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Research Article

INTRA-PLATE RARE METALLIC ONGONITE-LEUCOGRANITE ASSOCIATIONS OF THE MIDLLE TIEN SHAN, UZBEKISTAN

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ABSTRACT
Ongonites, ongorhyolites and rare-metallic leucogranites plays an important role among the intra-plate granitoid magmatism of Middle Tien Shan. An association of ongonite-ongorhyolite and rare metal leucogranites occurs in the Saryjaz tin ore-deposit, the Sargardon tungsten deposit, and in the Shavazsay lithium deposit within the Middle Tien Shan. This paper present first data on the geological occurrence, petrography and chemical composition of rare-metal-bearing ongonites and leucogranites of Karakushhana-Bashkizelsay, Yertashsey, Chetsu-Shavkali, Kelenchek-Tashsay and Charkesar areas, Middle Tien Shan. A special focus is made to the models of mineralization associated with ongonite-leucogranite magmatism.

Keywords: *Ongonite, Ongorhyolite, Li-F Leucogranite, Rare Metal Deposits, Geologic-Petrogenetic Models, Middle Tien Shan, Uzbekistan*

INTRODUCTION
The territory of Uzbekistan is considered as an igneous province of the Tien Shan – the Central Asian Orogenic Belt (Figure 1). There are two regions: the Northern, Middle and Southern Tien Shan. Magmatic processes are acted from rift (O-S), island arc (S-D_1) active continental margin (C_1-P_1) and intra plate (P_1-T_1) stages. The Tien Shan extends for over 2500 km, from western Uzbekistan, through Tajikistan, Kyrgyzstan and southern Kazakhstan to western China, and represents the central part of the Altaid Orogenic Collage of Central Asia.

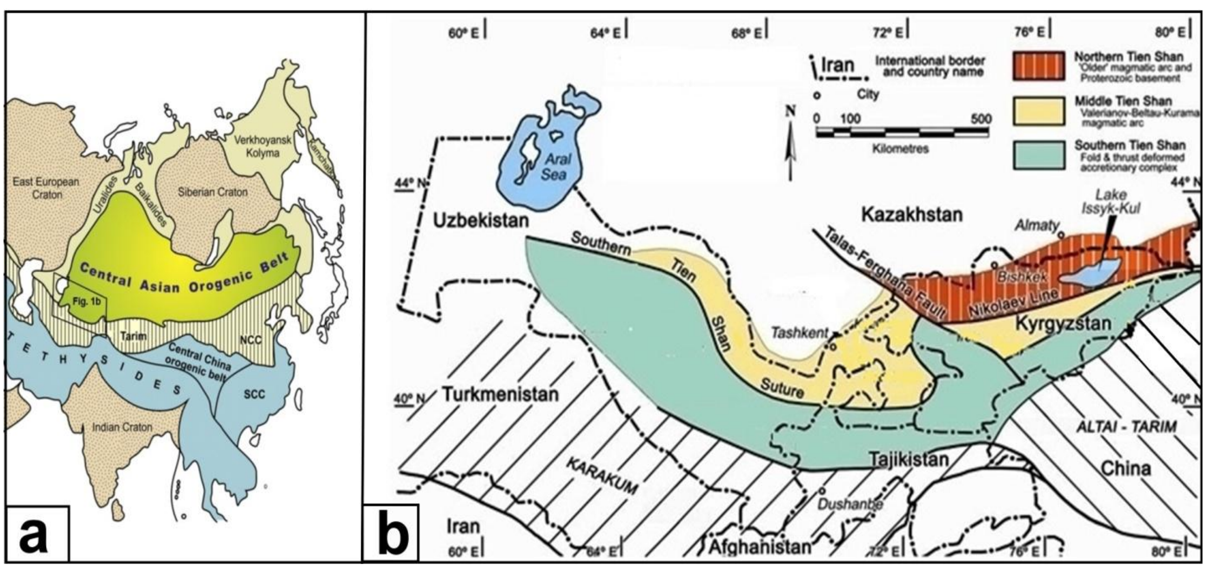

Figure 1: Tectonic Framework of Tien Shan (b), Located in the South-Western Part of the Central Asian Orogenic Belt (a); after Yakubchuk, (2004); Mao *et al.,* (2004).

These hint at crust-mantle interaction and dominance of a deep-seated regime during emplacement, referred to as the "Chatkal-Kurama plum" (Dalimov, 2007). They are temporally close (315 to 285 Ma, Seltmann *et al.,* 2011), their isotope signatures reveal the incorporation of a moderate mantle component, and geophysical patterns from the middle crust in the region exhibit zones of low reflection indicating the existence of extended mafic bodies just beneath both giant ore-magma systems.

The rare metal-bearing ongonite-ongorhyolite – Li-F-leucogranite association is a product of continental intraplate magmatism (Kovalenko *et al.*, 1999; Yarmolyuk and Kuzmin, 2012). The rocks are acidic (SiO_2 68–73%) and ultra-acidic (SiO_2 73-76%), containing albite, K-feldspar, quartz, and Li-fluorine mica and economic concentrations of Li, Be, W, Mo, Sn, fluorite and high concentrations of Nb, Ta, Rare earth elements (REE), Hf, Zr.

