Experimental determination of sulfide melt – silicate melt partitioning of metals at crustal conditions relevant to the formation of magmatic sulfide ore deposits

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Partitioning of chalcophile and siderophile elements between sulfide and silicate melts ($D^{sul/sil}$) has been largely investigated, mainly through experiments at mantle conditions and under low oxygen fugacities (fO_2 < FMQ-1). However, the formation of magmatic sulfide ore deposits occurs at crustal conditions and most likely at higher oxygen fugacities.

We present a new experimental set of partition coefficients for Ni, Cu, Pd, Ag, Pt and Au obtained at crustal conditions relevant to the formation of Noril'sk ore deposits (Siberia). Experiments were performed in internally heated pressure vessels equipped with a rapid quench device at 1200 °C and 700 MPa, under variable fO_2 (between FMQ-2 and FMQ+1). The specificity of this study is that (i) a natural, metal-undoped composition was used as starting material (a picrite from Noril'sk-1 intrusion), and (ii) the sufide melt segregated directly from the silicate melt, due to S addition. Magmatic textures were generally well preserved owing to the rapid quench.

The sulfide melt – silicate melt partitioning of metals can be expressed by an exchange equation of the form: $MO + 0.5\ S_2 = MS + 0.5\ O_2$. According to this equation, $D^{sul/sil}$ must be correlated with $\log fS_2^{1/2} - \log fO_2^{1/2}$, as generally shown in the litterature. However, such a clear correlation is hidden by the large variability in experimental conditions (T, P, composition of the sulfide and silicate melts). We therefore investigate the effect of each intensive parameter in order to present a new model applicable to the formation of magmatic sulfide ore deposits.