

## TAPP: Retrograde Mg-perovskite from subducted lithosphere?

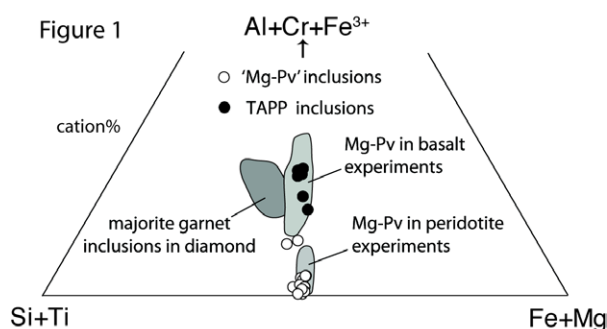
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A phase with a tetragonal structure and compositional similarities to garnet was discovered as inclusions in diamonds over a decade ago, and given the acronym TAPP (Tetragonal-Almandine-Pyrope-Phase) [1]. TAPP has no known stability field, having never been synthesized in high P-T experiments, but a narrow stability region near the base of the transition zone has been postulated on the basis of associated inclusions [2]. Crystallographic arguments support the possibility that TAPP may be a retrograde phase formed when a higher pressure mineral was trapped in diamond then subjected to lower P-T conditions during ascent through the transition zone or upper mantle [3]. Here we propose that single-phase TAPP inclusions originated as Mg-perovskite (Mg-Pv) formed in deeply subducted mafic lithosphere.

Rare MgSiO<sub>3</sub> inclusions found in ultradeep diamonds are considered to represent former Mg-Pv, and their compositions generally match well with Mg-Pv formed in high P-T experiments on ultramafic bulk compositions (Fig.1). Likewise, the bulk compositions of TAPP inclusions match well with the trivalent-cation enriched Mg-Pv that forms in experiments on mafic compositions; Ti-rich TAPP inclusions are nearly exact matches to Mg-Pv expected to form in subducted MORB. REE abundances measured in a TAPP inclusion [4] also closely match those found in Mg-Pv inclusions [5]. Preliminary diamond anvil cell experiments on an average TAPP composition indicate formation of nearly phase-pure Mg-Pv at lower mantle conditions.



[1] Harris *et al.* (1997) *Nature* **387** 486-488. [2] Hutchison *et al.* (2001) *Contrib. Min. Pet.* **142** 119-126. [3] Finger & Conrad (2000) *Am. Min.* **85** 1804-1807. [4] Bulanova *et al.* (2010) *Contrib. Min. Pet.* **160** 489-510. [5] Harte *et al.*, (1990) *Geochem. Soc. S. Pub.*, 1999: p. 125-153.

## Metal-silicate partitioning of iodine at high pressures and temperatures: Implications for the Earth's core

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The two major causes for the difference in elemental concentrations between the silicate Earth and primitive undifferentiated chondritic silicate material are volatility and/or partitioning in the Earth's core. Compositional models of the Earth [1,2,3] suggest that the depletion of some of the halogens in the Bulk Silicate Earth (BSE) are greater than can be explained by their volatility. The calculations indicate that up to 85% of the Earth's iodine could reside in the core but to date there is no published high-pressure liquid-metal, liquid-silicate partitioning experimental data for iodine to test this idea.

We present the first results for metal silicate partitioning behaviour of iodine. Candidate CI-like glass mixtures of silicate and iron (+iron alloy) were heated in a Laser Heated Diamond Anvil Cell (LHDAC) at pressures between 2-20GPa and at ~3000 K. No pressure dependence of the partition coefficient,  $D_{\text{liquid-metal/liquid-silicate}}$  was observed within this range, but the composition of the metal phase was shown to have an effect. When the dominantly iron liquid was alloyed with Ni, S, O and Si there was an increase in iodine solubility in the metal. Iodine exhibited siderophile behaviour over all the PT conditions with  $D_1 = 1.22 \pm 0.73$  (2 s.d.) (Fe metal) and  $D_1 = 4.40 \pm 1.36$  (2 s.d.) (Fe-alloy). In conjunction with a "best estimate" concentration for iodine in the bulk silicate Earth (BSE), it is calculated that the core could be a significant reservoir for iodine, depending on the model for separation.

The implications of iodine's siderophile behaviour are considered with regards to the decay system <sup>129</sup>I - <sup>129</sup>Xe ( $T_{1/2} = 15.7$ Myr). As it is thought the core would have formed while <sup>129</sup>I was still extant, preliminary modelling has been carried out to assess the core's radiogenic <sup>129</sup>Xe budget and the effect this may have on mantle xenon reservoirs and closure ages.

[1] Kargel & Lewis (1993), *Icarus* **105**, 1-25 [2] McDonough & Sun (1995), *Chemical Geology* **120**, 223-253 [3] McDonough (2003), *Treatise on Geochemistry*, 547-568