Study of intra-plate acid magmatism in folded regions is one of the pressing problems in petrology and metallogeny. Currently, rare metal ongonite-leucogranite associations, which are formed by large granitoid batholiths, are indicators of continental intra-plate geodynamic situation. Within western Tien Shan similar rocks are found in the Sarydjaz tin ore district of the Inilchek ore area, in the Sargardon tungsten deposit and in the Shavazsay lithium deposit.

In recent years (2005-2016) ongonites and ongorhyolites, rare metal leucogranites were examined us within the Karakushhana-Bashkyzylsey, Kelenchek-Tashsey, Yertashsey, Chetsu-Shavkatli and Charkesar areas (Figure 2). Exotic varieties of these rocks are first identified: aegirine ongorhyolites (Yertashsay neck) and fayalite ongonites (Angren dike). These rocks are related to areas of deep faults with manifestations of lithium, beryllium, tantalum, niobium and rare-earth metals. Studies have shown that rare-metal magmatism in western Tien Shan is also characterized by traditional mineralization (W, Mo, Sn, U, Th, fluorite) and occurrences of niobium, tantalum, rare and other metals. Association of rare-metal acid rocks form stocks and necks of ongonites, ongorhyolites and the small intrusives of leucogranites. As a result of complex geological, petrographic, mineralogical and geochemical studies petrologic models of formation for deposits closely associating with ongonite-leucogranite magmatism were made and deposit types were divided (Mamarozikov *et al.*, 2012; 2013a; 2013b; Suyundikova and Mamarozikov, 2009).

Table 1: Chemical Composition and Petrochemical Characteristics of Ongonites Ongorhyolites and Rare Metal Leucogranites in Middle Tien Shan

Wt.%	1	2	3	4	5	6	7	8	9
SiO_2	72,00	67,57	69,67	74,81	75,00	74,79	74,00	72,81	74,08
TiO_2	0,37	0,20	0,33	0,05	0,22	0,16	0,02	0,38	0,42
Al_2O_3	14,00	15,51	13,88	12,35	12,11	11,22	12,76	12,00	11,25
Fe_2O_3	0,84	3,36	1,62	0,25	1,61	0,77	0,05	1,44	1,68
FeO	1,15		1,82	1,00		1,07	0,93	1,25	1,10
MnO	0,01	0,19	0,03	0,04	0,12	0,02	0,01	0,04	0,05
MgO	0,95	0,65	0,88	0,28	0,14	0,64	0,30	0,39	0,44
CaO	0,98	3,16	1,45	1,15	0,74	0,63	0,30	1,15	1,15
Na_2O	6,28	4,23	4,06	3,94	4,80	4,49	6,18	4,01	4,35
K_2O	1,42	2,75	5,51	4,33	5,20	5,40	3,00	4,38	4,51
P_2O_5	0,08	-	0,05	0,03	-	0,02	0,02	0,40	0,45
Total	98,08	99,62	99,30	98,23	99,94	99,21	99,57	98,25	99,48
Na_2O+K_2O	7,70	7,98	9,57	8,27	10,00	9,89	9,18	8,39	8,86
Na_2O/K_2O	4,42	1,54	0,74	0,91	0,92	0,83	2,06	0,91	0,96
al’	4,76	4,62	3,36	8,07	6,92	4,52	9,97	3,90	3,49
f’	3,32	4,40	4,66	1,62	2,09	2,66	1,31	3,69	3,69

Note: 1-3 Ongonites: 1- Sarandon Tungsten Deposit, 2- Middle Reach of the Bashkizeilsay River, 3- Chetsy-Shavkatli Rare Metal Area (Angren Dikes); 4-5 Ongorhyolites of Shavazsay Rare Alkaline Metal Deposit (4) and Ertash Rare Metal-Bearing Area (5); 6-7 Rare Metal Leucogranites of Chetsu-Shavkatli (6) and Kelenchek-Tashsay Areas (7); 8-9 – Ongonites and Rare Metal Leucogranites of Charkesar Area

