

Tantalite-Cassiterite-Ilmenite-Monazite-Gold Placers in Mongolia (Ta, Nb, Sn, Ti, REEs, Au)

Dr. Baatar Tumenbayar (1), Mijin Batbayar (1) & Robin Grayson MSc (1)

(1) Eco-Minex International Co. Ltd.
emiweb@magicnet.mn

ABSTRACT

Attention is drawn to the presence in Mongolia of tantalite-cassiterite placers. The Urt Gozgor ('Long Peak') Placer covered by Exploration License 1997-X close to Janchivlan near to Ulaanbaatar is described as an example. Already known to be a Ta-Nb-Sn-Ti-REE placer, the Urt Gozgor Placer is shown to be also associated with gold. The placer is remarkable for its composition and because it is traceable up-valley with confidence to its source rocks for all its constituent minerals (apart from the problematic gold). The source rocks are associated with a multistage pluton, beginning with porphyreous coarse-grained granites in the core of the pluton, two-mica medium-grained granites and alaskites (K-feldspar alkaline biotite granite). Each granite represents a different stage of magmatic differentiation, and can be classified as S-type granites. The second group of stages of the multistage pluton began with crystallisation of miarolitic pegmatite, followed by tin (Sn) greisen and then by tin-tantalum-niobium-lithium rich (Sn-Ta-Nb-Li) magmas. These magmas were highly differentiated and crystallised as several types of amazonite-albite granites, microcline-albite granites and lepidolite-albite granites, collectively known as lithium-fluorine (Li-F) granites or tantalum (Ta) granites. These are best classifiable as A2-type granitoids due to the presence of higher yttrium/niobium (Y/Nb) ratios of 1.2-7 and highly variable strontium-87 to strontium 86 ratios ($^{87}\text{Sr}/^{86}\text{Sr}$ ratios). The Li-F granites are interpreted as having been emplaced as the end members of magmatic differentiation after continent-continent collision between the Siberia Continent and the Central Asian Continent, with the closure of the Mongol-Okhotsk Ocean in Triassic-Early Jurassic and Late Jurassic-Cretaceous times. The source of the Urt Gozgor tantalite is coarsely-crystalline albitite rock, part of the multistage pluton. Such Ta/Nb plutons are rather rare in the world, and most of the world's supply of tantalum is from such plutons in Australia being mined by Sons of Gwalia, and this paper suggests that the multistage pluton in Exploration License 1997-X merits comparison with the Sons of Gwalia pluton. However, past drilling is not adequate. In the short term, the focus of effort is the Urt-Gozgor Ta/Sn placer, because it has proven reserves of tantalite, cassiterite and ilmenite ready to mine, plus some as yet unquantified placer gold.



Fig.1: view from outcrops of the multistage pluton down the Urt Gozgor valley, floored by the Urt Gozgor Ta-Nb-Sn-Ti-REEs-Au Placer close to Ulaanbaatar, Mongolia.

Location

The Urt Gozgor ('Long Peak') placer is 65km S.E. of Ulaanbaatar in Nailakh Soum in Tov Aimag (central region), 8km west of the settlement at the therapeutic spring of Janchivlin. Coordinates are longitude 47° 34' latitude 107° 33'

The Urt Gozgor placer plus the Ta/Nb-rich plutons are in Exploration License 1997X, awarded 20th December 1999 to Eco-Minex International Co. Ltd. (EMI) covering 1,356 hectares. EMI is a UK-Mongolian joint venture and is reappraising the large volume of published and archival material available in the archives of the State Geofund, a series of theses and elsewhere, in order to determine the viability of start-up of placer mining in 2001 to produce tantalite and cassiterite concentrates for export.

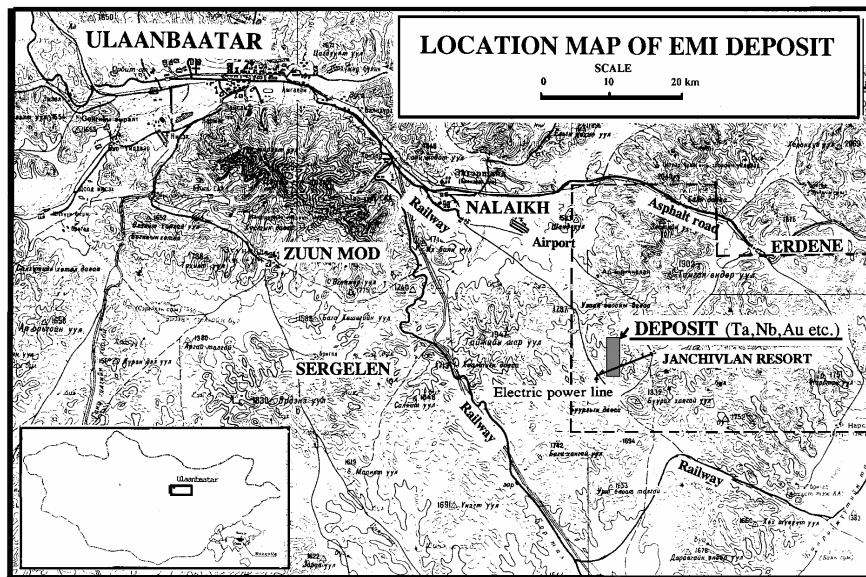


Fig.2: Location of the Urt Gozgor Placer close to Janchivlan, east of Ulaanbaatar.



Fig.3: Granite undergoing erosion, creating 'tor' landforms with blocks of fallen granite mixed with slope deposits of gravels and sand also derived from the granite, feeding the Urt Gozgor Placer in foreground.

