.1 Moz contained silver, 0.13 Mt lead and 0.18 Mt zinc).

Olympias

The Olympias poly metallic massive sulphide deposit is located 8km north of the Skouries deposit. European Goldfield plans the refurbishment of the previously working underground mine. Mineralisation is composed of polymetallic veining and massive sulphide bodies. A resource has been estimated to include 12.4Mt of mineralisation at 10 g/t Au, 152 g/t Ag, 5.1 % Pb and 6.7 % Zn ($ Moz contained gold, 60Moz silver, 0.6 Mt lead and 0.8 Mt zinc).

Fisoka

Fisoka, also owned by European Goldfields, comprises three porphyry centres, the most northerly of which has been drill tested. A chalcocite blanket of copper mineralisation was defined but there was no gold present. However, geophysical and geochemical surveys combined with detailed mapping indicate the un-tested central and southern porphyries carry gold as well as copper mineralisation. Drill testing of these previously unrecognised central and southern Fisoka porphyry targets is planned to define maiden resources in 2012.

[75] http://www.egoldfields.com/egoldfields/en/home

Tsikara

European Goldfields have identified new targets as Tsikara where several potential porphyry centres within a volcanic complex that underlies the area. Follow-up mapping and geological sampling has confirmed the presence of porphyry style veining and alteration with anomalous copper and gold values.

16.3 Political Considerations

Greece has been a member of the EU since 1981 and entered the EMU on 1 January 2001. Greece's main economic sectors are tourism, construction, agriculture and shipping.[76] Greece is facing growing unemployment and a proliferation of social protest movements against the severe but essential austerity measures of recent years. Localised authorities corruption and systemic tax-avoidance have been notable factors, compounding upon the deeper-than-expected recession, that have contributed to Greece's failure to meet its budget deficit targets as a lack of progress in cutting spending. This vicious circle of lower growth, lower tax returns and higher deficits seems set to continue.

The pressure on Greece's finances is likely to reach a decisive point in 2012, and it is widely believed that some form of debt default is all but inevitable. The interim government and opposition have failed to come to an agreement regarding debt relief and an initial election in May 2012 failed to establish a ruling party. Further elections in June 2012 are likely to be a tipping point, deciding whether Greece remains in the EU or leaves the union and the single currency. Public protests against the policies agreed by the government with the EU, European Central Bank and IMF troika are certain to continue, interspersed by the occasional violent interlude.

As a result of its economic difficulties, Greece is keen to promote investment and have readily accessible information in the public domain for foreign country investment, however finding information on investing within the natural resources sector is more difficult. The government is expected to be involved in planning an investment programme to improve the existing installations and lower operating costs for mining and exploration.

Benchmark assessments indicate that Greece ranks 100th out of 183 countries for Ease of Doing Business 2011[77] and 80th out of 183 countries for Corruption Perception Index 2011[78]. Within the scope of this report, Greece ranks 17th out of 24 countries for Ease of Doing Business 2011 and 11th out of 24 countries for Corruption Perception Index 2011.

The Control Risks RiskMap 2012 edition classifies the Political Risk of Greece as Medium[79].

16.4 Security Considerations

The Control Risks RiskMap 2012 edition classifies the Security Risk of Greece as Low with localised Medium risk around Athens as a direct consequence of the recent austerity measures protests. State institutions, banks and symbols of foreign capitalist involvement in Greece remain credible targets. An Islamist extremist terrorist attack is however unlikely. This is generally supported by other online resources such as the FCO travel advice pages[80] which recommend no restrictions on travel.

76 http://www.ukti.gov.uk/export/countries/europe/southerneurope/greece/overseasbusinessrisk.html
77 http://www.doingbusiness.org/rankings
78 http://cpi.transparency.org/cpi2011/results/
79 http://www.control-risks.com/Riskmap/Pages/Home.aspx
80 http://www.fco.gov.uk/en/travel-and-living-abroad/travel-advice-by-country/europe/greece

It is therefore likely that access might be made to all areas within the country and that standard security measures would not need to be augmented to protect company staff and assets during exploration and development.

16.5 Prospectivity

In the the USGS authored 'Mineral Industry of Greece' (2010), copper deposits or copper production does not feature either in the text or in the mineral production table. This could be attributed to the fact that to date Greece's countrywide copper production has been minimal or projects are in the exploration stages.

Nearly all of Greece's copper mineral wealth appears to be hosted in the Serbo-Macedonian metallogenic province. The mines and exploration in the area are predominantly operated by European Goldfields.

Prospectivity for large undeveloped deposits in Greece is low as deposits discovered to date are small and only appear economical due to their association with other minerals, particularly gold. If MMG were to undertake exploration in Greece it would be most sensible to do so within the Serbo Macedonian massif within the LHMZ zone of the Chalkadiki peninsula. The porphyry style mineralisation of primary interest is centred in the Krouissa Mountains of the Chalkadiki Peninsula. Cyprus-type VHMS deposits in the Orthys Mountains are associated with the Jurassic ophiolitic suture units of the Pelagonian zone. These deposits are likely to be too small a target for MMG.

The base metal deposits appear to be hosted in the same vicinities as the porphyry copper deposits in the Serbo Macedonian massif within the LHMZ zone of the Chalkadiki peninsula. The only information in the public domain for active copper and base metal exploration and exploitation of deposits appears to be being conducted by European Goldfields.

17 Cyprus

The Republic of Cyprus is an island state found in the eastern Mediterranean Sea (Figure 18-1). Cyprus is a member of the EU and adopted the Euro as currency in 2008.

Through the Roman Era Cyprus was the main supplier of copper to the known world. After the fall of the Roman Empire, there was a hiatus in the nation's copper mining activity until the 19th century, when pyrite and chalcopyrite were mined, mainly for sulphur production, but also for copper. Copper was produced by several companies from a number of mines until 1974 when armed confrontation between Greek and Turkish Cypriot military forces suspended mining operations. Cyprus Mines, which was the major copper miner, terminated operations when its mines were divided by the cease-fire demarcation line between Greek and Turkish forces. Other companies continued copper production through the political dispute, however, all operations were halted in 1979, when low copper prices rendered Cyprus' low grade deposits uneconomical. Recently, there is a renewed interest in the country's copper deposits due to record high copper prices, and an improvement in mining technology.

17.1 Geology and Tectonics

Until the 1970's the genesis of economic deposits in Cyprus was little understood. The discovery of high-temperature black smokers in the East Pacific Rise during the 1970's presented a genetic model for the Cyprus VHMS formations and has subsequently made Cyprus an academic and economic target. Cyprus is formed by 3 main domains; the Troodos ophiolitic sequence, the Mamonia Complex which represents the transition of sedimentary deposition to passive continental margin facies, continental rifting and the genesis of oceanic crustal sequences and the mountainous Kyrenia range of sedimentary units

17.1.1Troodos

The Troodos ophiolite makes up a portion of the Tethyan ophiolite belt accompanied by the Baer-Bassit ophiolite in Syria. During the closure of the Neotethys ocean in the Late Cretaceous a suprasubduction zone formed as sea floor spreading progressed above the subducting oceanic slab. The ophiolitic sequence in Cyprus differs from many other ophiolites as the geochemistry and the depleted nature of mantle material give rise to podiform chromite.

The ophiolitic complex and concomitant units are very well studied in Cyprus due to the good exposure and completeness of the ophiolitic sequence. The 'Troodos' units consist of the plutonic mantle sequence of ultramafics, gabbros and plagiogranites, encircled by higher sequences of sheeted dykes and basaltic pillow lava, Figure 17-2. It is in these stratigraphically highest sequences that VHMS deposits are found. Directly overlying these tend to be umber sequences that are iron-manganese rich, often exploited for paint pigment or the manganese itself.

Common to many ophiolitic sequences there is a melange zone. These metamorphic rocks in Cyprus and Syria are interpreted to have formed in the Late Cretaceous by overriding the Troodos and Baer-Bassit oceanic crust for a period of 15-18 Ma. These metamorphic complexes were then exhumed by extension and crustal thinning concomitant with slab rollback of the subducting crust and the rotation of the overriding plate until subduction ceased in Maastrichtian times, Figure 17-1.

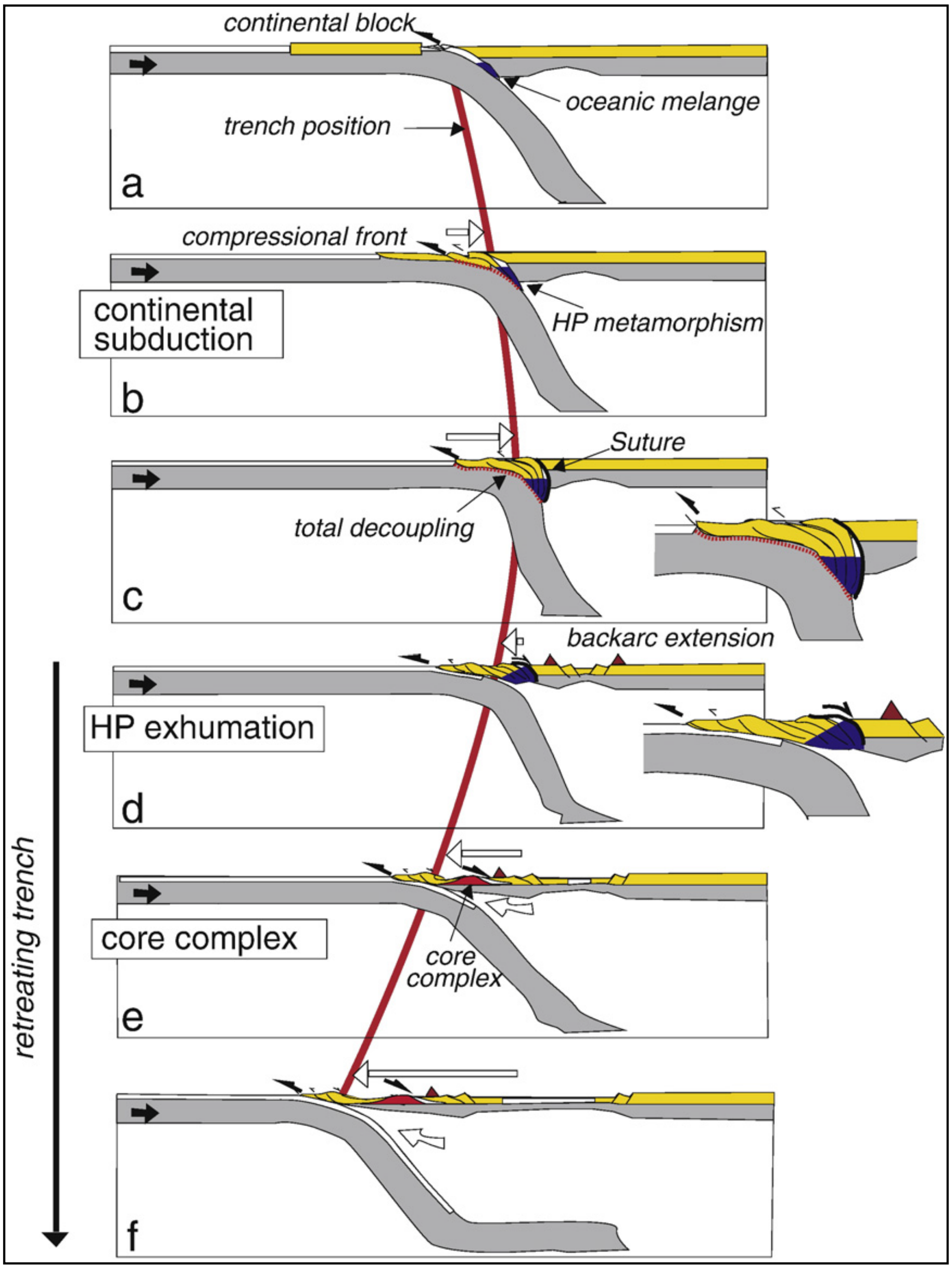

Figure 17-1: Schematic evolution of slab roll back and metamorphic core complex exhumation. (Brun and Faccenna, 2008)

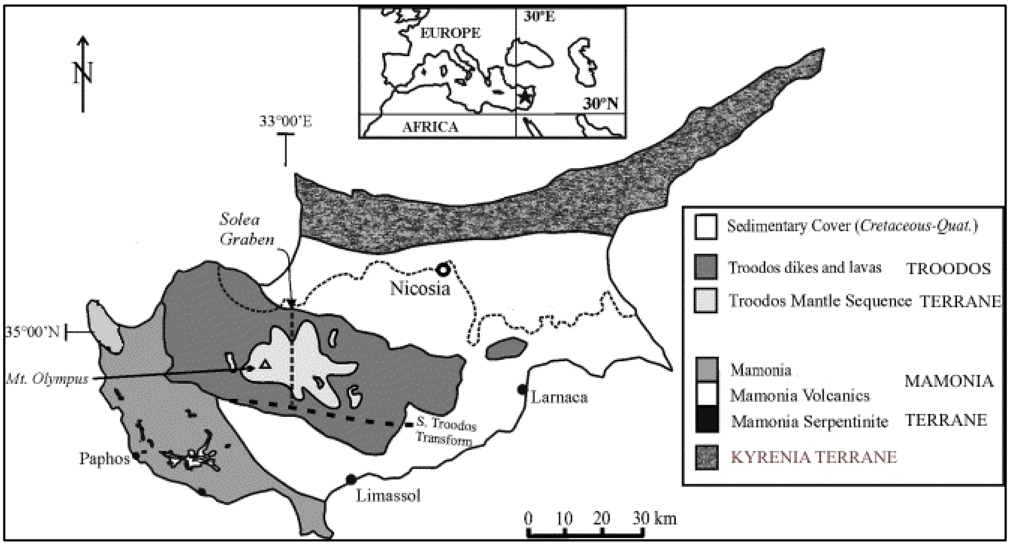

Figure 17-2: Tectonic map of Cyprus, (adapted from Borraidaile and Lucas, 2003). Taken from www.geologyrocks.co.uk)

17.1.2 Mamonia Complex

Cyprus depicts the suture zone between the Alpine orogenic belt and the Eastern Mediterranean basin with a complex of ophiolitic units and nappe sequences. The Troodos ophiolite is one of many oceanic fragments surrounding the eastern Mediterranean Sea, whilst SW Cyprus's Mamonia Complex's genesis is more debated. The sequences vary from Late Triassic to Lower Cretaceous reefal limestone, deep water pelagic cherts and orthoquartzose sandstones. The rocks can be highly deformed and have associated greenschist facies, serpentinites, amphibolite grade facies and a sedimentary melange, so exactly what the Mamonia Complex represents and its relationship to the Troodos ophiolite is still highly controversial. In broad terms the Mamonia Complex is Mesozoic base-of-slope to basin plane of passive margin sediments and Late Triassic oceanic crust overlain by deep-sea sediments.

17.1.3 The Kyrenia Range

The Kyrenia range in the North of Cyprus makes east-west running hills along the north coast of Cyprus. The hills are sedimentary and of Permian to Early Tertiary age. They are not prospective for copper or base metal mineralisation.

17.2 Known Deposits and Occurrences

Economic deposits of Cu, Pb and Zn are found within the pillow lava sequences of the Troodos ophiolitic units, the Kyrenia range is barren and Mamonia complex represents intense structural complexity and no economic deposits are known in the terrane.

The higher grades generally relate to smaller deposits and the lower grades to larger volume deposit, all of which are of VHMS type. Many of Cyprus's deposits have been exploited since ancient times.

Exploration in Cyprus is currently being undertaken by Northern Lion Gold Corp[81], who appear to be one of the largest licence holders currently in Cyprus, with 7 exploration licences all within the pillow lava stratigraphy targeting VHMS deposits.

Klirou Copper/Zinc Project

EMED Mining's exploration[82] in Cyprus has been centred around the Troodos ophiolite complex targeting VHMS style deposits within the pillow lava sequences approximately 20 km south-west of Nicosia. It has an inferred resource of 4.5 Mt at 0.41% Cu and 0.74% Zn, (18,000 t copper and 33,000 t zinc).

Skouriotissa

Skouriotissa owned by Hellenic Copper Mines Ltd is approximately 50 km W of Nicosia in the basaltic pillow lava sequence, and had a resource estimate in 2002 of 78 Mt at 0.3% Cu and 526,000t at 1.4g/t Au. It is unclear whether Skouriotissa is still in operation. There is some information that suggests workings are ongoing in the Phoenix pit of Skouriotissa.

17.3 Political Considerations

Cyprus' accession to the European Union in 2004 has been an important milestone in its economic development. In recent years, the services sector, and financial services in particular, have provided the main impetus for growth. Although a small country with a population of 797,000, Cyprus has one of the highest standards of living in EU with a GDP per capita € 21,281 ($28,237) in 2010.

In 1974 Turkish troops landed in and occupied the northern part of Cyprus following a coup on the island by extremists against the elected President, which was backed by the military junta then in power in Greece. The island has been effectively partitioned ever since and approximately 36% of the territory of the Republic is not under the control of the Government. The 'Green Line' buffer zone was set up from the coast north west of Morphou through Nicosia to Famagusta and continues to be patrolled by United Nations troops.

Recent years have seen improved access across the Green Line and the leadership of both sides have been proactive in working with the United Nations on a long term solution although it is far from clear as to how this might evolve.

On the Cyprus Investment Promotion Agency website[83] there is readily available information promoting Cyprus' foreign business sector. Despite no information being provided on the minerals or mining sectors it is understood that the mining law does provide security of tenure and right of access to private land for exploration purposes.

Benchmark assessments indicate that Cyprus ranks 40th out of 183 countries for Ease of Doing Business 2011[84] and 30th out of 183 countries for Corruption Perception Index 2011[85].

Within the scope of this report, Cyprus ranks 3rd out of 24 countries for Ease of Doing Business 2011 and 1st out of 24 countries for Corruption Perception Index 2011.

81 http://www.northernliongold.com
82 http://emed-mining.com
83 http://www.cipa.org.cy
84 http://www.doingbusiness.org/rankings
85 http://cpi.transparency.org/cpi2011/results/

The Control Risks RiskMap 2012 edition classifies the Political Risk of Cyprus as Medium[86].

17.4 Security Considerations

The Control Risks RiskMap 2012 edition classifies the Security Risk of Cyprus as Low. This is generally supported by other online resources such as the FCO travel advice pages[87] which recommend no restrictions on travel. It is therefore likely that access might be made to all areas within the country and that standard security measures would not need to be augmented to protect company staff and assets during exploration and development.

It should be noted that the Green Line buffer zone is in places planted with land mines. Care should be taken if operating in proximity to this zone and liaison made with the local security services which might include the British Army, the Turkish Military and United Nations peacekeepers.

17.5 Prospectivity

Cyprus has a rich mining history and culture. The geology of Cyprus is prospective for VHMS deposits and ophiolitic chromite. Many of Cyprus's larger historic mines are no longer in operation, however with the recent increase in copper price there is renewed interest in Cyprus's prospectivity.

SRK ES have included in the known occurrences section the licences that Golden Lion have acquired as they seem to be the company with the largest presence in Cyprus at the moment. Despite the apparent pedigree of mining history and the resurgence of interest in Cyprus, the deposit style would appear to not be of large enough tonnage to be of interest to MMG despite the characteristic high grade of VHMS deposits. With reference to MMG's interest in zinc and lead, there hasn't been a great amount of base metal exploitation documented in Cyprus apart from when it is in association with copper.

On this basis it is unlikely that Cyprus has the potential for a large enough deposit to interest MMG

[86] *http://www.control-risks.com/Riskmap/Pages/Home.aspx*
[87] *http://www.fco.gov.uk/en/travel-and-living-abroad/travel-advice-by-country/europe/cyprus*

18 Turkey

The Republic of Turkey lies at the boundary between Eastern Europe, the Caucasus and the Middle East (Figure 18-1). The capital is Ankara and the country covers an area of 783,500 km^2. Turkey is a democratic, secular, constitutional republic with an ancient cultural heritage.

There is a diverse history of mining in Turkey stretching back almost 9,000 years. Although there are numerous deposits of gold, copper, iron, silver, chrome and industrial minerals (including boron, feldspar, pumice, barite, bentonite, magnesite and others), few of these deposits are particularly large, limiting international investment in the past. In 2008/9, mining and quarrying contributed just 0.8% of the country's GDP. Turkey is the world's largest producer of boron minerals, possessing almost 72% of world reserves. Gold and copper exploration have increased in recent years, with a number of medium sized VHMS and porphyry systems being investigated across the country. This growth in production has now placed Turkey as Europe's largest gold producer and with several mines under development the annual production is projected to grow further.

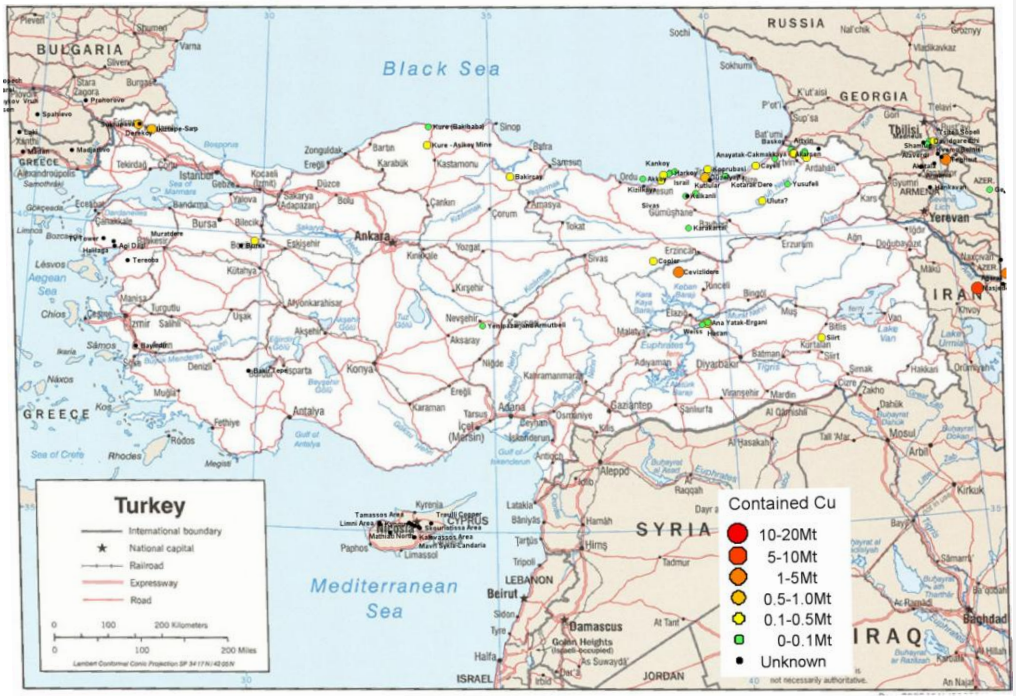

Figure 18-1 Political map of Turkey showing copper deposits by copper resources. Adapted from the University of Texas Libraries, The University of Texas at Austin (2006)

18.1 Geology and Tectonics

Turkey constitutes the eastern segment of the Alpine Orogenic Belt, where a number of remnants of the Tethyan Ocean have formed microterranes and then been amalgamated along a numerous complex suture zones.