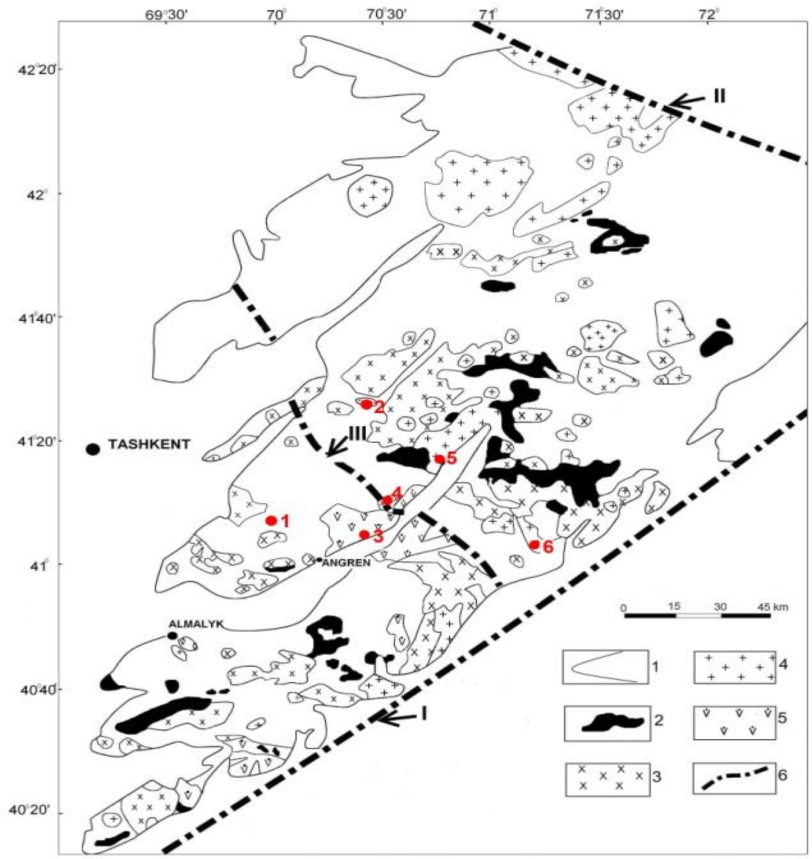

Figure 2: Schematic Geological Map of Late-Paleozoic Intrusive Complexes of Chatkal-Kurama Region (Middle Tien Shan) Showing the Localities of Ongonites, Ongorhyolites and Rare Metallic Leucogranites; Contour of Paleozoic Rocks; 2-4- Kurama (Karamazar) Intrusive Complex: 2- Gabbro (I-Phase), Diorites, Diorites-Quartz (II-Phase); 3- Granodiorites, Adamellites (III-Phase); 4- Granites and Alaskites (IV-Phase); 5- Hypabyssal Intrusives of Babaytoudor Complex (Rhyolite and Trachyrhyolite, Quartz-, Granite-, Granosyenite Porphyries); 6- Regional Fault Zones (I- Nord Fergana, II- Talas-Fergana, III-Kumbel-Ugam); Numbers in Figure – this Area Placing Ongonites, Ongorhyolites and Rare Metallic Leucogranites: 1 – Karakushhana-Bashkizelsay; 2 – Sargardon-Shabrez; 3 – Chetsy-Shavkatli; 4 – Ertashsay; 5 – Kelenchek-Tashsay, 6 – Charkesar

MATERIALS AND METHODS

Petrography and Geochemistry

Ongonites, ongorhyolites and rare metal-bearing leucogranites of the Middle Tien Shan are acidic (SiO_2 = 67.57–74.00%), ultra-acidic (SiO_2 = 74.00–75.00%), subalkaline ($Na_2O + K_2O$= 7.70–8.27%) and alkaline ($Na_2O + K_2O$= 9.18–10.00%), with high alumina ($al' = Al_2O_3/(FeO+Fe_2O_3+MgO)$ =3.36–9.97) of the potassic –sodic petrochemical series (Na_2O/K_2O = 0.74–4.2) (Table 1).

In the Sargardon-Shabrez area, the ongonite dykes associated with rare metal-bearing leucogranite stocks intrude larger granitic bodies and contain rare-metral-fluorite ores. Skarn, carbonate-greisen- rare metallic (W, Mo, Sn, Be and Li) and hydrothermal fluorite mineralization occurs as quartz – carbonate – fluorite, fluorite – beryllium and fluorite veins in marbles surrounding the Sargardon granite massif.

The ongonites and ongorhyolites of Karakushhana-Bashkizelsay rare-metal ore deposits are light-grey to white and occur as dykes, composite sills and necks hosted by ongorhyolite tuff. Locally, the rock is light brown due to pyrite oxidation. The distribution of ongonite and ongorhyolite bodies and their spatially associated trachydolerite and syenite-porphyry dikes is controlled by regional faults. The bodies intrude Late Carboniferous granosyenite porphyry of the Kizelsaisk complex in the middle reaches of the

Bashkizelsay river, and Early Permian rhyolitic volcanogenic-sedimentary rocks of the Shavazsay (rare alkaline metals – Li, Rb, Cs) Chetsu-Shavkatli and Ertash (rare metals) deposits A Rb-Sr isochron age of 263 ± 2 Ma was derived from ongorhyolite and its related sericitic alteration rocks which yielded a 87Sr/86Sr0 ratio of 0.7116. Among these rocks, the porphyries constitute between 15 and 35% and consist of phenocrysts of plagioclase (45–50), K-feldspar (15–20 and 25–30), quartz (15–30); mafic minerals (2.0–5.5). Plagioclase in ongonites varies from albite to An 20, and K-feldspar contains BaO up to 10 wt. %. Biotite is chloritised and opaque. In the groundmass, quartz-feldspathic, microgranular and cryptocrystalline textures are locally preserved. The central parts of Shavasay ongorhyolite dykes contain albite, potassic-sodic feldspar, and quartz in association with green Li-mica and topaz (~ 30% of the rock).

