



LAWRENCE
LIVERMORE
NATIONAL
LABORATORY

Diamond anvil cell experiments applied to the geochemistry of Earth's core formation

J. Siebert, F. Ryerson, D. Antonangeli, A. Corgne, A. Ricolleau, J. Badro, P. Weber

September 14, 2010

AGU Fall Meeting 2010
San Francisco, CA, United States
December 13, 2010 through December 17, 2010

Disclaimer

This document was prepared as an account of work sponsored by an agency of the United States government. Neither the United States government nor Lawrence Livermore National Security, LLC, nor any of their employees makes any warranty, expressed or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States government or Lawrence Livermore National Security, LLC. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States government or Lawrence Livermore National Security, LLC, and shall not be used for advertising or product endorsement purposes.

Diamond anvil cell experiments applied to the geochemistry of Earth's core formation

Julien Siebert¹, Frederick J. Ryerson², Daniele Antonangeli, Alexandre Corgne³, Angèle Ricolleau¹, James Badro¹, Peter Weber².

¹ *IMPMC, Université Pierre et Marie Curie, UMR CNRS 7590, Université Paris Diderot, IPGP, 140 rue de Lourmel, 75015 Paris, France*

² *Lawrence Livermore National Laboratory, 7000 East Avenue, Livermore, California, 94550, USA.*

³ *Laboratoire de Dynamique Terrestre et Planétaire, Observatoire Midi-Pyrénées - UMR 5562, 14 Avenue Edouard Belin, 31400 Toulouse, France*

The abundances of siderophile elements in the Earth's mantle are an imprint of the core formation in the early Earth. Thermodynamic expressions used to constrain the metal-silicate partitioning behavior of siderophile elements are mainly established from large volume press experiments that do not cover the predicted P-T space for core-mantle equilibrium. Diamond anvil cell is the only static technique capable of achieving required P-T conditions but until now its capabilities to perform quantitative metal-silicate partitioning experiments at extreme conditions has been untapped. We use protocols that effectively link high P-T diamond anvil cell with analytical techniques such as focused ion beam device (FIB); NanoSIMS; electron microprobe; transmission electron microscopes; and *in-situ* synchrotron X-ray diffraction measurements allow us to obtain quantitative data on element partitioning at superliquidus conditions above 30 GPa and 3000 K. Here we present our advances in both experimental and analytical methods. We look at the partitioning of 6 siderophile elements (Ni, Co, Cr, V, Mn, and Nb) that have been extensively studied at lower P-T conditions and constrain the solubility of light elements (Si and O) at these extreme conditions. We then update expressions that describe the partitioning behaviors of these elements to address the validity of main proposed core formation models (*i.e.* single-stage core formation model and continuous core formation model).

This work performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under Contract DE-AC52-07NA27344.