Towards an integrated geochemical-seismological image of melting at the southern margin of the Colorado Plateau

M.R. REID[1], S. RUDZITIS[1], J. BLICHERT-TOFT[2,3], AND A. LEVANDER[3]

[1]Northern Arizona University, Flagstaff, Arizona 86011, USA
[2]Ecole Normale Superieure de Lyon, 69007 Lyon, France
[3]Rice University, Houston, Texas 77005, USA

The Colorado Plateau (CP) in the southwestern USA is a region of high continental elevation and young volcanism. Aerially extensive (>8,500 km^2) basalt-dominated volcanic rocks of the San Francisco-Morman Mountain fields (SFMM) are located at the southern margin of the CP, with the latest activity occurring above the depth where the LAB shoals to ~70 km (Fig. 1). The volcanic fields also lie above and inboard of a band of low V_s that encircles more than half of CP at <80 to 150 km depth. Moderately enriched isotopic compositions are permissive of melt generation from lithospheric to asthenospheric sources. Judging by their chemistry, SFMM basalts are derived by melting of peridotite-dominated domains rather than lithologies that might have been introduced into the mantle by Laramide-aged shallow subduction. More deeply equilibrated melts appear to be dominated by the characteristics of asthenospherically-derived melts, as expected from decompression melting across the asthenosphere-lithosphere boundary (Reid et al., 2012, Geology 40, 387-390).

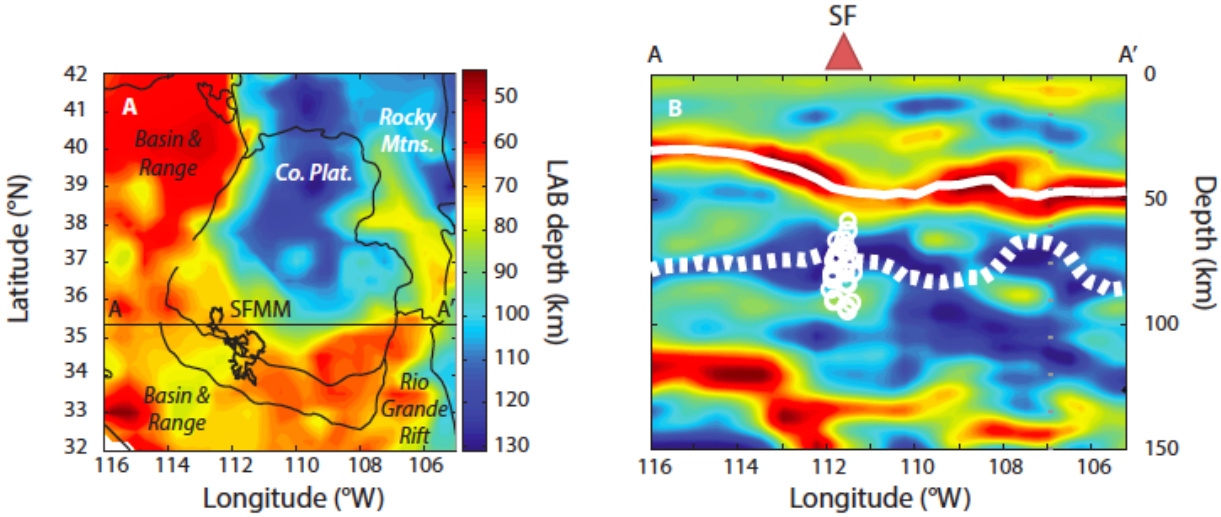

Fig. 1. Relationship of Colorado Plateau (CP) and San Francisco-Morman Mountain volcanic fields (SFMM) to upper mantle structure obtained using seismic data. A: Average lithosphere-asthenosphere boundary (LAB) depth determined from USArray Ps and Sp receiver functions and Rayleigh wave tomography (modified after Levander et al., 2011). B: P_S common conversion point stacking of cross section A-A' through the San Francisco Volcanic Field (SF). Color scale represents P to S converted signals (positive values are red). Solid and thick dashed white lines represent surfaces picked for the Moho and LAB, respectively. Circles are mantle-melt equilibration pressures. *Figure modified after Reid et al., 2012.*

Thermobarometry results for clinopyroxene-bearing SFMM basalts indicate magmatic temperatures of 1250-1330°C at or just below the Moho. Melting conditions delimited from olivine-melt equilibra mostly range from ~90 km to just above the seismic proxy for the LAB. Associated temperatures are 80-130°C higher than for clinopyroxene crystallization, assuming that melts have water contents inferred from mantle xenoliths (~0.5 wt.%). A more hydrous CP mantle, capable of producing melts with ~3 wt.% water, could better reconcile the P-T distributions, and magmatic water contents will be a focus of future work.

Acknowledgment and broader impacts: This project is supported by NSF EarthScope Grant EAR-1109826 and is providing graduate training in geochemistry and petrology for co-author Sean Rudzitis.