The fine-grained-cryptocrystalline quartz-feldspar groundmass contains abundant light green lithium mica and chlorite, and impregnated pyrite and Nb-bearing rutile. The accessory minerals are zircon, apatite, orthite, monazite, xenotime, thorite, titanite, yittro-titanite, and ilmenite. The increased concentrations of Li, Rb, Cs, Nb, Sn, W, Mo, Pb, La, and Yb are typical of the Shavazsay ongorhyolite (Table 2).

Table 2: Minor Elements (ppm) in Ongonite, Ongorhyolite and Rare Metal-Bearing Leucogranite, in Middle Tien Shan

Elements	1	2	3	4	5	6	7
Li	163	47	77	68	55	57	76
Rb	283	167	194	255	235	140	245
Cs	16	3,03	7,8	4,1	4,9	8,5	18
Sr	183	182	77	42	16	120	167
Th	10	22,49	26,7	33,8	24,8	38	69
U	2,1	6,54	6,6	8,9	15,1	4,5	16
Zr	169	156	140	180	41	90	130
Hf	8,1	3,86	13,9	7,2	1,6	1,7	2,2
Nb	31	21	29	31	61	110	104
Ta	2,2	1,41	1,6	2,0	7,9	9,5	10
Sn	4	3,38	10	12	2,9	11	3,3
W	40	45,6	8,9	12,4	8,29	3,1	3,4
Bi	011	0,16	0,12	0,09	0,16	0,08	0,04
Sc	9,9	9,97	7,9	3,5	0,74	2,9	1,6
Y	34	30	42	47	49	39	39
REE*	181,54	193,31	216,16	233,8	67,46	116,24	145,55

Note: Results of the Mass Spectrometric Analysis (ICP-MS-7500 Series Agilent Technologies); 1 - Shavazsay Ongorhyolite; 2 - Ertashsay Alkaline Ongorhyolite; 3-4 - Fayalite-Bearing Ongonite (3) and Leucogranite (4) from Chetsu-Shavkatli Area; 5 - Leucogranite from Kelenchek-Tashsay Area; 6-7 - Ongonite (6) and Leucogranite (7) from Charkesar Area; REE* - (La, Ce, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Tm, Yb, Lu)

The dykes and stocks of ongorhyolites occur within the Kumbel- Ugam fault zone of the Ertashsay Basin (Mamarozikov *et al.*, 2012; Suyundikova and Mamarozikov, 2009). The largest body is the Ertashsay neck of isometric shape more than 1 km in diameter, which yielded a Rb-Sr isotope age of 263± 3 Ma, i.e. Permian (Mamarozikov *et al.*, 2012). It is similar to other sub-volcanic (extrusive) bodies of alkaline (aegirine-bearing) ongorhyolite.

The Ertashsay ongorhyolite forms the marginal part of the Ertashsay neck. This massive and grey to dark-grey rock and consists of phenocrysts (15%-30%) and groundmass (70%-85%). The cryptocrystalline, microfelsic and spherulitic groundmass is dominated by quartz and feldspar. The phenocrysts are prismatic aggregates of albite with subordinate K-feldspar and quartz. The rocks are special for the occurrence (< 5%) of shlieren autoliths consisting of platy, prismatic, oval, egg-shaped, pod-like and isometric aggregates of aegirine, quartz and fluorite. Those 2.5 mm dark grey aggregates are submerged into light grey glassy matrix. The ongorhyolite contains grains of aegirine (ca. 2 modal %) and, small oval and angular-shaped xenoliths of fine-grained alaskite and quartzite, and spherulitic schlieren (< 5–10 mm) those are interpreted as fragments of earlier solidified ongorhyolite magma. The ongorhyolite is enriched in W, Sn, Th, Nb, and rare earth elements (Table 2) resulting in the occurrence of accessory chromite, chrome-spinel, Mn-ilmenite, Nb–bearing rutile, and titanite. The ongorhyolite yielded an $(^{87}Sr/^{86}Sr)_0$ isotopic ratio = of 0.7090, which suggests a mantle-crustal source (Mamarozikov *et al.,* 2012).

In the Chetsu-Shavkatli area, there are fayalite-bearing ongonites and their intrusive analogs, fayalite leucogranites. Fayalite-bearing ongonites form 200–300m thick dike-like bodies that intrude trachyrhyolite. The dikes extend in a sub-meridian direction and are exposed over a distance of 15 km along the right (northern) bank of the Angren River. Small bodies of fayalite –bearing leucogranite crop out on the left (northern) bank of Angren River, in the upper reaches of the Chetsu River (Chetsy stock) and its right branch (the Shavkatli tin deposit).

Early Permian fayalite-bearing leucogranite occurs as small bodies (from 20-30 m^2 to 4-5 km^2) that intrude trachyrhyolite, felsite porphyry and quartz porphyry of the Babaytaudor laccolith. In the exocontact and apical part of the fayalite-bearing ongonites and leucogranites, metasomatism have produced hybrid granosyenite-porphyry.