During Permian-Triassic times the Paleotethys was subducting southwards below Gondwana. Later in the Cretaceous, northwards-dipping subduction occurred as the Neotethys closed all along the Pontides. As the Black Sea opened up north of the Rhodope-Pontide island arc, extensive ophiolitic sequences were obducted onto the Anatolide-Tauride and Arabian platforms. The collision of the Anatolide-Tauride platform with the Pontide arc along the Izmir-Ankara-Erzincan suture completed the closure of the Neotethys Sea. Then the collision of the northwards moving Arabian platform along the Bitlis-Zagros suture zone created a compressional regime which, in turn, caused extension and associated volcanism in the Aegean region. This also established the north and East Anatolian transform faults (Yigit, 2009). Figure 18-2shows this tectonic regime.

The orogenic belts of Turkey have been classified a number of times by various academics, but the scheme presented in Figure 18-2 is one of the simplest and most widely accepted. There are four roughly east-west trending belts termed (from north to south); the Pontides, Anatolides, Taurides and Border Folds. The Izmir-Ankara-Erzincan suture separates the Pontides in the north from the Anatolide-Tauride platform in the south and the Bitlis suture marks the northern edge of the Arabian plate in south-eastern Turkey.

The crystalline basement in Turkey is now represented by the metamorphic massifs of the Stranjdja and Kazdag in the northwest, the Menderes in the west, the Kirsehir in central Turkey, and the Bitlis and Porturge massifs in south-eastern Turkey. Each has undergone numerous phases of metamorphism and range in age from Precambrian to Oligocene. Paleozoic rocks are typically sedimentary and unmetamorphosed, hosting large coal deposits in the north-western Istanbul Zone. Mesozoic limestones, volcanics, flysch and ophiolites cover extensive areas of Turkey. Upper Cretaceous submarine volcanics outcrop over large areas in northeast Turkey, extending across into Georgia and host a number of VHMS and porphyry copper-gold deposits. When grouped together with subaerial volcanics, these rocks cover some 20% of Turkey’s land area.

The style and timing of the tectonic and geological evolution of Turkey is contentious on many topics and it has been suggested that correlation of metallogenic belts with tectonic terranes is difficult as they are not all coincident.

18.2 Known Deposits and Occurrences

The known mineral deposits and prospects in Turkey are mainly associated with the Late Mesozoic to Cenozoic rocks, in particular those associated with magmatic and volcanic belts. Such terranes can be traced across Turkey and into neighbouring states. The Carpatho-Balkan metallogenic province (of Apuseni-Banat-Timok-Srednogorie belt) crosses south-eastern Europe, presents itself in north-western Turkey and then continues into the southern Transcaucasus belt in southern Georgia, Armenia and Azerbaijan. In Turkey, this belt contains numerous VHMS deposits as well as porphyries intruded into previous VHMS-bearing terranes. Deposits with significant copper content in this region of Turkey include; Guzelyayla, Gumushane, Bakicray, Balcili, Ulutas and Anyatak/Murgul. It is generally the case that the porphyry deposits contain greater tonnages, but at lower copper concentrations than the higher grade, lower tonnage VHMS deposits. Gold is also more abundant in the smaller Turkish porphyries than other large copper porphyries in the TMB.

The porphyries of western Turkey appear to have undergone less erosion than the porphyries in the northeast, as these deposits retain shallow high-sulphidation epithermal mineralisation. Porphyries seem to cluster along three east-trending belts; the Pontides, Anatolides and the Border Folds.

Occurrences recorded as polymetallic or epithermal veins should be considered for unidentified porphyry stocks below or near-by as deep drilling (>250m) has not been utilised extensively as an exploration tool in the past as easily identifiable outcropping epithermal deposits have been the primary target. There is also a spatial relationship between carbonate rocks, skarn mineralisation and productive porphyries, such as in the Copler-Cevizlidere district in central Turkey, which could be used in regional target identification (Yigit, 2009). It should also be noted that the large copper deposits of Turkey contain relatively low grade copper and are often supplemented by their gold and molybdenum production.

There are a very large number of early-stage exploration projects across Turkey, far more than those with resource estimates seen in Figure 18-1 or listed in the database associated with this report. Yigit's paper (2009) titled "Mineral deposits of Turkey in relation to Tethyan metallogeny: implications for future mineral exploration", gives a very good description and reasoning for the distribution of copper deposits that should be used as a basis for a more detailed investigation of mineral prospectivity in Turkey. Only those deposits with a significant resource already defined are summarised below.

Cevizlidere

The Cevizlidere Cu-Au-Mo porphyry is the largest copper deposit to date in Turkey, containing some 445Mt at 0.38% Cu (1.69 Mt copper metal), 0.11g/t Au (1.57 Moz gold) and 47ppm Mo (20,900 t molybdenum). It is currently operated by Alacer Gold Corp who is 50/50 joint venture partners in the project with Lydia Mining. Located 20km southwest of the town of Ovacik Tunceli province, Cevizlidere is found close to the East Anatolian Fault, which also hosts, among others, the 6.1Moz Copler Au-Cu porphyry/epithermal deposit (Alacer).

The rock at Cevizlidere includes Mesozoic limestones overlain by Tertiary andesitic flows and pyroclastic rocks. These units are cut by multiple porphyry intrusions, varying from the early feldspar porphyry to massive dacite porphyry, to narrow, late-stage porphyry dikes, all of which combine to make up a NW-SE elongate composite porphyry stock. Mineralisation has been traced for over 3.5 km of strike length.

The Cevizlidere deposit is one of several copper and gold anomalies and historical workings in the Tunceli province. Much of this ground was previously operated by Rio Tinto before Alacer took it on under a joint venture agreement. Alacer still owns rights to large licences areas in the vicinity, however local security constraints have led to delays in exploration and development at this project and the surrounding areas, see Section 18.4.

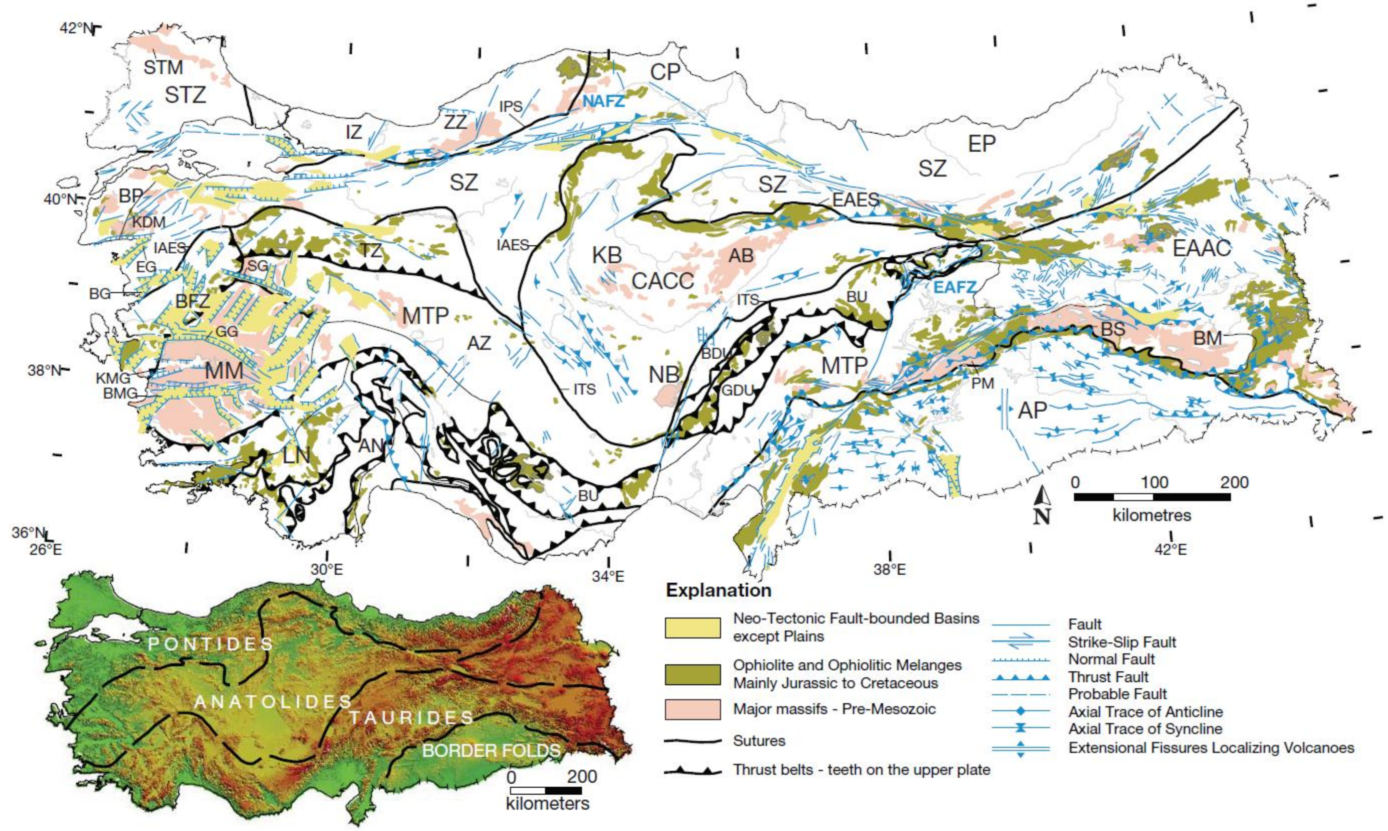

FIG. 2. Paleo- and Neotectonic units of Turkey (modified from Gorur, 1998) with major massifs and ophiolitic rocks (modified from MTA, 1989), inset shows major tectonic units (after Ketin, 1966) on DEM. AB = Akdag Block, AN = Antalya Nappes, AP = Arabian Platform, AZ = Afyon zone, BDG = Bolkardag Unit, BFZ = Bornova Flysch zone, BG = Bergama graben, BM = Bitlis Massif, BMG = Buyuk Menderes graben, BP = Biga Peninsula, BS = Bitlis Suture, CACC = Central Anatolian Crystalline Complex, CP = Central Pontides, EAFZ = East Anatolian Fault, EAAC = East Anatolian Accretionary Complex, EG = Edremit graben, EP = Eastern Pontides, GDU = Geyikdagi Unit, GG = Gediz graben, IAES = Izmir-Ankara-Erzincan Suture, IPS = Intra-Pontide Suture, IZ = Istanbul zone, KB = Kirsehir Block, KDM = Kazdag Massif, KM = Kirsehir Massif, KMG = Kucuk Menderes graben, LN = Lycian Nappes, MM = Menderes Massif, MTP = Menderes-Tauride Platform, NAFZ = North Anatolian fault zone, NB = Nigde Block, PM = Poturge Massif, SG = Simav graben, STM = Strandja Massif, STZ = Strandja zone, SZ = Sakarya zone, TZ = Tavsanli zone, ZZ = Zonguldak zone. This and all subsequent figures use a Lambert Conformal Conic Projection for Turkey, scale accurate for the location's latitude.

Figure 18-2 Structural units of Turkey (Yigit, 2009).

Sarp (Ikiztepe-Derekoy)

The Sarp property is located in the far northwest of Turkey near the Bulgarian border and encompasses six separate targets containing skarn and porphyry Cu-Mo mineralisation, epithermal Au-Ag and Au-rich magnetite skarn. Historic remains of copper workings have been found throughout the region suggesting artisanal work for thousands of years. The prospects are now owned by JVs between Alacer Gold Corp and Valhalla Resources.

The Ikiztepe skarn hosted Cu-Mo mineralisation deposit (formerly known as Demirköy), was initially investigated in the 1970s by Türk Maadin AS, Rio Tinto Zinc (RTZ) and Granges International., each establishing resource estimates for the deposit, but neither continuing development due to subeconomic grades (~13.5Mt @ 0.52% Cu and 0.05% Mo). A large 10x20 km monzonite stock has intruded into Paleozoic limestones, mica schist and quartzite, leading to skarnification in some areas. Mineralisation is thus split between stringers and disseminations of chalcopyrite, bornite and pyrite in the skarn and primary chalcopyrite, pyrite and molybdenite in the porphyry stock. There are thought to be insufficient sulphides to allow supergene enrichment.

The Derekoy prospect lies just 6 km from the Bulgarian border near the town of Derekoy and the Armagan Reservoir. Low grade porphyry copper mineralisation was investigated by MTA (Turkish Mineral Research & Exploration General Directorate) and the Japan International Cooperation Agency (JICA), from which a historical resource estimate of 221Mt containing 0.24% Cu (530,000 t contained copper) was established. The porphyry mineralisation is hosted in Upper Cretaceous tonalitic rocks with largely phyllic alteration. Copper mineralization is dominantly chalcopyrite in veins, hairline veinlets, and disseminations. Molybdenum is present most commonly in veins, but is often finely disseminated and peripheral to veins. Valhalla is continuing to evaluate the Ikiztepe and Derekoy projects through more drilling and geophysics. (Young, 2011)

Murgul (Anayatak-Cakmakkaya)

The Murgul deposit is the largest VHMS deposit in Turkey and comprises the Anayatak and Cakmakkaya mineralised bodies. These bodies lie within host rocks of dacitic pyroclastics of Senonian age which have undergone an intense multistage alteration associated with the subvolcanic hydrothermal activity. Pyrite-chalcopyrite stringer mineralisation dominates and there is little massive mineralisation. When compared with other deposits in the Eastern Pontides region, there appears to be a correlation between Cu:Pb+Zn ratios and volcanic activity in the Upper Cretaceous, both Cu dominance and thickness of volcanic rocks increasing from west to east. The mineralisation also becomes less stratiform and more disseminated and stockwork in form, towards the east. The Anayatak-Cakmakkaya bodies are thought to contain over 80Mt at 0.8% Cu and 0.05g/t Au (640,000 t copper and 128,600 oz gold).

18.3 Political Considerations

Turkey's political system is based on a secular, democratic, pluralistic and parliamentary system that has been stable since independence in 1923. The Grand National Assembly is elected by popular vote, and the nation is governed by the Council of Ministers headed by the Prime Minister. The government has made Turkey's acceptance as a member of the European Union a top priority, and has been steadily bringing its legislative and economic practices in line with those of the EU.

The ongoing EU accession talks are also a key driver for the modernisation of Turkey's economy and business environment. With a large domestic market of 73 million people, Turkey is also a springboard to the markets of Central Asia & the Middle East.

Turkey is currently Europe's largest gold producer and continues to draw significant investment from both national and western mining companies which deliver a wide variety of commodities and products. Investment has grown in recent years due modifications and improvements to mining legislation. This has brought Turkey more in line with other states most notably in terms of ensuring exploration activities are undertaken in accordance with expenditure plans and reporting procedures. There have also been improvements in transparency and the security of tenure although it is taking time for large areas of prospective ground, currently licensed under the old legislation, to be released for new licence applications or in some cases tenders by the speculative current owners.

Investment growth has seen an increase in discoveries and an increase in production, with Turkey's first commercial gold mine opening in 2001 and Europe's largest gold deposit, the Kisladag porphyry, opening in 2006.

Benchmark assessments indicate that Turkey ranks 71st out of 183 countries for Ease of Doing Business 2011[88] and 61st out of 183 countries for Corruption Perception Index 2011[89].

Within the scope of this report, Turkey ranks 11th out of 24 countries for Ease of Doing Business 2011 and 5th out of 24 countries for Corruption Perception Index 2011.

The Control Risks RiskMap 2012 edition classifies the Political Risk of Turkey as Medium[90].

18.4 Security Considerations

The Control Risks RiskMap 2012 edition classifies the Security Risk of Turkey as Low to High. This is supported by other online resources such as the FCO travel advice pages[91] which whilst recommending no restrictions on travel to the majority of the country, indicate that there are several provinces in south east Turkey that are High risk and should be avoided for all but essential travel.

The terrorist threat in Turkey is largely due to the separatist Kurdistan Workers Party (PKK) which originates from the Kurdish south east region of the country. Despite some recent concessions, dialogue with the Turkish government remains uncertain and PKK press statements have been made indicating that indiscriminate attacks could take place against tourists or places used by foreigners. Recently, IED and firearm attacks have taken place in major cities (including Istanbul and Ankara) and resorts against government, military and civilian targets. Terrorist attacks are regularly carried out against the security forces in the south east of the country and in the past, military personnel and even mountain climbers in the East of Turkey have been kidnapped.

To counter the terrorists the Turkish military and security forces are following an aggressive anti-insurgency campaign and have numerous fortified encampments strategically located throughout the south east. These range in size but are commonly equipped with artillery, armour and helicopter assets and are designed to disrupt insurgency supply corridors and to act as staging points for kinetic search

[88] http://www.doingbusiness.org/rankings
[89] http://cpi.transparency.org/cpi2011/results/
[90] http://www.control-risks.com/Riskmap/Pages/Home.aspx
[91] http://www.fco.gov.uk/en/travel-and-living-abroad/travel-advice-by-country/europe/turkey

and destroy operations. Care must be taken when operating in this region to a) liaise closely with the local Jendarma (military police force) and conventional military forces, and b) ascertain what routes and areas are deemed to be dangerous due to the present of terrorist personnel and or UXO/IED.

It is therefore likely that whilst access might be made to western, central and northern areas with standard security measures, that access to provinces in the south east would almost certainly require augmented security measures.

In the past decade several organisations, including large international exploration and mining companies have closed down their programmes due to incidents in the south east ranging from intimidation through to armed hijack and theft.

18.5 Prospectivity

Turkey is proving to be a very prospective country for gold and polymetallic deposits, as recent exploration successes have shown. Four regions are highlighted as holding significant potential for VHMS and porphyry deposits of small to medium scale. These are hosted in the Upper-Cretaceous submarine volcanic rocks along the Black Sea coast in northeast Turkey, the Triassic limestone and recent volcanic intrusions around the East Anatolian Fault in Central Turkey near Tunceli, the Tavsanli Zone containing ophiolitic assemblages and Miocene acid-intermediate volcanics, and the region of carbonates intruded by Cenozoic volcanics in the far northwest of Turkey bordering Bulgaria. It must be noted however that the largest porphyry deposits generally contain sub-economic grades of copper and are generally carried by the accessory contents of gold, molybdenum and/or silver. The copper dominated VHMS deposits contain higher copper grades, though are much smaller in volume.

Although a stand-alone "Tier 1" copper deposit is unlikely in Turkey, there are a number of porphyries to be found that contain appreciable amounts of gold, as well as modest copper content. If MMG are amenable to exploration for deposits of lower copper tonnage and grade, then eastern Turkey could prove to be a key target region in the TMB. It is suggested that a more detailed investigation of the large number of exploration stage projects is undertaken to properly assess the prospectivity and select the best target regions for licence acquisition.

18.5.1 Porphyry deposits

Supergene profiles, leached caps and enriched zones are generally missing from Turkish porphyries which is a downside to their economic potential. Most deposits contain Cu-Mo mineralisation dominant over Au, though grades of gold often significantly contribute to the economics of many deposits.

Areas of particular interest/potential include; the Sarp corridor of deposits near the Bulgarian border, Tunceli district in east-central Turkey containing the Copler and Cevizlidere porphyries, the region stretching from Artvin and Murgul districts across the border to Tkhiladziri in southern Georgia, and central western Turkey.

18.5.2 Skarn and IOCG deposits

Although numerous mineralised skarns are known in Turkey, they mainly follow the trend of the porphyry belts due to their association with the mineralising porphyry intrusion. So far most of them are of insufficient size or grade to be economical, though underexploration may mean that economic deposits are yet to be found.

18.5.3VHMS deposits

VHMS deposits and polymetallic epithermal systems are mostly confined to the Black Sea coastal region from Samsun, westwards to the Georgian border. The epithermal deposits are generally found along the southern edge of the mapped Upper Cretaceous-Eocene submarine volcanic rocks, whereas VHMS deposits tend to be found closer to the Black Sea along the northern edge of this lithology. The Cerattepe deposit shows both VHMS and epithermal characteristics and lies at the western end of this belt.

18.5.4Base metal deposits

This review has only identified one recorded clastic dominated base metal deposit recorded in Turkey. This is the Bayindir deposit in western Turkey that contains 0.9Mt at 1.5% Pb and 7.5% Zn. There are a number of carbonate-hosted Pb-Zn deposits in central Turkey each containing up to approximately 1Mt of mineralisation of variable Pb+Zn grade (up to 30%). However, most have not been properly investigated in the past and are poorly understood.

19 Georgia

The Republic of Georgia lies in Eastern Europe, bordering with Russia to the north, as shown in Figure 19-1. The capital is Tblisi and the country covers an area of 69,700km^2. Since gaining independence from Russia in 1991, Georgia has experienced turbulent socio-politics, with continuing tension and conflict in the Russian border regions of Abkahzia and South Ossetia, known within Georgia as the Tskinvali region.

During the Soviet period, a range of commodities were mined and exported from Georgia including; arsenic, barite, bentonite, coal, copper, diatomite, lead, manganese, zeolites and zinc. Gold is also known to have been extracted for thousands of years. The mythical Golden Fleece pursued by Jason and the Argonauts in Apollonius Rhodius' Argonautica, is thought to derive from the fleeces historically used to capture gold grains from rivers. In more recent years the non-fuel minerals industry has declined with the focus remaining mostly on the Madneuli and Sakdrisi copper-gold mines near Bolnisi, the Askanskoye bentonite deposit, the Kisatibskoye diatomite deposit and the manganese mines around Chiatura.

Figure 19-1 Political map of Georgia showing copper deposits by copper resources. Adapted from the University of Texas Libraries, The University of Texas at Austin (1999)

19.1 Geology and Tectonics

The Eastern Mediterranean section of the TMB is formed by a number of tectonic terranes that developed during the Paleozoic, Mesozoic and Early Cenozoic. These were then amalgamated and sutured onto the Eurasian Plate to the north as the Afro Arabian Plate moved northwards and the Neotethys closed. Later, during the Alpine Orogeny, these blocks underwent intense deformation and metamorphism. The tectonic and metallogenic zones of Georgia can be split broadly into three of these major structural terranes. These can then be further divided into sub-terranes, as described by Tvalchrelidze (2000), in Figure 19-2.

The most northerly terrane, that accreted onto the Eurasian plate around 400-300Ma, is named the **Greater Caucasus Terrane**. It is mainly composed of a granitic-metamorphic complex intruded by Paleozoic granites and only outcrops as a relatively narrow band along the Russian border in the Greater Caucasus Mountains. This terrane is separated from the **Black Sea-Transcaucasian Terrane** by the Greater Caucasus Main Fault which acted as a subduction zone in the Early Jurassic. This second major terrane constitutes the majority of lithologies found in Georgia.

The **Chkhalta-Tphani subterrane** (dark blue in Figure 19-2) consists of a 3-10km thick series of Lower Jurassic black schist with interlayerings of arkose sandstones and metamorphosed limestone. The **Gagra-Java subterrane** (light green) consists of layered volcanic flows and pillow lavas, typical of an island-arc setting in the Middle Jurassic. Sediments and limestone have been deposited over these at the same time as granitic magmas intruded the marginal suture between Gagra-Java and Chkhalta-Tphani subterranes.

