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Pressure, sulfur, and metal-silicate partitioning: The effect of sulfur species on the parameterization of experimental results

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Abstract

Performing well-controlled metal-silicate partitioning experiments at conditions directly simulating those of a deep magma ocean is difficult. It is therefore common to perform experiments at lower pressures and temperatures, which are used to determine the effects of salient variables. Often, these effects are determined by multiple linear regression of a data set covering a large range of *P*-*T*-composition space. In particular, these data sets often contain the results of experiments performed both with and without sulfur in the system. Data are often regressed, however, using a relationship based only upon the formation of oxide species in the silicate melt. Several studies have suggested that when sulfur is present in the system, siderophile trace metals may also dissolve into silicate melt as S-bearing species. We have derived a relationship for regressing experimental metal-silicate partitioning data that considers the formation of both oxide and sulfide species in the silicate melt. Using model data sets, we have assessed the ability of this relationship, and the more typical single-species relationship, to accurately parameterize data in which the formation of S-bearing species is important. We have also applied this new relationship to experimental results on the metal-silicate partitioning of gold and find it is able to reconcile the conflicting pressure dependencies of $\ln D_{Au}^{met/sil}$ found in previous studies.

Keywords: Sulfur, core formation, chalcophile, siderophile, speciation, high pressure