The Angren fayalite-bearing ongonite dikes and the fayalite-bearing leucogranite of the Chetsu intrusion have Rb-Sr isotope ages of 264 ± 3 Ma for ongonite of Angren dyke and 264 ± 2 Ma for the leucogranite of Chetsu. The ongonite of Angren dyke and leucogranite Chetsu stock have $(^{87}Sr/^{86}Sr)_0$ isotopic ratios of 0.70889, and 0.70989, respectively, indicating involvement of mantle materials in their genesis (Mamarozikov *et al.*, 2013).

Fayalite–bearing ongonites are dark grey, and porphyritic and consist of a micro-cryptocrystalline, microfelsitic to spherulitic quartz-feldspathic groundmass and 30–35% phenocrysts. Phenocrysts are albite-oligoclase (35-40%), K-feldspar (30-35%), idiomorphic quartz (25-30%), 2-5% Ti-bearing fayalite (largely altered to iddingsite), ferroaugite, aegirine-augite, ferropargasite, and biotite, 1.5-2% fluorite and REE-carbonates. Accessory minerals include zircon, titanomagnetite, ilmenite, ilmeno-rutile, niobic rutile, apatite, fluorapatite, yttro-apatite, rhabdophanite, phosphate-bearing yittro-thorite, synchysite, bastnaesite, orthite, tscheffkinite, Mo-, Co- and REE-bearing varieties of pyrite, Mo-Tl -bearing galena, sphalerite, and intratelluric compounds of Zn-Cu, Mo-Os.

In the fayalite-bearing ongonites, there are gabbroic xenoliths and dark grey glassy, cryptocrystalline autoliths. The autoliths have an average composition of – 77.7 wt% SiO_2; 13.60 Al_2O_3 wt%; 0.29 wt% $FeO+Fe_2O_3$ –;– 1.54 wt% CaO; and 6.37 wt% Na_2O. EMPA data obtained using "Jeol-8800R" reveal micro- and nanocrystals of albite, quartz, K-feldspar, pyroxenes (ferroaugite, aegirine-augite), alkaline amphibole (ferropargasite), fayalite intensively replaced by iddingsite, thorite, Nb-, Zr- rare earth metal silicates (risoerite, hydroorthite, zircon, cirtolite), fluor-carbonates (synchysite, bastnaesite, lanthanite), yittroapatite, Mo-, Tl-bearing galena, Zn-bearing titanomagnetite, and intratelluric compounds (alloys of Mo-Os composition). Nanocrystals of cassiterite are found in micro crystals of quartz. The phases of the enclaves are given here, while the mineral phases of ongonites and leucogranites are mentioned above.

Leucogranite of the Chesu stock is grey to dark grey, porphyritic with a fine-grained microgranitic to locally micropegmatitic quartz-feldspar groundmass. Phenocrysts are the same as for the fayalite–bearing ongonite, i.e., albite-oligoclase, K-feldspar, idiomorphic quartz, rare biotite, fayalite, pyroxene (ferro-augite, aegirine-augite) and alkaline amphibole (ferro-pargasite).

The rocks contain segregations of fluorite and primary REE carbonate minerals. Numerous accessory phases include zircon, magnetite, titanomagnetite, Mn-bearing ilmenite, ilmenorutile, garnet (mainly pyrope-almandine series), cassiterite, Nb-rutile, titanite, fergusonite, risoerite, samarskite, apatite, fluorapatite, yittroapatite, monazite, fluor-bearing rhabdophane, REE bearing fluor-phosphate of zirconium, fluor-orthite, thorite, phosphate bearing yittro-thorite, synchysite, bastnaesite, lanthanite, thori-orthite, hydroorthite and fluororthite, nagatellite, tscheffkinite, pyrite, arsenopyrite, molebdenite, scheelite, and intratelluric compounds (metallic alloys) of Ni-Al, Zn-Cu-Pb, Zn-Cu, and Fe-As-Mo compositions.

Rare metal-bearing leucogranite occurs in the south-western part of the Arashan intrusion which hosts the Kelenchek-Tashsay Ti-Nb-Ta-REE deposit. The leucogranites occur within biotite granite and are associated with intensive albitization and greisenization. They have a Rb-Sr isotopic age of 378 ± 4 Ma (upper early Permian) (Mamarozikov *et al.*, 2012) and an $(^{87}Sr/^{86}Sr)_0$ of 0.7064. The leucogranites form a swarm of NNE-trending dykes with thicknesses ranging from 0.2 to 1.0 m and are confined to the albite, cataclasite and silicification metasomatic zones developed around the Arashan granite. The rocks are light-grey to white and fine-grained. They are essentially composed of albite, microcline, quartz, and accessory Fe-chlorite and contain fluorite segregations associated with Ti-Nb-REE-U-Th minerals such as titanite, rutile, fergusonite, risoerite, yittrokeivite, orthite, thorite and uranothorite. Rocks hosting the leucogranite dykes are albitite and cataclasitic/silicified albitite. Near the marginal zone of the albitite, quartz–chlorite metasomatites occur that contain needle-like crystals of Nb-bearing rutile. The albitites have sharp contacts with the biotite granite which is composed of sericitized oligoclase, microcline, quartz and Fe-rich biotite. Compared with the rare metal leucogranite, albitite and quartz-chlorite metasomatic rocks, the biotite granite has extremely low Y, Nb, Zr, Hf and In. In particular, quartz in the leucogranite is distinguished by the presence of Y_2O_3 (1.71–2.16%) and Nb_2O_5 (< 0.42%), that, together with the characteristic Nb and REE mineralization (with HREE > LREE, Ta, W and P) in the rocks, provides evidence for the primary metallogenic specialization of a fluorine-rich magma.

