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Godzilla Mullion: Plagioclase Systematics of a Back-arc Core Complex

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Godzilla Mullion is the largest known example of a large low-angle oceanic detachment fault, or Oceanic Core Complex (OCC). It is located in the back arc of the Izu-Bonin-Mariana (IBM) system, at the southern tip of the Parece Vela Rift in the Philippine Sea and covers an area measuring roughly 125km by 55km. A total of 11 academic expeditions have been conducted in the area, including two recent dredging cruises and a submersible dive cruise on the megamullion itself. Peridotites recovered from the mullion are divided petrographically into Fertile, Depleted, and Plagioclase-bearing groups (1). Plagioclase rimming spinel (or rather its low temperature pseudomorphs) is a strong indicator of melt stagnation in the lithosphere (2). For this reason, the extant thin section collection was surveyed to determine the prevalence and geographic distribution of melt impregnation on Godzilla Mullion. A total of 178 thin sections were studied from the Kairei KR 03-01, Hakuho Maru KH 07-09 and Yokosuka YK 09-05 cruises. In these, 45. 56% of all peridotites were found to be plagioclase bearing. This compares with the worldwide abyssal peridotite average of ~20%(2). The mullion is divided up into three regions, the proximal region (closest to termination), the medial region, and the distal region (furthest from the termination)(3).Observations by region provide that 53.45% (62 out of 116 samples) in the proximal region (15 dredges), 11.76% (2 out of 17 samples) in the medial mullion(3 dredges), and 25% (7 out of 28) in the distal mullion (5 dredges) show of evidence of plagioclase impregnation. Unpublished major element compositions of spinels from the samples studied support these plag-systematics. The distal, depleted portion of the mullion represents a robust mantle section that was still producing abundant melt and can be compared to typical oceanic spreading with its relatively normal percentage of plag impregnation. The medial, fertile portion of the mullion represents a steep falloff in melt productivity, to a minimum of about 5%(4). The proximal, heavily plag-impregnated portion of the mullion represents an increasing stagnation of melt into a lithosphere that was progressively thickening. This coincides with a change in character of the massif surface in the proximal region from a domed striated mullion surface to a massive, slab-type exhumation more typical of ultraslow spreading ridges.
(1) Ohara, et al., (2003) G3. 4 (7), 8611, 10.1029/2002GC000469.
(2) Dick (1989) Geol Soc. Lond. Spec. Pub. 42:71-105.
(3) Ohara, et al., (2009), Eos Trans. AGU, 90(52), Fall Meet. Suppl. Abst.Num. T33D-06
(4) Hellebrand, et al., 2001 Nature

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