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Three differentiations of a single magma at Piton de la Fournaise volcano (Reunion hotspot)

V. Famin (1), B. Welsch (1), S. Okumura (2), P. Bachèlery (1) and S. Nakashima (4)

(1) Laboratoire Géosciences Réunion (LSTUR), Université de la Réunion, Institut de Physique du Globe de Paris / CNRS, UMR 7154. 15 avenue René Cassin, BP 7151. 97715 Saint Denis messag Cedex 9. La Réunion, France. Phone: +262 262 938 204. Fax: +262 262 938 266. E-mail: vfamin@univ-reunion.fr (2) Institute of Mineralogy, Petrology and Economic Geology, Graduate School of Science, Tohoku University, Aoba, Sendai 980-8578, Japan. (3) Osaka University, Graduate School of Science, Department of Earth and Space Science. 1-1 Machikaneyama-cho,Toyonaka-shi, Osaka 560-0043, Japan. (4) Institut de Physique du Globe de Paris / CNRS, UMR 7154. 4, place Jussieu, 75252 Paris cedex 05, France.

Assessing whether the large chemical variability in Ocean Island Basalts (OIB) results from heterogeneous sources, contamination or differentiation is important for understanding hotspot dynamics. Here we present major element and volatile concentration analyses in melt and fluid inclusions from two recent picrite eruptions (February 2005 and December 2005) at Piton de la Fournaise volcano (La Reunion Island, Indian Ocean). Combined with literature data, our new data show that the entire range of major element compositions at Piton de la Fournaise may be explained by three depth-dependent magmatic differentiations of a single transitional precursory magma (9 – 11 wt% MgO; 0.5 – 0.8 wt% K_2O and 10 – 12 wt% CaO). The deepest differentiation ($>$ 4 km), controlled by the fractional crystallization of clinopyroxene + plagioclase, yields gabbros and basalts enriched both in compatible and incompatible elements. In a shallower storage zone ($<$ 2.5 km), differentiation of the transitional precursory magma is dominated by the fractionation of Fo_{83-85} olivines, yielding Mg-poor basalts at the top of the reservoir and picrites at the base. In cooling dykes and subsurface pockets ($<$ 0.6 km), Mg-poor basalts may themselves evolve into more differentiated melts by clinopyroxene + plagioclase fractionation. Magmas mixing or incorporation of xenoliths are not necessary to explain the major element chemical

diversity of the volcano. Because Piton de la Fournaise products are representative of OIBs in the Indian Ocean, the same differentiations likely occur at similar depths in other shield volcanoes. Our study shows that hotspot dynamics may be better understood by combining melt and fluid inclusion chemical analyses with bulk rock data.