The specialization of leucogranite magma in Nb, Ta and REE is evidenced from the early crystallization minerals titanite and magnetite, and Nb-bearing rutile in leucogranites, albitites and quartz- chlorite metasomatitic rocks. The rare metal-bearing leucogranites of the Kelenchek-Tashsay area have similar compositions to the alkaline ongorhyolites of the Ertashsay neck. However, leucogranite from Tashsay is ultra acidic and highly alkaline, rich in alumina (al' = 4.52; 9.97) with $Na_2O >> K_2O$ (Table 1). With metasomatism and the formation of albitite, and quartz-chlorite rocks, there is an increase in Nb, Ta, REE Th, and U with respect to the leucogranites. Enrichment of LREE of the Ce-group in albitite is inferred to indicate the influence of hydrothermal fluids derived from the leucogranite magma. This resulted in the formation of Ce-group rare earth silicates such as orthite and zirconium, in the metasomatic rocks above the leucogranite intrusion. The heavier Y-rare earths became concentrated with fluorine in both the leucogranite melt and its late stage fluid phase resulting in ore-grade concentrations of titano-tantalo-niobate rare earths in ilmenite, rutile, fergusonite, risoerite, etc. The distribution of REE indicates saturation of the ongorhyolite-leucogranite in light and heavy lanthanoids and a prominent Eu-anomaly implies plagioclase fractionation in the magma.

Models of Mineralization Associated with Ongonite-Leucogranite Magmatism

As a result of complex geological, petrographic, mineralogical and geochemical studies petrgenetic models of formation for deposits closely associating with ongonite-leucogranite magmatism were made and deposit types were divided (Figure 3).

The first type is the explosive-intrusive fluidizated Shavazsey lithium deposit which is related to the Takeli-Karakushhana paleovolcano (Figure 3a). Since Lower Permian ore formation connected with granite-rhyolite magmatism was in the following sequence: 1) appearance of tuffs of basic composition and accumulation of them together with peraluminous rocks in lava lake conditions; 2) formation of dikes and sills of trachydolerites, syenite-porphyres and trachytes; 3) injection of fine clastic-aglomeratic tuffs of ongonitic composition; 4) formation of multi-stage sills, dikes and necks of ongorhyolites. The mineralization in these ore deposits is a product of fluid-saturated melts from the lower mantle.

The second type is an extrusive-intrusive mineralization in the Yertashsey area (Figure 3b). Its formation is related to neck-like bodies of alkaline ongorhyolites and, possibly, with depth to rare-metal alkaline leucogranites. The peculiar features of these rocks are: mineral isolations, consisting of aegirine, quartz and fluorite, the presence of rare earth minerals, rutile, sphene and Cr-spinels. Ores are enriched in W, Mo, Sn, Nb, Zr, HF, U, Th, and REE. The data reveals a significant role of the melt mantle fluids for the association alkaline ongorhyolite-leucogranite.

