L E G E N D

TO THE GEOLOGICAL MAP AND MAP OF MINERAL RESOURCES OF CRYSTALLINE BASEMENT

Achrone	Eon	Era	Time Boundary, Ma
	PHANEROZOIC	PALEOZOIC-MESOZOIC	205 – 360
ARCHEAN PROTEROZOIC	NEO-PROTEROZOIC PR_3		1350 – 1700
	MESO-PROTEROZOIC (KLESOVIY) PR_2		1700 – 2000
	PALEO-PROTEROZOIC (KRYVORIZHIY) PR_1		2000 – 2600
	NEO-ARCHEAN (DNIPROVIY) AR_3		2600 – 3150
	PALEO-ARCHEAN (DNISTROVIY) AR_1		3400 – 3800

ORIKHIVSKO-PAVLOGRADSKA LTZ | ZAKHIDNOPRYAZOVSKA LTZ | TSENTRALNOPRYAZOVSKA LTZ

PZ-MZvel — **V o l n o v a s k o - E l a n c h y t s k a A s s o c i a t i o n*** (210-340 Ma) trachites ( ), andesites, andesite porphyries ( ), trachy-andesites ( ), trachy-basalts ( ), picrite-basalts ( ). *The rocks of Association are favourable for discovery of gold mineralization*

PZ-MZ zk — **Z i r k s k a A s s o c i a t i o n*** (296 Ma) subalkaline gabbroids: feldspar-less essexites and shonkinites ( )

PR_3 (Б, qБ, И) — **D y k e C o m p l e x*** (1200-1450 Ma) diabases ( ), konga-diabases (q); biotite-amphibole-plagioclase lamprophyres (c); micaceous hornblendites with sphene, glimmerites ( ). *Hornblendites are prospective for diamond discovery*

PR_2ль (i) — **K a m y a n o m o g y l s k y i C o m p l e x*** (1720 Ma) biotite-albite-microcline aplite-like granites (2), rare-earth pegmatites (2). *Pegmatites with zircon-rare-earth mineralization are genetically linked with the rocks of the Complex.*

PR_1sd — **S a d o v a S e q u e n c e** graphite-muscovite-biotite schists, marbles, phlogopite-diopside calciphyres, diopsidites, muscovite-feldspar quartzites (up to 400 m). *The Sequence rocks are favourable for discovery of graphite bodies.*

PR_1лд — **K o l a r i v s k i y C o m p l e x*** (1950 Ma) olivine lamproites, phlogopite-olivine kimberlites, hornblendites ( ); olivine-amphibole-phlogopite lamproites ( ); olivine-orthopyroxene-phlogopite-amphibole lamproites (cortlandites) ( ); olivinites, serpentinites, tremolitites ( ). *The Complex rocks are prospective for discovery of diamond as well as gold mineralization. Vermiculite occurrences are genetically related to the weathering crust.*

PR_1ыд (mt_2, i) — **S a l t y c h a n s k i y C o m p l e x** (1900-2190 Ma) albite, epidote-albite metasomatites (mt_2), white albite, tourmaline-bearing, rare-metal pegmatites (2); orthite-sphene-bearing rare-earth aplitoid granites (1); biotite-muscovite-albite-oligoclase granites (2); biotite-microcline-plagioclase, orthite-sphene-bearing granites (1). *With the Complex rocks are genetically linked: rare-metal pegmatites with tantalum-niobium and lithium mineralization; ceramic pegmatite deposits; orthite mineralization and quartz-molybdenum stockworks.*

PR_1cr (c_3, al, q) — **C h e r n i g i v s k i y C o m p l e x*** (2090 Ma), generalized succession of phases: third phase nepheline syenites (3), fenites, zones of albitization and albitites (al) second phase clinopyroxene syenites (2) and amphibole quartz syenites (q 3); first phase pyroxenites, mica pyroxenites (1) *Carbonatites, nepheline syenites, their weathering crusts contain apatite and rare-metal rare-earth mineralization. Albitites are prospective for rare-metal type of mineralization.*

PR_1фт (i, m) — **A n a d o l s k i y C o m p l e x** aplites ( ); muscovite-biotite, leucocratic granites ( ); amphibole-biotite porphyry-blastic granites and granodiorites (;); amphibole-biotite shadow, banded migmatites (m)

PR_1щи — **O b i t o c h n e n s k i y C o m p l e x*** - gabbro ( ), amphibole melanocratic gabbro-diorites ( ), amphibole diorites ( )

