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Origin of rhyolites and associated silicic rocks in the Deccan Traps Large Igneous Province: Evaluation of Field, Textural and Geochemical Data

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The Deccan Traps in west-central India formed during 70-63 Ma is one of the widely studied Large Igneous Province (LIP) of the Phanerozoic age. Although several aspects of Deccan Traps volcanism have received close attention in the last three to four decades, e.g., its possible relations to the K-T mass extinction event, its origin in terms of plume and non-plume hypotheses, flow stratigraphy and physical volcanology of mafic lava flows, very little is known about the nature, mode of occurrence and origin of rhyolite. Although the volume of rhyolite inferred so far from field exposures is negligible ($\sim$500 km^3) compared to enormous volume of basalts, it is critically important to understand the nature and origin of rhyolite associated with basalts in the Deccan LIP. This study attempts to elucidate mode of occurrence and origin of Deccan Traps rhyolites using detailed field relations, petrography, and geochemistry of rhyolites.

Rhyolite is mainly exposed along rifts and margins of the Deccan LIP, which occur as circular hills (Girnar and Alech hills, Gujarat), as hill top lava flows (Osam and Pavagadh, Gujarat) and as isolated hills near Bombay (Maharashtra) and Rajula, Rajpipla and Barda in Gujarat. Maximum thickness of individual rhyolite flows reaches up to 100 m with columnar joints, scarps and flow folding. Major oxides abundances reveal wider SiO_2 variation from $\sim$63 to 80 wt%; few of the samples, however, fall in the Dacitic field in the TAS plot. The Al_2O_3, CaO, Fe_2O_3, MgO, and TiO_2 show negative correlation with silica (or SiO_2) content, whereas K_2O (1.73-8.46 wt%) increases with increasing SiO_2. Among all the locations, Girnar silicic rocks show less variation in major oxide contents indicating possibly less magmatic fractionation during its emplacement. But presence of shattered clinopyroxene and plagioclase xenocrysts in these rhyolites suggest interaction of the ascending silicic magma with a mafic source comprising of clinopyroxene and plagioclase, i.e. early basaltic flow. Rhyolites of Alech, Pavagadh, Osam, and Rajula show relatively larger variability in SiO_2 abundance, which might be related to magma evolution during multi-stage eruptions. Petrography of Osam rhyolite reveals pyroclastic fragments containing flow banding within non-banded rhyolite, also suggesting multi-stage volcanic activity. Interestingly, Deccan Traps rhyolites contain few unique petrographic features that may suggest volcanic style and possible involvement of multistage/multisource components in the rhyolite magma generation.