Genesis of a magmatic end-member IOCG deposit at El Laco

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The IOCG deposit group includes temporally and spatially associated hydrothermal and magmatic end-members which are associated with magmas belonging to the shoshonitic series, e.g., Olympic Dam, Missouri, El Laco, Great Bear Magmatic Zone. They have been interpreted to have formed from similar parental silicate magmas along contrasting petrogenetic paths involving either immiscible separation of Fe-P-O-S magma (e.g., El Laco) or Fe-Cu-S-rich aqueous fluid (e.g., Olympic Dam) [1].

A sample of unconsolidated tephra at El Laco is 86 mol% Fe_2O_3*, 12 mol% $FePO_4$, 2 mol% SiO_2 and minor S, REE. Ovoid cavities in hematite and magnetite ash particles are wholly or partially occupied by vesicular masses of Fe-phosphate, silica, and trace monazite interpreted to be finely crystallized melt with a composition nearly identical to that of the eutectic in the $FePO_4$-Fe_2O_3 system at 1 atm (84 mol% $FePO_4$, 1070 °C [2]). We have confirmed this by heating the tephra to 1081 °C in an evacuated silica tube, to produce Fe-P-O melt surrounding magnetite and hematite crystals. Ubiquitous occurrences of perlitic shoshonite glass form menisci partially lining cavities in oxide lapilli and bombs. Experimental equilibration of a synthetic shoshonite melt with magnetite, $FePO_4$, H_2O and CO_2 at 900 °C, 1 GPa produced immisicible high-silica rhyolite and Fe-P-O melt.

We suggest that deep crustal assimilation of Fe-rich sedimentary phosphorite by primitive potassic arc magma led to immiscible separation of Fe-P-O-S magma that later erupted and degassed violently, losing its H_3PO_4 and SO_3 and cooling as magnetite lava. Quenched airfall deposits retain some phosphate minerals. Large hydrothermal IOCG deposits are associated with felsic differentiates of similar potassic magmas that need not have previously generated immisicible Fe-P-O magmas.

[1] Tornos F, (2011) 11th SGA Biennial Meeting Let's Talk Ore Deposits, p. 26-28 [2] Zhang *et al* (2011) *J Amer Ceramic Soc* **94**, 1605-1610