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A melt inclusion study in primitive olivines from the adventive cones of the Piton de la Fournaise volcano, La Réunion Island : Implications for the nature of the Réunion mantle plume

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According to Courtillot et al. (2003), the mantle plume that forms the Réunion hot spot originates from the deepest part of the lower mantle. Based on the isotopic compositions of the lavas, this long-lived plume appears relatively homogeneous during the last 65 My (e.g Fisk et al., 1988), and is believed to correspond to an ubiquitous mantle component common to ocean island basalts (e.g Bosch et al., 2008). Here, we give additional information on the nature of the Réunion mantle plume by studying the chemical composition of silicate melt inclusions trapped within early-formed, primitive olivine crystals (Fo>85%) from the adventive cones of the Piton de la Fournaise volcano. These cones have emitted distinct magmas from the historical lavas. In particular, we focus on very incompatible trace element ratios, which reflect the long-term characteristics of the basalt sources and do not depend on the age of the source. The results indicate that the trapped melts have primitive compositions (up to 10.55 wt.% MgO) relative to the lavas. They also suggest that the magmas found in the adventive cones originate from a common chemical source, corresponding to either (1) a homogeneous mixed source between different mantle components (HIMU, EM 1, EM 2 and DMM), or (2) a near-primitive less-differentiated mantle source. Some very incompatible trace element ratios (e.g Th/La, Nb/La) display values similar to the primitive mantle ones, giving thus further support for hypothesis (2), as also inferred by Vlastélic et al. (2006) and Schiano et al. (2012). If based on Ce/Pb and Nb/U systematics, Hofmann et al. (1986) argued that the sources of all oceanic basalts (MORB and OIB) have undergone continental crust extraction, we propose an intermediate origin for the Réunion plume, between a primitive-like mantle domain and a depleted one, almost not affected by the recycling processes.