Magnetite-hosted melt inclusions from phoscorites and carbonatites (Kovdor, Kola): A hydrous analog of Oldoinyo Lengai natrocarbonatites?

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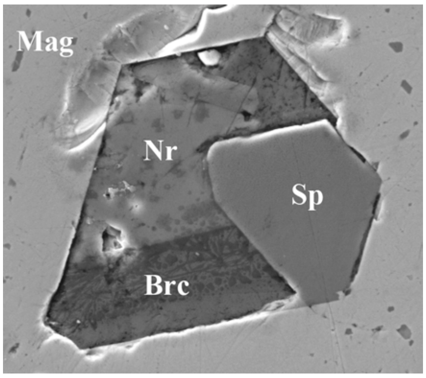
Kovdor is a well-studied Devonian complex from the Kola peninsula, Russia consisting of various ultrabasic and alkaline rocks, phoscorites and carbonatites [1]. Silicate minerals composing these diverse rocks often contain primary melt inclusions, particularly in carbonatites,with Na–K–Ca and Na–Mg carbonates as common daughter minerals [2]. Magnetite is a major to minor mineral in Kovdor rocks and SEM study of a mineral from the early-formed calcite-rich phoscorite and calcite carbonatite revealed presences of abundant negative-shaped polymineralic crystallized melt inclusions. SEM/ED analyses and Raman spectroscopy indicate occurrence of various minerals within inclusion including (1) oxides – spinel, baddeleyite, pyrochlore, (2) hydroxides – brucite, (3) silicates – phlogopite, (4) carbonates – nyerereite, eitelite, bradleyite, tychite, calcite, dolomite, (6) phosphates – apatite, (7) halogens – sylvite, and a number of unindentified mineral phases. Coexistance of brucite and unaltered nyerereite in crystallised melt inclusions (Fig.) indicate existance of hydrous and alkali-rich carbonate (±phosphate, sulphate) melt from which Kovdor phoscorites and carbonatites were crystallised.



Spinel (Sp), brucite(Brc), nyerereite (Nr) in magnetite (Mag).

[1] Krasnova *et al*. (2004) *Mineral Soc Series* 10, 99-132. [2] Veksler *et al*. (1998) *J Petrol* **39**, 2015-2031.

The effect of silicate melt composition on the volatile/melt partitioning of oxidized sulfur

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Sulfur is the third most abundant volatile element in magmas and it impacts society via volcanic degassing and by its essential role in the formation of magmatic-hydrothermal ore deposits. Therefore, it is necessary to understand the partitioning of S between silicate melts and exsolving volatile phases. The construction of a thermodynamic model that predicts the volatile/melt partition coefficients of S ($D_S^{volatile/melt}$) requires the understanding of the dissolution mechanism of S in silicate melts.

I conducted experiments at P=500 MPa and T=1240 °C in a piston cylinder apparatus to assess the effect of melt composition on $D_S^{melt/volatile}$, which was used as a measure of the silicate melt's affinity to dissolve oxidized sulfur species. Iron-free, three- and four-component silicate melts were equilibrated with H_2O-S volatiles with $X_S \leq 0.02$ at an fO_2 imposed by the Re-ReO_2 buffer. At these conditions, SO_2 is predicted to be the dominant sulfur species in the volatile phase and S^{6+} is the dominant oxidation state of S in the silicate melt. The values of $D_S^{melt/volatile}$ were calculated by mass balance. The results show that $D_S^{melt/volatile}$ increases exponentially with the degree of depolymerization of the silicate melt structure expressed with the parameter NBO/T=[Na+K+2(Ca+Mg)-Al]/(Si+Al). At a constant NBO/T of 0.4, $D_S^{melt/volatile}$ in equilibrium with sodium-aluminosilicate (NAS) melts is more than an order of magnitude higher than in equilibrium with calcium-aluminosilicate (CAS) melts, and more than two orders of magnitude higher than in equilibrium with magnesium-aluminosilicate (MAS) melts. The variation of $D_S^{melt/volatile}$ in equilibrium with various CNAS and MNAS melts indicates that alkalis are only availabe for sulfate complexation when they are present in excess compared to the required amount to charge balance for the Si^{4+} to Al^{3+} substitution in the melt structure. Calcium has moderate, Mg has very minor affinity to replace alkali elements in this charge balancing role.

At subvolcanic depth, decompression induced degassing of S is more efficient at reducing than at oxidizing conditions, in particular from mafic and peralkaline felsic melts. Effective transfer of S to the ore-forming environment from such magmas requires relatively low fO_2 or advanced degree of crystallization.

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