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Carbonatite-silicate immiscible melt inclusion in lamprophyre from Kutch, western India: Implication for plume-lithosphere interaction and initiation of Deccan Trap magmatism

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Kutch province of western India has undergone repeated rifting and marine transgression events from late Triassic to the late Cretaceous. Magmatic rocks occur in profusion in Kutch Basin. The southern part is characterized by occurrences of thick flows of tholeiitic basalt of Deccan Trap affinity, central part of Kutch Basin has numerous volcanic plugs of alkali basalt which is also considered as member of Deccan Trap, contain thin, discoidal mantle xenoliths of spinel lherzolite and wehrlite composition. Northern Kutch is dominated by suite of alkaline magmatic rocks similar to magmatic rocks of continental rift zone. The alkaline suite contains alkali pyroxenite, theralite, teschenite, basanite, nepheline syenite and kaersutite bearing lamprophyre (Ray et al., 2006, Das et al., 2007, Paul et al., 2008). The newly discovered east-west trending lamprophyre dyke swarm of northern Kutch (Pachham Island) is camptonite in composition and contains kaersutite phenocrysts in large proportion. These kaersutite phencrysts contain immscible melt/glass phases as melt inclusions. The lamprophyre yields an age of ca. 67 Ma.by Ar-Ar method (Sen et al., 2014 in press) synchronous with alkali basalt of central Kutch. The melt inclusions are fundamentally of two types - calciocarbonatite and alkaline silicate melts. We found sphene within carbonatitic melt and the rare mineral rhonite in silicate melt. Petrographic evidence indicates that carbonatite melt always occurs within alkali silicate melt as immiscible fraction. These carbonatite melts are extremely rich in $CaCO_3$ (upto 95%) which contradicts the experimental results of carbonate melt composition (upto 80% $CaCO_3$) in silicate-carbonate immiscible melt pair by Lee and Wyllie. The abundance of wehrlite xenoliths over lherzolite in alkali basalt, petrographic evidence of orthopyroxene to clinopyroxene transformation in wehrlite xenoliths, occurrence of calcite vein in mantle xenoliths indicate carbonatite metasomatism of spinel lherzolite layer of upper mantle prior to eruption of alkali basalt lava. It has been proposed that carbonatite melt was generated below the lithosphere by low degree melting of the Deccan plume (Sen et al., 2009). In this model, this low-degree, volatle-rich melts detached as tiny blobs from the cooler edge of the Deccan plume head and permeated the Kutch lithosphere as it was extending and fracturing due to plate-driving forces and caused carbonatite metasomatism of upper mantle. Partial melting of this carbonated peridotite yields $CaCO_3$ rich alkaline silicate melt. The carbonatite-silicate immiscible melt pair and its host lamprophyre possibly originated during the interaction of Reunion Plume with the rifted lithosphere beneath Kutch and these together with alkali basalt of central Kutch mark the initiation of Deccan Trap magmatic activity.

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