The **Mestia-Tianeti subterrane** also evolved in the Middle Jurassic as accumulations of sandstone and limestone overlain by a flysch sequence. The **Dzirula subterrane** (grey) and **Middle-Mtkvari subterrane** (orange) both comprise of carbonate sequences. The Dzirula also contains older Paleozoic schist intruded by Paleozoic-Jurassic gabbros, quartz-diorites, granite and pegmatite veins. Paleogene sediments that fill the Rioni and Mtkvari river basins host Georgia's rich hydrocarbon reserves and a limited number of manganese deposits.

A rift trough later formed in carbonate sediments in the **Adjara-Trialeti subterrane** (yellow).

Finally, the **Somkhito-Karabakh subterrane** is found in the far south bordering Armenia (pale blue). This sequence begins with a basal conglomerate overlapping Paleozoic granites, followed by arkose sandstones. To the south, in Armenia, a thick Middle-Jurassic calc-alkaline andesitic volcano-sedimentary sequence developed, however this island-arc affinity wanes and thins into Georgia. In the Bolnisi region of southern Georgia lies a thick Cretaceous andesitic calc-alkaline formation created volcanism and submarine pyroclastic deposits. It is in these 1.5km thick sequences that the Madneuli and associated VHMS polymetallic ore deposits are located. Overlying this can be found a several hundred metre thick layer of massive andesitic lavas that form the extensive plateaus near the Armenian border.

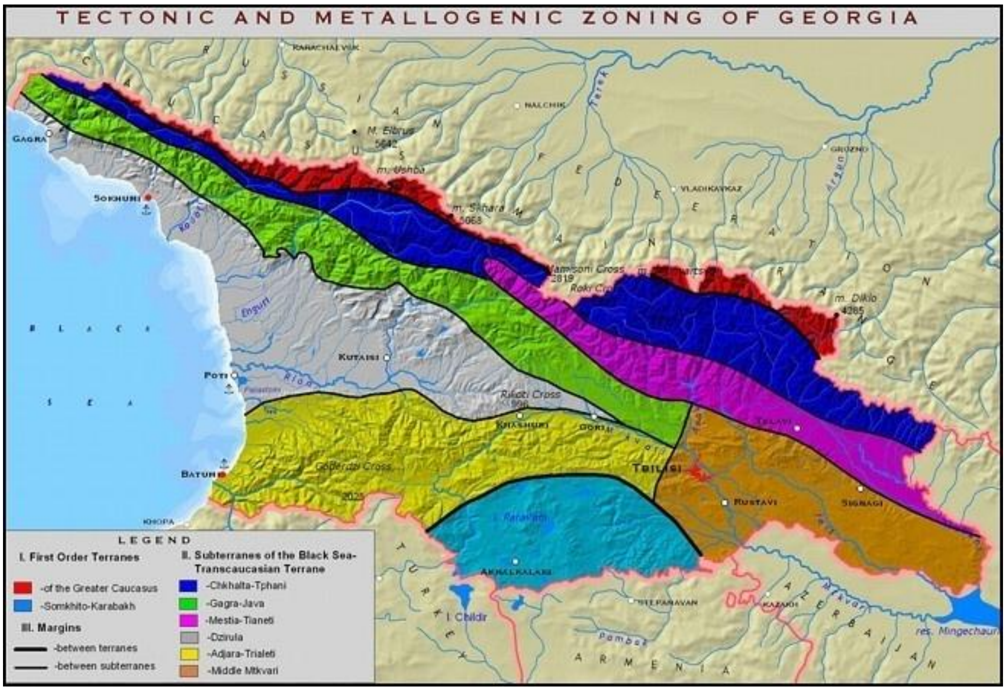

Figure 19-2 Metallogenic terranes of Georgia (Tvalchrelidze, 2000)

19.2 Known Deposits and Occurrences

Madneuli

The Madneuli mine lies 80km south of Tblisi near the town of Bolnisi and the Armenian border. The deposit is thought to be a VHMS style deposit associated with a rhyolitic dome, with probably only limited discharge of hydrothermal fluids to the seafloor and surrounding Jurassic andesitic volcanics. Mineralisation is similar to that seen in the Murgul deposits in Turkey, with predominantly stockwork pyrite and chalcopyrite, with a barite-rich zone near the top of the deposit. There is also an oxide zone on the northern side of the sulphide which is mined for its elevated gold grades. The style of mineralisation is replicated in major deposits elsewhere in the Bolnisi district.

The Madneuli mine has been in production since 1965 and is currently owned and operated by JSW Madneuli, a subsidiary of GeoProMining Ltd, a diversified minerals holding company that also controls the Sakdrisi Cu-Au deposit in Georgia, as well as gold and Cu-Mo operations in Armenia. The Metals Economics Group ("MEG") website states the most recent (1997) estimate of the mineral resource at Madneuli to include proven reserves of 23.25Mt @ 1.29% Cu and 1.06 g/t Au (0.3 Mt contained copper and 0.7 Moz gold), however the Intierra website provides a 2010 estimate of only 15.2Mt @ 0.46% Cu in the Probable category, (70,000 t contained copper and 0.2 Moz gold). Neither service provides a source for these estimates and the JSW Madneuli/GeoProMining company websites state no resource figures. Production rates are in the region of 11,000 t of copper and 2,000 t of gold, which contribute to almost 10% by value of Georgia's export revenue (Levine, 2009).

Sakdrisi

Situated approximately 3km NNE of the Madneuli mine, the Sakdrisi deposit is being investigated by GeoProMining through one of its subsidiary companies. Details regarding mineralisation and the project development are sparse. The MEG database suggests that the $1600 km^2$ licence area previously held by subsidiaries of Stanton Equities Corp, now GeoProMining, contained potential to host about 5 Moz Au across five deposits close to Madneuli (Bnelikhevi, Darbazi, Kvemo Bolnisi, Sakdrisi and Tsiteli Sopeli) and a further significant copper resources in five further areas near-by, (Kvemo Bolnisi, Sakdrisi, Balichi, Dambludka, David Garegji and Tamarisi). These estimates were made in the 1990s based upon the Soviet system of estimation and cover a very large area that cannot be confirmed. GeoProMining only state that they are undertaking exploration and mining activities at Sakdrisi.

Zoti

In 2010 Lydian International discovered anomalous gold mineralisation in numerous sub-parallel fault zones and hydrothermal breccia veins located structurally below an interpreted silica-cap in the Guri region of Ozurgeti Province, southwest Georgia. Initial surface sampling suggests that these faults are located adjacent to a porphyritic, pyrite-sericite altered quartz-diorite intrusion which returned anomalous gold values of up to 0.3 g/t gold in grab samples. Exploration is still at a very early stage,

19.3 Political Considerations

The main reason for the decline of the minerals sector in Georgia over the last 20 years has been the aftermath of Soviet rule and the consequent years of political unrest, particularly in the disputed northern border regions such as Ossetia (Tskinvali).

The political system remains in the process of transition, with frequent adjustments to the balance of power between the President and Parliament, and opposition proposals ranging from transforming the country into parliamentary republic to re-establishing the monarchy. Observers note the deficit of trust in relations between the Government and the opposition. Georgia is however becoming more and more involved with Europe, NATO and western nations, most notably the USA and EU. The President maintains a goal to join the EU, but to also develop relations with Russia so as to prevent Georgia becoming a staging post for Russian-NATO tensions.

As with many other former-Soviet states, Georgia suffered a severe economic crisis in the 1990s. Assistance from the World Bank and IMF in 1995 marked the start of self-sufficient economic development. By 2007 Georgia's real GDP growth rate reached 12%, making it one of the fastest growing economies in Eastern Europe. The World Bank also dubbed Georgia "the number one economic reformer in the world" because it had, in one year, improved from being ranked 112th to 18th in terms of ease of doing business[92].

High-level corruption and a weak judicial system will continue to hamper the business environment, though this will affect local businesses to a greater extent than foreign companies. Similarly, the threat of asset expropriation is low for foreign companies. Georgia has started to re-attract foreign minerals investment back into the country. Corporate tax in Georgia is 15% and a royalty on resource depletion is levied at 0.9 Georgian Lari (GEL) per gram of gold which equates to approximately 1.4%.

Benchmark assessments indicate that Georgia ranks 16th out of 183 countries for Ease of Doing Business 2011[93] and 64th out of 183 countries for Corruption Perception Index 2011[94].

[92] http://www.doingbusiness.org/~/media/FPDKM/Doing%20Business/Documents/Profiles/Country/GEO.pdf
[93] http://www.doingbusiness.org/rankings
[94] http://cpi.transparency.org/cpi2011/results/

Within the scope of this report, Georgia ranks 1st out of 24 countries for Ease of Doing Business 2011 and 6th out of 24 countries for Corruption Perception Index 2011.

The Control Risks RiskMap 2012 edition classifies the Political Risk of Georgia as Medium whilst the Political Risk in the breakaway regions of South Ossetia and Abkhazia is deemed to be High[95].

19.4 Security Considerations

The Control Risks RiskMap 2012 edition classifies the Security Risk of Georgia as Medium to High. This is supported by other online resources such as the FCO travel advice pages[96] which advise against all travel to the breakaway regions of South Ossetia and Abkhazia, and all but essential travel to areas near the Administrative Boundary Lines (ABLs) with Abkhazia and South Ossetia.

There might also be some localised risk from UXO as a result of the Russian incursion in 2008.

It is therefore likely that access to most areas would almost certainly require augmented security measures to protect company staff and assets during exploration and development. Liaison with the local security services would be highly recommended and might indeed be compulsory.

19.5 Prospectivity

The regions in southern and western Georgia with extensive volcanic sequences are of highest prospectivity in terms of porphyry copper potential. The Bolnisi region is well explored already with a number of historic Russian resource estimates attributed to a district scale. Further deposits, previously identified as porphyry and VHMS deposits, lie southeast of Madneuli in Armenia. However, these appear to have seen only limited development. It would not be unreasonable to postulate further extensive mineralisation beneath the mountains which run along the border between the two states.

The region of Eocene submarine volcanics bordering the Black Sea and Turkey should be further investigated for continuation of porphyry, skarn and VHMS mineralisation as seen in Turkey. The more recent Neogene sub-areal volcanics west of the Ajara district may mask surface exposures of mineralisation, but it is thought that deeper porphyry and VHMS systems are present under these volcanics, joining the Artvin-Borska and Bolnisi districts in Turkey and Armenia respectively. Lydian International's work at Zoti may be indicative of this potential.

[95] *http://www.control-risks.com/Riskmap/Pages/Home.aspx*
[96] *http://www.fco.gov.uk/en/travel-and-living-abroad/travel-advice-by-country/europe/georgia*

20 Armenia

The Republic of Armenia is a landlocked country in the Lesser Caucasus region (Figure 20-1). Armenia has a population of approximately 3 million and over 95% are ethnic Armenians. Additional ethnic minorities of Armenia include Russians, Yezidis, Kurds, Greeks and Assyrians. Yerevan the Capital has a little over 1 million people. Armenian is the officially spoken language by 97.7% of the population.

In the 19th century, mining started in the Alaverdy and Zangezur regions, and during Soviet times these activities increased greatly. In the 1980s, 25 % of the Soviet molybdenum was supplied by Armenia. In 1991 the mining industry collapsed due to deteriorating conditions in the mines and a decline in demand for metals, following the decline Armenia's minerals and mining industry has started to make a strong recovery. In 2009 Armenia was ranked as the 7th largest producer of molybdenum in the world (Polyak 2010 in Levine 2009). Armenia also produces copper, gold, silver and zinc along with numerous industrial minerals. Armenia is looking to increase the production of copper and molybdenum, but also enhance their processing facilities to be able to export partially processed products instead of the raw material.

20.1 Geology and Tectonics

Armenia lies within a tectonically active where the Arabian plate is slowly moving northwards, impacting the southern edge of the Eurasian plate. The result has been the formation and uplift of the Caucasus mountain range and a NW-SE structural trend that includes the Lesser Caucasus Mountains that run the length of Armenia, extending into Georgia and Azerbaijan.

Structurally Armenia can be divided into three tectonic domains; the Gondwanian derived autochthonous South Armenian Block (SAB), the ophiolitic Sevan-Akera suture zone and the Eurasian Plate (Sosson et al 2010). Two subduction events have been identified; one being the subduction of the Neotethys beneath the Eurasian margin and the other a supra-subduction zone. The subduction of the supra subduction zone induced the opening of a back arc basin and the accretion of ophiolitic fragments to the Eurasian-SAB suture zone during the late Cretaceous.

The Eurasian plate and SAB finally collided following a subduction regime that started in the Palaeocene. From the Eocene to the Miocene, as a result of the Arabian plate colliding into the SAB from the south, southward propagating shortening features of folding and thrusting occurred throughout a belt of deformation. This belt was then sealed by a thick sequence of unconformable Miocene to Quaternary clastic and volcanic rock (Sosson et al., 2010).

Figure 20-1 Political map of Armenia showing copper deposits by copper resources. Adapted from of the University of Texas Libraries, The University of Texas at Austin (2002)

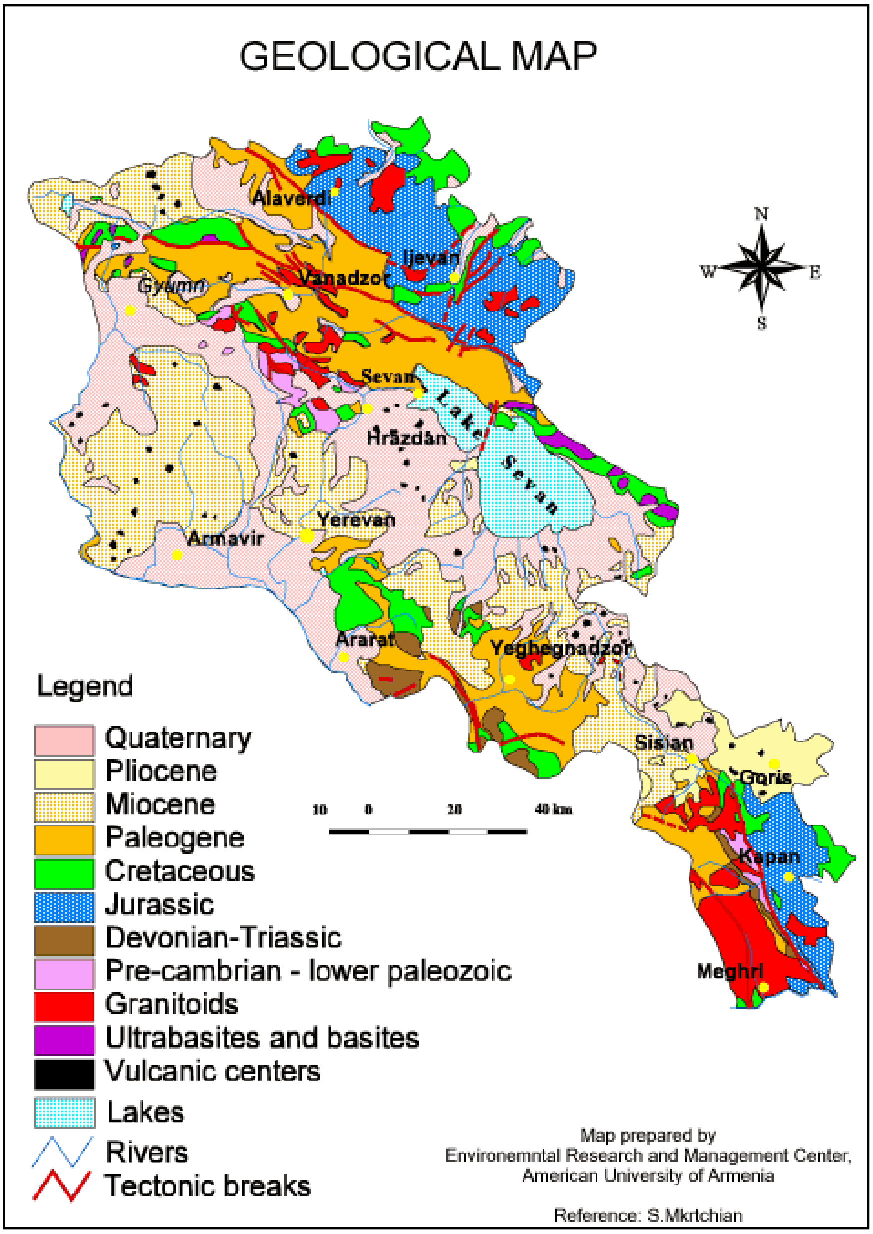

Figure 20-2 Simplified geological map of Armenia[97]

20.2 Known Deposits and Occurrences

Armenia has significant deposits of copper, molybdenum and gold, as well as smaller deposits of zinc, lead and silver. All of Armenia's known mineral resources have now been privatised. There are working enrichment plants and smelters near most mines. Most mining companies operating in Armenia have investment commitments to upgrade their facilities and expand production, which may

[97] *http://enrin.grida.no/htmls/armenia/soe2000/eng/maps/geology.htm*

create export opportunities for U.S. equipment suppliers. A few firms are looking for investment partners or debt financing to expand their existing operations.

Figure 20-1 and Figure 20-2 illustrate that the major copper deposits in Armenia are coincident with granitoid and Jurassic lithologies in the northeast and far south of the country. It is these areas that are most prospective for further copper exploration, particularly of porphyry and epithermal types.

Kajaran

Kajaran is one of Armenia's larger mining assets, the copper-molybdenum mine in the southern Syunik region was privatised in 2004 . Several companies led by the German Cronimet have taken over the "Zangezur Copper Molybdenum Combine" Closed Joint Stock Company[98] (ZCMC JSC) and expects to produce 18,000t Cu and 4000t of Mo annually from the region. The southern ore field hosts the Kajaran and Agarak copper-molybdenum porphyries, both of which are in production, and the Aygedzor and Lichk porphyries, which remain undeveloped. The Kajaran deposit is stated on ZCMC JSC 's website as having reserves of a B+C1 (Russian classification system) of 2.21 billion tons, with a copper content of 5.2 Mt and molybdenum 0.72 Mt.

Agarak

The Agarak copper-molybdenum complex was originally established in 1958 and is located in the Syunik district, near the Iran-Armenia boarder. GeoPro Mining[99] purchased the Agarak Copper-Molybdenum Mine Complex in 2007, the complex consists of an open pit operation with an adjacent processing plant. The reported resource estimate stands at 125 Mt containing 0.56% Cu, 0.025% Mo 0.6 Au g/t (equivalent to 0.7 Mt copper metal, 30 Kt molybdenum and 2.4 Moz Au).

Dastakert

Dastakert copper mine is situated in the Sisian region of the Syunik district. The Cu-Mo deposit is an operational mine owned by Molybdenite Ashkharh LLC.Resources are not stated but reserves are estimated at 26 Mt grading 0.43% Cu and 0.02% Mo (equivalent to 0.1 Mt contained copper and 5,000 t molybdenum) [100].

Teghout/Tekhut

The Teghout/Tekhut deposit is located in the Lori region 200km north of Yerevan. The development of the project has been a point of contention for many years due to the unique nature of the forest surrounding the site. The deposit represents the second biggest copper-molybdenum deposit in Armenia. The most recent resource estimate calculated for the project was in 2000 and came to 450 Mt at 0.35% Cu and 0.2% Mo (equivalent to 1.57 Mt contained copper and 900 Kt molybdenum) (. The mine and processing enterprise is currently operated by the Armenian Copper Programme (ACP), ACP has also acquired exploration licences the Alaverdi mine that is also currently a smelting works.

Armanis

Armanis is one of the larger gold-polymetallic deposits in Armenia. It is located in Lori Marz, west of the town of Stepanavan. The open pit and underground mine is operated by Sagamar CSJS, as is the Armanis enrichment plant. The deposit reportedly contains a resource of 18 Mt at 0.9g/t Au, 10g/t Ag, 0.9% Cu, 2.2% Zn, 1% Pb (equivalent to 0.5 Moz gold, 0.5 Moz silver, 0.1 Mt copper, 0.4 Mt zinc and 0.2 Mt lead).

[98] www.zcmc.am
[99] http://www.geopromining.com
[100] http://www.globalmetals.am

20.3 Political Considerations

2012 marks the start of the next election cycle, with parliamentary elections due to be held by May, and a presidential election scheduled for February 2013. Sustained domestic and international pressure on President Serzh Sarkisyan to ensure clean legislative elections should help to secure the opposition increased parliamentary representation, though persistent divisions among the opposition parties will continue to weaken their political voice. Little progress in combating long-standing political failings – corruption, weak rule of law, the extensive influence of vested interests over policy-making – is likely in the run-up to the elections, while disputes over the election results can be expected to provide further distraction in the subsequent months. Poor implementation of Armenia's relatively favourable legislative and regulatory frameworks will continue to hamper the business environment (Control Risks, 2012).

At the fall of the Soviet Union Armenia experienced extensive economic collapse. The economy was already damaged due to the 1988 earthquake that hit Armenia's second biggest city, Gyumri, and suffered badly from the breakdown of inter-Soviet and former Warsaw pact trade, and the consequences of the war over Nagorno Karabakh, including the closure of borders with Azerbaijan and Turkey. The economy recovered somewhat in subsequent years, and Armenia weathered the 1998 Russian financial crisis better than other CIS states. Over the following decade Armenia benefited from annual double-digit growth, fuelled by the construction industry and high commodity prices. But, following the global financial crisis, the Armenian economy contracted by 14.4% in 2009. From late 2009 the economy showed signs of recovery, helped by recovering commodity prices and government borrowing which increased public debt to nearly 50%[101].

The Armenian Development Agency[102] promotes foreign investment is promoting the country in a positive light for foreign investment.

There is also an independent Judiciary and laws protecting foreign investors against legislative changes. Armenia is a member of the World Trade Organisation and is a signatory to the International Centre for Settlement of Investment Disputes (ICSID[103]).

The mineral potential of the country has attracted several western exploration and mining organisations over the past decade including: Lydian International, Dundee Precious Metals Inc, Global Gold Corp, Cronimet, Caldera Resources Inc, GeoProMining and Anglo African Minerals Plc.

Benchmark assessments indicate that Armenia ranks 55th out of 183 countries for Ease of Doing Business 2011[104] and 129th out of 183 countries for Corruption Perception Index 2011[105]. Within the scope of this report, Armenia ranks 6th out of 24 countries for Ease of Doing Business 2011 and 19th out of 24 countries for Corruption Perception Index 2011.

The Control Risks RiskMap 2012 edition classifies the Political Risk of Armenia as Medium[106].

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[101] http://www.fco.gov.uk/en/travel-and-living-abroad/travel-advice-by-country/country-profile/europe/armenia?profile=economy
[102] www.ada.am
[103] www.icsid.worldbank.org
[104] http://www.doingbusiness.org/rankings
[105] http://cpi.transparency.org/cpi2011/results/
[106] http://www.control-risks.com/Riskmap/Pages/Home.aspx

20.4 Security Considerations

The Control Risks RiskMap 2012 edition classifies the Security Risk of Armenia as Medium to High. This is supported by other online resources such as the FCO travel advice pages which advise against all but essential travel to areas including the border with Azerbaijan due to the unresolved dispute over Nagorno Karabakh.

