Geophysical Research Abstracts
Vol. 12, EGU2010-1616-1, 2010
EGU General Assembly 2010

Melting and remobilization of felsic protoliths through mafic recharge: evidence from basalt-trachyte mingling in Mumbai, Deccan Traps

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Contrasting, mingled magmas are widespread, and often erupt at volcanoes, or form intrusive bodies. Field evidence, petrography, mineral chemistry, and whole-rock major, trace and Pb isotope chemistry of trachytes and their mafic enclaves from the Manori-Gorai area of Mumbai, in the Deccan Traps flood basalt province, are used here to assess the petrogenetic processes that operated to produce these rocks. Local hybridization has occurred and has produced hybrid trachytes and intermediate rocks such as a quartz monzonite. Feldspar crystals have complex textures and an unusually wide range in chemical composition. Crystals from the trachytes cover the alkali feldspar compositional range and include plagioclase crystals with Ca contents up to An_{47}. Crystals from the mafic enclaves are dominated by plagioclase An_{72-90}, but include orthoclase microphenocrysts and other feldspars covering the entire compositional range sampled in the trachytes. And feldspars from the hybridized quartz monzonite yield mineral chemical clusters of An_{80-86}, An_{47-54}, Ab_{94-99}, Or_{45-60} and Or_{96-98}, all sampled within individual phenocrysts.

We show that these feldspar crystals provide a record of remobilization of felsic protoliths by influx of mafic magmas, followed by magma mixing and hybridization processes that result in bulk rock major and trace element variations which can be modeled by essentially simple bulk mixing. However, heterogeneities in Pb isotopic compositions of trachytes and their microscopic to meter-sized enclaves are observed on the scale of individual outcrops, likely reflecting initial variations in the isotopic compositions of the involved magmas and protoliths, and provide evidence for one or more shallow trachyte magma chambers disturbed by multiple injections of trachytic, porphyritic alkali basaltic, and variably hybridized magmas from depth.