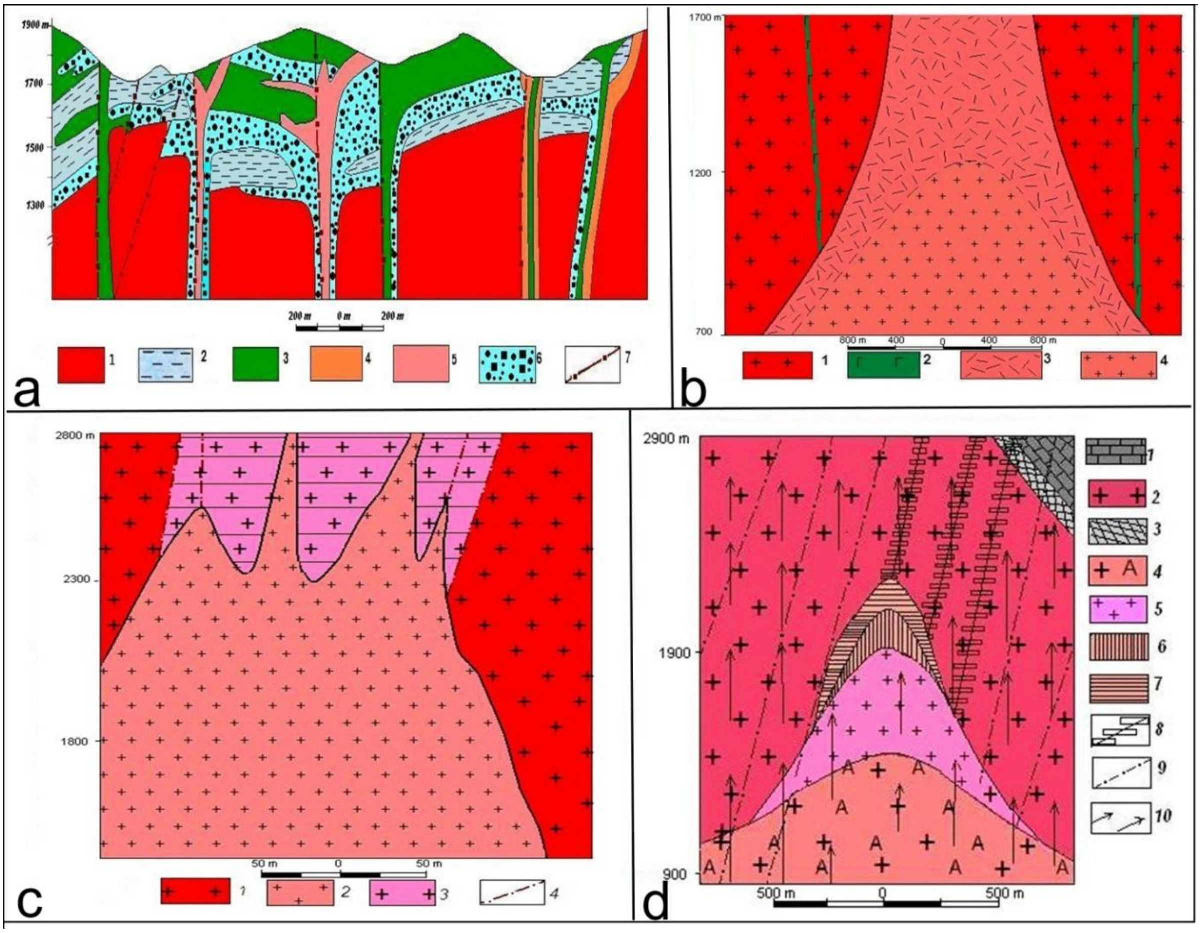

Figure 3: Schematic Illustration of the Hypothetical Ore Systems that may be Associated with Ongonites, Ongorhyolites and Li-F-Leucogranites in Middle Tien Shan; a- Fluidizate-Explosive-Intrusive Model of Shavazsay Type: 1- Rhyolite and their Tuffs; 2- Carbonaceous-Carbonate-Siliceous Tuffizits (Ore-Bearing Horizon); 3- Trachidolerites; 4- Syenite-Porphyries, Trachytes; 5- Ongorhyolites; 6- Fluidizate-Explosive Fine-Fragmentary - Agglomerative Tuffs of Basic – Acid Composition (Ore-Bearing); 7- Faults; b - Extrusive-Intrusive Model of Ertashsay Type: 1- Alaskites; 2- Dolerites; 3- Alkaline (Aegirine) Ongorhyolites (Ore-Mineralized); 4- Alkaline (Aegirine) Leucogranites; c - Intrusive - Apogranitic Albitic Model of Kelenchek-Tashsay Type: 1- Biotite Granites; 2- Rare-Metal Leucogranites; 3- Albitites, Albitizated Biotite Granites; 4- Faults, Quartz- Chloritic Veins; d- Exogreisens Model of Sargardon Type: 1- Carbonate Rocks of D_2-C_1; 2- Porphyraceous Granites Alaskitic; 3- Skarn- Magnetite Bodies; 4- Chamber of Alaskite Melt, Saturated by Fluorine (0,3-0,5%); 5- Chamber of the Hyperacidic Melt of the Lithium-Fluoric Granites; 6- Melt-Fluid; 7- Fluid; 8- Zone of Zwitter, Apogranites, Aposkarns and Apocarbonates Greisens with the Quartz- Wolframite and Fluoritic Veins; 9- Veins of Quartzwolframite; 10- Direction of Flow of the Fluids

The third type is apogranite-intrusive-deposits with tantalum-niobium and rare-earth metals in the Kelenchek-Tashsay area (Figure 3c). Here mineralization is localized in albities (apogranites) within granites of the Arashan intrusive. Rare-metal leucogranites occur as dikes among these rocks. Dike swarms are expected to move with the depth of the stock. Leucogranites are characterized by an abundance of volatiles and fluorite, associating with minerals of Ti, Nb, REE, U and Th. Ores are enriched in Rb, Cs, Hf, Nb, Ta, W, Au, As, Sn, U, Th, and REE. Content of REE in albitites is 0.1-0.2 wt %. The third type of apogranite-intrusive mineralization also includes rare-metal ore deposits of tin, molybdenum and tungsten in the Chetsu-Shavkatli area. Within this area, the authors identified dikes of fayalite ongonites and their intrusive analogues - stocks of fayalite rare-metal leucogranites with traditional rare-metal and rare-earth mineralization. Their complex study was based on petrography, mineralogy, geochemistry and fluid inclusions. Higher than clarks of Sn, Nb, W, Mo, Cs, U, Th, Hf, REE, Sb, As, Au, etc., point out melt geochemical specialization of these elements; the abundance of volatiles and fluorite, fluorapatite and primary fluorcarbonates associating with minerals of Ti, Nb, Sn, Mo, W and REE (Ti-magnetite, ilmenite, ilmenorutile, Nb-rich rutile, fergusonite, rizorite, yttroapatite, rabdophanite, yttrothorite, baestnasite, synchysite, lanthanite, allanite, chevkinite, cassiterite, molybdenite, scheelite, etc.). Among accessories in fayalite ongonites and leucogranites minerals with the yttrium subgroup REE essentially prevail over those with the cerium subgroup. According to apogranite-intrusive model for rare-metal deposits, formation granosyenite-porphyry bodies of ongonites and leucogranites seems to be the result of contact metasomatism and pyrometamorphism that took place under the influence of fluids from ongonitic melt. Non-traditional localization of rare-metal mineralization in granosyenite-porphyries is possibly due to concentration of ore-generated heterogeneous fluids separated from ongonitic melt. This scientific prediction was probated during study of hybrid granosyenite-porphyries and metasomatic rare-metal leucogranites of intrusive zone at Shavkatli and fayalite ongonites from the exocontact zone the Angren dikes.

