EVIDENCE OF RAPID GROWTH OF OLIVINE IN UNUSUALLY OXIDIZED INTRAPLATE MELTS FROM WESTERN MEXICO

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A unique suite of intraplate basalts from the Tepic-Zacoalco rift (TZR) in western Mexico, surrounding V. Sangangüey, have a geochemical signature that indicates an asthenospheric mantle source with no involvement of a slab-derived fluid. In the literature, these basalts have been identified as moderately high-μ and derived from a mantle source that includes recycled oceanic crust [1]. These basalts span a wide range of MgO contents (10-6 wt%) and yet compositional histograms of olivine phenocrysts in each sample consistently show unimodal patterns without breaks, and the most Fo-rich olivine in each sample is close to ~Fo_{89-90}, suggesting progressively higher melt ferric-ferrous ratios in melts with lower MgO. Surprisingly, textural and compositional evidence shows that the most Fo-rich olivine phenocryst in each sample grew from the melt and do not reflect incorporation of olivine xenocrysts (i.e., from mantle xenoliths). Phosphorous maps of the most Fo-rich olivine in each sample are underway to further test evidence of diffusion-limited growth (versus incorporation of mantle xenocrysts that should not display cryptic evidence of rapid growth). In addition, 1-bar experiments are underway to test the effect of undercooling (i.e., high crystal growth rates following a kinetic delay to olivine nucleation) on whether equilibrium partitioning of Mg^{2+}, Fe^{2+} and Ni^{2+} occurs between olivine and melt during rapid, diffusion-limited crystal growth, and over what time scales. Two key hypotheses are being tested in this study: (1) the most Fo-rich olivine in each basalt represent the first olivine to crystallize from liquids with compositions of the whole rock, and (2) these intraplate basalts were derived from a mantle source that included recycled oceanic crust that was relatively more oxidized than surrounding lherzolite. If the latter hypothesis is true, the recycled oceanic crust may be relatively young (≤ 600 million years) in order to reflect seafloor alteration under relatively oxidizing conditions [2].

[1] Diaz-Bravo et al. (2014) Geosphere **10**, 340-373 [2] Stolper et al. (2017) Nature Geosciences **553**, 223-227.