^{13}C–depleted diamonds in Jericho eclogites: Diamond formation from ancient subducted organic matter

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The high-MgO, diamond-bearing eclogites from the Jericho kimberlite in the northern Slave craton are unique in their high Mg# (82-87), high incompatible element contents, radiogenic Sr isotope ratios, and abundant diamonds (up to 20 modal %) that contain lower-Mg garnet inclusions (Mg#~54). As first noted by [1], these diamonds have the lightest carbon isotope compositions ever reported for diamonds (δ^{13}C = -37 to –41‰). Although upcoming SIMS δ^{13}C analyses will help delineate the mechanism of diamond formation, we note that δ^{13}C values of ca. –40‰ cannot reasonably be explained by Rayleigh-style fractional crystallization of diamond at mantle temperatures (T>800°C) from a parental fluid isotopically heavier than –35‰. Thus, these Jericho diamonds require the existence of a strongly ^{13}C-depleted carbon reservoir beneath the northern Slave craton.

The δ13C of organic carbon in modern marine sediments is ~ –20‰ [2], and therefore not a viable carbon source for the Jericho diamonds. Consequently, [1] invoked a heretofore unidentified, highly localized and ^{13}C-depleted carbon source for the Jericho high MgO eclogitic diamonds. We suggest that this anomalous carbon source may have been organic carbon formed by methane fixation by methanogenic bacteria in the Neoarchean (ca. 2.7 Ga) or Paleoproterozoic (ca. 2.0 Ga) times, which are characterized by δ^{13}C values as low as –50‰ [2, 3]. Interestingly, these time periods broadly correspond to hypothesized subduction events beneath the Slave Craton.

We propose that the protoliths of the high-MgO Jericho diamond eclogites were similar to those of common 'basaltic' eclogites, but melt depletion coupled with peridotite chemical equilibration produced the high-MgO compositions. Diamond formation was coincident with a semi-cryptic metasomatic event, which trapped some of the original, low-Mg eclogitic garnet and produced the incompatible-element-rich and radiogenic nature of the eclogites. The ca. -40‰ organic carbon may have been intrinsic to slab eclogitization during Neoarchean and/or Paleoproterozoic subduction events. Alternatively, the eclogites may have been older and metasomatized by slab-derived fluids generated during Neoarchean or Paleoproterozoic subduction events.

[1] De Stefano *et al*. (2009) *CMP* **158**, 295–315 [2] Freeman (2001) *in* Stable Isotope Geochem. **43**, 579–97. [3] Eigenbrode & Freeman (2006) *PNAS* **103**, 15759–64.

Heterogeneity in the mantle source of La Réunion Island

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Piton des Neiges (PdN) and Piton de la Fournaise (PdF) volcanoes (La Réunion Island, Indian Ocean) are famous to produce lavas considerably more homogeneous than other hotspots worldwide. Their products show narrow ranges of ^{87}Sr/^{86}Sr (0.70397 – 0.70436), ε_{Nd} (3.1 – 4.6) and ε_{Hf} (7.9 – 11.0) throughout the whole 2 Ma volcanic history of the island [1, 2, 3, 4, 5]. Modest variations in Pb isotopes were identified which do not disrupt much the homogeneous picture of the magmas [3, 4].

We report for the first time Sr-, Nd-, Hf- and Pb-isotope compositions for submarine basalts dredged along the NE rift zone of PdF. The composition of the samples is enriched in incompatible elements ($1.10<K_2O<1.44$, $0.35<P_2O_5<0.56$, $2.58<(La/Sm)_{C1\ norm.}<2.93$) and radiogenic Sr, Nd and Hf [^{87}Sr/^{86}Sr = 0.70460–0.70476, ε_{Nd} = 2.9–3.6 and ε_{Hf} = 7.5–8.3] and isotopically the most radiogenic ever published (Fig. 1).

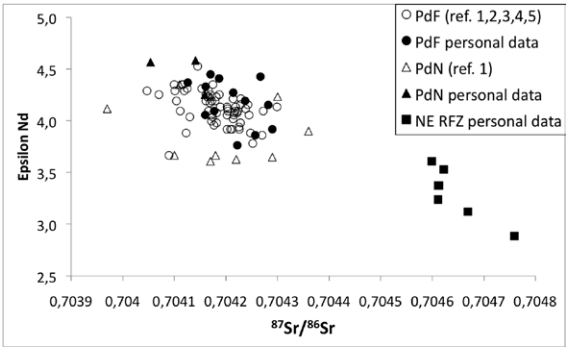

Figure 1: Plot of ^{87}Sr/^{86}Sr ratio vs ε_{Nd} values.

Pb isotope data (^{206}Pb/^{204}Pb = 18.943 – 18.974; ^{207}Pb/^{204}Pb = 15.598 – 15.606; ^{208}Pb/^{204}Pb = 39.045 – 39.141), design a specific trend in ^{206}Pb/^{204}Pb – ^{208}Pb/^{204}Pb with respect to PdN and PdF's trends. One of these samples is dated by K-Ar at 3.3 Ma corresponding to the oldest dated rock of all the edifices. Our new data shed lights on the existence of a third volcano at La Réunion Island.

[1] Fisk *et al*. (1988) *JGR* **93**, 4933–4950. [2] Albarède *et al*. (1997) *J. Petrol*. **38**, 171–201. [3] Bosch *et al*. (2008) *EPSL* **265**, 748–768. [4] Vlastélic *et al*. (2009) *JVGR* **184**, 63–78. [5] Pietruszka *et al*. (2009) *J. Petrol*. **50**, 661–684.