History of Research of the Janchivlan area

The amount and detail of the research into the geology and mining potential of the Janchivlan area is quite remarkable, having been the subject of intensive study by Mongolian and Russian geologists and mineralogists for 80 years. The following list indicates some highlights, and detailed references are given at the end of the paper:

The amount and detail of the research into the geology and mining potential of the Janchivlan area is quite remarkable, having been the subject of intensive study by Mongolian and Russian geologists and mineralogists for 80 years. The following list indicates some highlights, and detailed references are given at the end of the paper:

- 1913-14 M.A. Ysovs conducted a general geological overview.
 1925-26 B.E. Kupletskiis conducted a geological survey at 1:1000 000
 1926-27 B.G. Smirnovs researched the Janchivlan spring.
 1932 A.A. Monin and P.P. Epifanov made a 1:100 000 geological map.
 B.K. Chaikovsky and A.B. Shanskayas researched the petrography of the Janchivlan ore region and discovered pegmatite ore body.
 1934 A.M. Shanskaya made a 1:25000 scale map and researched quartz in pegmatite and discovered a SnO₂ ore body 0.07-0.08%
 1946 N.N. Khomnzuv discovered that there was no radioactive substance in pegmatite at Janchivlan.
 1953 Yu.Yu. Smirnov made a geological 1:200 000 scale map, and discovered 64.1 ton SnO₂ reserves in the Urt Gozgor valley, the average content being 106 -146g/m³
 1954 M.G. Korolev conducted research into the geology of the Janchivlan area.
 1964 V.I. Doljinka, L.M.Kvalenko about Geological Searching. Part 322
 1964 L.E. Egel, I.S. Bonzelovsky studied Urt Gozgor's 3,500m x 800m albitite ore body from area of Buuralkhangai, with 0.001-0.015% Ta₂O₅
 1964 V.I. Ushakov researched albitite, and discovered niobium (Nb) in Dut Mountain.
 1966 N.N. Senkeivich and other geologists researched optical-grade quartz. (corpus 10).
 1967-69 V.E. Kvalenko, M.E. Kusenkov researching Petrology, geochemistry
 1968 L.N. Rossovsky and A.N Shostatsky (from SNEGEMS Krityarsk) took from technological hard rock
 1968 T. Narangerel researched the hydrogeology
 1969-70 L.F. Lavrenko, T.Zakhai researched Dalilkhan exploring and projects
 1969-70 T.Zakhai, L.F.Lavrenko researched hard rock and alluvial.
 1971 L.F. Lavrenko, T. Zakhai and team wrote report on their exploration for tantalum and other rare metals in the Janchivlan area. For a long while this report remained Top Secret.
 1971 V.I.Kovalenko and M.I.Kuzlyov researched about granite.
 1971-78 Dandar conducted an experiment at the hard rock.
 G.I.Pedgenko and D.Ivanov assessed wastes of the Janchivlan area.
 1979 C.Dashdavaa and team prepared a high-scale 1:1000 Geological Sketch-map of Urt Gozgor and Buural Khangai Raion.
 1982 Sengee Doobat published research on the metallogeny of tin-tungsten mineralisation of the Janchivlan area.
 1983 Sereegotov Chojjildorj published a paper on the geological and mineralogical characteristics and evaluation of tin-tungsten mineralisation of the Janchivlan area.
 1983 Vanchin Baljinnyam published his thesis on the formation types and metallogenic specialisation of granitoids in the South Khentii Ore Region.
 1983 Dugaraa Purev published on the tectonics of the Janchivlan area using geophysical data.
 1984 Anon wrote a report on the rare-metal granites of the Janchivlan area.
 1985 Dr. Bold Yadamsuren completed his PhD thesis on the structural and geomorphological setting of the placers at Janchivlan.
 1990 Ukhnaa Genden published a paper on the primary and secondary lithogeochemical haloes and dispersion flows in the Janchivlan area.
 1990 Ochir Gerel was awarded DSc. For thesis on the geochemistry and mineralisation of subalkaline igneous rocks of Mongolia, including the multiple plutons of the Janchivlan area.
 1999 Ochir Gerel and Kanisawa and Ishikawa presented geochemical characteristics of the Janchivlan plutons.
 1999 License Area 1997X awarded to Eco-Minex International Co. Ltd. covering Urt Gozgor and Ta-Nb albitite.

Geology of the Janchivlan Area

The country rocks of the Janchivlan area consist of terrigenous Devonian sediments to the NW in fault contact with regionally-metamorphosed Proterozoic-Cambrian schists and slaty mudstones and siltstones. The country rocks are intruded by a large composite intrusion that dominates the landscape and is called the Janchivlan massif. The sketch-map below illustrates the main rock units, together with some of the mineralised areas and the location of the cassiterite placers.