Although a ceasefire has been in place since May 1994, the borders between Azerbaijan and both Armenia and Armenian occupied territory remain closed. There are no peacekeeping forces separating the two sides. There are regular exchanges of sniper fire and some skirmishes. The border areas also contain mines and unexploded ordnance. Any foreigners venturing within five kilometres of these borders are liable to be stopped by the police or the military[107].

It is therefore likely that access to most areas would almost certainly require augmented security measures to protect company staff and assets during exploration and development. Liaison with the local security services would be highly recommended and might indeed be compulsory.

20.5 Prospectivity

The prospective Palaeogene intrusives in the Lori and Syunik districts in the north and south of the country respectively, are of particular interest for copper potential. The northern Lori district contains larger lower grade porphyry copper molybdenum deposits, whereas the Syunik district hosts a greater number of already discovered copper and polymetallic deposits that appear to have a stronger affinity with gold.

Copper grades are generally lower than the 1% suggested as a target by MMG, however tonnages are large and combined with reasonable gold grades in some deposits could be increasingly prospective. Noting the very high tonnages for the Karajan region and the respectable copper percentages accompanying the reserve estimate the Karajan region seems highly prospective given the nature in which porphyry copper deposits tend to cluster. The classification scheme that has been selected for the Karajan reserve estimate is the Russian reporting for resources and reserves system. It is therefore advised an understanding of the classification scheme and the confidence applied to each category is understood when taking into consideration estimates of this high tonnage and grade nature. Karajan is classified into B+C_1reserve category , category B is known in some detail, and C_1 even less so.

It is considered by SRK ES that Southern Armenia is a favourable area for deposits that MMG are interested in. Considering the known geology, tectonic history and deposits of the southern tip of the country, areas surrounding Karajan in Armenia and the Sungun mine into southern Iran appear favourable for prospectivity and MMG may consider a further more detailed investigation into the prospectivity of Armenia.

[107] http://www.fco.gov.uk/en/travel-and-living-abroad/travel-advice-by-country/europe/armenia

21 Azerbaijan

The Republic of Azerbaijan is the largest of the Caucasus states, covering an area of approximately 86,600km^2 (Figure 21-1). The exclave of Nakhchivan to the southwest maintains autonomy from the rest of Azerbaijan as the Nakhchivan Autonomous Republic. Nagorno-Karabakh is a region covering most of the southwest of Azerbaijan and is governed by the Nagorno-Karabakh Republic, a de facto independent, but unrecognized state established when previously part of the Soviet Union. The territory is internationally recognized as part of Azerbaijan, although the Azerbaijan government has not exercised power over most of the region since 1991.

Despite potential for the exploitation of solid mineral resources, Azerbaijan has historically focused on the development of hydrocarbon resources both onshore and offshore. In 2009, 44.8% of GDP was derived from the mining and quarrying sector, almost all of which coming from the production of oil and gas. As such, the exploration and mining of metalliferous and non-metalliferous mineral deposits has been somewhat neglected and not well documented.

21.1 Geology and Tectonics

The geological features of Azerbaijan are dominated by the Greater Caucasus mountain range in the north, the Lesser Caucasus Mountains in the west and the Kura Basin stretching between the two from the Georgian border to the Caspian Sea. Figure 21-2 shows a simplified geological map of Azerbaijan. A more detailed 1:500,000 geological map is included in the project database.

21.1.1Lesser Caucasus

Sosson et al. (2010) suggest that the Lesser Caucasus is composed of three main domains identified from the SW-NE as the autochthonous South Armenian Block (SAB), the ophiolitic Sevan-Akera suture zone and the Eurasian Plate. The SAB outcrops in the Nakhchivan region of south-western Azerbaijan where a number of NE dipping thrusts juxtapose Devonian-Permian platform formations, Late Cretaceous sediments and Paleogene molasses and volcanics. Further southeast, Cretaceous and Cenozoic intrusives near Ordubad give rise to mineralised porphyry copper-gold-molybdenum systems.

The Sevan-Akera suture zone represents the only suture in the Lesser Caucasus and crossed Azerbaijan in the south, running parallel with the Armenian border. Here multiple occurrences of collision, subduction and obduction of oceanic crust (Tethyan) onto the underlying SAB occurred as the Arabian plate collided with the Eurasian Plate and closing the Tethys. Extensive magmatic and volcanic activity is found north of the Sevan-Akera suture and is related to the one of the initial subduction zones on the Eurasian active margin in the Upper Jurassic. This Somkheto-Karabakh island arc stretched northwest into Armenia, Georgia and into Turkey as the Pontides metallogenic belt. This is too related to porphyry mineralisation.

Figure 21-1 Political map of Azerbaijan showing copper deposits by contained copper resources. Adapted from the University of Texas Libraries, The University of Texas at Austin (2004)

21.1.2Greater Caucasus

The Greater Caucasus mountain range results from the inversion of the Greater Caucasus back-arc-type basin, created by the closure of the Tethys and collision of Arabia and Eurasia. The orogenic uplift of Jurassic carbonate sediments and thrusting that created the current mountain range began in the early Cenozoic, accelerated in the Pliocene and continues to the present day. The polymetallic deposits in the Balkan region can be attributed to this orogenesis.

21.1.3Kura Basin

The Kura basin formed as a back-arc basin between the Early Eocene and Pliocene. The basin-fill sediments are derived both from the volcanic rocks of the Lesser Caucasus to the south and from the carbonate rocks of the Greater Caucasus to the north. Sediments to a depth of 8000m have been recovered from the Kura Basin that indicates shallow-marine and deltaic sedimentation has been dominant from Miocene times onwards. Recent (Pliocene-Pleistocene) folding of these sedimentary sequences, as a result of continued uplift of the Greater Caucasus, gives rise to the numerous mud volcanoes found in Azerbaijan.

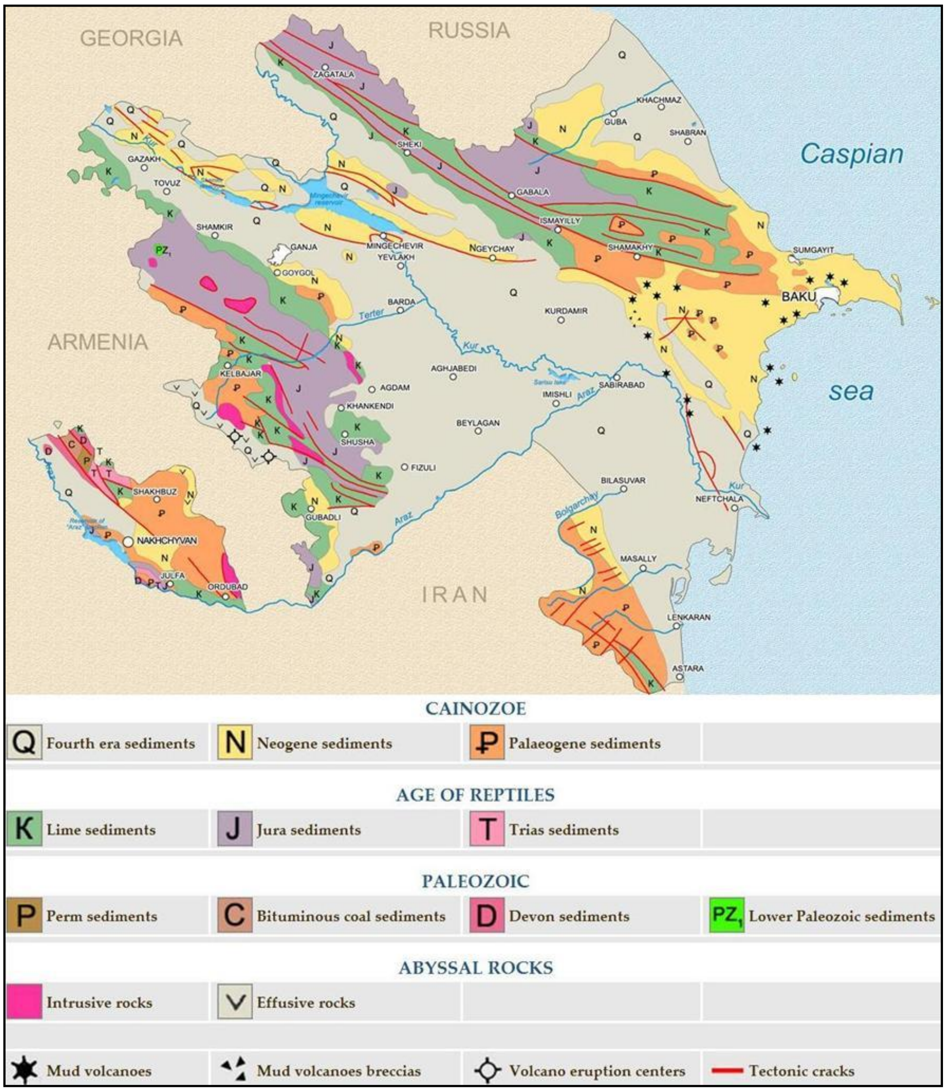

Figure 21-2 Simplified geological map of Azerbaijan. Not to scale.[108]

[108] http://azerbaijan.az/_Maps/_geologic_include_e.html

21.2 Known Deposits and Occurrences

Mineral exploration is recorded as having been conducted in the 19th and 20th centuries by German, Russian and Azerbaijani groups, particularly around the Dashkasan cobalt deposit and the Gadabay, Bittibulag and Balakan copper deposits. Porphyry deposits have been investigated to varying degrees mostly in the Lesser Caucasus Mountains in Nakhchivan and Ganja-Gazakh regions of western and south-western Azerbaijan. Polymetallic Pb-Zn ±Cu±Ag deposits are known in the Nakhchivan and Shaki-Zaqatala districts.

Nakhchivan Region

Anglo Asian Mining's Ordubad Contract Area in the southwester Nakhchivan autonomous region contains numerous targets including Shakardara, Piyazbashi, Misdag, Agyurt, Shalala and Diakhchay, all of which are all located within a 5km radius. These last three are all known for their porphyry copper-gold-molybdenum occurrences and were investigated during Soviet times. Little is known of current exploration activities in this region. Old reports mention porphyry copper and gold mineral occurrences, but no recent details have been discovered.

Gadabay Region

During the period from 1867-1914 the German company Siemens extracted a reported 56,000t of copper, 200,000-400,000oz of gold and ~120t of silver from the Gadabay deposit in the Ganja-Gazakh region of western Azerbaijan. It is thought that they were in fact exploiting the gold in this deposit as a primary commodity, rather than the copper. A number of small porphyry systems have since been identified, many having been mined to some extent in the past. Information regarding deposit geology, size and grade is sparse though includes the Gyzildzhadag, Bittibulag, Gosha Maarif, Ertep, Geyer, Shekerbey, Gumlu and Aitalin occurrences.

The deposits in this region now largely fall into the exploration and mining licences of Anglo Asian Mining and its subsidiary, the Azerbaijan International Mining Company. The Gedabek mine, commencing production in 2009, has a JORC-compliant measured and indicated resource of 16.2 Mt containing 1.3g/t Au (0.6 Moz gold), 13.1g/t Ag (213 t silver) and 0.27% Cu (43,700 t contained copper).

Balakan Region

Deposits in the Greater Caucasus region are recorded as polymetallic occurrences, though further specific property details have not been found. The Filizchay deposit contains an estimated 90Mt @ 0.59% Cu (0.53 Mt contained copper), 3.63% Zn (3.27 Mt zinc), 1.43%Pb (1.28 Mt lead), 44.2g/t Ag (3900 t silver), with accessory Au, Bi, Cd, Co, Se, Te. It is not known what form this mineralisation takes. The Kasdag and Katekh occurrences are said to be satellite deposits of Filizchay, providing supplementary resources to the Filizchay deposit.

21.3 Political Considerations

Although Azerbaijan has made significant progress and economic development since independence in 1991, the socio-political situation in Nakhchivan and Nagorno-Karabakh raises some concerns over commercial development from international companies. Mineral exploration, licensing and exploitation are likely to be contentious or unstable in any region in which there is dispute over independence, self-governance and ownership of natural resources.

In spite of the existence of the Laws and regulations to control the corruption, they are not enforced properly, and this remains a serious problem in the country. However, on 15 March 2005, Azerbaijan became the first oil producing country in the world to publish Extractive Industries Transparency Initiative (EITI) reports examined by an independent audit firm, and the first country to involve civil society in the implementation of the initiative. The reports represented a significant and public step forward in the implementation of the Initiative in Azerbaijan and worldwide. The full text of the government reports and accompanying accountants' reports are available on the website of the State Oil Fund of Azerbaijan and the EITI website[109].

International companies that are currently involved in Nakhchivan (Anglo Asian Mining), indicating that investment is possible and it may be a case of those who make the first forays into Azerbaijan's mineral sector may prove most successful.

Benchmark assessments indicate that Azerbaijan ranks 66th out of 183 countries for Ease of Doing Business 2011[110] and 143rd out of 183 countries for Corruption Perception Index 2011[111].

Within the scope of this report, Azerbaijan ranks 10th out of 24 countries for Ease of Doing Business 2011 and 21st out of 24 countries for Corruption Perception Index 2011.

The Control Risks RiskMap 2012 edition classifies the Political Risk of Azerbaijan as Medium[112].

21.4 Security Considerations

The Control Risks RiskMap 2012 edition classifies the Security Risk of Azerbaijan as Medium to High. This is supported by other online resources such as the FCO travel advice pages which advise against all travel to Nagorno-Karabakh and the military occupied area surrounding it.

Although a ceasefire has been in place since May 1994, the borders between Azerbaijan and Armenia Armenian occupied territory remain closed. There are no peacekeeping forces separating the two sides. There are regular exchanges of sniper fire and some skirmishes. The border areas also contain mines and unexploded ordnance. Any foreigners venturing close to these borders are liable to be stopped by the police or the military[113].

Azerbaijan faces a general threat from terrorism. Attacks could be indiscriminate and against civilian targets, including places frequented by foreigners, such as international hotels, restaurants and pubs, as well as energy sector facilities. Control Risks 2012 assessment notes, "The threat of terrorist attack by Islamist militants will persist, but the risk to business will remain low".

It is therefore likely that access to most areas would almost certainly require augmented security measures to protect company staff and assets during exploration and development. Liaison with the local security services would be highly recommended and might indeed be compulsory.

[109] http://eiti.org/
[110] http://www.doingbusiness.org/rankings
[111] http://cpi.transparency.org/cpi2011/results/
[112] http://www.control-risks.com/Riskmap/Pages/Home.aspx
[113] http://www.fco.gov.uk/en/travel-and-living-abroad/travel-advice-by-country/europe/azerbaijan

21.5 Prospectivity

Although porphyry deposits do exist in Azerbaijan, their geology, mineralisation, size and grade are not well documented. Historic exploration has been generally limited to Russian activities during Soviet times and around the Gedabek deposit more recently by German and then London-based organisations. For these reasons SRK ES regards Azerbaijan as very underexplored.

The southwest of Azerbaijan contains volcanogenic and intrusive lithologies, which typically host porphyry deposits elsewhere in the TMB. Those deposits that have so far been investigated and described in literature are generally relatively small, containing no more than a few hundred tonnes of copper. The most prospective regions lie west, north and east of the town of Gadabay, Ganja-Gazakh region, in the Jurassic volcanogenic sequences and magmatic stocks which stretch northwest through northern Armenia and into the Bolnisi mineralised district of southern Georgia.

There are likely to be further undiscovered, or at least under-explored deposits in this region, though the limited public domain data makes it difficult to highlight key areas of potential or postulate the size of undiscovered deposits. The southern regions near the Iranian border certainly look promising, the potential confirmed by the presence of the Sungun copper mine in Iran.

22 Islamic Republic of Iran

The Islamic Republic of Iran is a mountainous state in the Middle East covering an area of just over 1,648,000 km^2 (Figure 22-1). Since the 1979 revolution, Iran has been an Islamic Republic where the teachings of Islam are the basis of all political, social and economic relations. Various civilisations have flourished in this region for over 5000 years, with evidence of the use of copper from around 4000 years ago.

Despite its long history and extensive mineral resources, the mining sector in Iran is underdeveloped. This is due to a number of reasons including; a lack of suitable infrastructure, legal barriers with regards to international investment and current UN and international sanctions, exploration difficulties, government control over many large deposits and a focus on hydrocarbon resources. Iran is currently OPEC's second largest producer of crude oil and possesses the second largest reserves of natural gas in the world. There is however significant potential for all exploration and exploitation of many metallic and non-metallic mineral commodities across the whole country.

Figure 22-1 Political map of Iran showing copper deposits by contained copper resources. Adapted from the University of Texas Libraries, The University of Texas at Austin (2001)

22.1 Geology and Tectonics

Förster (1978) splits the tectonic units of Iran into 8 distinct regions and discusses the metallogenesis of each individually in relation to the structural evolution of this section of the TMB (Figure 22-1). These tectonic units give rise to distinct styles of mineralisation and mineral deposit and understanding them will help with targeting copper and base metal exploration.

22.1.1 Plain of Shatt-al-Arab

In the southwest of Iran, near the town of Abadan and the border with Iraq at the head of the Persian Gulf, an area of stable Precambrian Shield belonging to the Arabian Platform is found. This is covered with Paleozoic-Tertiary sediments. There is little tectonic activity in this region and it is of no mineral interest.

22.1.2 Zagros Fold Belt

This may be regarded as the north-eastern limit of the Arabian Platform Precambrian basement, overlain by platform sediments and thick accumulations of late Triassic-Neogene marine sediments which have been folded during the Plio-Pleistocene. This sequence is also of minimal interest in mineral exploration terms, containing a limited number of clay, kaolin, sulphur and phosphate occurrences. This however, is the region in which the majority of Iran's oil and gas fields are found.

22.1.3 Zagros Thrust Zone

The Zagros Thrust is thought to represent the main structure along which the Arabian Platform has been over thrust by the Iranian Platform. On the north-eastern hanging wall of this thrust, the Zagros Thrust Zone is comprised of Upper Cretaceous ophiolites and radiolarites that previously composed the Zagros Trough, thrust upwards and deformed during the collision of the Arabian and Iranian microcontinents.

The exact timing and initial components of the closure of the Tethys and collision of plates and microcontinents in this region is contentious. Some authors suggest that Iran and Afghanistan were separate microcontinents that separated a north and south Tethyan Sea. The northern sea closed initially, accreting Iran onto the Eurasian Plate in the Early Mesozoic, followed by the collision and subduction of the Arabian plate under the Iranian platform during the Alpine Orogeny in the Early Cenozoic.

22.1.4 Sanandaj-Sirjan Zone

The Sanandaj-Sirjan Zone forms the highest peaks of the Zagros mountains, running for over 1500 km from Piranshahr near the Iraq and Turkish borders in the northwest, to an area just north of the Strait of Hormuz in the south. This zone is comprised of highly deformed, faulted and metamorphosed Mesozoic-Tertiary sedimentary sequences, frequently intruded by granodiorite magmas. It is along the northern edge of this zone that Tertiary volcanics erupted (the Central Iranian Volcanic Belt, described later), to which many of Iran's largest mineral deposits are related.

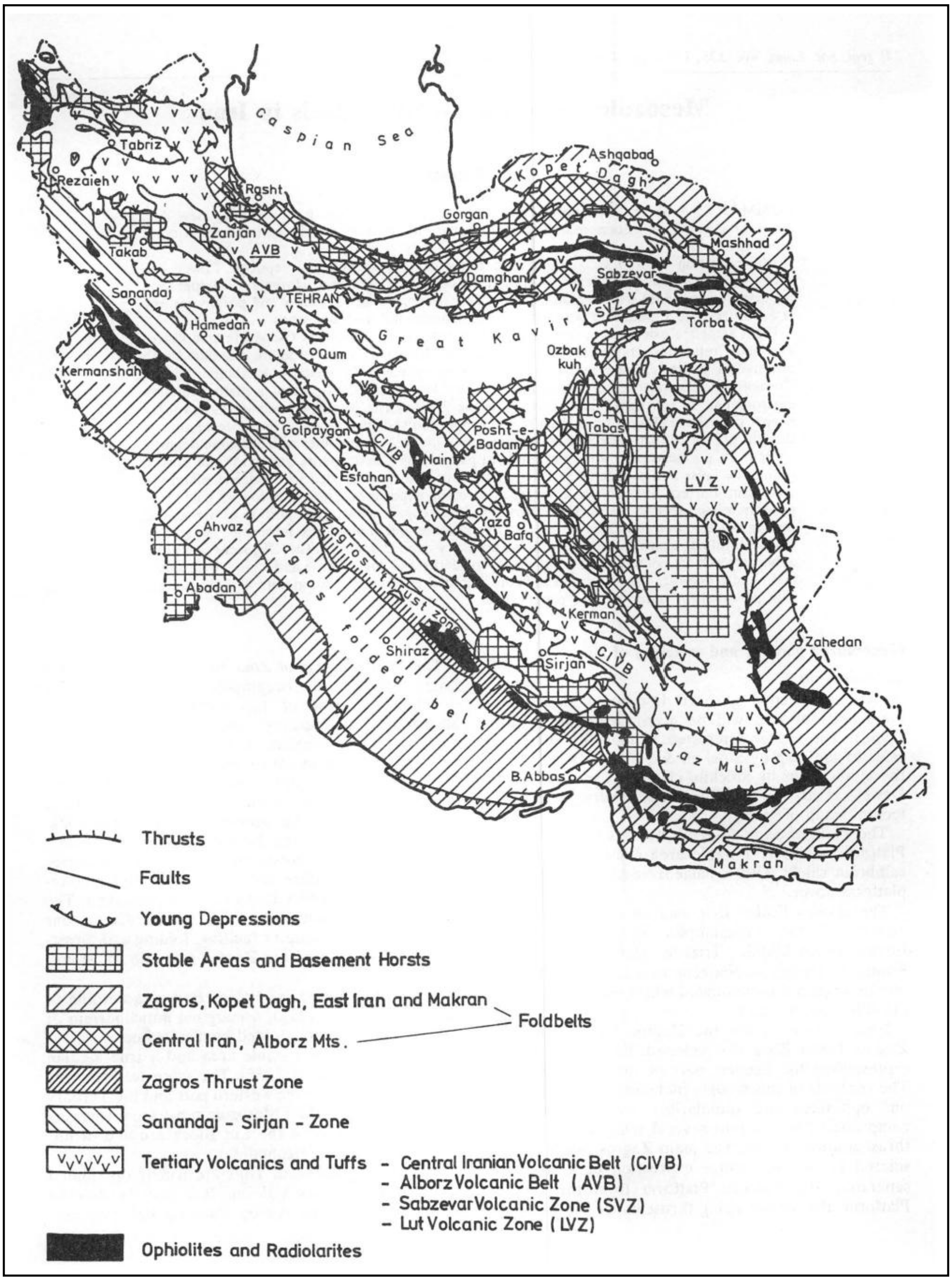

Figure 22-2 Tectonic map of Iran from Förster (1978)

22.1.5 Central Iran Depressions/Basins

An area of stable platform during the Paleozoic, central Iran was subject to extension in the late Triassic, leading to the formation of a number of horst and graben structures. The hosts have preserved Precambrian crystalline and pre-Tertiary platform rocks, whereas the grabens have filled with unusually thick sequences of Jurassic-Cretaceous sediments affected by complex folding and faulting.

