Compressibility change in Fe-rich melt and implications for core formation models

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Density measurements

The physical and chemical properties of molten iron play a key role in core formation, the largest chemical differentiation event in the early evolution of the Earth [1]. We have performed density measurements of molten iron containing an appropriate amount of light elements (5.7 wt.% carbon) up to 8 GPa using the *in situ* X-ray absorption technique [2, 3].

Discussion of the results

A liquid–liquid transition is identified by a significant compressibility increase in the vicinity of the δ-γ-liquid triple point at 5.2 GPa [4]. The observed increased compressibility of the melt is consistent with the reported molar volume difference between δ and γ phases that increases by a factor of 2 along the Fe melting curve between 0 and 5 GPa [5].

This transition pressure coincides with a marked change in the pressure evolution of the distributions of nickel, cobalt and tungsten between liquid metal and silicate melt that form a cornerstone of geochemical models of core formation. The identification of a clear link between molten metal polymorphism and metal-silicate element partitioning implies that reliable geochemical core formation models will need to incorporate the effects of these additional liquid metal transitions.

[1] Stevenson (2008) *Nature* **451**, 261–265. [2] Katayama (1996) *High Pressure Res.* **14**, 383–391. [3] Sanloup *et al.* (2000) *Geophys. Res. Lett.* **27**, 811–814. [4] Sanloup *et al.* (2011) *Earth Planet. Sci. Lett.* accepted. [5] Besson & Nicol (1990) *J. Geophys. Res.* **95**, 21717–21720.

Diurnal cycle of Strontium/Calcium ratio in a giant clam shell: A super-fine pyrheliometer

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Insolation is an important meteorological parameter and a primary determinant of the Earth's climate system. The historical record of insolation in tropical and sub-tropical regions is short. Moreover, it remains difficult to extract solar radiation from a past marine environmental proxy, even though past seawater temperature [1], salinity [2], pH [3], and nutrients [4] were successfully estimated from geochemical data of biogenic marine carbonates such as coral skeletons, foraminifera tests, and mollusk shells. Herein, we describe the precise analysis of Sr/Ca ratio by using a NanoSIMS [5] with 2 micro-meter resolution in a cultivated giant clam shell exhibiting striking diurnal variations, elevated as high as 25% relative to the mean, associated with regional hourly solar radiation. This is the finest proxy among all data ever published. Annual variation of the Sr/Ca ratio is also observed in the sample by a 10 micro-meter spot with 50 micro-meter interval, again correlated with daily insolation record with similar amplitude. Light enhanced calcification and elemental transportation processes in giant clam and symbiotic algae may explain these diurnal and annual variations. Therefore, the Sr/Ca ratio of a giant clam shell might be a useful paleo-chemical-pyrheliometer.

[1] T. Felis *et al.* (2004) *Nature* **429**, 164–168. [2] N.J. Abram *et al.* (2007) *Nature* **445**, 299–302. [3] A.K. Tripati *et al.* (2009) *Science* **326**, 1394–1397. [4] H. Ren *et al.* (2009) *Science* **323**, 244–248. [5] Y. Sano *et al.* (2005) *Anal. Sci.* **21**, 1091–1097.