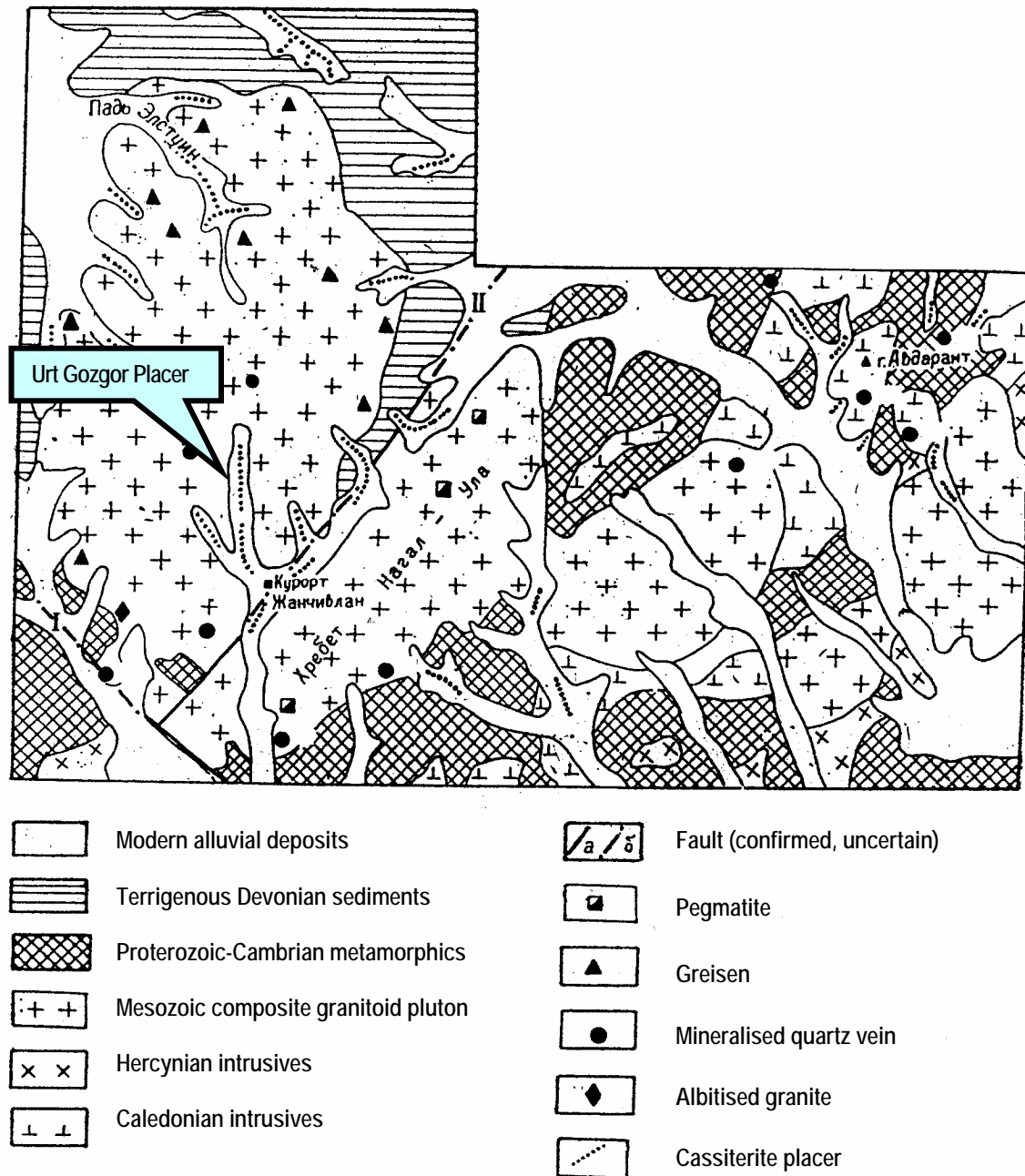


Fig.4: Geological sketch map of the Janchivlan area. The location of the Urt Gogzor placer is highlighted.

Geological Setting of Mineralisation

The Janchivlan pluton complex is a rare example of a multistage series of plutons. The multistage origin of the Janchivlan plutons is attributed by Gerel, Kanswana and Ishikawa (1999) to the magma rising on the line of the South Khentii Fault. The pluton complex has a surface area of about 1,000 km² and is intruded into the Devonian and Carboniferous accretionary complex of the Khentii Formation and the Riphean-low Cambrian metasedimentary sequence of the South Khentii Horst.

The **first group of stages** of the multistage pluton are porphyreous coarse-grained granites in the core of the pluton, two-mica medium-grained granites and alaskites (K-feldspar alkaline biotite granite). According to Gerel et al. (1999), each of these granites represents a different stage of magmatic differentiation, and can be classified as S-type granites.

The **second group of stages** of the multistage pluton began **firstly** with crystallisation of miarolitic pegmatite, followed **secondly** by tin (Sn) greisen and **thirdly** by tin-tantalum-niobium-lithium rich (Sn-Ta-Nb-Li) magmas. The Sn-Ta-Nb-Li-rich magmas were themselves highly differentiated and crystallised as several types of amazonite-albite granites, microcline-albite granites and lepidolite-albite granites, which are collectively known as lithium-fluorine (Li-F) granites or tantalum (Ta) granites due to the abundance of lithium, tantalum, niobium and rubidium. As shown by Gerel (1980), the Li-F granites have a distinctive major element chemistry, notably high silica content (68.76-77.23%), very low calcium (0.08-0.40% as CaO) and very low magnesium (0.00-0.04% as MgO), indicating extreme late-stage differentiation, with high sodium (3.70-6.37% as Na₂O) and high potassium (3.63-5.25% as K₂O). According to Gerel et al. (1999) the Janchivlan Li-F granites are best classifiable as A2-type granitoids according the scheme of Eby (1992), due to the presence of higher yttrium/niobium (Y/Nb) ratios of 1.2-7 and highly variable strontium-87 to strontium 86 ratios (⁸⁷Sr/⁸⁶Sr ratios). If correct this suggests the magma originated from continental crust or underpleted crust that had been through a cycle of continent-continent collision or island-arc magnetism.

Thus the Li-F granites are interpreted as having been emplaced as the end members of magmatic differentiation after continent-continent collision between the Siberia Continent to the north and the Central Asian Continent to the south, with the closure of the Mongol-Okhotsk Ocean. Li-F granites of the collision zone are reported for two episodes (Triassic-Early Jurassic and Late-Jurassic-Cretaceous). A radiometric age of 195± 0.6 million years is noted by Antipin (199, p.21) for some of the Janchivlan Li-F granites. The Li-F granites have high fluorine content (0.37-1.15% as F) according to Gerel et al (1999), which they interpret as evidence of a highly-mobile magma, capable of reaching a high level in the crust.

