Neogene magmatism and coeval crustal extension Part 3: Bimodal magmatism in the northern Greenwater Range, Death Valley, CA

EUGENE SMITH*[1], HUGO BELMONTES[1], ASHLEY TIBBETTS[2], RACHEAL JOHNSEN[1] AND J.D. WALKER[3]

[1]Department of Geoscience, University of Nevada Las Vegas, Las Vegas NV 89154-4010 (correspondence: gene.smith@unlv.edu)

[2]Department of Earth and Atmospheric Sciences, Cornell University, Ithaca, NY 14853

[3] Department of Geology, University of Kansas, Lawrence, KS 66045

Bimodal volcanism characterized by the eruption of rhyolite and basalt without intermediate rock types was common during late Miocene to Pliocene in western North America but has not been previously described in the Death Valley area. One of these bimodal fields is in the Greenwater Range located on the eastern margin of Death Valley National Park. The 4.9 ± 0.2 Ma Greenwater rhyolite (71.9 wt. % SiO_2), comprised of 8 to 10 volcanic domes, pyroclastic flow, surge and air-fall, and volcaniclastic deposits, crops out within a 9-km semi-circular area of subsidence, which may represent a caldera. We suggest that rhyolite was produced by partial melting of Cretaceous granitic basement in the Pliocene by heat advected into the crust by rising basaltic magma. This resulted in low-temperature granitic-rhyolitic melts that erupted to produce the Greenwater rhyolite. After "caldera" formation, Funeral Formation alkali basalt (4.0 ± 0.10 Ma $^{40}Ar/^{39}Ar$ date) formed a field of monogenetic volcanoes and lava flows that surround the caldera to the north and east. Basalts have ε_{Nd} -2.33 to -12 and $^{87}Sr/^{86}Sr$ 0.706 to 0.708; signatures suggesting melting of lithospheric mantle (LM), but melting depths of 45-50 km calculated by using a silica barometer imply that melting occurred in the upper asthenosphere. These apparently contradictory observations may be explained by melting of LM thermally and mechanically converted to asthenosphere without a significant change in chemistry. La/Y vs. ε_{Nd} indicate variable degrees of partial melting of three distinct mantle sources. Mixing of thermally converted LM with asthenosphere may explain the heterogenous nature of the mantle reservoirs.