22.1.6 Alborz Mountains

The Alborz Mountains of northern Iran formed as a result of the accretion of Iran onto the Eurasian Plate in the late Triassic. Mapped as Pleistocene sediments overlying Paleogene substratum, the Alborz Mountains represent a zone of transpressional and transtension related tectonics active do varying degrees over the last 100 million years. Recorded mineral occurrences in this region and north into the Kopet Dagh fold belts on the border with Turkmenistan are minimal and of no real interest. Tertiary volcanics in the Sabzevar Volcanic Zone immediately south of Alborz Mountains are of economic interest however..

22.1.7 Lut Block

The Lut Block is a median mass of continental crust that accreted onto Eurasia before the collision of the Arabian Plate. It is a relatively rigid block covered in thick accumulations of Mesozoic sediments and Eocene volcanics. The majority of this region has limited mineral potential, though the Lut Volcanic Zone north of the Lut Depression are of interest for copper and lead-zinc deposits.

22.1.8 Tertiary Volcanic Belts

It is within the Tertiary volcanic belts of Iran that large copper and base metal deposits are found, some of which are world class in size and contained metal. Volcanism occurred in an island-arc setting due to the subduction processes taking place during the collision of the Arabian and Eurasian plates. The volcanic belts are all now found proximal to the zones of suturing and thrusting where these crustal scale tectonic processes occurred, namely along the northern edge of Iran where the Iranian Platform initially accreted onto Eurasia, the eastern edge where the Kabul Block joined the Lut Block and along the south-eastern edge where the Arabian plate finally collided with Eurasia.

22.2 Known Deposits and Occurrences

Copper deposits in Iran are confined mainly to the Tertiary volcanic belts, namely; Central Iranian Volcanic Belt (CIVB), the Alborz Volcanic Belt (AVB), the Sabzevar Volcanic Zone (SVZ) and the Lut Volcanic Zone (LVZ). The database presented here lists 41 copper occurrences and deposits. Only a limited number of these have been confirmed through searching online databases and as such many of the individual occurrences and historic mines cannot be accurately placed. They have been included in the database however, as their distribution, although approximate in many instances, serves to illustrate the distribution of copper mineralisation across Iran. The major mines and prospects of interest are summarised below.

22.2.1 Central Iranian Volcanic Belt / Kerman Region

Sarcheshmeh

Situated in the Fars Province of south-central Iran, between the towns of Sirjan and Rasfanjan, the Sarcheshmeh Cu-mo porphyry is one of the largest in the world. As with many of the state run mines in Iran information regarding the deposit characteristics and resource are sparse and often out of date. The Mineral Economics Group, USGS and other published papers all place the Sarcheshmeh deposit in the top 35 largest deposits by contained copper, with a resource of approximately 1.2Bt @ 0.7% Cu, 0.03% Mo and 0.27g/t Au (8.4 Mt contained Cu, 360,000 t Mo and 10.4 Moz Au). It was discovered in ancient times, though concerted exploration started in the 1960s before the state run National Iranian Copper Industries (NICICO) took control and developed an open-pit mine.

The Sarcheshmeh mineralisation is associated with late Tertiary granodiorites intruded into, predominantly, andesitic volcanics and conformable sediments along the axial portions of anticlinal folds. Copper and molybdenum mineralisation is associated with a porphyry that post-dates the granodiorite and is itself intruded by a small, low grade monzonite stock.

The andesites adjacent to the Sar Cheshmeh porphyry are strongly mineralized and accommodate a substantial proportion of the ore body. Mineralization in both the andesites and the porphyry is associated with intense fracturing and there is substantial post mineral faulting. The presence of a supergene cap in the Sarcheshmeh deposit adds significant quantities of high grade mineralisation that is frequently eroded away in other, now smaller, deposits.

Miduk

The Miduk deposit is located just 85km northwest of the Sarcheshmeh deposit and the two are separated by the Abdar caldera. Also owned by NICICO, the deposit was discovered in 1966 and entered production in 2004. Containing a resource of approximately 145Mt @ 0.85% Cu (1.1Mt contained copper), the Miduk porphyry is of similar age and composition as Sarcheshmeh.

Darrehzar, Ali-Abad and Darreh-Zerreshk

The Darrehzar deposit is located only 8km southeast of Sarcheshmeh and contains an estimated 200,000t contained copper. The Ali-Abad and Darreh-Zerreshk deposits are separated by only a few kilometres, some 185km northwest of the Miduk deposit. These contain a combined resource similar to that of Darrehzar, but no exact figures have been confirmed.

Dalli

The Dalli (Dauli) prospect is currently being investigated by Dorsa Plc, an Iranian based mineral exploration company. They have reported encouraging drill intercepts of porphyry mineralisation in an area of the CIVB, not previously known for large copper deposits. There are however, extensive volcanic outcrops in this region southwest of Tehran, that have significant potential.

Mehdiabad Pb-Zn Deposit

The Mehdiabad deposit is a Mississippi Valley type lead-zinc deposit found midway between the Miduk and Ali-Abad copper porphyries in the CIVB. The deposit reportedly contains over 460Mt of mineralisation containing 3.5% Zn (16.1 Mt contained zinc), 1.3% Pb (5.98 Mt lead) and 29g/t Ag (13,340 t silver), making Mehdiabad one of the largest, unexploited lead-zinc deposits in the world. The deposit is currently owned by a JV between UC: Resources, KDD Group, Itok Resources and other minority investors, though ownership issues are reportedly ongoing with the Iranian Government.

There are a number of other MVT and CD lead-zinc occurrences recorded along the length of the CIVB, some with resources estimated up to~1Mt of contained lead and zinc. These should be considered as a potential upside to exploration in this region for copper porphyries.

Angouran

The Angouran Pb-Zn deposit in north-western Iran lies along the CIVB and contains a reported 26Mt of Mississippi Valley-type and clastic dominated mineralisation with grades of 9.6% Zn and 20.3% Pb (2.5 Mt and 5.2 Mt of contained zinc and lead respectively). It is owned by the privately-held Iran Zinc Mine Development Co (IZMD) and supplied over 80% of the ore processed by Iranian zinc smelters prior to a significant slope collapse in the pit in 2008.

Mineralisation is hosted in by a Neoproterozoic metamorphic complex of mostly marbles and schist that is overlain by a Tertiary-Quaternary sedimentary and volcanic sequence. The deposit lies in one of a number of erosional windows that expose the metamorphic complexes below the Tertiary volcanics of the CIVB. The potential for further world-class sedimentary Pb-Zn deposits along this belt, possibly hidden by younger sediments and volcanics, is untested, but not an unreasonable assumption.

22.2.2 Alborz Volcanic Belt

Sungun

The Sungun deposit in the East Azerbaijan Province of northwest Iran is another world-class copper porphyries, containing a resource of 1Bt @ 0.67% Cu (6.7 Mt contained copper). Mineralisation is associated with an early quartz monzonite and late diorite-granodiorite phase stock of Miocene age which intruded Eocene volcano-sedimentary and Cretaceous carbonate rocks. The presence of a supergene cap of high grade copper mineralisation (~1.5% Cu) contributes significantly to the size of the Sungun resource. Initially discovered in 1977 and entering production in 2006, the Sungun mine is owned by NICICO and currently produces around 40,000t of copper metal annually. Expansion of the processing plant facilities aims to increase this rate significantly in the near future.

Masjed Daqi

The Masjed Daqi deposit is said to contain 300Mt @3% Cu (9Mt contained Copper), according to the Mineral Economics Group website, though it is not thought that the source quoted on this site is reliable. Other sources suggest epithermal mineralisation containing gold, copper and base metals is present in the Jolfa region in the far northwest of Iran. The existence of porphyry deposits in this region is likely given the presence of Tertiary volcanics and the nearby Sungun (60km to the east), Kadjaran and Agarak mines (these later two are in southern Armenia, ~50km to the east-northeast).

22.2.3 Lut and Sabzevar Volcanic Zones

There are no recorded copper mines in these two volcanic belts, though there are numerous occurrences of copper mineralisation. This may be due to the fact that these zones represent areas of suturing between Eurasia and the Central Iranian, Lut and Kabul Blocks, rather than the large scale subduction seen beneath the Zagros Mountains in south-central Iran. Although there has been Tertiary volcanism in both regions, it is not thought to have been over such an extended period as in the CIVB. Occurrences of low grade porphyries exist at Kuh-e-Sorkh, north of Kashmar in the northeast and at Qaleh Zari on the Lut Block. Although further exploration may discover economic deposits of porphyry mineralisation, it is not thought that they will be on the same scale as those in the CIVB that follow a path northwest into the Caucasus states of Armenia, Azerbaijan and Turkey.

22.3 Political Considerations

In the past foreign direct investment in Iran has been hindered by unfavourable or complex operating requirements and by international sanctions. In the early 2000s the Iranian government liberalized investment regulations and has since offered numerous incentives to investors and companies wishing to operate in Iran. The government has made the development of non-oil exports a priority and the exploitation of copper, lead, zinc and gold form a significant contribution to the mining sector Iran would like to further develop.

International sanctions however do remain in place due to Iran's pursuit of its nuclear program. The extent to which these sanctions affect current international investment or potential new investment is un-certain, though it is possible that the Iranian governments attitude may change towards foreign companies should restrictions increase in the coming years. The Iranian Geological Survey maintains a well resourced website with GIS resources and information[114]. This might be an indication that the Iranian state is keen to encourage minerals development. However, of the few advanced copper and Pb-Zn deposits recorded that are owned by international companies, a number have had issues in the past relating to ownership and financial commitments to and from the government. The process of negotiation and arbitration over disputes also appears to be slow.

Benchmark assessments indicate that Iran ranks 144th out of 183 countries for Ease of Doing Business 2011[115] and 120th out of 183 countries for Corruption Perception Index 2011[116]. Within the scope of this report, Iran ranks 21st out of 24 countries for Ease of Doing Business 2011 and 18th out of 24 countries for Corruption Perception Index 2011.

The Control Risks RiskMap 2012 edition classifies the Political Risk of Iran as High[117].

22.4 Security Considerations

The Control Risks RiskMap 2012 edition classifies the Security Risk of Iran as Low to Medium. This is generally supported by other online resources such as the FCO travel advice pages which advise in general against all against all but essential travel to Iran and locally against all travel to within 100km of the Iran/Afghanistan border, and to within 10km of the entire Iran/Iraq border. The Pakistan border is also deemed to be high risk[118].

At present, Iranian nuclear ambitions continue to steadily escalate political tensions with the international community, and the irreconcilable agendas of all parties concerned mean that a resolution of the crisis is unlikely in the coming year (Control Risks, 2012).

Social unrest is likely to erupt occasionally, both around parliamentary elections in March, but also because of the persistence of deep socio-economic grievances. Foreigners caught up in any unrest might be seen as an easy target for the venting of national frustrations. However, the threats posed by indiscriminate terrorism or crime remain low.

It is therefore likely that access to most areas would almost certainly require augmented security measures to protect company staff and assets during exploration and development. Liaison with the

[114] *http://www.gsi.ir//Lang_en/WebsiteId_11/Home.html*
[115] *http://www.doingbusiness.org/rankings*
[116] *http://cpi.transparency.org/cpi2011/results/*
[117] *http://www.control-risks.com/Riskmap/Pages/Home.aspx*
[118] *http://www.fco.gov.uk/en/travel-and-living-abroad/travel-advice-by-country/middle-east-north-africa/iran*

local security services would be highly recommended and might indeed be compulsory. Other high risk areas are likely to be completely inaccessible for the foreseeable future.

22.5 Prospectivity

It is evident from the existence of very large copper-molybdenum porphyry deposits in the Kerman region (Sarcheshmeh and Miduk) and in the East Azerbaijan region (Sungun), that the Central Iran Volcanic Belt, north of the Zagros Mountains, is a highly fertile and prospective section of the TMB. Momenzadeh and Rashidnejad (1989) suggest that the erosion of Tertiary stratovolcanoes has allowed the discovery of relatively shallow porphyries that were concealed at depth in the past, most notably in the south-eastern parts of the belt. Some of these have been eroded to the extent that any supergene enriched zone has been removed leaving smaller, deposits without the high-grade cap above the main porphyry stock. However, this also leads to the valid supposition that there are undiscovered and uneroded porphyries below volcanic sequences elsewhere along the Central Iranian Volcanic Belt (CIVB), possibly with intact supergene enriched zones. This is true for the entire length of the CIVB, in the region of Sarcheshmeh in the south, through to the border region around Sungun. It is the discovery of these deposits with supergene zones that are most likely to contain the quantity of copper that MMG is interested in.

A number of studies have been completed in Iran using hyperspectral satellite images to map alteration assemblages, a key indicator of porphyry mineralisation. Although most effective for those deposits closer to the surface, this could be an effective technique for further exploration. Occurrences of vein hosted copper, gold and base metals within the volcanogenic lithologies of the CIVB and AVB should be considered for their potential as epithermal aureoles above and adjacent to deeper porphyry mineralisation.

The major obstacle to mineral exploration in Iran is likely to be the political and beaurocratic framework making international investment and operation difficult and slow. The sanctions in recent years imposed by the international community in relation to Iran's nuclear development are likely to make Iran less welcoming of international companies wishing to exploit the nation's natural resources. Despite this, the supporting infrastructure needed to operate mineral exploration and mining activities is established, particularly in relation to copper mining. SRK ES suggests that Iran possesses some of the greatest copper potential of all the TMB countries.

23 Pakistan

The Islamic Republic of Pakistan lies in southern Asia covering an area of just over 796,000 km^2 (Figure 23-1). The capital of Islamabad is found in the central northern Islamabad Capital Territory. Pakistan has a varied cultural past, being incorporated into many empires and dynasties over the centuries, including the British Empire until independence and separation from India in 1947. Pakistan became an Islamic Republic in 1956 and in 1974, following armed conflict, East Pakistan separated to create Bangladesh.

Despite considerable mineral reserves, the contribution of the mineral industry to GDP was only 2.5% in 2010 (USGS, 2010). There has been limited exploration or development of mineral resources in the past with the greatest extraction coming from industrial minerals such as clays, gypsum, building stone and cement etc. Despite moderate unexplored oil, gas and coal resources, Pakistan still imports the majority of these fuels from abroad. The same can be said for solid minerals. The government is attempting to attract international investment in these sectors with offers of favourable tax and royalty agreements, though is struggling to do so in the shadow of cultural and socio-political disturbances seen across the Middle East and Indian subcontinent over the last decade.

23.1 Geology and Tectonics

The geotectonic evolution of Pakistan can be classified by the influences of three successive events (Sillitoe, 1978);

1. During the Paleozoic the Iran-Afghanistan microcontinent detached from Gondwana, and subsequently drifted northwards across the Tethys Ocean. Ophiolitic sequences from the newly formed southern arm of the Tethys, are now found in the Axial Belt running north-south through Pakistan. Then in the late Cretaceous, movement north of the Indian continent from Gondwana caused subduction beneath the Iran-Afghanistan microcontinent in the western arm of the Tethys and beneath Tibet in the east. Magmatic and volcanic sequences across southern Iran and south-western Pakistan and Afghanistan attest to the subduction of the southern arm of the Tethys from the late Jurassic throughout much of the Cenozoic.

2. Collision of the Indian Plate into the Iran-Afghanistan microcontinent began in the late Cretaceous, with initial collision happening in the Baluchistan region of Pakistan some time before the collision in the region of the Himalayas. An extensive mélange sequence throughout the Axial Belt of Pakistan is thought to represent the suture zone between the Indian and Eurasian plates and contains numerous transform faults linking the subduction front below southern Iran-Pakistan with the east-west suture zones of the Himalayas. This belt consists mainly of carbonates and interbedded shales of Jurassic age, moving to Eocene sedimentary sequences in the east of the belt, proximal to and within the Indus Basin.

3. Post collisional uplift, particularly in the Hindu Kush and Karakoram in northern Pakistan, was associated with the continued northwards under plating of the Indian continent below Eurasia beginning approximately 30 Ma (Oligocene). The final collision of Arabian Plate continental crust with that of the Iran-Afghanistan block took place in the Pliocene, uplifting the Zagros Mountains in southern Iran. It is thought that there are no collisional mountains between southern Iran and the Axial Belt of Pakistan because no continental lithosphere was present on the subducting plate.

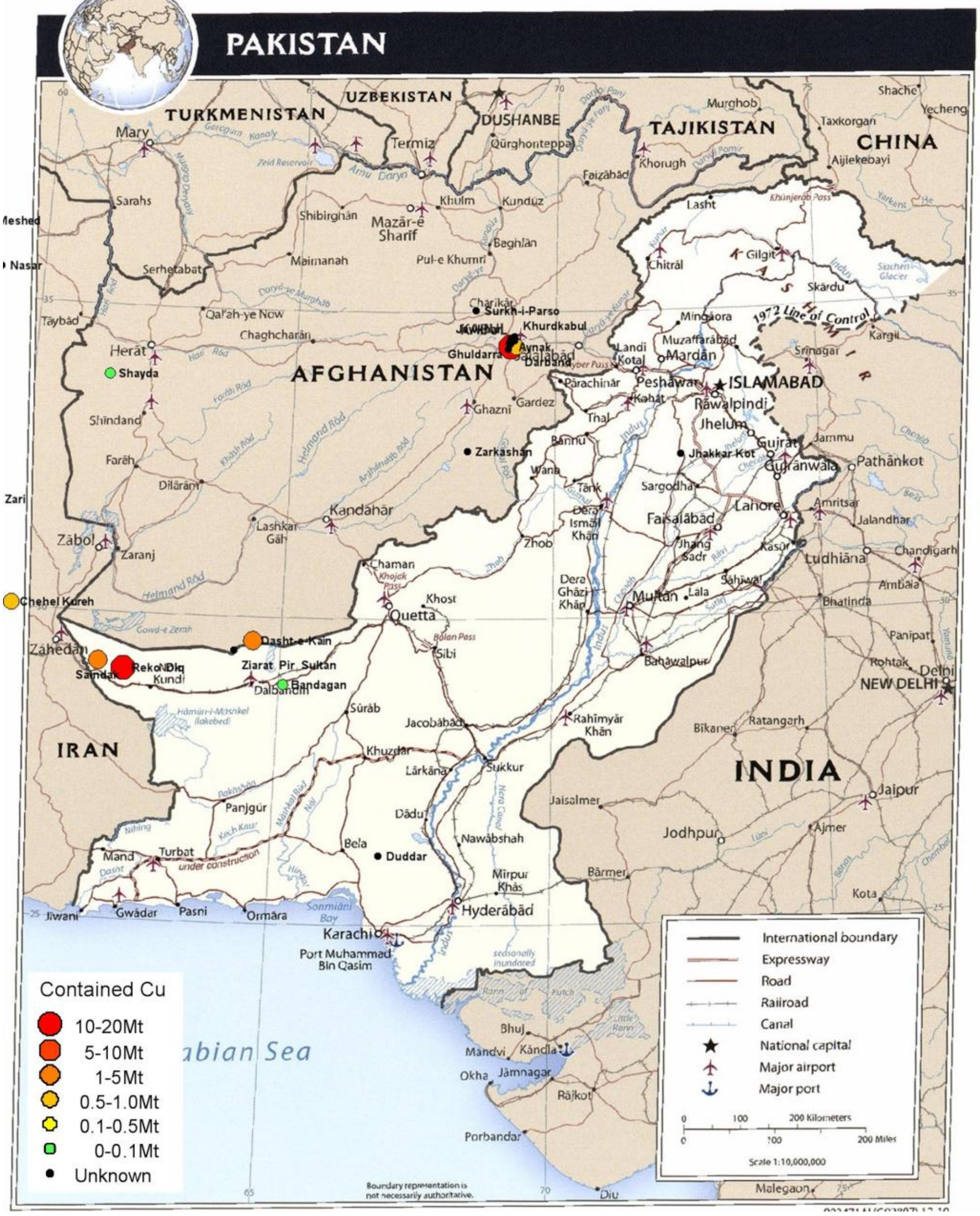

Figure 23-1 Political map of Pakistan showing copper deposits by contained copper resources. Adapted from the University of Texas Libraries, The University of Texas at Austin (2010).

It was following this most recent stage of collision that Pleistocene volcanism in the Chagai magmatic belt of Baluchistan Province formed extensive porphyry copper-molybdenum-gold deposits. Multiple phases of intrusive and extrusive activity are evident along an east-west trending corridor along the Afghan border from the Iranian border in the west to the Chaman transform fault that marks the boundary with the Axial Belt to the east.

23.2 Known Deposits and Occurrences

23.2.1 Baluchistan

The Chagai porphyry copper belt in Baluchistan Province runs for over 300km from Saindak near the Iranian border, eastwards to the Dasht-e kain deposit north of Chaghai. Perelló et al (2008) suggest that 48 porphyry systems have been identified along this belt, six of which attain the status of deposit, five of which are grouped under the Reko Diq cluster and one at Saindak. The porphyry mineralisation is related to a number of consecutive events at 43-37Ma, 24-22Ma, 18-16Ma, 13-10Ma and 6-4Ma. Although hypogene mineralisation in most deposits is low grade (~0.5%) and supergene blankets absent in all but the Tanjeel deposit, the size of the resources at Saindak and Reko Diq attest to the economic potential of deposits in this region.

Saindak was the first site in Chagai District where porphyry copper deposits were discovered in 1961, following decades of small scale lead-zinc, iron, marble, sulphur and marble mining. Concerted exploration was undertaken in cooperation between the Geological Survey of Pakistan and the US Geological Survey. Since this initial discovery identification of other porphyry systems has been carried out using satellite image interpretation, airborne geophysical surveys, surface geological mapping and drilling. Currently only the Saindak mine is in operation, though the Tethyan Copper Company ("TCC") is in the process of acquiring the mining lease for the Reko Diq deposit. It is not known if any companies are comprehensively investigating other porphyries or exploring for unidentified deposits, or indeed, who currently owns exploration licences in the Chagai District.

Reko Diq

Clustering of three or more porphyry stocks is common in the Chagai belt, as seen at Saindak, Sor Baroot, Bukit Pasir, Koh-i-dalil and Ting-Dargun, though the greatest concentration is at Reko Diq where at least 13 main intrusions have been identified within $10km^2$ (Perelló et al., 2008). The coalescence of two main porphyries (as well as a number of later minor intrusions) at the H14-H15 cluster, also known as the Western Cluster, are the focus of the Tethyan Copper Company's operations[119]. These intrusions are of different ages, as are the numerous dykes which cross-cut the deposits. Typically it is the earliest intrusive that coincides with the main stage of copper and gold mineralisation, these intrusives being dominantly magnetite series granodiorites and quartz diorites. The leached caps over the porphyries are generally thin (<30m) and supergene blankets are patchy and irregular, generally making little significant contribution to the metal content of the deposit. The supergene at Tanjeel is greater, 50-70m thickness of 0.6% Cu, but at the expense of a low grade hypogene zone containing just 0.3% Cu.

