87. **Titanite** crystals (up to 3 cm in length) partly sprinlked from one side by crystals of uvarovite enriched in Al (*specimen has been studied*) on the clinochlore crystal crust within the crack in chromitite. 20 x 15 cm. Specimen: I.V. Pekov, #12779. Photo: M.B. Leybov.

4. MINERALS OF THE SARANOVSKOE DEPOSIT

Specimens are from Glavnoe deposit of the Saranovskoe deposit, Perm Krai, Middle Ural, Russia, if not other mentioned

There are one hundred and eleven mineral species (many of which occur in varieties that are interesting in various aspects) and more 30 minerals that can be characterized as poorly studied (Table 1). The minerals are briefly described below. They are grouped by chemical composition. Mineral species are **bold**, whereas varieties are *italicized*. Those whose presence at the deposit is questionable or poorly described (the published data are insufficient for reliable determination) are ***bold and italicized***, and accompanied by a question mark **(?)**. The poorly studied minerals are ***bold and italicized*** without question mark.

4.1. Native Elements and Intermetallic Compounds

Native silver, Ag was identified by Kobyashev in 1970 from the supergene zone as silver-white porous films and grains up to 1 mm in size associated with bornite and violarite and coating walls of the former calcite veins hosted in serpentinite.

Cu-bearing silver was found by Chaikovsky and Korshunov (2014) on the surface of the crystals of millerite as occasional grains up to a few microns in size associated with gold and antimony. The compositions were given, wt.% of Ag and Cu: 95.97 and 4.03; 83.96 and 16.04; and 87.38 and 12.62.

***Native gold (?),* Au** was reported by Chaikovsky and Korshunov (2014) as a micropowder and a film on the surface and within fractures cutting the millerite crystals from calcite veins. No identification information was published.

***Platinum (?),* Pt** was presumably described by Vakhromeev in 1936 in the sample from the Central chromite Layer as white irregular-shaped grains up to 0.08 mm with high hardness and reflection in a brecciated grain of chrome-spinel. Acids did not affect it. Most likely, it was laurite.

Osmium, (Os, Ir, Ru) was identified as a superaccesory mineral only in the lower chromitite layers in association with laurite (Ivanov *et al.*, 1996). It occurs as lamellae up to 10-12 micron in size enclosed in the grains of chrome-spinel. The compositions of native osmium from the chromite-bearing bronzite dunite (analyses 1 and 2) and porphyry chromitite of the Central Layer are wt.%: 2.43, 1.77, 2.81 Ru; 56.63, 56.47, 53.11 Os; 38.58, 38.23, 37.59 Ir; 0.09, 0.09, 0.25 Rh; 0.76, 0.84, 1.12 Pt; 1.08, 1.42, 1.85 Fe; 0.01, 0.00, 0.00 Ni; 0.36, 0.37, 0.44 Cu; 0.00, 0.31, 0.57 S; 0.17, 0.00, 0.91 As, totals 100.14, 99. 67, 99.67. As is seen, native osmium is enriched in Ir close to its boundary with ruteniridosmine.

Sulfur, S was found in 1970 as bright yellow fine-grained powder up to 5 mm close to the leached sulfide grains within dolomite and calcite veins in the samples from the

