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Partial molar volumes for lanthanide sesquioxides in silicate melts

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Lanthanides are of great interest in igneous petrology as trace indicators of magmatic processes that control the origin and evolution of igneous rocks. A key to the petrogenetic modelling of magmatic processes and to determine the phase diagrams of lanthanide host phases is the accurate determination of the physico-chemical and thermodynamic properties of lanthanide-containing materials, such as the volumetric properties of lanthanide-bearing silicate melts. Therefore, we have undertaken to provide a new reliable volumetric data set for lanthanide-bearing silicate melts which allows the available models in the literature to be extended to lanthanide-bearing melts.

For this purpose, the densities of various lanthanide-bearing silicate melts distributed along various pseudo-binary joins have been measured using the double-bob Archimedean method. In a recent work, we have investigated the densities along the Na-disilicate - lanthanide sesquioxides pseudo-binary joins, where lanthanide sesquioxides are La_2O_3, Ce_2O_3, Pr_2O_3, Nd_2O_3, Sm_2O_3, Eu_2O_3, Gd_2O_3, Tb_2O_3, Dy_2O_3, Ho_2O_3, Er_2O_3, Tm_2O_3 and Yb_2O_3. In the present work, we extended the compositional range by investigating the densities along the one atmosphere anorthite-diopside eutectic - lanthanide sesquioxides pseudo-binary joins.

The present results show that the addition of any lanthanide leads to an increase in the melt density and that the melt density increases with increasing atomic number of the lanthanide. From the present preliminary data set, the molar volumes of these melts have been calculated and the partial molar volumes of each lanthanide sesquioxide have been determined using a linear regression through each pseudo-binary join. The partial molar volumes of the lanthanide sesquioxides preliminary estimated for the anorthite-diopside eutectic system will be compared to those obtained for the sodium

silicate system in order to investigate the possible compositional dependence of the partial molar volumes of lanthanide sesquioxides in silicate melts.