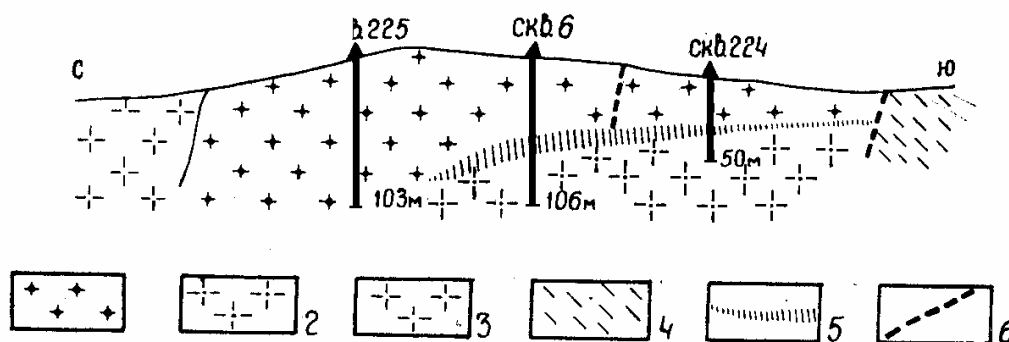


Fig.5: Sketch-section of borehole results: 1 = lepidolite-albitite granite; 2 = pink, coarse porphyritic granite; 3 = light grey very porphyritic granite; 4 = micaceous schist; 5 = zone of fractures with mylonitisation, chloritisation, talcisation and kaolinisation; 6 = faults.

Hard Rock Late-stage Granitoids

Lekhovich (1963) researched the geochemistry of the hard-rock late-stage granitoids in the Janchivalin area and recognised 4 types of granitoid intrusions:

- Type 1: allanitic granitoids containing titano-zircon-REE minerals;
- Type 2: monazitic granitoids containing titano-zircon-REE minerals
- Type 3: columbite-tantalitic granitoids containing tantalum-niobium-lithium minerals
- Type 4: tantalite lepidolitic granitoids containing olivine-tantalum-niobium-lithium minerals

Types 3 & 4 were considered by Lekhovich (1963) to be potential ores for rare earths. Lekhovich (1963) discovered that all 4 types of granitoids contain some accessory minerals in common, although in significantly varying proportions, notably:

- magnetite Fe_3O_4
- ilmenite $FeTiO_3$
- apatite $(Ca,Sr,Pb,Na,K)_5(P,As,V,SiO_4)_3(F,Cl,OH)$
- monazite $(Ce,La,Nd,Th)PO_4$
- zircon $ZrSiO_4$
- sphene $CaTiSiO_5$
- allanite $(Ce,Ca,Y)_2(Al,Fe)_3(SiO_4)_3(OH)$.

Lavrenko et al (1971) related the accessory minerals to 3 phases of magmatic differentiation of the granitoid plutons, and conducted numerous analyses to derive the following chart of AVERAGE values:

		1 ST PHASE		2 ND PHASE				3 RD PHASE				
		GRANDIORITE, QUARTZ DIORITE, PLAGIOGRANITE	PORPHYRYTIC BIOTITIC GRANITE	BIOTITIC GRANITE	SMALL & MEDIUM-GRAINED BIOTITIC GRANITE	SMALL & MEDIUM-GRAINED BIOTITIC MUSCOVITE GRANITE	LI-MICA & MICROLITE ALBITTIC GRANITE	AMAZONITE-ALBITTIC GRANITE	LEPIDOLITE & ALBITTIC GRANITE IN VEINS	LEPIDOLITIC ALBITTIC	AMAZONITISED & AMAZONITIC ALBITTIC	QUARTZ ALBITTIC
AVERAGE VALUES →		Gram /Ton	Gram /Ton	Gram /Ton	Gram /Ton	Gram /Ton	Gram /Ton	Gram /Ton	Gram /Ton	Gram /Ton	Gram /Ton	Gram /Ton
Magnetite	Fe	88	62	28	29	41	15	+	+			
Sphene	Ca+Ti+F	27	8	+								
Apatite	P, As, V	61	34	19	11	+	+					
Monazite	Ce+La+Nd+Th+P	2	18	37	36	32	30	12		+	15	8
Zircon	Zr	18	22	27	44	41	11	8	+	+	+	+
Allanite	Ce+Y	44	12	+								
Thorite	Th+U		+	8	+	+	+	+	+	+	3	+
Ilmenite	Fe+Ti	7	23	26	40	28	12	13		43	900	36
Columbite-Tantalite	Ta+Nb		+	+	2	8	40	46	50	31	96	38
Microlite	Ta						+	+	18	2	9	8
Cyrtolite	Hf+Zr		+	+	+	4	6	17	29	14	32	12
Malacon	Zr	+	+	+	+	+	+	+	28	+	12	6
Cassiterite	Sn		+	+	11	26	41	52	48	78	174	225
Topaz	F			+	8	58	240	410	520	240	311	440
Fluorite	Ca+F	+	2	12	23	43	84	156	231	320	340	290
Anatase	Ti		+	+	+	+	+	+	+	+	+	+

The bulk rock average concentrations are sufficient to arouse exploration interest, but not commercial. Lavrenenko et al (1971) determined the maximum bulk rock values for the minerals:

		1 ST PHASE	2 ND PHASE				3 RD PHASE					
		GRANODIORITE, QUARTZ DIORITE, PLAGIOGRANITE	PORPHYRYTIC BIOTITIC GRANITE	BIOTITIC GRANITE	SMALL & MEDIUM-GRAINED BIOTITIC GRANITE	SMALL & MEDIUM-GRAINED BIOTITIC MUSCOVITE GRANITE	LI-MICA & MICROLITE ALBITTIC GRANITE	AMAZONITE-ALBITTIC GRANITE	LEPIDOLITE & ALBITTIC GRANITE IN VEINS	LEPIDOLITIC ALBITTE	AMAZONITISED & AMAZONITIC ALBITTE	QUARTZ ALBITTE
MAXIMUM VALUES →		Gram /Ton	Gram /Ton	Gram /Ton	Gram /Ton	Gram /Ton	Gram /Ton	Gram /Ton	Gram /Ton	Gram /Ton	Gram /Ton	Gram /Ton
Magnetite	Fe	131	70	39	31	44	19	+	+			
Sphene	Ca+Ti+F	32	10	+								
Apatite	P, As, V	73	41	26	14	+	+					
Monazite	Ce+La+Nd+Th+P	3	21	45	42	44	34	13		+	224	20
Zircon	Zr	26	34	49	58	54	26	12	+	+	+	+
Allanite	Ce+Y	56	14	+								
Thorite-Orangite	Th+U		+	16	+	+	+	+	+	+	8	4
Ilmenite	Fe+Ti	14	30	31	47	39	16	18		63	1320	108
Columbite-Tantalite	Ta+Nb		+	+	6	12	49	81	185	50	642	55
Microlite	Ta						+	+	34	19	18	29
Cyrtolite	Hf+Zr		+	+	+	10	8	36	51	28	38	14
Malacon	Zr	+	+	+	+	+	+	+	37	+	16	12
Cassiterite	Sn		+	+	13	30	48	61	129	149	384	400
Topaz	F			+	18	500	1000	1000	5000	280	353	518
Fluorite	Ca+F	+	3	21	38	89	98	166	249	360	382	400
Anatase	Ti		+	+	+	+	+	+	+	+	+	+

