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Estimates of the Extent and Amount of Melt in Lower Crustal "Magma Chambers" Beneath the East Pacific Rise and the Juan de Fuca Ridge

W. Crawford [1,2], S. C. Webb [3], J. A. Hildebrand [2]

[1] Laboratoire Geosciences Marines, IPGP, 4 Place Jussieu, Paris, 75252, France
[2] Scripps Institution of Oceanography, 9500 Gilman Drive, La Jolla, CA 92093-0205, USA
[3] Lamont Doherty Earth Observatory, P.O. Box 1000 61 Route 9W, Palisades, NY 10964, USA

We report across-axis variations in lower crustal shear velocities and the corresponding amount of melt within the East Pacific Rise at 9°N and the Cleft and Coaxial segments of the Juan de Fuca Ridge. Our data come from seafloor compliance measurements along and across the different ridges. Compliance is the seafloor deformation under ocean surface gravity waves and is approximately inversely proportional to the crustal shear velocity, making the measurements particularly sensitive to low velocity bodies and melt. The EPR measurements show an asymmetric lower crustal melt body (with an average shear velocity of 1.7 km/s) centered beneath the rise axis at 9°50'N, that shifts west of the rise axis as the EPR approaches an OSC to the south. Apart from this shift, the melt body is remarkably consistent in size and shape between 9°50'N and 9°30'N and perhaps as far south as 9°15'N. Just north of the OSC the melt body becomes anomalously wide and robust, spanning the 6 km distance between the two overlapping axes. The Juan de Fuca Ridge compliance measurements show a low velocity zone with shear velocity 2.5-3.0 km/s centered 3 km beneath the seafloor, indicating high temperatures but not necessarily melt. At the Cleft segment, the high-temperature body is centered at the rise axis and extends several km off-axis. A narrow region of much higher compliance at the rise axis may correspond to a narrow melt body or melt injection zone. Compliance measurements across the Coaxial segment axis reveal a cold lower crust on-axis and a Cleft-like low-velocity zone several km to the west, beneath the overlapping North Rift of Axial Volcano. These results suggest that the amount of lower crustal heating or melt is consistent over long distances along a given rise crest, but that the center of this heating/melt is not always aligned with the rise axis. These misalignments are associated with rise axis offsets, but it is unclear whether they are generated by or generate these offsets.