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Thermal-chemical corrosion beneath the Colorado Plateau: constraints from 1-D models, melt thermobarometry and seismic measurements

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Processes that lead to temporal evolution of the lithosphere-asthenosphere boundary (LAB) and accompanying changes in its physical characteristics are not well understood. In locations where a plate comes into contact with hotter asthenosphere than that from which it formed, the LAB can migrate as heat and melt work their way into the plate. Such "thermal-chemical corrosion" is a proposed mechanism for boundary evolution, in which the thermal and chemical potential gradients across the LAB cause it to migrate upwards, thinning the lithosphere. Tomographic imaging and encroaching volcanism suggest that lithospheric thinning by hot asthenosphere may be occurring underneath the margins of the Colorado Plateau (CP). Seismic velocity profiles of the Colorado Plateau and the nearby Basin and Range and thermobarometric measurements of lavas from monogenetic volcanic fields are used as constraints on 1D forward thermodynamic models of the underlying LAB system. The models consist of open-system two-phase flow calculations predicting thermal structure and melt distribution. The state variable distribution from these models is then used to calculate frequency dependent seismic velocity and attenuation, for comparison with seismic measurements. Models are produced for a range of asthenospheric potential temperatures in order to find the conditions that best fit the seismic and thermobarometric constraints. The best fitting models then predict an LAB migration velocity which may be compared to geologic observations of magmatic patterns, leading to a better understanding of heat transfer processes and lithosphere evolution.