Melt compositions and processes in the kimberlite provience of southern West Greenland

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The kimberlite province of southern West Greenland (600-560Ma) comprises kimberlite *sensu stricto* on the Archean craton and aillikites on the paleoproterzoic sheild to the North. Carbonatite melt and xenocrystic olivine dominate the kimberlite *sensu stricto* occurrences of the Manitsoq region [1] whilst the silica content and H_2O/CO_2 ratio of the bulk rocks increases towards Sisimuit [2, 3]. A common carbonatite rich end-member is implicated [2]. This is in contrast to the prevailing dogma of a continuum from carbonatite though aillikite to kimberlite with increasing melting degree [4].

The authors have demonstrated that a process of DFC (digestion fractional crystallisation) whereby the cognate olivine crystallisation is coupled to entrained xenocrystic orthopyroxene assimilation is a key process during the formation of the Majugaa occurrence of the Manitsoq region [5]. Mass balance considerations are here applied to the Majuagaa bulk rock in term of the DFC mechanism obtaining an estimate of parental melt and magma composition for the Majuagaa kimberlite.

We use bulk rock major and trace element geochemistry together with mineral chemistry to investigate the range of melt compositions involved in the region. Melting models involving introduction of a carbonatite melt are applied to inferred lithospheric mantle compositions based upon nodule assemblages. Compositional variations across the southern West Greenland province are explained by interaction of an aesthenospheric carbonatite melt with lithospheric mantle. The major and trace element budgets are understood as a combination of melting regime together with mixing and reaction between the primary melts and the dispersed xenocryst assemblages. Variations of the mineral assemblages of the cognate groundmass are similarly explained.

[1] Nielsen & Sand (2008) *Can. Min.* **46**, 1043–1061. [2] Nielsen *et al.* (2009) *Lithos* **112S**, 358–371. [3] Tappe *et al.* (2011) *EPSL* doi: 10.1016/j.epsl.2011.03.005. [4] Dalton & Presnall (1998) *J.Pet.* **39**, 1953–1964. [5] Pilbeam *et al.* In prep.

Evidence for metasomatic enrichment in the oceanic lithosphere and implication for the generation of enriched reservoirs

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Recycled metasomatized deep portions of oceanic lithosphere are potential candidates for enriched fertile mantle sources accounting for the overall enriched geochemistry of OIBs. However, the mechanisms of metasomatic enrichment in the oceanic lithosphere are poorly constrained. Here we report new petrological data that support the existence of metasomatic veins in the oceanic lithosphere, and explore the isotopic evolution of metasomatized lithosphere after its recycling and storage in the convecting mantle.

Metasomatic veins in the oceanic lithosphere are documented by cpx xenocrysts in accreted basaltic sills from northern Costa Rica. New field observations, ^{40}Ar-^{39}Ar radiometric dating, biostratigraphic ages and geochemical analyses indicate that the sills represent a possible, ancient analogue of petit-spot volcanoes formed by oceanic plate flexure offshore Japan [1]. The cpx xenocrysts are interpreted as relic of metasomatic veins based on their compositions which are similar to cpx from metasomatic veins observed in mantle outcrops and xenoliths. We interpret the formation of these veins as an early stage of the process that led to formation of the basaltic sills; some low degree melts do not reach the surface but differentiate within the lithosphere and form metasomatic cumulates (i.e. veins).

The generation of low degree melts at the base of the lithosphere by plate flexure is likely to represent a common mechanism in the oceanic lithosphere. Our data suggest that oceanic lithosphere is metasomatized before subduction. Monte Carlo simulations of this enrichment process [2] show that such metasomatized oceanic lithosphere is highly enriched in incompatible trace elements and its recycling and storage for 1 to 1.5 Ga could produce an enriched mantle reservoir with trace element and isotope compositions similar to HIMU mantle 'end-member'.

[1] Hirano *et al.* (2007) *Science* **313**, 1426. [2] Pilet *et al.* (2011) *J.Pet* doi: 10.1093/petrology/egr007.