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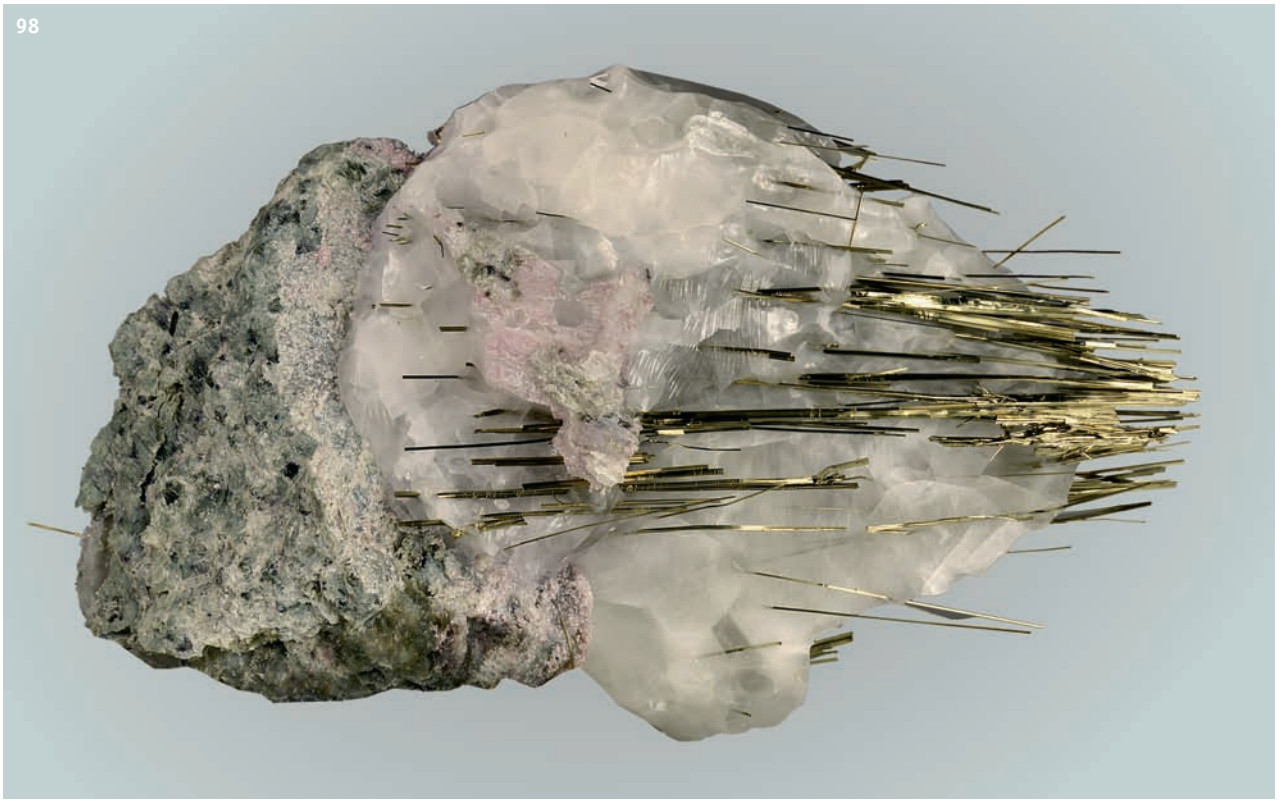

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101. Intergrowth of **millerite** crystals. Height of the specimen: 4.1 cm. Specimen: Mark Feinglos. Photo: J. Scovil.

On page 50:

98. **Millerite** crystals in calcite (*calcite was partly dissolved while specimen preparation*). 10 x 6 cm. Specimen: Fersman Mineralogical Museum, Russian Academy of Sciences, #92304. Photo: M.B. Leybov.

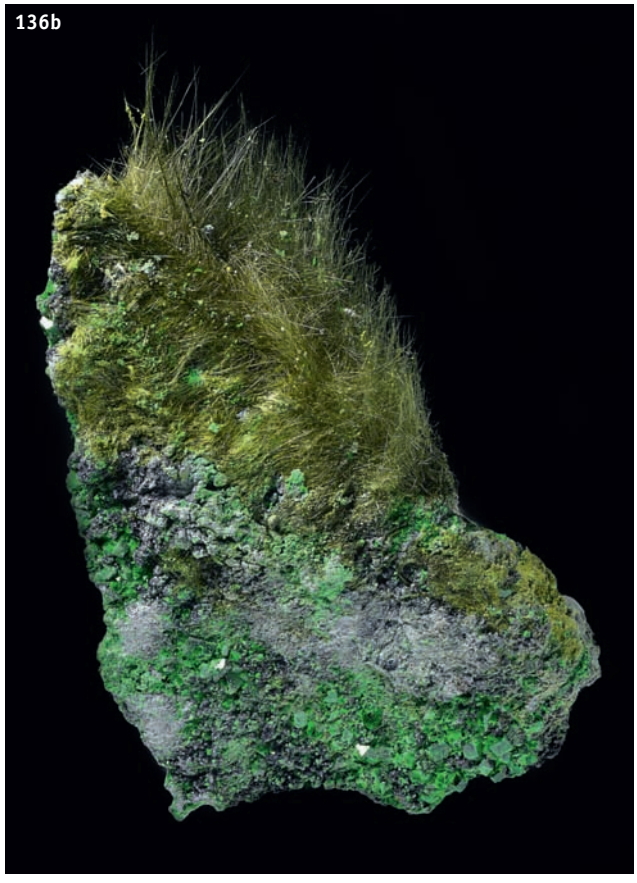
99. **Millerite** crystals in calcite (*calcite was partly dissolved while specimen preparation*). 5 x 7 cm. Specimen: I.V. Pekov, #2764. Photo: M.B. Leybov.