The 50:50 JV between Antofagasta plc and Barrick Gold Corp owns 75% of the project and the Government of Baluchistan the remaining 25%. A bankable feasibility study has been completed on the deposit which contains a total mineral resource of 5.9 Bt containing 0.41% Cu and 0.22 g/t Au. The economically mineable portion of the deposit has been calculated at 2.2 Bt with an average content of 0.53% Cu (11.66 Mt contained copper) and 0.3 g/t Au (21 Moz gold). In total, TCC have invested over $220 million since 2006 on exploration and technical studies at Reko Diq. However, the completed feasibility study has recently been rejected by the Government of Baluchistan, who has denied TCC the Mining Lease required to begin mining operations. TCC have filed for international arbitration to resolve the issue as negotiations between the two parties have not been forthcoming.

[119] www.tethyan.com

Saindak

Porphyry copper mineralisation was first identified in the Chagai District of Baluchistan southwest of the village of Saindak in the 1970s by a team of Chinese geologists. Three main multiphase quartz diorite porphyry stocks (North, East and South) host mineralisation of early Miocene age. This is similar to the age of the Tanjeel deposit, though approximately 10 Ma older than the Western Cluster of deposits at Reko Diq.

The discovery was neglected due civil war and national problems until 1995 when the Government of Pakistan established Saindak Metals Limited which began development of a mine. In 2002 the government signed a 10 year lease agreement with the Metallurgical Construction Corporation (MCC) of China. This was then renewed in 2011. Open pit mining of the 400 Mt deposit containing 0.45% Cu and 0.5g/t Au (1.8 Mt contained copper and 6.4 Moz gold), began in 2003 and remains the only large scale copper mine in operation in Pakistan

Chagai Hills

Perelló et al., (2008) list a number of occurrences of porphyritic intrusions and copper mineralisation in the Chagai Hills east of Reko Diq and the Koh-i-Sultan volcanic centre. Although older (40Ma), these too have weak supergene enrichment above the hypogene chalcopyrite mineralisation and are of smaller areal dimensions than the Saindak stock and composite Reko Diq porphyries. Lake Resources N.L[120] has undertaken approximately 3,000m of drilling at their Koh-i-Sultan prospect and has intersected gold-bearing porphyry-style mineralisation. Lake Resources have held reconnaissance and exploration licences in the Chagai Hills since 1998 and utilised extensive interpretation of satellite data to locate alteration zones associated with porphyries.

Ras Koh Range

The Ras Koh Range runs eastward from approximately 90km south of the Chaghai Hills, to the Chaman Fault on the edge of the Axial Belt. Throughout the eastern half of this range Miocene volcanics and Chagai age (Eocene-Oligocene) intrusives are found. No porphyry deposits have so far been identified in this region and no references to copper occurrences have been found, despite the prospective lithologies.

Duddar

The Duddar zinc-lead mine is co-owned by MCC of China and the Hunan Nonferrous Metals Corporation Ltd and is found 135km north of Karachi in Baluchistan Province. The mine reportedly contains a resource of approximately 15.5Mt containing 7.2% Zn and 3.2% Pb (1.12 Mt zinc and 496,000 t lead), hosted in carbonaceous shales. These Jurassic-Cretaceous continental shelf sediments continue northwards for ~160 km and have a number of base metal occurrences noted, though the precise location of these within the 25km wide zone is not clear due to the scale of the metallogenic maps reviewed. Occurrences of barite and other Mississippi Valley-type deposits are recorded within these shelf sediments and are related to the host rocks, mineralising in the Mesozoic prior to Indian-Eurasian continental collision, rather than as a result of magmatic intrusion at a later date.

The presence of other stratified deposits in this zone is likely, though the size of further deposits cannot be speculated upon.

[120] www.lakeresources.com.au

23.3 Political Considerations

Democracy returned to Pakistan in February 2008, following almost ten years of military rule by Pervaiz Musharraf. However, despite this Pakistan continues to face significant challenges to its political stability. Large areas of government policy (including relations with India) remain the remit of the Establishment (shorthand for the Army and the security agencies). Accusations of corruption continue to dog many parliamentarians, undermining people's confidence in governance and the rule of law. In fact, corruption in Pakistan is widespread and deeply entrenched into the system. Corruption takes many forms in Pakistan ranging from petty bribery, nepotism and misuse of power. The main reasons for this high rate of corruption are poverty and low incomes especially of government employees and lack of accountability.

The ongoing threat from terrorism further affects public confidence in the ability of their government to protect them. All of this takes place in the context of a country facing an acute energy and water shortage, sclerotic economic growth, a denuded tax base and population demographics which estimate a doubling of the population by 2030[121].

The trend in recent years has generally been one of international investors shying away, or even leaving Pakistan due to socio-political and security issues. However, despite the financial crisis, impacts of the post-9/11 war on terrorism in neighbouring Afghanistan and severe droughts, floods and earthquakes, the economy of Pakistan has continued to grow, contrary to the predictions of the international community.

Due to this growth, the reliance on imported mineral products has risen. To encourage the development of domestic mineral reserves and a greater self reliance, the Government of Pakistan has been encouraging foreign investment, allowing foreign equity of up to 100% in the exploration and mining sector. Each Province in Pakistan has developed its own mining code based on the National Mineral Policy, and therefore there is some variation in business terms in different regions of Pakistan. The recent experiences of the Tethyan Mining Company[122] clearly show both the ability for international investment to succeed in finding world class deposits in Pakistan, but also the potential pitfalls of dealing with a provincial government unaccustomed to dealing with international investment on such a vast scale.

Benchmark assessments indicate that Iran ranks 105th out of 183 countries for Ease of Doing Business 2011[123] and 134th out of 183 countries for Corruption Perception Index 2011[124]. Within the scope of this report, Iran ranks 18th out of 24 countries for Ease of Doing Business 2011 and 20th out of 24 countries for Corruption Perception Index 2011.

The Control Risks RiskMap 2012 edition classifies the Political Risk of Iran as High[125].

23.4 Security Considerations

The Control Risks RiskMap 2012 edition classifies the Security Risk of Pakistan as High to Extreme. This is generally supported by other online resources such as the FCO travel advice pages which

[121] http://www.ukti.gov.uk/export/countries/asiapacific/southasia/pakistan/overseasbusinessrisk.html
[122] http://www.tethyan.com/
[123] http://www.doingbusiness.org/rankings
[124] http://cpi.transparency.org/cpi2011/results/
[125] http://www.control-risks.com/Riskmap/Pages/Home.aspx

advise in general against all against all but essential travel to Pakistan and locally against all travel to a large number of areas listed and update at the FCO website[126].

The business capital for Pakistan is Karachi, a city estimated to hold between 15 and 20 million people. The stock exchange is located here, and many businesses have their headquarters in the city. Karachi suffers from widespread sectarian violence, which can erupt at short notice and engulf large parts of the city.

The federal capital for Pakistan is Islamabad and there are regular warnings from the Interior Ministry about suspected and proven militant activity. The 'Blue Zone' of embassies and UN missions is the only relatively secure zone within the city.

It is therefore likely that access to most areas would almost certainly require heavily augmented security measures to protect company staff and assets during exploration and development. Liaison with the local security services would be highly recommended and might indeed be compulsory. Foreigners requiring travel to provincial areas are required to carry permits. In recent months there has been a steady tightening of permit issues and in fact, most areas highlighted as "Extreme Risk" are now likely to be completely inaccessible for the foreseeable future.

23.5 Prospectivity

A number of tectonomagmatic characteristics seen in the Chagai belt, Baluchistan Province, are similar to those seen in the highly prospective Cordilleran region of the Andes and in Central America. It is not unreasonable to suggest the existence of undiscovered porphyry deposits along this linear chain of volcanic centres in Pakistan, potentially of a size similar to that of Saindak and Reko Diq. Although exploration has been intensified in this region over the last few decades, it is not thought that this has in any way been an exhaustive search and that deeper, hidden deposits are likely.

Within the known deposits of reasonable size, supergene enriched blankets are generally absent, a feature thought to be due to the youthfulness of the intrusions, high neutralisation potentials and low pyrite content of the ore-hosting hydrothermal alteration, and the barren nature of sericitic alteration haloes. The supergene enriched blanket seen at Tanjeel however formed in relation to sericitic hypogene rocks containing low grade mineralisation and numerous through going sulphide veins. Perelló et al (2008) believe that these conditions are likely to be found elsewhere in the belt in undiscovered porphyries deposits.

SRK ES are of the opinion that the availability of licences should be investigated covering areas of the Chagai Hills, the Mirjawa Range between and south of Saindak-Reko Diq, and in the Ras Koh Range south of the Chagai Hills, particularly within the volcanics and intrusives at the eastern end. Pakistan is effectively underexplored, despite the recent interest in the Chagai Hills, and warrants further exploration.

It is not thought that elsewhere in Pakistan there is much potential for significant copper deposits at scale of interest to MMG. There are some occurrences recorded in the far northern provinces (e.g. Jhakkar Kot, unknown size or status), but these are not thought to be substantial. There may be limited potential for polymetallic deposits in the Chagai belt, and for lead-zinc mineralisation in the southern Axial Belt, but again not of significant size.

[126] http://www.fco.gov.uk/en/travel-and-living-abroad/travel-advice-by-country/asia-oceania/pakistan

24 Afghanistan

The Islamic Republic of Afghanistan lies in the centre of Asia between Pakistan, Iran, Turkmenistan, Uzbekistan, Tajikistan and China (Figure 24-1). It is a highly mountainous country with a dry climate and covers an area of 647,000 km^2. Since ancient times Afghanistan has been a major producer of precious and semi-precious gems and evidence of artisanal extraction of gold copper and iron stretch back thousands of years. Initial geological mapping in the 1800s and early 1900s by British and Indian expeditions was followed in the mid 20th century by coordinated mapping and investigation of over 1,200 mineral occurrences by the newly established National Geological Survey. After the Russian invasion in 1979, Afghanistan was effectively closed to western geologists and geological knowledge advanced little during the following two decades of war. Many records were destroyed and a lack of investment in skills and programmes of work has left the Afghan Geological Survey in a poor state, as with most other government institutions.

Since the fall of the Taliban regime in 2001, the Government of the Transitional Islamic State of Afghanistan, with the support of generous international assistance, has begun to rehabilitate the AGS and the mining sector. Collaborative efforts with the BGS and USGS began in 2004 to properly catalogue and remap vast areas of the country, train new geologists and assist in the tendering of new mineral licences containing some significant mineral occurrences. This new assessment of minerals in Afghanistan identified a large number of deposits, some with significant potential, including sedimentary copper in Kabul, Logar, Kandahar, Zabul and Herat provinces, as well as gold, iron lead-zinc, REEs and a variety of industrial minerals. For further details of the work completed by the BGS and USGS, a wealth of information and documents can be found on the respective websites[127 and 128].

24.1 Geology and Tectonics

The tectonic and structural evolution of Afghanistan is very complex due to the geographical position held during the closure of the Tethys Ocean and collision between India, Eurasia and numerous smaller microcontinents over the last 100 million years. A good summary is provided in the introductory chapters of Peters et al (2007), and is briefly discussed here (Figure 24-2).

The Tadjik Block in northern Afghanistan formed the southern boundary of the Eurasian continent in the Permo-Triassic. The first stages of subduction related to the closing Tethys causes granitic magmatism and intrusion into the Tadjik Block. Later in the Jurassic clastic sequences let on to platform carbonate deposition in the Cretaceous.

The Farad and Helmand Blocks of central Afghanistan are separate blocks which moved northwards from the separating Gondwana and collided with the Tadjik Block in the Jurassic. Both the Herat and Panjao sutures, which mark the boundaries between individual block, bear ophiolitic sequences and contain sedimentation and volcanism from throughout the Tertiary. The Farad Block has since been overlain by Upper Jurassic-Cretaceous sediments and the Helmans Block by Cretaceous cover only. The Pamir and West Nuristan blocks accreted onto Eurasia at a similar time and are referred to, together with the Farad and Helmand blocks, as the Afghan Block.

Following a period of relative calm, the collision of the Indian and Eurasian Plates began in the Cretaceous to Early Tertiary. Arc and extension related volcanism is evident across the Helmand and

[127] *http://afghanistan.cr.usgs.gov*
[128] *http://www.bgs.ac.uk/AfghanMinerals/Index.htm*

western Nuritan Blocks. Reactivation of faults, folding and basin inversion accompanied large amounts of uplift as the Indian Plate continued northwards. The mountains of the Hindu Kush in northeast Afghanistan now rise to over 5000m above sea level. The Kabul block contains ophiolitic assemblages and is believed to be a sliver of oceanic crust that was accreted onto the Afghan Block prior to collision with India. It is this Kabul Block with is most prospective for sediment-hosted copper mineralisation.

Finally, the Katawaz Basin in eastern Afghanistan is thought to represent a flexural basin on the western margin of the Indian Plate, filled with over 10km of Tertiary sediments that have been shortened, inverted and folded by the collision of the Indian Plate.

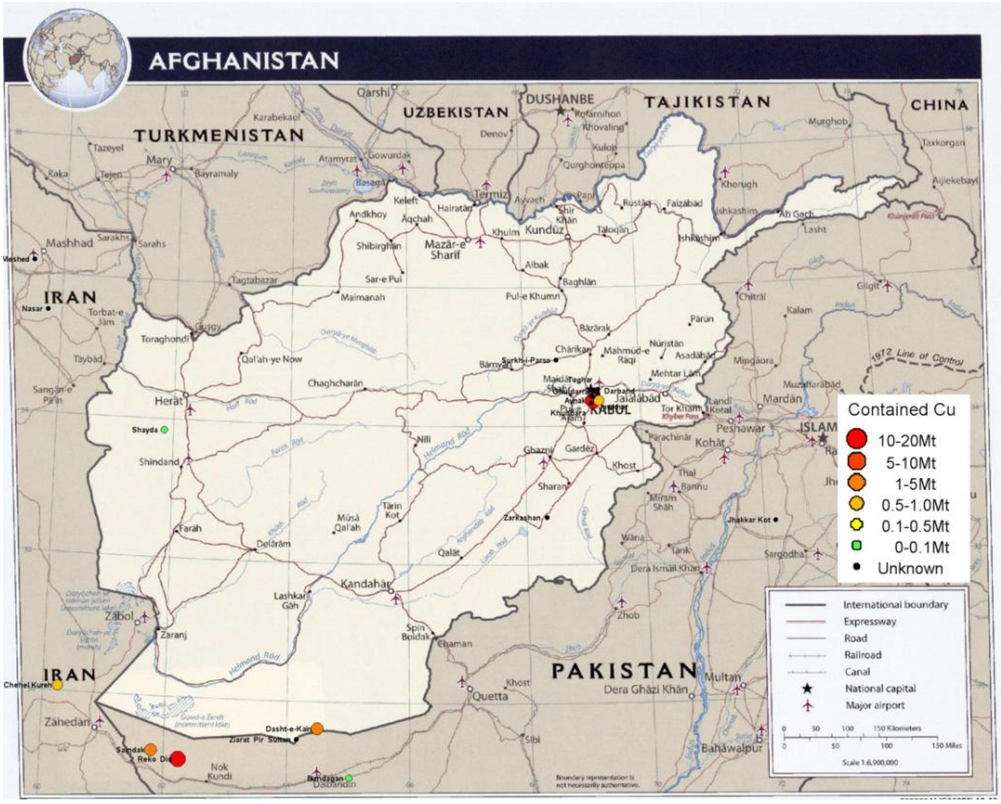

Figure 24-1 Political map of Afghanistan showing copper deposits by contained copper resources. Adapted from the University of Texas Libraries, The University of Texas at Austin (2008)

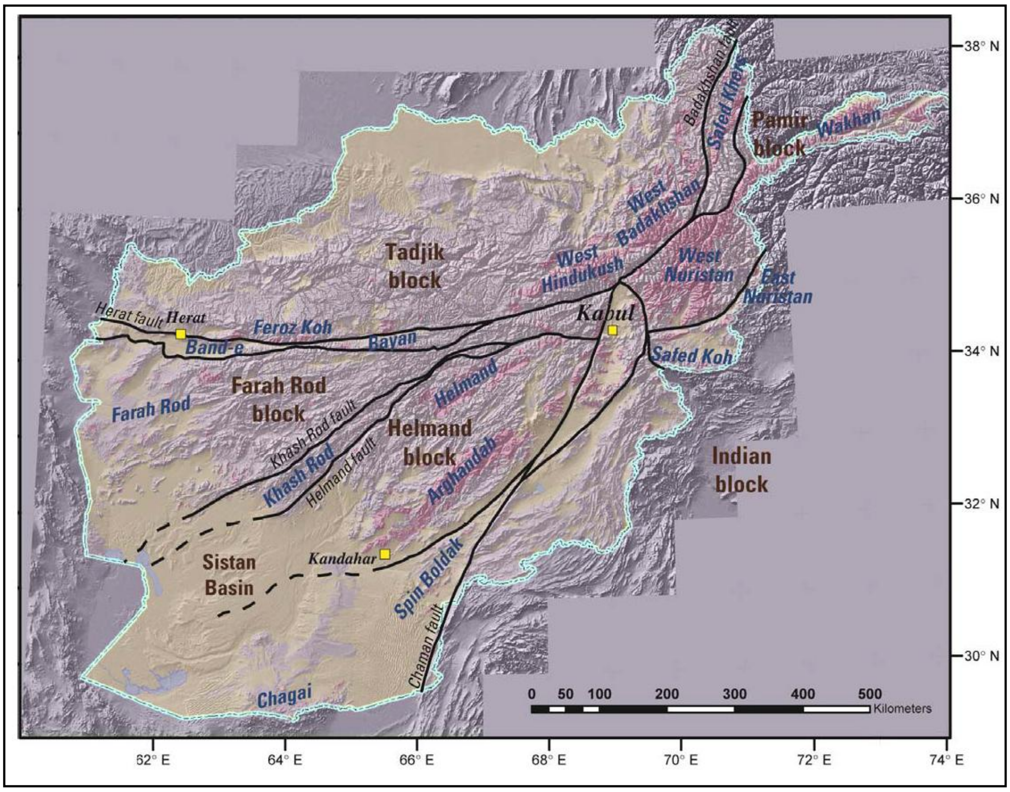

Figure 24-2 Map of Afghanistan showing major structural blocks (dark brown labels), plutonic belts (blue labels), and faults (black labels). Plutonic rocks are shown in red, other basement rocks in beige, and unconsolidated Quaternary sediment in yellow (Peters et al, 2007)

24.2 Known Deposits and Occurrences

In the past, copper had been mined from Herat Province and Farah Province in the west, Kapisa Province in the east, and Kandahar Province and Zabul Province in the south. Afghanistan has no operating copper mines and those historically active locations were only ever small scale artisanal operations. Due to the political troubles in Afghanistan of the last 30 years, exploration has been almost non-existent and has only seen considerable interest in the last 10 years since the intervention of the international community in rebuilding post-war stability. The most well-known sedimentary deposits south of Kabul have seen most interest, particularly from Chinese organisations.

In the 1970s and 1980s teams of Soviet and Afghan geologists recorded over 250 copper occurrences during systematic mineral exploration across the country. Deposits of different genetic type were identified including the large sedimentary deposits south of Kabul (Aynak area) and skarn deposits running southwest from Ghanzi Province towards Kandahar, which although described as skarns, are related to Oligocene intrusives and may well be associated with porphyry deposits, typical of the TMB.

The report titled "*Preliminary Non-Fuel Mineral Resource Assessment of Afghanistan"*, published by the USGS in 2007, details occurrences and prospectivity of numerous commodities and deposit types across Afghanistan. Extensive time and resources were put into this assessment over a four year period. A thorough review of this document (and related data), has not been performed by SRK ES. Should MMG wish to pursue exploration in Afghanistan, then the interrogation of this document should be a priority.

24.2.1Kabul Province Sedimentary Copper Deposits

Aynak

Located 30 km south-southeast of Kabul at the northern end of Logar Province, the copper mineralisation at Aynak is stratabound and characterised by bornite and chalcopyrite disseminated within the Loy Khwar Formation dolomitic marble and quartz-biotite-dolomite schist. A resource of over 700Mt @ 1.56% Cu (10.9 Mt contained copper) has been reported, though it is thought that this refers to a total resource contained in a number of separate deposits. The central main mineralised body holds 240Mt at a copper grade of 2.3% (5.52 Mt contained copper). China Metallurgical Group (MCC) won the tender for this property in 2008, though not without rival Canadian and US companies criticising the bidding process, alleging corruption and questioning the winner's commitment to the project. MCC's $30 billion investment for the 30 year lease to this project makes this the largest foreign investment and private business venture in Afghanistan's history.

Darband

Located only 7km west of Aynak, the Darband deposit is thought to fall within the licence won by MCC in 2008. Mineralisation is generally disseminated and forms a number of stratigraphically controlled lenticular pods in which bornite is the dominant copper mineral. Exploration during Soviet times included surface and underground drilling from adits, which led to an estimate of inferred/possible resource of over 80Mt containing over 660,000t of copper.

Other prospects within the Kabul Block

A number of other sites were explored in Soviet times, though the majority of the records relating to these prospects were lost over the last 30 years. The most significant results came from Jawkhar, ~5km north of Aynak. Detailed mapping, sampling and adit excavation defined 15 mineralised zones up to 440m in length, up to 29m thick and with average copper grade of 0.49-1.2%. Other sites with similar stratigraphically controlled mineralisation and grades include Sorbog, Zakhel, Katasang, Palangar, Kakhay and Kalagay.

24.2.2Chagai Hills – Southern Helmand and Kandahar province

Although no copper deposits have been identified in the far south of Afghanistan, bordering Pakistan, the Chagai Hills have proven their potential with the massive Saindak and Reko Diq projects less than 50km from the Afghan border. The Cretaceous volcanics, intruded by Oligocene granites and granodiorites that host mineralisation in Pakistan also outcrop across an area of approximately 300 x 20km in southern Afghanistan. The 2007 USGS report also suggests that magnetic anomalies beneath the Tertiary cover point towards intrusives and volcanics being buried under sediments across a wider area still.

24.2.3Kundalyan-Zarkhashan tract

Defined by the USGS as an area stretching between Ghanzi and Kandahar, by numerous skarn related copper, gold, magnetite and tin occurrences, this tract may also hold potential for porphyry mineralisation. No porphyries have yet been identified despite some exploration during Soviet times that in some locations included diamond drilling, trenching and minor excavation of adits.

24.2.4Katawaz tract

Described as the Katawas Tract, this prospective area identified by the USGS lies in eastern Zabul province, approximately 60km east of the town of Qalat-e-Gilzay. There are no known mineral deposits in this zone, but there are Miocene volcanics with widespread phyllic and lesser argillic alteration that may hold potential for porphyry-style mineralisation.