These maximum figures suggest that some of the bulk rocks may contain zones that are prospective as bulk ores. The most notable is the amazonised/amazonitic albitite with very high maxima for tantalite-columbite (642g/ton) plus useful maxima for monzonite (224g/ton), cassiterite (348g/ton) and ilmenite (1,320g/ton).

Ore Potential of Hard Rock Granitoids

The ore potential of the hard-rock granitoids is a matter of speculation and requires drilling and use of modern analytical methods. Resource calculations for the albitite-lepidolite granite given by Lavrenenko et al (1971) are based on substantial number of analyses of outcrops and trenches but borehole results and very limited. The reserve calculations do not reflect current world prices, realistic cut-off grades or probable technological losses. However they do indicate the potential for further delineation by drilling, and the potential for further discoveries using modern methods:

Tantalum	Ta	434 tons
Niobium	Nb	350 tons
Lithium	Li	5,568 tons
Tin	Sn	525 tons
Beryllium	Be	168 tons
Fluorine	F	2,625 tons

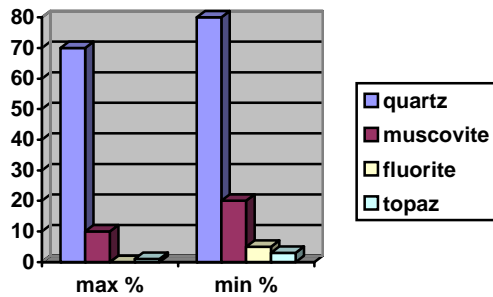
Encouragement is provided by the Ta:Nb ratio being in favour of more valuable tantalum (2:1) and in a few local areas is 20:1. More investigation is merited.

Ore Potential of Greisens

The greisen ore-bodies have a range of different configurations, such as lenticular, tabular, and veins. The main greisens mapped are 2-3m thick and 250m long but have not been drilled. Three types of greisen are reported by Lavrenenko et al. (1971):

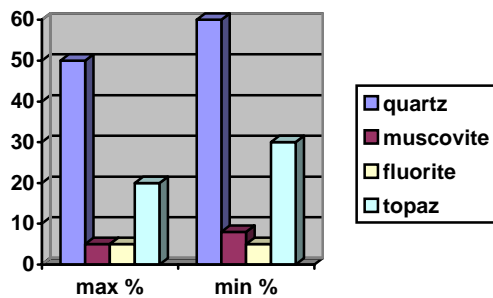
a) Mica-Quartz Greisen

This has significant topaz $Al_2SiO_4(F,OH)_2$, cassiterite SnO_2 , chalcopyrite $CuFeS_2$, hematite Fe_2O_3 and occasional molybdenite MoS_2 , sphalerite $Zn,Fe)S$ and bornite Cu_5FeS_4 .



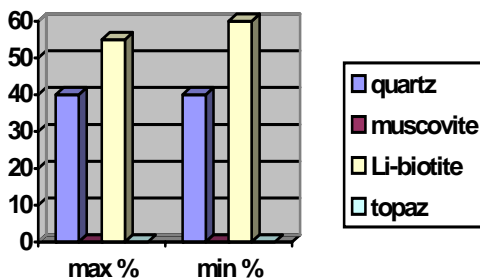
b) Topaz-Quartz Greisen

This has substantial topaz (20-30%), and significant pyrite FeS_2 , cassiterite SnO_2 , hematite Fe_2O_3 , wolframite $(Fe,Mn)WO_4$, chalcopyrite $CuFeS_2$ and molybdenite MoS_2 .



c) 'Zwitter' Greisen

This is quite different from the other greisens, in being exceptionally rich in lithium-rich biotite (zinnwaldite $KLiFeAl(AlSiO_3)O_{10}(F,OH)_2$ as well as fluorite CaF_2 ..



Ore Potential of Quartz Veins

The quartz veins range from 100cm to 1m wide with varying strike and angle of dip (60-500). Potential ore minerals are wolframite $(Fe,Mn)WO_4$ with cassiterite SnO_2 (1-3mm size), sphalerite ZnS , galena PbS and magnetite Fe_3O_4 . In places fluorite CaF_2 attains 70g/ton and topaz 7.1g/ton. The largest quartz veins is 1-4m thick and 300m long, with 8.4g/ton wolframite $(Fe,Mn)WO_4$; 24.4g/ton cassiterite SnO_2 , and 111g/ton fluorite CaF_2 .

Geomorphology of Urt Gozgor Placer

The steepness of the sides of the Urt Gozgor valley attain 15-20° in the upper reaches but in the southern part are as little as 5-8° degrees. The southern end of the valley is ill-defined and the contours are diffuse rendering placer exploration difficult. In contrast the middle and upper reaches have smooth contours which define the slopes and axis of the valley floor rather well, so placer exploration is easier. The width of the upper reaches of the valley floor are narrow, not exceeding 40-60m, the middle increasing to 100-200m and in the southern part attain 600-800m.