100. **Millerite** crystals with pink Cr-bearing chlorite and gray chromite (fragments of chromitite) within calcite (*calcite was partly dissolved while specimen preparation*). 7.5 x 5.5 cm. Specimen: I.V. Pekov, #893. Photo: M.B. Leybov.

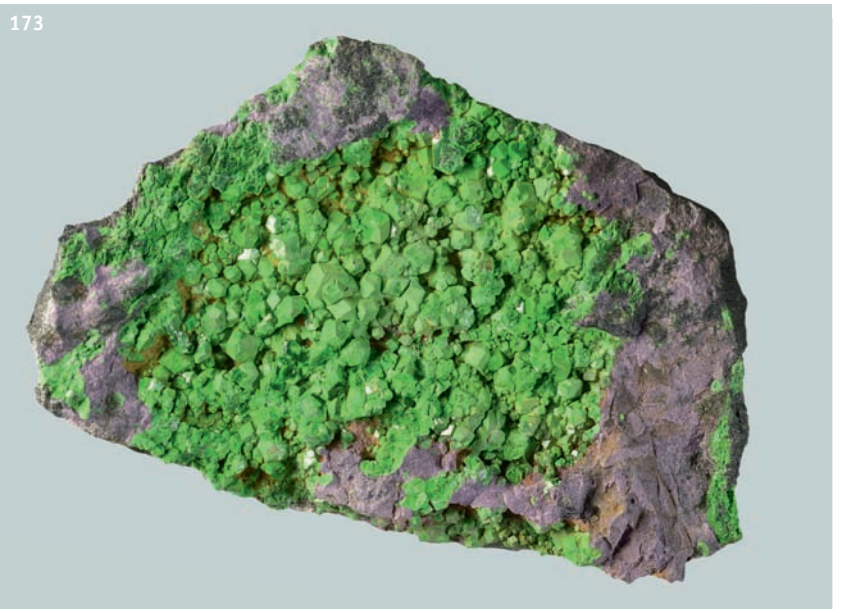
102. Bended **millerite** crystals within calcite covering the uvarovite brush. Image width 3 cm. Specimen: A.V. Donskov, #8245. Photo: M.B. Leybov.

135. Sheaf-like and near-parallel intergrowths of acicular to hair-like crystals of **redledgeite** (*the specimen was studied*) up to 2.5 cm in length on chromitite (from open space of a crack in chromitite);
cluster of uvarovite crystals "hangs" within the aggregate of redledgeite crystals.
Specimen: I.V. Pekov, #12774.
Photo: M.B. Leybov.

136. (a, b – two sides of the same specimen) Brush of acicular crystals of **redledgeite** (*the specimen was studied*) on chromitite partly covered by crystal crusts of uvarovite and chlorite (from open space of a crack in chromitite). 7 x 3.5 cm. Specimen: I.V. Pekov, #12772. Photo: M.B. Leybov.



173. Crust of **uvarovite** crystals with light-green dull surface on the fine-grained chlorite aggregate. 13 x 8 cm.
Specimen: V.I. Ermolenko, #G2186.
Photo: M.B. Leybov.



ranges from 0.1 to 9 mm[4], usually 1–3 mm. Uvarovite is powdered within milonitization zones.

