

## Granite compositions in a veined-lower mantle, as indicated by mineral inclusions in diamonds from Juína deposits, Brazil

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The mineral inclusions of diamonds are the only natural samples from lower mantle. Recent studies of the inclusions in the alluvial diamonds from Juina province, Brazil, which are believed to be formed in the lower mantle and in the transition zone, have shown the presence of K- and Na-bearing inclusions with structures corresponding to hollandite and composition equivalent to those of alkali feldspars. Compositional determinations were obtained with electron microprobe, and structural information from RAMAN microspectroscopy. Hollandites, stichovite, phengite, CAS-phase, titanite and Na-Ca-garnet/cpx are in composite inclusions with hydrous MgFeAl-perovskite and almandine-grossularite garnet; isolated inclusions of ferropericlaase, ilmenite and pigeonite-augite clinopyroxene were also observed. Na- and K-hollandite can also occur as isolated inclusions. K- and Na-hollandite + SiO<sub>2</sub> in the same diamond grains indicate the presence of melts crystallizing, at the lower mantle, products with compositions corresponding to granitic rocks. The association with abundant inclusions of ferropericlaase and MgFeAl-perovskite suggests a highly heterogeneous mantle, probably with a 'veined'-structure similar to that suggested by Foley<sup>(1)</sup>, but, with veins of granite composition. The growth of diamonds in the parts of mantle where melting occurred and these veins were formed, is consistent with high concentrations of volatiles, probably originated from subducted oceanic lithosphere.

<sup>(1)</sup> Foley, SF (1992) *Lithos* 28:435-453.

## Crystal-melt partitioning of REE and evolution of Martian melts

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REE concentrations in the SNC (Shergottite-Nakhilite-Chassignite) meteorites preserve information about the nature of their source regions, now widely believed to be the Martian mantle [1]. In particular, the influence of major phases on partial melting and fractional crystallisation can be inferred from REE concentrations in the meteorites, provided mineral-melt partition coefficients are known for each element under the appropriate conditions, and provided the REE concentrations (assumed chondritic) of the source region are known. Such information may then be combined with knowledge of the pressure-temperature-dependences of the inferred phase's stability to yield constraints on the depth of melting within the Martian mantle.

We have experimentally determined mineral-melt partition coefficients for a wide range of trace elements, between a synthetic Martian primary melt [2] and each of the conjectured major mantle-forming minerals (olivine, orthopyroxene and clinopyroxene) [3]. Experiments were conducted in a piston-cylinder apparatus at 15 kbar pressure, 1340°C, in graphite capsules. The  $fO_2$  conditions approximate those anticipated during melting of Mars' mantle [4]. The new data have relevance for questions concerning the degree of relatedness among the SNC meteorites, and by extension the extent of heterogeneity within the Martian mantle.

In addition to their application to Mars specifically, these new partitioning data provide a test of the Wood and Blundy partitioning model [5] for iron-rich systems, and of its extension to similar situations for which experimental data are not currently available. Data for clinopyroxene in particular show close agreement with the model (for trivalent cations occupying the M2 site), with a maximum partitioning value ( $D_o$ ) of 0.31, and an ideal radius ( $r_o$ ) 0.97Å similar to the values reported for terrestrial clinopyroxenes under similar conditions [5].

[1] Treiman *et al* (2000). *Planetary and Space Science*, 48(12-14), 1213-1230. [2] Bertka and Holloway (1993a). *Contributions to Mineralogy and Petrology*, 115(3), 313-322. [3] Bertka and Holloway (1993b). *Contributions to Mineralogy and Petrology*, 115(3), 323-338. [4] Filiberto, *et al* (2010). *Geophysical Research Letters*, 37(13). [5] Wood and Blundy (1997). *Contributions to Mineralogy and Petrology*, 129(2-3), 166-181.