24.3 Political Considerations

Afghanistan is located in a region that has seen decades of political instability, war and terrorism which have in turn led to poor and destroyed infrastructure, an under-educated workforce and under-developed mining industry. The situation has improved significantly since 2001, though the south and eastern regions remain very dangerous due to the Taliban insurgency which itself if sustaining and leading to a massive expansion in drug trafficking, smuggling and coordinated crime to fund its efforts.

The new Minerals Law and Mining Regulations, revised in 2009, have led the way to defining a new and more structured minerals sector. A number of international agencies, led by the US Department of Defence, have been assisting the Afghan Government in the preparation of mineral licence areas for international tender, of which Aynak is the most high-profile example. More recently a further four licences have been awarded to an Indian consortium (three) and a Canadian listed junior (one) for sections of the Hajikak iron ore project.

The most recent tender for four copper and gold licences is due to close to pre-qualification in March 2012. The following tender process for shortlisted companies will be conducted using international best practice methods and will be fair and transparent. Independent consultants supporting the tender process and assessing each tender's technical ability and financial strength include: SRK Consulting (technical), Mayer Brown (legal) and Canaccord Genuity (financial).

In order to support and protect companies wishing to enter the Afghan minerals sector, the Afghan Ministry of Mines has established a 7000-strong Mining Protection Unit which, with the support of the Afghan military and police forces, is available to protecting mineral exploration assets.

Benchmark assessments indicate that Afghanistan ranks 160th out of 183 countries for Ease of Doing Business 2011[129] and 180th out of 183 countries for Corruption Perception Index 2011[130].

Within the scope of this report, Afghanistan ranks 23th out of 24 countries for Ease of Doing Business 2011 and 24th out of 24 countries for Corruption Perception Index 2011.

The Control Risks RiskMap 2012 edition classifies the Political Risk of Afghanistan as Extreme[131].

[129] http://www.doingbusiness.org/rankings
[130] http://cpi.transparency.org/cpi2011/results/
[131] http://www.control-risks.com/Riskmap/Pages/Home.aspx

24.4 Security Considerations

The Control Risks RiskMap 2012 edition classifies the Security Risk of Afghanistan as High to Extreme. This is supported by other online resources such as the FCO travel advice pages which advise in general against all but essential travel to Afghanistan and locally against all travel to a large number of areas listed and update at the FCO website[132].

The ‘transition' to Afghan security control, driven by war fatigue and waning political will in the US and NATO countries, will proceed regardless of deteriorating ground realities. The Taleban, Haqqani network and Hizb-i Islami Gulbuddin (HiG) militant groups will retain the initiative, shaping the security environment in most parts of the country. Kidnap-for-ransom and extortion rackets will persist, and foreign personnel will remain vulnerable.

Pakistan's failure to interdict Islamist extremists flowing in from its tribal areas will continue. Insurgents are likely to retain the capacity to attack prominent government, security-force and civilian targets in major cities; disrupt transport and road travel; and coerce local populations. Increases in the size of the Afghan national security forces will not be matched by improvements in capability or professionalism, and security operations will continue to require significant support from increasingly reluctant NATO forces (Control Risks, 2012).

It is therefore likely that access to most areas would almost certainly require heavily augmented security measures to protect company staff and assets during exploration and development. Liaison with the local security services would be essential and would likely be compulsory. Those areas identified as at Extreme risk are likely to be completely inaccessible for the foreseeable future.

24.5 Prospectivity

Afghanistan is blessed with significant mineral wealth that has not been exploited on a commercial scale in the past due to decades of war. Stability is slowly returning to the region and the government is taking steps to develop a mining sector that has the potential to contribute significantly to the economy in coming years. It remains to be seen however whether this path to development is taken following the withdrawal of international forces in 2014.

In terms of copper deposits, it is likely that new deposits will be found in the coming decades, both in regions already identified as having some occurrences and potential, as well as in the unexplored parts of the country. Infrastructure in a very mountainous and arid regions, as well as the security of personnel and property, will however remain the biggest hurdles to development for the medium term at least.

SRK ES is of the opinion that the far southern border region, proximal to the Chagai Hills deposits in Pakistan, holds significant potential for porphyry copper mineralisation. It is also clear that the Kabul Block sedimentary copper deposits possess great potential that has been underexplored in the past. There are numerous other locations throughout Afghanistan with the potential to host a number of different styles of mineralisation, though their discovery will rely on coordinated programs of “grass-roots” exploration involving mapping and sampling on a regional scale before deposits can be defined comprehensively and exploited. Although the current round of tender opportunities are coming to a

[132] *http://www.fco.gov.uk/en/travel-and-living-abroad/travel-advice-by-country/asia-oceania/afghanistan*

close, future tenders will provide further opportunities for investment through a transparent government process with support from western mentoring.

Should MMG wish to further investigate the large potential in Afghanistan, the wealth of data collected by the BGS and USGS over the last decade should be reviewed and interrogated as a priority.

25 Conclusions

Cook et al (2005) list the 25 largest porphyry copper deposits in the world by contained copper metal, ranging from the 94Mt of copper found in the El Teniente deposit in Chile, to the 10.85 Mt Toki, also in Chile. Three of these massive deposits are found in the Miocene-Pliocene province of Central Chile, seven lie in the Eocene-Oligocene of Northern Chile and six within the Laramide province of Arizona and Mexico. The only Tethyan belt deposits to make the list was the Sar Cheshmeh deposit in Iran at 18th largest. However, more recent resource estimates of new deposits and revision of Sar Cheshmeh (now 8.4 Mt Cu), means that Reko Diq (11.6 Mt Cu) would also be included. It is clear from the map below that there is a dominance of large deposits in the Andean range, over smaller deposits in the TMB. The paper by Cook et al (2005) goes some way into suggesting reasons for this based on the configuration of subducting crust and resultant composition of magmatic and volcanic magmas. There is clearly a difference between the subduction zones found in the TMB and that in South America as Andean range is far more fertile in terms of porphyry mineralisation.

It is suggested that tectonic triggers may have been more prevalent in the South American subduction system, which caused abnormal subduction and the production of more fertile magmas. Such triggers may be a change in angle of the subducting plate (slab flattening), crustal thickening and uplift, the subduction of seamount chains and a balance between weathering and erosion that forms the economically important supergene enrichment of certain deposits. The wealth of Chilean porphyries appear to have formed along a 550km length of flat-slab subduction zone. It is difficult to comment on the causative processes of mineralisation of the largest Tethyan deposits in Iran and Pakistan due to the complex deformation and tectonism associated with accretion of multiple microcontinents and the transition from oceanic to continental plate subduction. Crustal scale structures in the overriding plate also play a role in focusing intrusions and porphyry mineralisation. This is evident in Chile where porphyry deposits follow a number of arc-parallel crustal-scale faults.

Tethyan deposits are generally low grade porphyry deposits with limited supergene enrichment, either due to erosion of much of the deposit or a lack of supergene forming weathering. However there is particular support for the existence of undiscovered porphyries below and adjacent to epithermal gold and copper mineralisation, as seen in a number of smaller porphyries in Turkey and Romania.

The sedimentary copper deposits found at Aynak, Afghanistan and across Poland contain significant amounts of copper mineralisation. Those in Afghanistan occur over a limited area in a complex zone of microcontinent suturing and structural deformation. All of the listed occurrences in this region are also all thought to have recently been acquired by the China Metallurgical Group Corporation (MCC). The Polish Kupferschiefer deposits occur over a large area with largest mineralised area covering about 350 km². KGHM (Polska Miedz) currently produce from the most prospective zones found to date, however some other companies are currently exploring for extensions to mineralisation on the periphery of these known areas.

Although VHMS deposits do exist in the Tethyan belt, none are of significant size and dominated by copper mineralisation, the largest being Madneuli in southern Georgia which contains just over 1.3Mt of copper metal (Galley et al, 2007). It is not thought that extensional environments were long lived or widespread during the formation of the TMB. VHMS deposits generally form at ocean spreading centres and in back-arc extensional basins. In the TMB, compression and uplift of the overriding plates dominated, with only minor upwelling of mafic magmas that may form VHMS mineralisation. Some small deposits associated with ophiolite complexes are known (Cyprus, Afghanistan), though again, do not contain large tonnages of mineralisation. VHMS deposits within Europe are mainly held within the Triassic rifting terranes of Cyprus. Cyprus has moderately sized deposits of VHMS but not of the size within the terms of MMG's criteria. There are also a few smaller deposits dotted within the sutures of the Dinaric-Hellenides; again these are of little significance.

Of the world's largest Mississippi Valley and CD-type lead-zinc deposits, containing more than 2Mt of combined Pb-Zn metal, only the Mehdiabad (Iran), Filizchai (Azerbaijan), Boleslaw (within the Krakow-Silesian mining district, Poland) deposits are found to lie in the TMB. A limited number of smaller Pb-Zn deposits, mostly Mississippi Valley type, are found along the northern boundary of the Central Iranian Volcanic Belt. Pb-Zn mineralisation is recorded as vein-hosted occurrences throughout the TMB, deposits in Europe are defined within the Serbo-Macedonian metallogenic province and the Rhodope Massif, these deposits are not of higher tier deposits and will not be interest to MMG.

SRK ES has selected a number of target regions which are thought to hold significant potential for undiscovered copper mineralisation, forming deposits at a scale of interest to MMG. These regions highlighted in Figure 25-1 and summarised in Table 25-1have been selected based on the past success of mineral exploration and mining, regional geology and position within the TMB.

Table 25-1 Prospective areas identified by SRK ES

Area	Location	Evidence of Prospectivity
1	Chagai Hills, SW Pakistan and southern Afghanistan	• Saindak and Reko Diq deposits • Corridor of Tertiary volcanics and porphyry intrusives stretching for over 300km • Arid region ideal for satellite/spectral mineral mapping and airborne geophysics
2	Central Iranian Volcanic Belt, Iran	• Sarcheshmeh and Miduk mines • Belt of Tertiary volcanics and porphyry intrusions stretching for over 1,500km • No deposits so far discovered between Sarcheshmeh cluster and the Sungun mine in the far northwest, despite prospective geology
3	Alborz Volcanic Belt, NW Iran, and southern Azerbaijan/Armenia	• Sungun and Kadjaran mines and Masjed Daqi deposit • Tertiary volcanics and porphyry intrusives. Skarn mineralisation • Limited historic exploration due to political instability
4	Eastern Turkey and Southern Georgia	• Madneuli mines and Teghut deposit • Focus in Turkey has been on easily found and exploited surface deposits • Little western interest in eastern Turkey, possibly due to security concerns • Neogene volcanics cover earlier volcanics and intrusives exposed and investigated elsewhere in NE Turkey – hidden deposit potential • Many epithermal deposits not drilled to >250m depth to test porphyry potential • Many Turkish porphyries are Au-rich and do not report Cu content or recovery (Copler and Cevizlidere in central Turkey) • Potential for multiple deposit types
5	Panagyrishte District, Bulgaria	• The Chelopech high sulphidation epithermal deposit • Cretaceous magmatism of porphyry intrusives, often with epithermal overprinting • NW-SE trending corridor of porphyry swarms with particular potential in the north of this zone.
6	Bor Basin, Serbia and Western Romania and the Apuseni Mountains	• The Bor complex deposits (Serbia), Rosia Montana and Moldova Nouă (Romania) • Cretaceous to Paleogene volcanics, with proximity to limestone for skarn potential • Porphyry deposits Cu-Au

7	Slovakia/Northern Hungary	• Central Slovakian Volcanic Complex and hidden porphyries beneath epithermal systems • Recsk and its surrounding area for porphyry Cu deposits
8	South central Poland	• The Krakow Silesian Pb-Zn MVT Mining district • Mo-Cu porphyry deposits in the Hamburg-Krakow Fault Zone, along strike from the Myszkow Project
9	Kupfershiefer	• The peripheries of the Kupfershiefer deposit in south western Poland

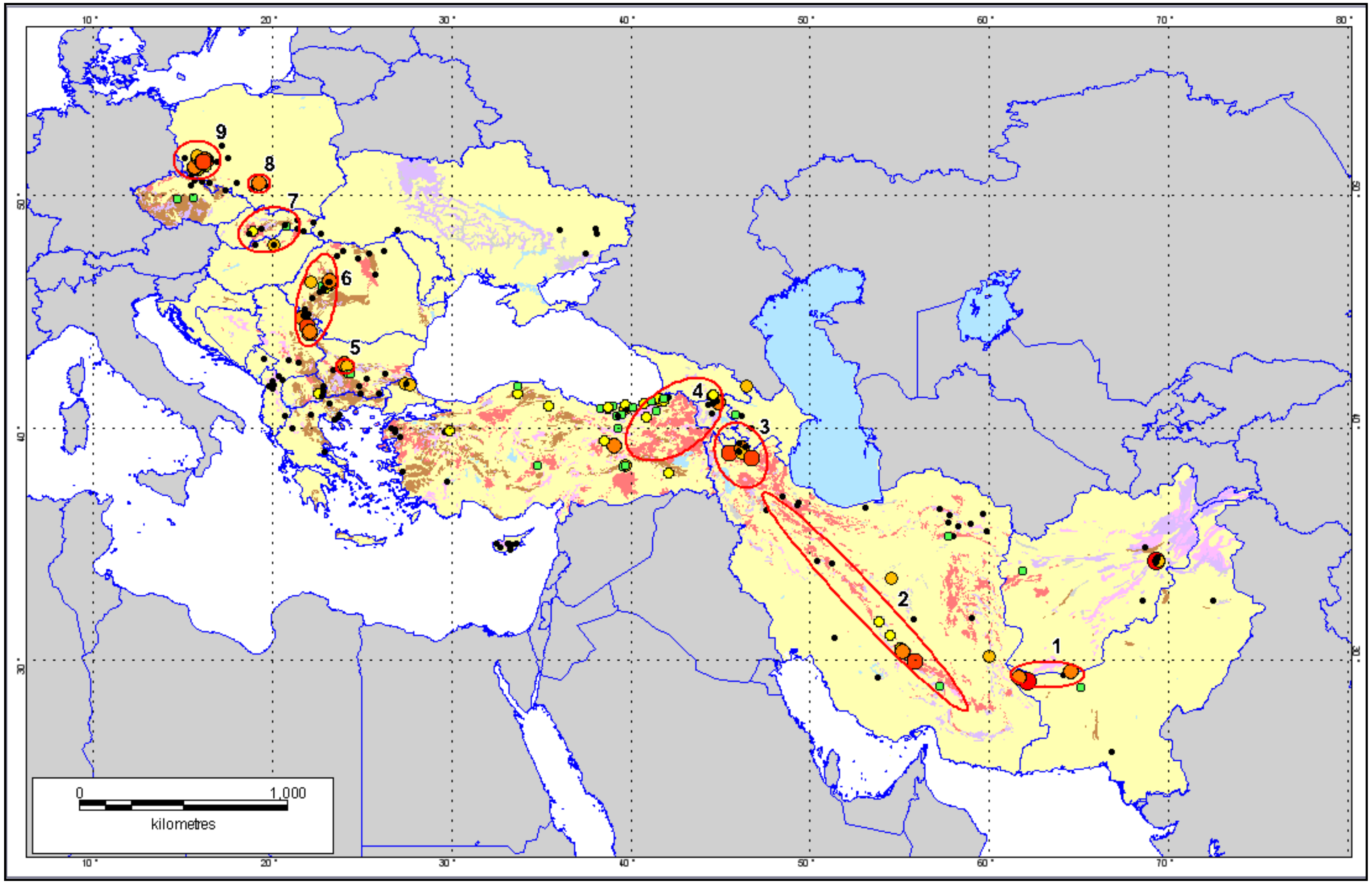

Figure 25-1 Prospective areas identified by SRK ES and described in Table 25-1. Full A3 map can be found in Appendix 1 along with full map legend.

To further simplify the vast amount of data and information collated during this review, it is necessary to revert back to the Terms of Reference initially provided by MMG and to answer those questions directly and succinctly.

10. **Which regions are more fertile, in terms of copper porphyries, than others and why? Why does there seem to be a greater contained copper volume in certain countries?**

Major porphyries have already been discovered and exploited in western Romania, southern Poland, eastern Serbia, throughout Turkey, in southern Armenia, North-eastern and Central Iran and south-western Pakistan. The largest porphyries tend to form clusters of 2-3 large deposits within a 50km radius, reflecting geological factors/triggers that caused voluminous porphyry mineralisation and the results of more intensive near-mine exploration.

The subduction processes involved in the Tethyan orogeny were far more complex than seen in the Andes of South America, and therefore a simple model of porphyry formation cannot be applied to the entire TMB. Certain areas have seen more voluminous intrusive and volcanic activity during the Tertiary that is key to porphyry mineralisation, and other areas have seen increased uplift and erosion, leading to the removal and destruction of any supergene mineralisation, as well as the hypogene porphyry core.

11. **Which areas hold greatest potential for VHMS deposits?**

It is not thought that there is potential for world-class VHMS deposits within the TMB. A significant number of deposits of this type are found in northeast Turkey, though the largest (Madenkoy) contains only 0.8 Mt Cu and 1.3Mt Zn. Further undiscovered deposits are likely to be found beneath the recent volcanics covering much of far north-eastern Turkey and across into southern Georgia and northern Armenia.

12. **Is the IOCG deposit model prospective in the TMB?**

Although some occurrences of copper mineralisation have been attributed to IOCG deposit types, it is not thought that IOCGs constitute a primary target for exploration. The presence of small deposits is likely in areas of magmatic activity and may be used as a guide in porphyry exploration in a similar targeting role as epithermal and skarn mineralisation proximal to porphyry centres.

13. **What potential exists for Kupferschiefer style sedimentary copper deposits?**

The Sedimentary copper deposits in Poland are extensive, containing millions of tonnes of metal. The Polish mining company KGHM currently produce approximately 30Mt of ore a year from the Lubin, Polkowice-Sieroszowice and Rudna mines and they also hold licences for much of the known deposit area. Some smaller exploration companies are currently running drilling programmes the delineate extensions to currently known mineralisation. The Afghan deposits south of Kabul are also very prospective, though not as extensive in aerial extent. It is also thought that a tender for the development of all the sedimentary prospects in this region has recently been awarded. No further suggestion of basins containing large sedimentary deposits in the TMB has been found.

14. What potential exists for clastic-dominated (CD) zinc (± lead) deposits?

There are a limited number of Pb-Zn deposits of note in the TMB, the largest being Mississippi Valley-type deposits in the Central Iranian Volcanic Belt proximal to significant porphyry deposits and south central Poland. Pb-Zn deposits are not as numerous as copper occurrences and are of much smaller scale. For this reason, their discovery is more difficult, though the regions immediately on the continental side (back-arc basins) of porphyry-bearing volcanic belts, hold potential for sedimentary base metals, e.g. Iran, Poland and Ukraine.

15. What potential exists for nickel (± copper) deposits, but not lateritic nickel?

The major sources of nickel are found in lateritic weathering profiles, or from magmatic intrusions in which sulphides precipitate out of a fractionating melt. This latter deposit model is associated with (1) deformed greenstone belts and calc-alkaline batholiths associated with convergent plate margins, (2) ophiolite complexes that formed at constructive plate margins, (3) intraplate magmatic provinces associated with flood-basalt type magmatism, and (4) passively rifted, continental margins. Of these only ophiolitic sequences are present in the TMB and these are limited in extent and are not thought to have significant potential for large deposits (Cyprus and sections of Iran, Afghanistan and Pakistan).

16. Which areas are most prospective for greenfield exploration?

The areas selected in Table 25-1*cover both regions of moderate historical exploration activity, as well as regions where minimal commercial exploration has been conducted. Those areas that are most amenable to greenfield exploration of under investigated geology lie mostly in states where access has been restricted in the past. This may be due to the physical terrain of certain mountainous regions being too rough, because of political restrictions effectively closing off countries during times of conflict, or due to a nationalist hostility to foreign investment and exploration projects.*

For this reason SRK ES suggests that south-easternand eastern Turkey, Iran, Azerbaijan, Armenia, Georgia and south-eastern Pakistan possess the greatest scope for picking up licences in prospective areas and beginning mineral exploration from the very basics of geological mapping, GIS interpretation and surface sampling.

Although not specific to the TMB Sillitoe (2010) also gives a good summary of implications of target selection and exploration for porphyry deposits in greenfield and brownfield terranes

17. Do any known porphyry deposits have potential for an unidentified/untested deep hypogene core?

The majority of deposits in the TMB have little or no supergene enriched blanket overlying hypogene mineralisation. Most existing and planned mines exploit low grade hypogene mineralisation, often with copper production supplemented by gold or molybdenum by products. The use of epithermal and skarn deposits as vectoring tools to locate porphyry mineralisation has been proven in Turkey and is expected to be an important factor in the target regions suggested.

The geology of specific mines has not been thoroughly assessed due to the sheer number of deposits present in the TMB. This would, however, be a priority when comprehensively assessing any selected target region/country and the existing deposits/occurrences in more detail at a district, rather than global scale.

18. How does each country rank in terms of political risk

The mining legislation and governmental attitude towards the mining sector has not been evaluated for the countries in this review. It is however evident that in some target countries, such as in the Caucasus region and Iran, investment from international organisations may be more difficult. Pakistan and Afghanistan are becoming much more geared towards international investment in their developing mineral sectors, though the threat from terrorism and organised crime pose a significant threat to operations on the ground.

The prospective regions in the Caucasus are also disputed territories, with Azerbaijan and Armenia, as well as autonomous republics, claiming rights to the land. How mineral licences issued by respective governments would be viewed or respected by these parties is likely to cause some issues.

The prospective regions in Europe are all relatively stable and have no major issues. Difficulties faced by MMG would be minor corruption or petty crime within the government and law. In many of the prospective countries foreign companies are already operating in the minerals sector, indicating a suitable working environment. Ease of obtaining licences and development of mining polices will vary from country to country, however many of them have got established mining sectors.

Table 25-2 details the political and security risk characteristics of each country reviewed in this report, as identified by various independent international organisations.