PR_1ns — **N o v o s i l s k a A s s o c i a t i o n*** - peridotites tremolite-serpentine-chlorite, amphibolised pyroxenites, feldspar hornblendites, tremolite actinolitites ( ). *Copper-nickel mineralization is genetically linked with the Association rocks; discovery of diamond-bearing bodies is possible. Hornblendites are favourable for localization of gold-sulphide-quartz mineralization.*

PR_1ви — **D i b r o v s k a S u i t e** cummingtonite-magnetite, diopside-magnetite, sillimanite-muscovite-biotite-magnetite, actinolite-magnetite quartzites; biotite, graphite-biotite with garnet and sillimanite plagiogneisses; biotite amphibolites; garnet-carbonate-quartz schists; interbeds of marbles and muscovite-diopside calciphyres (up to 1000 m). *Ferruginous quartzite deposits are related to theSuite rocks; the rocks are favourable for graphite ore bodies formation.*

AR_3ел (Э, en) — **T o k m a t s k i y C o m p l e x** (2700 Ma) chernockites (Э), enderbites (en)

$AR_3\check{s}\check{v}$ (q, p, p m)

Tsentralnopryazovska Series:

AR_3вь — **D e m y a n i v s k a S u i t e** magnetite, amphibole-pyroxene-magnetite quartzites, magnetite-amphibole-two-pyroxene, graphite-biotite with garnet and sillimanite mafic gneisses and plagiogneisses, in single cases marbles (up to 500 m). *The Suite rocks are favourable for the formation of ferruginous quartzite deposits.*

AR_3tm — **T e m r y u t s k a S u i t e** feldspar with garnet quartzites; two-pyroxene, garnet, graphite, high-alumina mafic gneisses and plagiogneisses; marbles, calciphyres, ferruginous quartzites (up to 1500 m). *The Suite rocks are favourable for discovery of graphite, ferruginous quartzite and high-alumina mineral ore bodies as well as the rocks with scheelite mineralization. Vermiculite occurrences are para-genetically linked with the weathering crust.*

Osypenkivska Series:

AR_3ли — **K r u t o b a l k i n s k a S u i t e** biotite, muscovite, staurolite, andalusite-staurolite, garnet-biotite-muscovite, feldspar-quartz schists; biotite-muscovite micro-gneisses; meta-sandstones, meta-gravelites, meta-pebble-stones, rarely with boulders (up to 500 m). *Staurolite deposits are genetically linked with the Suite rocks; the rocks are favourable for localization of silicification and sulphidization zones which control gold mineralization.*

ЙAR_3ык — **S o r o k y n s k i y U l t r a m a f i c C o m p l e x*** - serpentinized peridotite komatiites, chloritized komatiitic peridotites,porphyry serpentinites, tremolitites ( ). *The Complex rocks are favourable for localization of gold mineralization*

AR_3щд — **O l g i n s k a S u i t e** amphibolites; actinolite, tremolite, anthophyllite-tremolite, chlorite-serpentine, garnet-biotite and biotite-garnet schists; ferruginous quartzites; meta-komatiites (up to 700 m). *The Suite rocks are favourable for localization of: 1) gold mineralization; 2) spodumene pegmatites which control tantalum-niobium and lithium mineralization. Vermiculite occurrences are para-genetically linked with the weathering crust.*

Dragunska Sequence:

AR_1dr_2 — **U p p e r S u b - S e q u e n c e** biotite, amphibole-biotite plagiogneisses, amphibolites (up to 1000 m)

AR_1dr_1 — **L o w e r S u b - S e q u e n c e** biotite, biotite-amphibole, sillimanite-garnet-biotite, garnet-sillimanite, rarely corundum-bearing gneisses; amphibolites, often with garnet, in places clinopyroxene (up to 1200 m). *The Sub-Sequence rocks are favourable for the formation of corundum and sillimanite ore bodies.*