The fourth type is exogreisen fluorite and tungsten mineralization in the Sargardon-Shabrez area (Figure 3d). Here at the depths of 800-1000 m rare-metal leucogranites are embedded in large intrusive body (intrusive in intrusive granites). Dikes of ongonite are placed into more ancient granite intrusive naked on the surface. They associate with others rocks represented by quartz diorites and granosyenite-porphyries. Formation of ore field is related with fluids derived from leucogranite melt.

Conclusion

The formation of above ranked rare-metal deposits in the Middle Tien Shan are seems to be product of fluid-saturated high fluorine rare-metal acid magmatism, manifested in the intra-plate stage of development of the region. Invasion and crystallization of these ore-containing melts from different levels of the Earth's crust have led to formation of: rare-metal leucogranite intrusives with W, Sn, Mo, Nb, Ta, Be, Li and fluorite in hypabyssal facies (the Sargardon deposit); albitites with Ti-Nb-Ta-REE (+ Zr, Hf, Au, U, Th, etc., this Kelenchek-Tashsay and Charkesar areas) and non-traditional ore deposits and mineralization zones with tin, niobium and REE (the Chetsu-Shavkatly area); fluidizated explosive-intrusive type of rare-metal rocks of subvolcanic facies with Nb, Ta, Zr, Hf, W, Mo, Au, U, Th, REE and fluorite (the Shavazsey deposit) and mineralization in the Yertashsey area. The origin of melts is represented as a result of interaction of residual granitic and alyaskitic magmas with ore-generating intratelluric fluids.

REFERENCES

Dalimov TN (2007). Evolution and model of development of Chatkal-Kurama plum. *Geology and Mineral Resources* **3** 3-18.

Kovalenko VI, Yarmolyuk VV, Budnikov SV, Kostitsyn YA, Kovach VP, Kotov AB, Sal'nikova EB and Antipin VS (1999). Magma sources and the isotopic (Sr and Nd) evolution of Li-F rare-metal granites. *Petrology* **7**(4) 383-409.

Mao J, Konopelko D, Seltmann R, Lehmann B, Chen W, Wang Y, Eklund O and Usubaliev T (2004). Postcollisionalc age of the Kumtor gold deposit and timing of Hercynian events in the Tien Shan, Kyrgyzstan. *Economic Geology* **99** 1771-1780.

Mamarozikov UD, Akhundjanov R, Saidiganiev SS and Suyundikova GM (2012). Ongonite magmatism of Middle Tien Shan. *International Scientific, Technical and Industrial Electronic Journal «GEO SCIENCE»* **1** 14-31.

Mamarozikov UD, Akhundjanov R, Saidiganiev SS and Suyundikova GM (2013). Fayalite-bearing ongonite-leucogranite assotiation of Chatkal-Kurama region (The Middle Tien Shan). *Litosfera* **5** 93–110.

Mamarozikov UD, Suyundikova GM and Normatov UA (2013). On detection of rare metal ongonite-leucogranite association in Charkesar area (Middle Tien Shan). *Geology and Mineral Resources* **1** 8-24.
Seltmann R, Konopelko D, Biske G, Divaev F and Sergeev S (2011). Hercynian post collisional magmatism in the context of Paleozoic magmatic evolution of the Tien Shan orogenic belt. *Journal of Asian Earth Sciences* **42** 821-838.
Suyundikova GM and Mamarozikov UD (2009). Ongonites and ongorhyolites of the Karakushhana-Bashkyzyksay perspective rare metallic area. *Geology and Mineral Resources* **3** 15-27.
Yakubchuk A (2004). Architecture and mineral deposit settings of the Altaid orogenic collage: a revised model. *Journal of Asian Earth Sciences* **23** 761-779.
Yarmolyuk VV and Kuzmin MI (2012). Late Paleozoic and Early Mesozoic rare-metal magmatism of Central Asia: Stages, provinces, and formation settings. *Geology of Ore Deposits* **54**(5) 313-333.