Table 25-2 Risk and security indicators for each TMB country based on findings of various independent monitoring organisations

Economy	Ease of Doing Business Rank (TMB only)	Ease of Doing Business Rank	Starting a Business	Corruption Perception Index 2011 - TMB Rank	Corruption Perception Index 2011 - Global Rank	Corruption Perception Index 2011 - Score	Security Risk - Travel Advice (UK FCO)	Control Risks - Security Risk	Control Risks - Political Risk
Poland	8	62	126	2	41	5.5	No Restrictions	Low	Low
Czech Republic	9	64	138	4	57	4.4	No Restrictions	Low	Low
Slovak Republic	4	48	76	7	66	4	No Restrictions	Low	Medium
Croatia	13	80	67	8	66	4	No Restrictions	Low	Low
Ukraine	22	152	112	22	152	2.3	No Restrictions	Low	Medium
Hungary	5	51	39	3	54	4.6	No Restrictions	Low	Medium
Romania	12	72	63	10	75	3.6	No Restrictions	Low	Medium
Moldova	14	81	88	16	112	2.9	No Restrictions	Low	Medium
Serbia	16	92	92	13	86	3.3	No Restrictions	Low	Medium
Bosnia and Herzegovina	20	125	162	14	91	3.2	No Restrictions	Medium	Medium
Macedonia, FYR	2	22	6	9	69	3.9	No Restrictions	Low	Medium
Bulgaria	7	59	49	12	86	3.3	No Restrictions	Low	Medium
Albania	15	82	61	15	95	3.1	No Restrictions	Low-Medium	Medium
Kosovo	19	117	168	17	112	2.9	All But Essential Travel	Low-Medium	Medium
Greece	17	100	135	11	80	3.4	No Restrictions	Low	Medium
Turkey	11	71	61	5	61	4.2	All But Essential Travel	Low-High	Medium
Cyprus	3	40	33	1	30	6.3	No Restrictions	Low	Medium
Georgia	1	16	7	6	64	4.1	All Travel to Parts/All But Essential	Medium-High	Medium
Armenia	6	55	10	19	129	2.6	All But Essential Travel	Medium-High	Medium
Azerbaijan	10	66	18	21	143	2.4	All Travel to Parts	Medium-High	Medium
Iraq	24	164	176	23	175	1.8	All But Essential Travel	Medium-High	High
Iran, Islamic Rep.	21	144	53	18	120	2.7	All Travel to Parts/All But Essential	Low-Medium	High
Pakistan	18	105	90	20	134	2.5	All Travel to Parts/All But Essential	High-Extreme	High
Afghanistan	23	160	30	24	180	1.5	All Travel to Parts/All But Essential	High-Extreme	Extreme

26 Recommendations

SRK ES has not discussed with MMG how this report is to be utilised for the advancement of MMG copper portfolio. SRK ES has merely produced a high level opinion of the most prospective areas for extensive copper mineralisation across the TMB. A number of regions have been highlighted as holding such potential and the following suggestions are some possible steps which may be taken in moving towards developing and exploration project in these areas.

- Selection of countries in which MMG are willing to invest in based on the risk profile of each prospective region. This will necessarily involve a review of the political and social risk to the company as well as, financially given the degree of exploration development needed in each target region. This could involve the services of a specialist security and risk consultants.

- Undertake a more thorough review of the geology, structure, current and past exploration activities and national mining policy for the selected target country. This current report has not gone into such detail as it is not warranted for an initial, high-level review. This will likely involve an interrogation of archives held in the chosen State's mining ministry and national archives.

- Thorough structural interpretation and alteration mapping using satellite imagery and other remote sensing techniques. Acquire geophysical datasets from government sources.

- Investigate the licensing procedures and laws that govern mineral exploration in that country. A review of the available licence areas, as well as those potentially open to JV or take-over should be conducted. Licences should then be acquired.

- Begin exploration activities, initially through desk based target generation using purchased geophysical and geochemical datasets if available, followed by field activities, dependent on the development stage of the project undertaken.

For and on behalf of SRK Exploration Services

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27 References

Birkenmajer, L., 1974, *Carpathian Mountains*, Geological Society, London, Special Publications Vol. 4, p127-157.

Birkenmajer, L., 2007, *Pieniny Klippen Belt, West Carpathians: Stratigraphy, Tectonics, Palaeogeography*, Studia Geologica Poloinica, Vol. 127, p7-50.

Bogdanov, K., Filipov, A., Kehayov, R., 2005, *Au-Ag-Te-Se minerals in the Elatsite porphyry-copper deposit, Bulgaria***.** Bulgarian academy of sciences geochemistry, mineralogy and petrology, 43

Brininstool, M., 2009. *The Mineral Industry of the Czech Republic*, 2011, USGS Minerals Yearbook.

Brininstool, M., 2010. *The Mineral Industry of the Hungary,* 2009, USGS Minerals Yearbook.

Brininstool, M., 2010. *The Mineral Industry of Montenegro,* 2009, USGS Minerals Yearbook

Brininstool, M., 2011-1. *The Mineral Industry of the Poland,* 2009, USGS Minerals Yearbook.

Brininstool, M., 2011-2. *The Mineral Industry of the Romania,* 2009, USGS Minerals Yearbook.

Brininstool, M., 2011-3. *The Mineral Industry of the Slovakia,* 2009, USGS Minerals Yearbook.

Brininstool, M., 2011-4. *The Mineral Industry of the Ukraine,* 2009, USGS Minerals Yearbook.

Brininstool, M, 2010. *The Mineral Industry of Bosnia and Herzegovina,* 2010, USGS Minerals Yearbook,

Brun. J., Faccenna, C., 2008, *Exhumation of high-pressure rocks driven by slab rollback,* Earth and Planetary Science Letters. 272, p1-7

Ciobanu, C.L., Cook, N.J., Stein, H., 2002, *Regional setting and Re–Os age of ores at Ocna de Fier Dognecea (Romania) in the context of the banatitic magmatic and metallogenic belt*. Mineralium Deposita 37, p541– 567.

Cooke. D., Hollings. P., Walshe. J., 2005, *Giant Porphyry Deposits: Characteristics, Distribution, and Tectonic Controls*, Economic Geology, Vol 100, p801-816

Cox, D. P., Lindsey, D. A., Singer, D. A., Moring, B. C., and Diggles, M. F., 2007, *Sediment-Hosted Copper Deposits of the World: Deposit Models and Database*, U.S. Geological Survey Open-File Report 03-107

De Vos, W., Batista, M. J., Demetriades, A., Duris, M., Lexa, J., Lis, J., Marsina, K., and O'Connor, P. J., 2005, *Metallogenic Mineral Provinces and World Class Ore Deposits in Europe*, FOREGS Geochemical Atlas Of Europe, Part 1.

Dilek, Y., Furnes, H., Shallo, Minella., 2007,. *Suprasubduction zone ophiolite formation along the periphery of Mesozoic Gondwana*, Gondwana Research, Vol 11, p453-475.

Dokov R, Popov A (1963) Structural conditions for the localization of sulphide mineralization and certain pecularities in the distribution of lead and zinc in the lead-zinc deposits in the Madan ore district. *Travaux sur la Géologie de Bulgarie, Serie Géochemie, Minéralogie et Pétrographie*, 4, 73-92 (in Bulgarian)In: Vassilev, R., Atanassova, R., Bonev, I., K., (2009) *A review of the morphological variteites of ore bodies in the Madan Pb--Zn deposits, Central Rhodopes, Bulgaria.* Geochemistry, Mineralogy and petrology. Sofia. vol 47 p 31-49

Fodor, L., Csontos, L., Gabor, B., Gyorfi, I., and Benlovics, L., 1999, *Tertiary Tectonic Evolution of the Pannonian Basin System and Neighbouring Orogens: A New Synthesis of Palaeostress Data*, Geological Society, London, Special Publications, Vol. 156, p295-334.

Fodor, L., 2006, *Tertiary Tectonic Evolution of the Pannonian-Capathian-Eastern Alpine Domain*, Geolines, Vol. 20, p34-36.

Förster, H., 1978, Mesozoic-Cenozoic metallogenesis in Iran, Journal of the Geological Society, London, Vol. 135, p443-455

Galley, A.G., Hannington, M.D., and Jonasson, I.R., 2007, *Volcanogenic massive sulphide deposits*, in Goodfellow, W.D., ed., Mineral Deposits of Canada: A Synthesis of Major Deposit-Types, District Metallogeny, the Evolution of Geological Provinces, and Exploration Methods: Geological Association of Canada, Mineral Deposits Division, Special Publication No. 5, p141-161.

Golonka, J., Pietsch, K., and Marzec, P., 2011. *Structure and plate tectonic evolution of the northern Outer Carpathians,* Tectonics, INTECH, Rijeka, Croatia. pp. 65–92.

Garson, M. S., and Mitchell, A. H. G., 1977, *Mineralization at destructive plate boundaries: a brief review*, Geological Society, London, Sp. Pub. Vol. 7, p81-97

Georgiev, G., 2008, *A genetic model of the Elatsite porphyry copper deposit*, Bulgarian academy of sciences geochemistry, mineralogy and petrology, Vol 46, p143-160.

Gilbert Smith, A., Morton Moores, E., (1974) Hellenides. *Geological Society, London, Special Publications* 4:159-185

Groves, D. I., Bierlein, F. P., Meinert, L. D., and Hitzman, M. W., 2010, *Iron Oxide Copper-Gold (IOCG) Deposits through Earth History: Implications for origin, Lithospheric Setting, and Distinction from Other Epigenetic Iron Oxide Deposits*, Economic Geology, Vol. 105, p641-654

Heinrich, C. A., and Neubauer, F., 2002, *Cu-Au-Pb-Zn-Ag Metallogeny of the Alpine – Balkan – Carpathian – Dinaride Geodynamic Province*, Mineralium Deposita, Vol. 37, p533-540.

Himmerkus, F.,Anders, B., Reischmann,T., Kostopoulos, D., **(2007)** Geological Society of America Memoirs, 200, p. 379-390

Hitzman, M., Kirkham, R., Broughton, D., Thorson, J., and Selley, D., (2005), *The Sediment-hosted StratiformCopper ore System*, Society of Economic Geologists, Economic Geology 100th Anniversary Volume, p609-642.

Hrvatovic, H., Pamic, J., (2005) *Principal thrust-nappe structures of the Dinarides.*Acta Geologica Hungarica, vol 48, p133-151

Holub, F. V., Rapprich, V., Erban, V., Pecskay, Z., Mlcoch, B., and Mikova, J., 2010, *Petrology and geochemistry of the Tertiary Alkaline Intrusive Rocks at Doupov, Doupovske Hory Volcanic Complex (NW Bohemian Massif)*, Journal of Geosciences, Vol. 55, p251-278.

Jakubiak, Z., 2008, *NI 43-101 Technical Report, Strieborna Vein Silver Project, Roznava Mining District, Slovak Republic*, for Global Minerals.

Janković, S., 1977, *The copper deposits and geotectonic setting of the Tethyan Eurasian Metallogenic Belt*, Mineralium Deposita, Vol. 12, p37-47.

Janković, S., 1997, *The Carpatho-Balkanides and adjacent area: a sector of the Tethyan Eurasian metallogenic belt*, Mineralium Deposita, Vol. 32, p426-433.

Jelenkovic. R., Serafimovski. T., *Magmatic -Hydrothermal Cu-Au-(Mo-Pb-Zn-Ag) systems in the SW-part of the Carpatho-Balkanides*,International Journal of Geologica Carpathica,

John, D.A., Ayuso, R.A., Barton, M.D., Blakely, R.J., Bodnar, R.J., Dilles, J.H., Gray, Floyd, Graybeal, F.T., Mars, J.C., McPhee, D.K., Seal, R.R., Taylor, R.D., and Vikre, P.G., 2010, *Porphyry Copper Deposit Model*, chap. B of Mineral deposit models for resource assessment: U.S. Geological Survey Scientific Investigations Report 2010–5070–B, p169.

Jurkovic, I., (1995) *Bakovici the bigest gold deposit of Bosnia and Herzegovina*, Rudarsko-geoloSko-naftnzib ornik 7, p1-15.

Kamenov, B., Vergilov, V., Dabovski, C., Vergilov, I., Lyudmila., 2010. *The Sakar Batholith-petrology, geochemistry and magmatic evolution.*Geochemistry, Mineralogy and Petrology Sofia. vol 48, p 1-37

Kolkovski, B Dobrev, S Petrov P, Manev D (1996) Geology, mineralogy and genesis of Madan orefield. In: Plate tectonic aspects of the Alpine metallogeny in the Carpatho-Balkan region. Proceedings of the Annual meeting, Sofia, UNESCO-IGCP Project No. 356, 2, 157-173. In: Vassilev, R., Atanassova, R., Bonev, I., K., (2009) *A review of the morphological variteites of ore bodies in the Madan Pb--Zn deposits, Central Rhodopes, Bulgaria*. Geochemistry, Mineralogy and petrology. Sofia. vol 47, p 31-49.

Kouzmanov, K., Quadt, A., Peytchev, I., Harris, C., Heinrich., C., A., Roşu, O'Connor, G., 2005, *Rosia Poieni porphyry Cu-Au and Rosia Montana epithermal Au-Ag deposits, Apuseni Mts., Romania: Timing of magmatism and related mineralisation*, Bulgarian academy of sciences geochemistry, mineralogy and petrology. Vol 43

Kovacs, L. O., Szebenet, G., Kovacs, G. P., Foldessy, J., (2007) *Statistical Distributions of Ore Elements in the Resck Ore Field, Hungary*. Acta Mineralogica-Petrographica, Szeged 2006-2007. vol 47, p 1-16.

Lawrence, D., 2005, *A Tectonic Model for the spatial Occurrences of Porphyry Copper and Polymetallic Vein deposits- Application to Central Europe*, USGS Scientific Investigations Report 2005-5272.

Lczka, A., Krugov, S., Golonka, J., Oszczypko, N., and Popadyuk, I., 2006, *Geology and Hydrocarbon Resources of the Outer Carpathians, Poland*, Slovakia, and Ukraine: General Geology, AAPG Special Volumes, p221-258.

Leach, D. L., Bradley, D. C., Huston, D., Pisarevsky, S. A., Taylor, R. D., and Gardoll, S. J., 2010, *Sediment-Hosted Lead-Zinc Deposits in Earth History*, Economic Geology, Vol. 105, p580-625

Levine, R. M., 2009, *The Mineral Industry of Georgia*, USGS Mineral Yearbook

Lips, A., L., W., Herrington, R., J., Stein, G., Kozelj, D., Popov, K., Wijbrans, J. R., 2004, *Refined timing of porphyry copper formation in the Serbian and Bulgarian portions of the Cretaceous Carpatho-Balkan belt*, Economic Geology, Vol99, p601-609.

Marchev, P., Kaiser-Rohrmeier, M,. Heinrich, C., Ovtcharova, M., Albrecht von Quadt , Raicheva. R., (2005) *Hydrothermal ore deposits related to post-orogenic extensional magmatism and core complex formation: The Rhodope Massif of Bulgaria and Greece,* Ore Geology Reviews, Vol 27, p53–89

Marroni, M., Pandolfi, L., Onuzi, K., Palandri, S., Xhomo, A., 2009, *Ophiolite-bearing Vermoshi Flysch (Albanian Alps, Northern Albania),* Elements for its correlation in the frame of Dinaric-Hellenic Belt. Ofioliti 34 :95-108

Martinovic, M., Milivojevic, M., 2010, *Serbia Country Update*, Proceedings World Geothermal Congress 2010 Bali, Indonesia, p25-29.

Mikes, T., Baldi-Beke, M., Kazmer, M., Dunkl, I., Eynatten, H., 2008. Calcareous nannofossil age constraints on Miocene flysch sedimentation in the Outer Dinarides (Slovenia, Croatia, Bosnia-Herzegovina and Montenegro, In: Siegesmund, S., Fu¨ Genschuh, B. & Froitzheim, N. (eds) Tectonic Aspects of the Alpine-Dinaride-Carpathian System. Geological Society, London, Special Publications, 298, p 335–363

Momenzadeh, M., and Rashidnejad, N., 1989, *Porphyry Copper in Kerman Region, SE-Iran*, Geological Survey of Iran

Monthel, J., Vadala, P., Leistel J.M., Cottard, F., 2002, *Minerals deposits and mining districts of Serbia Compilation map and GIS database*, Republic of Serbia Ministry of Mining and Energy Geoinstitute.

Moritz, R., Chamberfort, I., Georgieva, S., Jacquat, S., Petrunov, R., 2005. *The Chelopech high sulphidation epithermal Cu-Au deposit.* Earth Sciences Institute, University of Geneva, Rue des Maraîchers 13, 1205 Geneva, Switzerland.

R.Moritz, K.Kouzmanov & R. Petrunov., 2004. *Late Cretaceous Cu-Au epithermal deposits of the Panagyurishte district, Srednogoric zone, Bulgaria.* Earth Sciences Institute, University of Geneva, Rue des Maraîchers 13, 1205 Geneva, Switzerland.

Neubauer, F., Hienrich, C., 2003, *Late Cretaceous and Tertiary geodynamics and ore deposit evolution of the Alpine-Balkan-Carpathian-Dinaride orogen*, Mineral exploration and sustainable development, Millpress 2003, Rotterdam.

Neubauer, F., 2002, *Contrasting Late Cretaceous with Neogene ore provinces in the Alpine-Balkan-Carpathian-Dinaride collision belt*. in: Blundell, D.J., Neubauer, F. and von Quadt, A. (eds): *The timing and location of major ore deposits in an evolving orogen*. Geol. Soc. London Spec. Publication 204, p81–102.

Newman , H, 2009. *The Mineral Industry of Greece*, 2009, USGS Minerals Yearbook.
Plant, J. A., Whittaker, A., Demetriades, B., De Vivo, B., and Lexa, J., 2005, *The Geoloogical and Tectonoc Framework of Europe*, FOREGS Geochemical Atlas Of Europe, Part 1.

Peters, S. G., Ludington, S. D., Orris, G. J., Sutphin, D. M., Bliss, J.D. and Rytuba, R.R and the U.S.Geological Survey-Afghanistan Ministry of Mines Joint Mineral Resource Assessment Team,, 2007, *Preliminary Non-Fuel Mineral Resource Assessment of Afghanistan*, USGS Open- File Report 2007-1214, USGS Afghanistan Project Product No. 157, Version 1.0, 852p.

Polyak, D.E., 2010, *Molybdenum*: U.S. Geological Survey Mineral Commodity Summaries 2010, p. 106-107.In: Levine, R. M., 2009, *The Mineral Industry of Armenia*, USGS Mineral Yearbook

Richards. J., 2003, *Tectono-Magmatic Precursors for Porphory Cu-(Mo-Au) Deposit Formation*, Economic Geology, Vol.98, p1515-1533

Robb, L. J., 2008, *Introduction to ore-Forming Processes*, Blackwell Publishing, pp373.

Robertson, A., Karamata, S., Šarić, K. 2009. *Overview of ophiolites and related units in the Late Palaeozoic–Early Cenozoic magmatic and tectonic development of Tethys in the northern part of the Balkan region*.Lithos, vol 108, 1-4, p1-39

Palinkaš, A., Šoštaric, S., Palinkaš, S., (2008) Metallogeny of the Northwestern and Central Dinarides and Southern Tisia. *Ore Geology Reviews 34*: 501-520

Papanikolaou, D., 1984, *The three metamorphic belts of the Hellenides: a review and a kinematic interpretation*, Geological Society, London, Special Publications, Vol. 17, p 551-561

Paulis, P., and Malec, J., 2010, *Occurence of Cu-mineralisation in the Permian Basaltic Intrusion from Kostalov near Semily (Krkonose-piedmont Basin, Czech Republic)*, Bulletin of Mineralogy and Petrology (Prague), Vol. 18/2, p106-108.

Perelló, J., Razique, A., Scholoderer, J., and Asad-ur-Rehman, 2008, *The Chagai Porphyry Copper Belt, Baluchistan Province, Pakistan*, Economic Geology, Vol. 103, p1583-1612

Picha, F., 2002, *Late orogenic strike-slip faulting and escape tectonics in frontal Dinarides-Hellenides, Croatia, Yugoslavia, Albania, and Greece*, AAPG Bulletin 86, p1659 - 1671

Pinter, N., Grenerczy., Weber, J., Stein. S., Medak., D., 2004, *Proceedings of the NATO Advanced Research Workshop on The Adria Microplate: GPS Geodesy, Tectonics and Hazards Veszprem, Hungary*. Dordrecht, Springer.

Quadt, A., Moritiz, R., Peytcheva, Heinrich, C., A., (2005) *Geochronology and geodynamics of Late Cretaceous magmatism and Cu–Au mineralization in the Panagyurishte region of the Apuseni–Banat–Timok–Srednogorie belt, Bulgaria*

Shanks, W.C.P., III, Dusel-Bacon, Cynthia, Koski, Randolph, Morgan, L.A., Mosier, Dan, Piatak, N.M., Ridley, Ian, Seal, R.R., II, Schultz, K.J., Slack, J.F., Thurston, Roland, 2009, *A new occurrence model for national assessment of undiscovered volcanogenic massive sulfide deposits*, U.S. Geological Survey Open-File Report 2009–1235, p27.

Sillitoe, R. H., 1978, *Metallogenic evolution of a collisional mountain belt in Pakistan: a preliminary analysis*, Journal of the Geological Society, Vol. 135, p377-387

Sillitoe, R. H., 2010, *Porphyry Copper Systems*, Economic Geology, Vol. 105, p33-41

Sillitoe, R.H., and Perelló, J., 2005, *Andean copper province—Tectonomagmatic settings, deposit types, metallogeny, exploration, and discovery*, Society of Economic Geologists, Economic Geology 100th Anniversary Volume, p845–890.

Smith, A., and Rassios, A., 2003, *The evolution of idea for the origin and emplacement of the western Hellenic ophiolites,* in Dilek, Y., and Newcomb, S., eds., Ophiolite Concept and the Evolution of Geological Thought: Geological Society of America Special Paper, v. 373, p. 337–350.

Stary, J., Kavina, P., Vanecek, M., Sitensky, I., Kotkova, J., and Hodkova, T., 2010, *Mineral commodity Summaries of the Czech Republic,* Czech Geological Survey – Geofond.

Strashimirov, S., Petrunov, R. and Kanazirski, M., 2002, *Porphyry-copper mineralisation in the central Srednogorie zone, Bulgaria*. Mineralum Deposita, Vol.37, p587–598.

Sosson, M., Kaymakci, N., Stephenson, R. A., Bergerat, F., Starostenko. 2010. *Sedimentary Basin Tectonics from the Black Sea and Caucasus to the Arabian Platform.*Geological Society Special Publication 340.

Tari, G. C., 1994. *Alpine tectonics of the Pannonian basin*, PhD thesis, Rice University, Houston, Texas.

Tvalchrelidze, A.G., 2000, *Geological and Metallogenic Framework of Georgia*, Tbilisi

Williams, P. J., Barton, M. D., Johnson, D. A., Fonboté, L., Haller, A., Mark, G., Oliver, N. H. S., and Marschik, R., 2005, *Iron Oxide Copper-Gold Deposits: Geology, Space-Time Distribution, and Possible Models of Origin*, Society of Economic Geologists, Economic Geology 100th Anniversary Volume, p371-405.

Xypolias, P., Dörr, W., Zulauf, G., (2006) *Late Carboniferous plutonism within the pre-Alpine basement of the External Hellenides (Kithira, Greece): evidence from U-Pb zircon dating*. Journal of the Geological Society, vol 163, p 539-547

Yigit, O., 2009, *Mineral Deposits of Turkey in Relation to Tethyan Metallogeny: implications for Future Mineral Exploration*, Society of Exploration Geologists, Economic Geology, Vol. 104, p19-51.

Young, B. B., 2011, *NI 43-101 Technical Report, Sarp Property, Kirklareli Province, Turkey,* for Valhalla Resources

Zelic, M., Marroni, M., Pandolfi, L., Trivić., B., 2010, *Tectonic setting of the Vardar suture Zone (Dinaric-Hellenic Belt); The example of the Kopaonik area (Southern Serbia),* Ofioliti, Vol 5, No 1.

Appendix 1: Regional copper deposit distribution maps

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