

Ge-bearing minerals in rocks and ores of native iron from Dzhaltul intrusion (Siberian platform)

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There are two types of native iron in the Dzhaltul intrusion: ellipsoidal nodules in taxitic gabbro-dolerite, where native iron form sponges, and fine disseminations with graphite in dyke-like bodies of dolerite, which cut gabbro-dolerite [1, 2].

Ge is contained isomorphically into native iron, up to 0.15 wt.%. Ge content in tanite can reach 0.63 wt.% [1].

At the external contacts of dyke-like bodies of dolerite we found a unique association of tanite – wairauite (CoFe) – NiFeCo-alloy – cobaltpentlandite – orcelite ($\text{Ni}_{4.77}\text{As}_2$) – cabriite and determined; we also found that Ge content in tanite can vary from 1.02 to 1.15 wt.%, NiFeCo-alloy - from 0.58 to 1.28 wt.% and orcelite - from 0.89 to 1.03 wt.%. Grain sizes of these minerals range from 3 to 40 μm .

Also, in association with heazlewoodite we found a new phase of the following composition (wt. %): Ni – 65.44; Fe – 3.71; Cu – 5.03; Ge – 16.65; S – 8.8; Sb – 0.56. This mineral ($\text{Ni}_{4.43}\text{Cu}_{0.31}\text{Fe}_{0.26}\text{S}_5$) ($\text{S}_{1.09}\text{Ge}_{0.91}$)₂ form an angular grain in pyroxene, size 16x27 μm . This phase is the first finding of high-Ni sulfogermanide, unlike the well known high-Cu minerals (renierite, germanite, maikainite *et al.*).

Our studies show that Ge content in native iron ores varies from 0.1 to 51.8 ppm. There is a direct correlation between native iron ores and As-Ge-Ni-PGE [2, 3]. The location of Ge-bearing minerals with graphite and other rare minerals allowed us to suggest that they formed as the result of dissociation of hetero-organic compounds (HOC). The dyke-like bodies were a channel for reduced fluids of complex composition. Volatile HOC dissociated at a geochemical barrier being host taxitic gabbro-dolerites.

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[1] Oleinikov *et al.* (1985) *Native iron formation in platform basic rocks* (in Russian). [2] Ryabov *et al.* (2000) *Magmatic formations of the Noril'sk region* (in Russian). [3] Ryabov & Anoshin (1999) *Geology & Geophysics* **40**.

Stable oxygen isotope measurements of arsenic and selenium oxyanions

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Stable oxygen isotope ratios may be useful indicators of aqueous metal and nonmetal oxyanion transformations because their oxidation, reduction, and exchange reactions involve bond-breaking and bond-forming between the central metal and peripheral oxygen atoms, leading to kinetic or equilibrium isotope effects. This study is evaluating whether stable oxygen isotopes within arsenic and selenium oxyanions are sensitive to physical, chemical, and microbial transformations and whether specific transformation processes produce unique isotopic signatures.

Analytical methods have been developed for measuring $\delta^{18}\text{O}$ values of oxygen within arsenic and selenium oxyanions. Aqueous arsenate, arsenite, selenate, and selenite oxyanions are precipitated as silver or barium salts and pyrolyzed at 1450 °C during TCEA-GC-IRMS analysis. Current precisions for barium salts of selenium are less than 0.2 ‰. $\delta^{18}\text{O}$ values are being monitored for O exchange reactions with water, oxyanion sorption to minerals, microbial respiration, and abiotic redox transformation. Our preliminary results confirm that arsenate exchanges O with H₂O somewhat rapidly (half-life of <1 day), and this equilibrium process would likely override any kinetic isotope effect resulting from physical or chemical transformations.