PERCOLATION OF Fe-FeS MELTS THROUGH AN OLIVINE MATRIX. A STUDY WITH A CENTRIFUGING PISTON CYLINDER

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Theories about the formation of the Earth's core postulate the segregation of molten iron-sulfide material through solid silicates [1]. The efficiency of this mechanism has not yet been proved and is still under discussion. The present study aims to establish the percolation threshold [2] for a simplified composition representative of the Earth's core and silicate mantle and to verify whether and under which conditions buoyancy driven segregation of such melts is a feasible process. Starting materials are iron-sulfide powder (on the eutectic composition of the Fe-FeS system) mixed with natural (S. Carlos) olivine powder. Experiments were performed in a standard end-loaded piston cylinder and in the newly developed centrifuging piston cylinder. With the centrifuging piston cylinder it is possible to spin a small press (standard 14 mm diameter, salt-pyrex assembly) to a maximum speed of 2900 rpm (equivalent to an acceleration of 3000g) at experimental conditions to 1.5 GPa and 1300°C.

A series of static and centrifuge experiments were performed using iron-sulfide plus olivine mixtures in double Pt-Graphite capsules (highly reducing conditions). No oxygen was detected in the melt pools (EDS measurements performed with an EMPA, Jeol JXA-8200) after the experiments. BSE images of quenched samples show interconnection of the melt in samples with 20 vol. % of iron-sulfide, whereas at 10 vol. % the melt is located in isolated pockets and in triple junctions. Centrifuge experiments were performed with mixtures containing 20 vol. % of melt in an olivine matrix and an additional thin layer of pure iron-sulfide on top of the olivine-melt. No sign of a melt displacement towards the bottom of the capsule was observed, although theory predicts melt segregation velocities of about 40 mm/h at 100g [3]. A reason for this behavior could be a low surface tension of the metallic-anionic melt that hinders its mobility in the inter-grain space. In a different series of centrifuge experiments, on olivine plus silicate melt, we have shown, that melt segregates (towards the top of the capsule), proving that the experimental set-up is proper to study percolation in partially molten systems. Thus, the absence of segregation for the iron-sulfide melt cannot be ascribed to an experimental flaw.

In conclusion, percolation of metallic-rich melts through a solid silicate matrix does not seem a plausible mechanism for core formation in terrestrial planets (at least in absence of shear deformation) at reducing conditions.

References: [1] Ringwood A. E. 1990. In *Origin of the Earth and Moon*: 101-134. [2] von Bargen N. and Waff H. S. 1986. *Journal of Geophysical Research* 91: 9261-9276. [3] McKenzie D. 1989. *Earth and Planetary Science Letters* 95: 53-72.