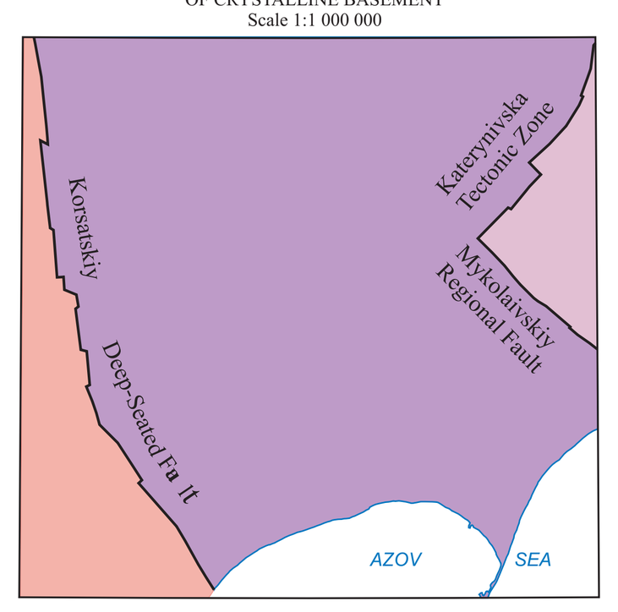
Zakhidnopryazovska Series:

AR_1knk — **K a i n k u l a t s k a S e q u e n c e** biotite, amphibole-biotite, biotite- and amphibole-pyroxene, rarely garnet plagiogneisses and mafic gneisses; amphibolites; rarely ferruginous quartzites and eulizites, calciphyre interbeds (more than 3000 m). *The Suite rocks are favourable for the formation of ferruginous quartzite ore bodies.*

AR_1vt — **V e r k h n y o t o k m a t s k a S e q u e n c e** biotite-two-pyroxene, amphibole-clino- and amphibole-orthopyroxene plagiogneisses; clino- and orthopyroxene mafic gneisses and pyroxene amphibolites (more than 3000 m)

Note: * - complexes of intrusive genesis, otherwise ultra-metamorphic and metamorphic genesis
** - straton is absent in the "Geological map of pre-Quaternary units" but is included in the text

SCHEME
OF LITHO-TECTONIC ZONATION
OF CRYSTALLINE BASEMENT
Scale 1:1 000 000



Orikhivsko-Pavlogradska LTZ
Zakhidnopryazovska LTZ
Tsentralnopryazovska LTZ

ROCK COMPOSITION

1 meta-sandstones, 2 meta-gravelites and meta-pebble-stones, 3-8 schists muscovite (3), staurolite (4), actinolite and tremolite-actinolite (5), feldspar-quartz (6), graphite (7), garnet (8), meta-komatiites (9)

1-9 gneisses: biotite (1), biotite-amphibole (2), garnet (3), sillimanite-garnet-biotite (4), graphite (5), biotite-clinopyroxene (6), two-pyroxene (7), two-pyroxene-amphibole (8), magnetite-bearing (9)

1-2 - mafic gneisses: two-pyroxene (1), biotite-amphibole (2); 3 amphibolites, 4 magnetite amphibolites

1-3 quartzites: pyroxene-magnetite (1), cummingtonite-magnetite (2), muscovite-feldspar (3), 4 - marbles, 5 phlogopite-diopside calciphyres

1 amphibole-biotite plagiomigmatites, 2 biotite, amphibole-biotite migmatites

1-4 granites: amphibole-biotite porphyry-blastic (1), muscovite-biotite (2), muscovite-biotite with garnet (3), biotite orthite-bearing (4), 5 pyroxene-biotite plagiogranites, 6 amphibole-biotite granodiorites

1-3 diorites: amphibole (1), amphibole-biotite (2), quartz (3)

1 amphibole quartz syenites, 2 nepheline syenites

1 biotite-amphibole-pyroxene gabbro-diorites, 2 clinopyroxene-amphibole gabbro, 3 subalkaline gabbroids (essexites, shonkinites)

METAMORPHIC FACIES

a C_1, b C_{2+3}, c C_{3+4} — Facies of regional metamorphism: a granulite, b amphibolite, epidote-amphibolite, c epidote-amphibolite, greenschist

ALTERED ROCKS

1 al, 2 vk, 3 sk — Metasomatites and metsomatically altered rocks: albitites (1), secondary quartzites and argillisites (2), skarn-like rocks and epidosites (3)

1-2 migmatization: two-feldspar (1), plagioclase (2)

TECTONITES

1 b, 2 kt, 3 bk, 4 ml, 5 bm, 6 t — 1 breccias, 2 cataclasites, 3 blasto-cataclasites, 4 milonites, 5 blasto-milonites, 6 tectonites undivided

FAULTS

1-A deep-seated
1-B deep-seated separating LTZs
2-A major proven
2-B major inferred
3-A minor proven
3-B minor inferred