Uvarovite graduates to *chromian grossular*; the Al_2O_3 and Cr_2O_3 contents are negatively correlated because of isomorphic substitution. Uvarovite is light to dark green and emerald-green. Its crystals are zoned occasionally. Uvarovite can be transparent, but more frequently it is cloudy. The luster is vitreous to dull and weak. The crystals with the major form dodecahedron *d* {110}, (Figure 164) are predominant. Narrow and occasionally broad faces of the trapezohedron *n* {211} are seen on crystals from a calcite vein (sample M-722). Crystal faces are commonly smooth, shining, and occasionally with striations and spirally vicinals; less frequently faces are dull with dissolution features.

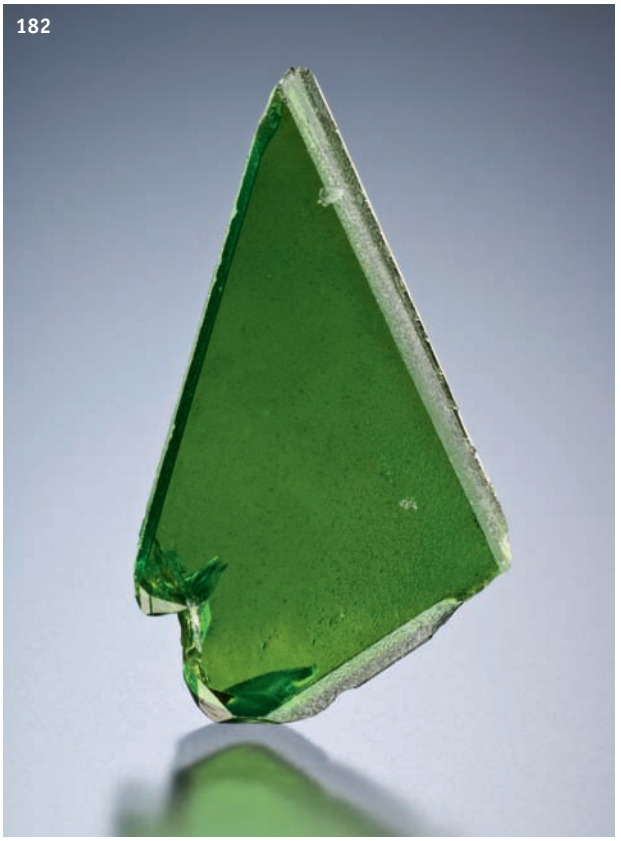
Pink chlorite at the base of crystal crusts and inclusions of chrome-spinel in the uvarovite grain cores are characteristic. The garnet described is associated with chro-

174. **Uvarovite** crystals (up to 0.7 cm) with clinochlore. Private collection.
Photo: M.M. Moiseev.

175. **Uvarovite** crystals (up to 0.5 cm) in calcite. Specimen and photo: M.M. Moiseev.

176. **Uvarovite** crystal outstanding in size for the Saranovskoe deposit (1.5 cm in diameter) with chlorite on chromitite. Specimen: T.G. Fattykhov, #106. Photo: M.B. Leybov.

[4] – The largest ideally-formed shining crystal of the Sarany uvarovite that I held in my hands is 1.1 cm across (*editor's note: I.V. Pekov*).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182. Platy interpenetration twin of **titanite**. 2.9 cm height.
Specimen: B. Larson. Photo: J. Scovil.

