Geophysical Research Abstracts
Vol. 19, EGU2017-2325, 2017
EGU General Assembly 2017

Oxygen regime of Siberian alkaline-ultramafic magmas

Igor Ryabchikov (1) and Liya Kogarko (2)

(1) IGEM RAS, Moscow, Russian Federation (iryabchikov@gmail.com), (2) GEOKHI RAS, Moscow, Russian Federation (kogarko@geokhi.ru)

Regimes of S2 and O_2 are decisive factors controlling behavior of chalcophile and siderophile elements in magmatic processes. These parameters play important role during magmagenesis and in the course of crystallization and fluid mass transfer in magma chamber.

Alkaline-ultramafic magmatism in Maymecha-Kotuy Province (Polar Siberia) is represented by giant intrusive complexes as well as by volcanics and dyke rocks, which include a well-known variety – meimechites. The latter are considered primary magmas of alkaline-ultramafic plutons in the region like for instance Guli intrusive complex.

Sulfur content in primitive magmas estimated from the analyses of melt inclusions in olivine megacrysts from meimechites is close to 0.1 %. fO_2 values calculated using olivine+clinopyroxene+spinel and spinel+melt oxygen barometers (1, 2) are 2-3 log units above QFM buffer. The relatively high oxygen potential at the early magmatic stage of alkaline-ultramafic Guli pluton provide predominance of sulfates among other forms of sulfur in the melt. This leads to the almost complete absence of sulfides in highly magnesian rocks. The oxidizing conditions exert important effect on behavior of many ore metals. At the stage of magma generation absence of sulfides in mantle materialresults in the presence of siderophile elements in metallic form and saturation of primary magmas in respect of metallic phases at an early stage of injection of the melt into the magma chamber. Later, under favorable circumstances during magma crystallization nuggets of precious metals may be formed.

During further evolution of magmatic system fO_2 and activity of oxidized sulfur decrease due to intensive crystallization of magnetite during the formation of koswites, then oxygen fugacity becomes even lower as a result serpentinization at a postmagmatic stage. These serpentization processes are caused by the displacement of reactions in the aqueous phase due to cooling towards the formation of methane and other reduced components and, possibly, with their concentration in the gas phase due to boiling at lowered pressure.

This leads to the appearance of late sulfides in the intergranular space of the investigated rocks. Sulfides are represented by pentlandite, monosulfide solid solution and heazlewoodite. Thermodynamic analysis of equilibria involving these minerals has shown that the oxygenpotential in the later stages is significantly reduced (up to three logarithmic units below QFM buffer at 300 ° C). The transition from an oxidizing to a reducing environment will contribute to the mobilization of many ore metals by aqueous fluids and then theirconcentrated deposition. This may be particularly important factor for gold, which is mobilized by fluid under oxidizing environment and precipitated due to the decreasing fO_2. Au is present in placers on the territory of the Guli complex.

Highly oxidized nature of the early phases of alkaline-ultramafic magmatic systems (high magnetite component of chrome spinel, high concentrations of ferric iron in pyroxene), and signs of the transition to a more reducing environment at a late stage (intensive crystallization of magnetite, occurrence of sulfur-deficient sulfides) can be considered as a potential prognostic signs of gold mineralization.

Russian Science Foundation (grant 15-17-30019) has supported this work.

1. I. D. Ryabchikov, Oxygen potential of high-magnesium magmas. Doklady Earth Sciences 448, 149 (Jan, 2013).
2. I. D. Ryabchikov, L. N. Kogarko, A new version of the spinel-olivine-pyroxene oxybarometer and extreme redox differentiation in magmatic systems of mantle sources. Doklady Earth Sciences 430, 248 (Feb, 2010).