Permanent surface water is present but only for a section of 150-200m of the valley floor, with the source being an axial spring at the confluence with a side valley. Water flow is small, 0.5 litre/second claimed by Lavrinenko et.al. (1971).



Fig.6: Lower part of the Urt Gozgor valley, looking up-valley, with weak surface stream cutting into the Urt Gozgor Placer. Gold occurs at the surface on the terrace to the right.

The lower slope and watershed of the Urt Gozgor valley is composed of a medium to coarse-grained biotitic granite. However, the middle section of the valley has a large zone of coarse-grained albitite plutonic rock, 800-900m wide, some 2.5km-3.0km long. There are clear zones of quartz-albitite, amazonite-lepidolite-albitite and lepidolite-albitite, a mapped by L.F.Lavrinenko (1971) and Dashdavaa et al. (1979).

The floor and lower sides of the Urt Gozgor valley have a thin cover of friable alluvial-proluvial sediments, consisting of thin loamy soil, sand with large subangular pebbles and sand with large unweathered granite cobbles. Often the pebbles and cobbles occupy 70-75% of the volume. Local patches of permafrost ('frozen ground') occur at a depth of 1.5-2m deep across the area.

The origin of the Urt Gozgor placer is alluvial-proluvial, Under the present climatic regime, episodes of water flow down the full length of the valley are highly unlikely, if ever, able to occur, except perhaps at the time of seasonal spring thaw if the winter snow accumulation has been for exceptionally thick. It appears that almost all the water flow is underground.

The source of heavy minerals of the Urt Gozgor placer is clear – from the multistage pluton and associated hard-rock mineralisation. However, the origin of the gold in the placer is problematic.

History of Exploration of Ta-Nb-Ti-Sn-REE-Au Placer

The Ta-Nb-Sn-Ti-REE-Au placer of Urt-Gozgor ('Long Peak') has a remarkably long history of exploration. Ja.G.Borodjaev (1952) described testing placer which was prospected for in 1953 year by JY.b.Smirnov who made a 1:200,000 scale geological map and discovered 64.1 tons of SnO₂ reserves in the Urt Gozgor valley, the average content being 106-146g/m³

In 1970 L.F.Lavrinenko & T.Zakai prospected the Urt Gozgor placer, but unfortunately over-estimated the cassiterite reserves. During 1979-1980 the Modot Expedition examined the cassiterite placers around Janchivlan and examined a placer by the Nagan mountains near Janchivlan by prospect holes, and examined the cassiterite in the Urt Gozgor placer.

Yu.B. Smirnov (1953) established the cassiterite content of the placer sand for 2,000m length of the Urt Gozgor placer, and later L.F.Lavrinenko & T.Zakhai (1971) established it for a total length of 2,500m. The width of the placer varies from 60m to 280-300m. Some of the placer sands were found near to the upper reaches of the valley.

In the upper section of the valley, the sandy cassiterite placer consists of friable sediments of gravel-shingle resting on porphyritic granite in substantial quantities (L5/4 SH-45, 28; L9/4 SH-18,19, L13/2, SH-36, 11a, 6). The thickness of the placer varies between 0.5 – 2.5m. The middle layer of the placer consists 1.10–1.6m. Distribution of cassiterites is inequigranular, its content modified 100 g/m³–500g/m³ and more than 1000 g/m³.

Smirnov (1953) determined the average cassiterite content of the placer to be 286 g/m³, but recalculated as 552 g/m³ by Lavrinenko & Zakhai (1971). Reserves of cassiterite evaluated at 83.4 tons by Yu.F. Smirnova (19630, increased to 286 tons by Lavrinenko & Zakhai (1971).

Recently, EMI discovered that the placer is associated with gold.