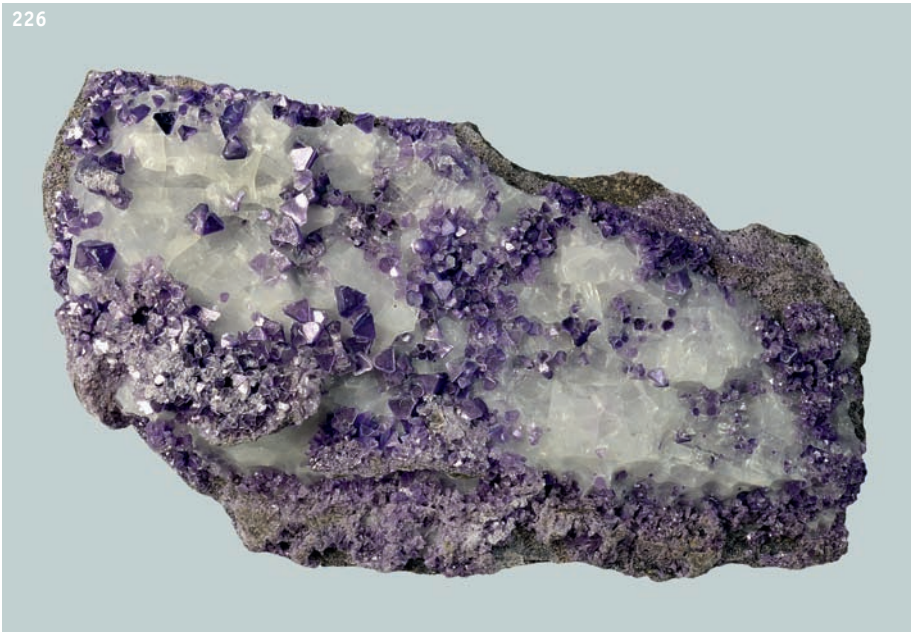
183. Twin of **titanite** of unusual for the Saranovskoe deposit prismatic form. 2.0 x 1.0 cm.
Specimen and photo: V.V. Levitskiy.

184. **Titanite** crystals on the crust of clinochlore with separate crystals of uvarovite and calcite. 13 x 7. cm.
Specimen: A.V. Kasatkin.
Photo: M.B. Leybov.

185. (a, b) **Titanite** crystals on the thin crust of violet Cr-bearing chlorite covering chromitite.
(b) specimen width 6.2 cm,
(a) enlarged crystal width 1.4 cm.
Specimen: J. & G. Spann.
Photo: J. Scovil.

222. Druse aggregate of **amesite** with unusually large for the Saranovskoe deposit crystals. 4.1 x 4.1 cm. Specimen: K.I. Klopotov, #2331. Photo: A.A. Kalinkin.

223. Brush of **amesite** crystals with **perovskite** crystals replaced by **rutile**. 14.5 x 11 cm. Specimen and photo: J. Fabre (FabreMinerals.com).



224. Brush of splitted crystals of **amesite** (up to 1 cm long) of acuminate form unusual for the Saranovskoe deposit. Private collection. Photo: M.M. Moiseev.

225. Multicolored crystals of amesite (up to 0.5 cm). Private collection. Photo: M.M. Moiseev.

226. **Amesite** crystals in calcite (*calcite was partially dissolved while preparation of the specimen*) on chromitite. 15 x 8 cm. Specimen: V.I. Ermolenko, #G3374. Photo: M.B. Leybov.

and fine-grained masses. Its individuals are short- or long-prismatic; crystals are hexagonal-bipyramidal and bytrigoinal, elongated, and sharply striated on the faces of trigonal pyramids. Near parallel crystals of amesite frequently overgrow faces {001} of corundophyllite (Figure 220). Amesite crystals are transparent or translucent. Strong alexandrite effect is characteristic of Cr-bearing amesite: at day light this variety is greenish gray to gray-blue, whereas at artificial electric yellow light it is bright lilac to deep purple. The deepest color of the core and sectored twins are very characteristic. Individuals reach 2.5 cm in length and 5 mm across.

The chemical composition of Cr-bearing amesite is wt.%: 21.80 SiO_2, 32.87 Al_2O_3, 1.76 Cr_2O_3, 0.45 Fe_2O_3, 0.47 FeO, 28.48 MgO, 13.32 H_2O^+, 0.66 H_2O^-, total 99.81.

The empirical formula is $(Mg_{4.08}Fe^{3+}_{0.04}Cr_{0.11}Al_{1.76})_{\Sigma 6.00}(Al_{2.02}Si_{1.98})_{\Sigma 4.00}O_{9.81}(OH)_{8.25}$.