How melting, mixing and mush cause 4D variability in MORB compositions

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Geochemical data from (1) recent eruptive events sampled in high spatial density on the northern East Pacific Rise (EPR), Galapagos Spreading Center (GSC) and southern Juan de Fuca ridge (JdFR), (2) gabbroic xenoliths, and (3) olivine-hosted melt inclusions (MI) provide important insights into MOR mantle and crustal magmatic processes. Variations in MORB and/or melt inclusion geochemistry (e.g. volatile content) can be related to the location of the axial melt lens (AML) in the crust, which have recently been shown by seismic methods to occur throughout the crust at distances up to 10 Km off axis, and whose depth and chemistry are related to magmatic budgets. For example, AML segments along the 9-10°N EPR and Cleft segment of the JdFR, exhibit across-axis variability from the most primitive above the AML to more evolved and contaminated (by AFC) over off-axis melt lenses (OAML). The spatial distribution of more evolved lavas (and sometimes the volume of EMORB erupted) with distance off axis is in part controlled by the thermal distribution in the underlying crystal mush zone. CO_2+H_2O in olivine MI from mafic near-axis seamounts suggest crystallization depths up to 9 km below the seafloor and a range of parental melt types whereas MORB erupted on the ridge axis are more homogeneous and crystallize at shallower depths. Compositional variations suggest plumbing system differences between near-axis seamounts, seamount chains (e.g. Lamont and Vance), and ridges in degree of magma mixing and parent melt homogenization.