# Field, petrological, and geochemical evidence for injection of mafic magma into felsic reservoirs at the Mono domes and Mono Lake islands, California

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Long Valley caldera is best known as the site of the 760 ka Bishop Tuff supervolcanic eruption. Since 760 ka, magmatism in the area has occurred both within the caldera complex and around its periphery, primarily to the north. The most recent of these eruptions, starting 40 ka, emplaced the Mono and Inyo domes and the Mono Lake islands. While most post-caldera volcanism has been either basaltic or rhyolitic in composition, the Mono Lake lavas, as well as enclaves present in several of the Mono domes, represent the only recent intermediate composition (basaltic andesite, dacite) eruptive products. An improved understanding of the igneous processes responsible for the emplacement of this extensive magmatic suite is necessary to better gauge the likely locations and compositions of future eruptions in the Long Valley area. Field observations and petrological evidence support the hypothesis that the centimeter-scale mafic enclaves prevalent in several of the Mono and Inyo domes formed as hot injections into the more felsic magmas of the domes. Enclaves are stretched, commonly with chilled margins coupled with melting rims in the felsic host rock. Thin sections cut along the border between enclave and host reveal the presence of millimeter-scale felsic inclusions within the enclaves, and vice versa, implying some magma mingling occurred. Similarly, the petrology of the Mono Lake lavas may support injection of a fluid, mafic magma into a more voluminous, felsic magma body. While the Mono Lake lavas lack the enclaves of the domes further to the south, feldspar and pyroxene phenocrysts are revealed in thin section to have sieve textures and distinctive regrowth rims that could reflect injection of hot magma causing resorption of crystals. Chemically, the Mono domes are quite evolved, with low Sr and Ba concentrations (1-25 ppm and 10-40 ppm, respectively) and high Rb and Th concentrations (130-180 ppm and 18-22 ppm, respectively). Highly variable trace element concentrations suggest the presence of accessory mineral phases such as zircon (Zr), apatite ($P_2O_5$, Y), feldspar ($K_2O$, Ba, Eu), titanomagnetite (V), and a LREE phase. Given these evolved trace element concentrations, the Mono domes may have been extracted from a crystal mush or formed by partial melting. By contrast, the Mono Lake lavas are noticeably less evolved than the Mono domes despite their comparative youth, suggesting derivation from a different magma source. Mono Lake is dominated by dacites and low-silica rhyolites, which are characterized by high Sr concentrations, from 300-540 ppm; extremely high Ba concentrations, ranging from 1000 ppm to as high as 1600 ppm; and quite low Rb and Th concentrations (100-130 ppm Rb and 5-10 ppm Th). It is possible that there is source variation within the Mono Lake lavas themselves, as high field strength elements such as Y and Nb suggest that the islands are chemically segregated geographically.