Basalts of the western Colorado Plateau margin: Magma composition and mantle processes

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The eastward migration and ε_{Nd} values of late Neogene (<20 Ma) volcanism in the western Colorado Plateau region suggest that their melt sources may have become increasingly depleted with time. The regional ε_{Nd} shifts could be explained by decreasing crustal contamination or increasing contributions of asthenosphere. Comprehensive new geochemical and isotope data from NW Arizona to south-central Utah have been obtained from the most primitive basalts to track the regional evolution of melting. Pressures and temperatures obtained using cpx-liquid thermobarometry (i.e., 5-15 kb and 1185-1280 °C) indicate crystallization in the middle crust to upper mantle. Amongst basalt flow samples collected in NW Arizona, old (15-20 Ma) basalts are strikingly more enriched (ε_{Hf} = -10 to -14; Ba/Nb = 87-109; La/Nb = 4.7-5.1) than the narrow ranges characterizing younger (2-11 Ma) basalts (ε_{Hf} = +6 to +9; Ba/Nb = 12-19; La/Nb = 0.8-0.9). Trachy-basaltic flows and shallow intrusives in south-central Utah are intermediate in age (4.0-6.4 Ma) and in degree of enrichment (ε_{Hf} = 0 to +6; Ba/Nb = 62 to 75). New transition metal analyses of olivine show mainly low values of Zn/Fe $\times 10^4$ (<11) such as those expected for melts of peridotite sources, but older (15-20 Ma) NW Arizona basalts have both high Zn/Fe (> 13.5) and Ni/Co (> 20) values, suggesting input from olivine-poor lithologies. Lead isotope values plot above MORB and regional crust values ($^{206}Pb/^{204}Pb$ = 17.6-18.6 and $^{207}Pb/^{204}Pb$ = 15.50-15.62), and the older NW Arizona basalts are most radiogenic. The enriched signature of south-central Utah basalts is associated with thicker lithosphere (~100 km), whereas the lithosphere is thinner (~70 km) under NW Arizona regions associated with the youngest volcanism. Progressive lithosphere erosion and increased asthenosphere input may account for changing magma sources in NW Arizona from 20 Ma to the present, and for the region overall.