Composition of the Earth's core from density measurements of liquid iron alloys at megabar pressure

G.MORARD[1,*], D.ANTONANGELI[1], J.SIEBERT[1], D. ANDRAULT[2], N.GUIGNOT[3], F.GUYOT[1,5] AND G.GARBARINO[4]

[1]Institut de Minéralogie et de Physique des Milieux Condensés, Univ. Pierre et Marie Curie, Paris, France
*correspondence: guillaume.morard@impmc.jussieu.fr
[2]Laboratoire Magmas et Volcans, Clermont-Ferrand, France
[3]Synchrotron SOLEIL, Gif-sur-Yvette, France
[4]European Synchrotron Radiation Facility, Grenoble, France
[5] Institut de Physique du Globe de Paris, France

The liquid core of the Earth extends between 2900 km and 5150 km depth accounting for 18% of the total planetary volume. Although mostly composed of iron, it contains impurities that lower its density and its melting temperature with respect to pure Fe. Knowledge of the nature and content in light elements (O, S, Si, C) in the core has major implications for establishing the bulk composition of the Earth and for building models of Earth's differentiation.

Angle dispersive X-ray diffraction experiments in double-sided laser heated diamond anvil cell (LH-DAC) were performed at ID27 beamline at the European Synchrotron Radiation Facility (ESRF) in Grenoble. *In situ* investigations enable determination of melting temperature and structural and density properties of the Fe-based alloys. Experiments were performed on an Fe-Ni-S alloy up to 94 GPa and 2800 K and on an Fe-Ni-Si alloy up to 91 GPa and 3200 K. New results on Fe-O and Fe-C liquid alloys will be also presented.

The appearance of a diffuse X-ray scattering signal at wavevectors of about 30 nm^{-1} was used to determine the onset of melting. Extrapolations of measured melting curve up to the core–mantle boundary pressure yielded values of 3,600–3,750 K for the freezing temperature of plausible outer core compositions. We extracted densities and compressibilities from the diffuse X-ray signal scattered by the liquid up to megabar conditions, using a method developed for diamond anvil cells by Eggert and collaborators [1]. The obtained equations of state parameters indicate that sulfur, and not silicon, can more easily account for the differences in density and bulk modulus between pure iron and a reference Earth seismic model. This challenges traditional Earth's accretion and differentiation models, that do not foresee S as major light element in the core. These results thus rather argue for strong disequilibrium Earth formation mechanisms.

[1] Eggert, Weck, Loubeyre and Mezouar (2002), *Phys RevB*, 2002, **65**, 174105

Origin of noble gases on Earth: a mixture of Solar, solar wind implantation and phase Q

MOREIRA MANUEL[1] AND CLAIRE ROUBINET[2]

[1]moreira@ipgp.fr
[2]roubinet@ipgp.Fr

The origin of noble gases on Earth is debated since more than 70 years and the observation that the noble gas elemental relative abundances are not solar [1]. Mantle and atmospheric noble gas isotopic compositions are neither chondritic nor solar, at the exception of the neon isotopic ratio that shows a value intermediate between the chondritic components and the solar value, wlode to the neon B value. Since the works of Cafee *et al.* [2] and Holland *et al.* [3], the question of the terrestrial primordial isotopic composition of the Kr and Xe is discussed. They show that the primordial mantle might have been chondritic instead of atmospheric. In addition to that, Pujol *et al.* [4] have shown that the archean atmosphere might have been chondritic, suggesting a xenon loss fractionation accompanied with mass fractionation. A major implication of these observations is the massive subduction of atmospheric xenon in the whole mantle.

We show in this study that the Ne and Ar were added to the parent bodies of the Earth by solar wind implantation. Atmospheric Kr isotopes, on contrary, suggest a late veneer of cometary material with a solar composition added to the chondritic krypton degassed from the mantle. The primordial noble gas compositions on Earth are therefore a mixture between the chondritic, solar, and implanted solar wind. An unknown isotopic fractionation has modified the isotopic composition of the xenon of the atmosphere, without affecting the other noble gases. Subduction of atmospheric Kr and Xe into the whole mantle is required in such a model.

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