Element partitioning between sulphide and silicate liquids: the effect of silicate melt composition

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Our recent work (Kiseeva and Wood, 2013, 2015) demonstrated that $LogD_M$ ($(D_M=[M]_{sulph}/[M]_{sil})$ for trace element M should depend linearly on –n/2log[FeO], where n is the valency of M and [FeO] is the weight% FeO in the silicate melt. Most chalcophile elements fit the model reasonably well, but there are deviations from the ideal slope due to the presence of oxygen in sulphide when [FeO] is >~7%. Deviations correlate with relative lithophile or chalcophile character of M. This "oxygen effect" was parameterised by Kiseeva and Wood (2015) using the ε-model of non-ideal interactions in metallic liquids. A second significant compositional effect is that caused by the presence of Ni and Cu replacing Fe in the sulfide liquid. A simple ideal solution adjustment to the model suffices to correct for this effect.

In addition to temperature, we show here that silicate melt composition also affects partitioning behaviour. Crudely-speaking the degree of silica saturation is an important parameter, but we find that NBO/T is an inadequate description of the effect. Based on our experiments on 100 compositions at 1.5 GPa/ 1300-1700ºC we have found that CIPW norms are a good way of describing the silicate melt effects. Normative olivine is the most significant silicate parameter for chalcophile and moderately chalcophile elements such as Ag, Sb, Tl, Pb, Ge and V. Albite and orthoclase are significant for Cu, Cd, Cr and Ni. In order to account for the new components, we re-regressed all the available partitioning data and updated the equations from Kiseeva and Wood (2015).

Some examples of the additional compositional terms are: LogDCu ∝0.005Ab, LogDCo ∝ 0.002Ab + 0.003Q, LogDCd ∝0.003Ab + 0.002Ol, LogDSb ∝ -0.003Ol – 0.016Or, where Ab (albite), Q (quartz), Ol (olivine) and Or (orthoclase) are in weight % of normative minerals.

Kiseeva E.S., Wood B. J. (2013). EPSL 383, p. 68-81.

Kiseeva E.S., Wood B. J. (2013). EPSL 424, p. 280-294.