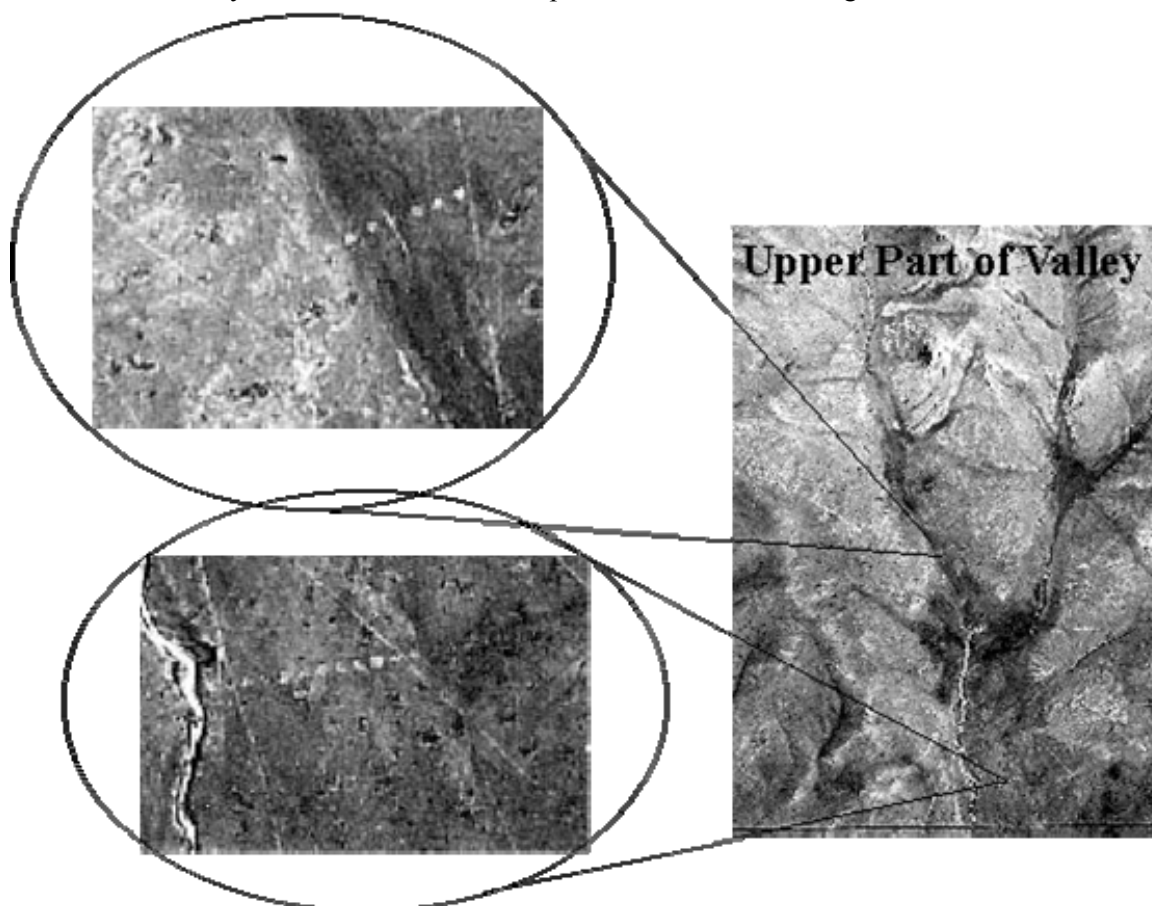


Fig.7: Vertical aerial photographs of the Urt Gozgor valley, flown in 1968, showing pits from earlier successful exploration for cassiterite placer. Each of the pits is still visible on the ground today.

Reserves of Urt Gozgor Placer

The following table shows the calculated reserves of tantalite and cassiterite in the Urt Gozgor Placer to which a significant volume of low value ilmenite should be added. Also to be added to the chart is placer gold, but this awaits detailed surveying:

Resource block	area m ²	overburden thickness m	overburden volume m ³	placer thickness m	Overburden ratio	max placer volume m ³	oversize %	GRADES		RESERVES		
								content of columbite-tantalite g/m ³	content of cassiterite g/m ³	reserve of columbite-tantalite tons	reserve of Ta ₂ O ₅ tons	reserve of cassiterite tons
I	12,000	1.90	22,800	2.00	0.95	24,000	2.00%	18	242	0.43	0.22	5.70
II	22,120	2.25	49,770	2.50	0.90	55,300	1.60%	59	374	2.08	1.09	20.35
III	63,000	1.26	79,380	0.80	1.58	56,700	1.20%	34	1,405	1.69	0.88	78.71
IV	128,750	0.99	127,460	1.00	0.99	128,750	0.60%	131	697	16.86	8.80	89.20
V	111,430	1.23	137,050	1.10	1.12	122,570	0.30%	45	329	5.52	2.88	39.47
VI	145,080	1.65	239,380	1.20	1.38	203,110	0.40%	24	264	4.18	2.18	53.41
VII	12,880	1.75	22,540	0.75	2.33	9,660	1.40%	18	142	0.17	0.08	1.35
VIII	21,520	1.16	24,980	1.75	0.66	43,040	1.00%	45	89	1.69	0.88	3.79
IX	23,030	4.00	92,120	1.10	3.64	25,330	2.00%	8	78	0.20	0.10	1.94
X	77,150	3.50	270,000	0.50	7.00	38,580	0.50%	15	120	0.58	0.30	4.60
XI	34,750	0.60	20,850	1.00	0.60	34,750	0.30%	21	280	0.73	0.38	9.70
XII	20,750	0.25	5,180	1.50	0.17	31,130	0.40%	0	96	0.00	0.00	2.98
XIII	71,000	1.60	113,600	0.80	2.00	56,800	0.10%	4	199	0.23	0.12	11.20
XIV	33,200	1.75	58,100	1.00	1.75	33,200	0.20%	0	184	0.00	0.00	5.99
XV	21,800	1.50	32,700	0.50	3.00	10,900	0.40%	2	586	0.02	0.01	6.36
	798,460	1.69	1,295,910	1.17	1.87	873,820	0.83%	28	339	34.38	17.92	334.75



Fig.8: Lower part of Urt Gozgor valley, showing TWO sets of prospect holes in placer, and powerline.

Resource Blocks of Urt Gozgor Placer

Fig.9: Resource blocks of Urt Gozgor Placer, with main prospect lines shown as black dots.