1,7 Dextral strike-slip
-0,7 80° Normal faults
0,1 80° Normal fault-slip

DIPPING FEATURES

à 70° b 80° Dipping: a) the rocks in outcrops; b) the fault planes

GEOLOGICAL BOUNDARIES

Boundaries of stratified and non-stratified units: proven (a), inferred (b)
Boundaries of: tectonites (a), hydrothermally-altered rocks (b)
Boundaries of bodies of diverse composition inside the stratigraphic and non-stratified units (facial)
Boundaries of regional metamorphic facies
Stratigraphic discontinuities in the legend and stratigraphic columns
Angular unconformities (in the legend and stratigraphic columns)
Undefined relationships (in the legend and stratigraphic columns)
Stratigraphic interruptions (in stratigraphic columns)

MINERALS

Group	Sub-Group	Commodity Type	Mineral Type	Deposits	Occurrences
METALS	FERROUS METALS		Iron	Fe	Fe, Fe,(Ni), Fe,(W)
	NON-FERROUS METALS		Copper		Cu
			Copper, nickel		Cu,Ni
			Nickel		Ni
	RARE METALS		Tungsten		W
			Molybdenum		Mo
			Tantalum, niobium, lithium	Ta,Nb,Li	Ta,Nb,Li
			Niobium, tantalum		Nb, Ta
			Rubidium, niobium, tantalum		Rb, Ta; Rb, Nb
			Rubidium, caesium		Rb, Cs
			Zirconium		Zr
	PRECIOUS METALS		Gold	Au	Au,(Fe), Au,(Ag,Cu), Au,(Cu)
			Silver		Ag,(Pb), Ag
	RARE-EARTH METALS		Cerium, lanthanum	Ce,(Zr)	Ce,(Zr), Ce, La
			Yttrium		Y
NON-METALS	NON-ORE RAW MATERIALS FOR METALLURGY	REFRACTORY RAW MATERIALS	Sillimanite and corundum	si, cor / в	
		FLUX RAW MATERIALS	Staurolite	st / ф	
	CHEMICAL RAW MATERIALS	AGRO-CHEMICAL RAW MATERIALS	Apatite	ap / ar	ap / ar
	NON-METAL ORE COMMODITIES	ABRASIVE RAW MATERIALS	Diamond		di / аб
		ELECTRIC- AND RADIOTECHNICAL RAW MATERIALS	Graphite	gp / е-рт	gp / е-рт
		ADSORPTIVE RAW MATERIALS	Vermiculite	vr / ад	vr / ад
		FACING RAW MATERIALS	Granite, gabbroids, marble	, , c / o	, , c / o
	CONSTRUCTION RAW MATERIALS	GLASS AND PORCELAIN-FAIENCE RAW MATERIALS	Primary kaoline		c
			Pegmatite	c	
		QUARRY-STONE RAW MATERIALS	Gabbro, pyroxenite	б	
			Granite, migmatite	б	
			Migmatized gneisses	б	
WATERS	UNDERGROUND WATERS	MINERAL	Radon		Rn / Л

Note:
Deposit (occurrence) symbol arrangement includes:
for metallic minerals
example: 123 Au,(Ag,Cu) — number in the list; symbols: major valuable component, in parentheses accompanied one
for non-metallic minerals
example: 123 gn / в — number in the list; symbols of minerals and rocks; field of use
for underground waters
example: 112 / K_2 Br / Л — number in the list; chemical compounds; field of use; age of water-bearing horizon

GENETIC TYPES OF DEPOSITS

Metamorphogenic
Pegmatite
Plutonogenic-hydrothermal

STUDY DEGREE OF DEPOSITS AND OCCURRENCES

Explored deposits with economic reserves
Weakly studied deposits
Assessed prospective occurrences
Assessed non-prospective occurrences
Weakly studied occurrences

DEGREE OF DEPOSITS ECONOMIC DEVELOPMENT

In production | Conserved
Exhausted | Never been mined

DEGREE OF UNDERGROUND WATER MINERALIZATION

Slightly salty

OTHER INDICATORS

2730 / U-Pb — Radiological age in Ma, in denominator determination method used
Minor intrusions of apparently Novosilska Association defined by geophysical data
1, 2 — Areas of near-surface location of mafic (1) and felsic (2) intrusions
1, 2, 3 — Out-of-scale marker horizons defined by geophysical and geological data: calciphyres and marbles (1); graphite gneisses (2); ferruginous quartzites (3)
A_1 – A_2 Geological cross-section line
a 0131, b 0131 — Drill-holes and their numbers: in the map (a), in the cross-section (b)
3764 Outcrops and their numbers in the map
40, 0, -40 — Strato-contour lines of crystalline basement surface: positive (a), zero (b), negative (c)