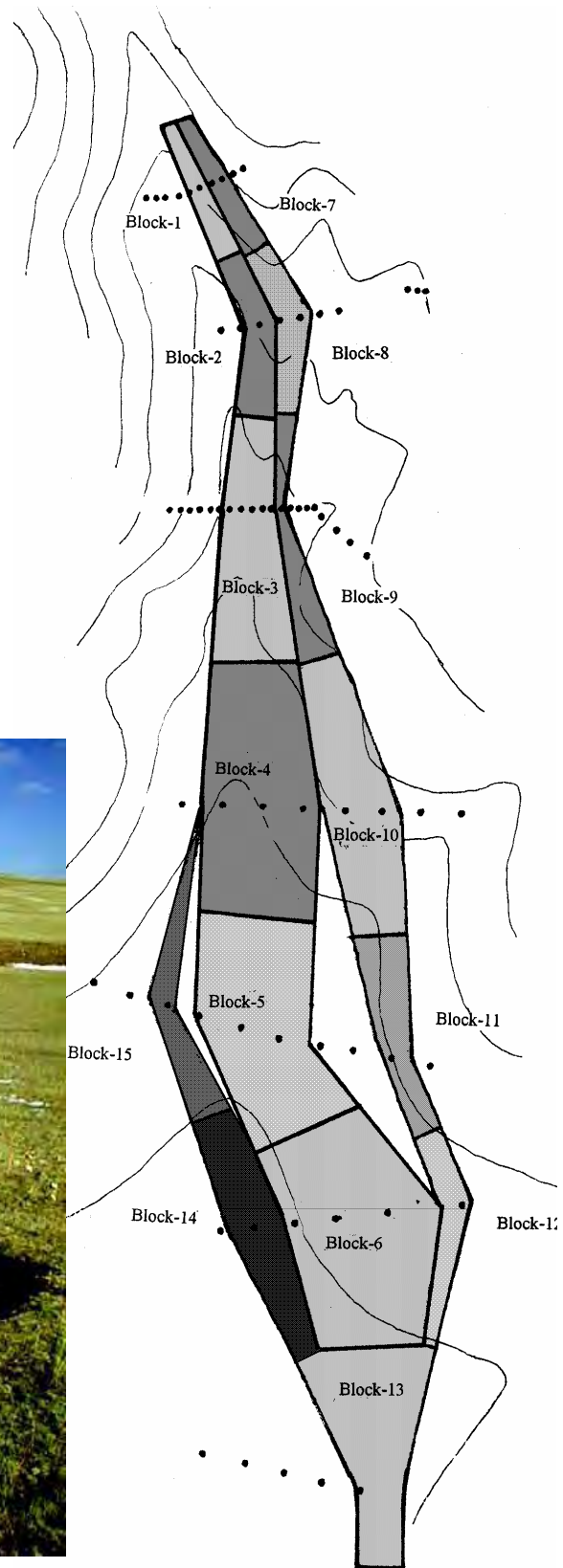


Fig.10: Example of old prospect pits, with small stream incision in centre of view.

Mineralogy of Ta-Nb-Ti-Sn-REE-Au Placer

Mineralogical study by several workers proves the Urt Gozgor placer to have a remarkable range of heavy minerals. Lavrinenco & Zakhai (1971 p.78) discovered that the Urt Gozgor placer contains the same heavy minerals as found by Lekhovich (1963) in all the 4 granitoids (Types 1,2,3,4). Thus the placer is an excellent demonstration of traceability of heavy minerals back to the source rocks in the catchment of the placer valley. A puzzle is that Lavrinenco & Zakhai (1971) did not report the presence of gold. The descriptions below are summarised from Lavrinenco & Zakhai (1971):

<u>Magnetite</u>	Fe_3O_4	iron oxide
Up to 0.02mm to 2mm crystals, black colour, metallic lustre.		
<u>Ilmenite</u>	$FeTiO_3$	ferrotitanium oxide
Iron-black coloured crystals with semi-metallic lustre, often tabular in form.		
<u>Apatite</u>	$(Ca,Sr,Pb,Na,K)_5(P,As,V,Si O_4)_3(F,Cl,OH)$	phosphates,arsenates,vanadates
Up to 0.5mm blue green crystals.		
<u>Monazite</u>	$(Ce,La,Nd,Th)PO_4$	cerium, lathanium, niodymium, thorium phosphate
red-brown colour covering monazite in placer		
<u>Zircon</u>	$ZrSiO_4$	zirconium silicate
Up to 0.05mm, rose-pink outer colour, vitreous lustre		
<u>Sphene</u>	$CaTiSiO_4(O,OH,F)$	calcium, titanium, fluorosilicate
0.5 to 0.01mm, yellowish colour, vitreous lustre		
<u>Allanite</u>	$(Ce,Ca,Y)_2(Al,Fe)_3(SiO_4)_3(OH)$	cerium, calcium, yttrium, aluminium, iron silicate
Pinacoid rhombic prisms, colour brownish, sometimes greenish-black colour, resinous lustre.		
<u>Columbite-Tantalite</u>	$(Fe,Mn)(Nb,Ta)_2O_6$	ferromanganese niobio-tantalum oxide
0.01 to 0.5mm crystals, often with crystal faces clearly visible, iron-black in colour, vitreous to metallic lustre.		
<u>Microlite</u>	$Na,Ca)_2Ta_2O_6(O,OH,F)$	fluorohydrous sodium calcium tantalum oxide
0.01 to 0.03mm crystals, varying from yellow to bright yellow.		
<u>Cassiterite</u>	SnO_2	tin oxide
Dark yellow to black grains 0.1 to 5mm diameter, often crystal faces clearly visible, oily lustre.		
<u>Topaz</u>	$Al_2SiO_4(F,OH)_2$	fluorohydrous aluminium silicate
Pale yellow to amber-coloured crystals, sometimes colourless, vitreous lustre		
<u>Fluorite</u>	CaF_2	calcium fluoride
Asymmetrical cubic crystals, from colourless to dark purple, vitreous lustre.		

Revised mineralogy of Ta-Nb-Ti-Sn-REE-Au Placer

A brief revision of the mineralogy of the Urt Gozgor Placer in 2000, focussed on the overburden, was carried out for EMI by Dr.Khishigsuren and Dr. S. Myagmarsuren. Both found rather similar minerals to those reported by Lavrinenco & Zakhai (1971) but also detected native gold, xenotime (trace), wolframite, monazite, pyroxene, chlorite, epidote, biotite, tourmaline, thorite-orangite (trace) and r-zircons. Tantalite was absent.

<u>Gold</u>	Au	native gold
Four surface samples were all positive:		
Sample 1: White-yellow, 0.005 x 0.02mm, irregular shape, with parallel lines.		
Sample 2: White-yellow, 0.005 x 0.005mm, isometric, rounded spherical.		
Sample 3: White-yellow to golden-yellow, 24 pieces of gold, of which:		
1 piece 0.04 x 0.03mm, like a flake; 1 piece 0.01 x 0.03mm, rough;		
10 pieces 0.01 x 0.01mm; 12 pieces 0.005 x 0.005mm.		
Sample 4: golden-yellow, rough surface, 18 pieces, ranging from 0.04mm to 0.14mm.		

The presence of gold in the supposed overburden was unexpected and is not yet understood. It is possible that a hitherto undetected gold placer overlies the tin-tantalite placer, or that the gold content increases downwards and the tin-tantalite placer also includes gold.

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