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Neoproterozoic (ca. 820 Ma) shoshonitic calc-alkaline lamprophyre from the Western Dharwar craton, southern India: Petrology, geochemistry and geodynamic significance

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We report petrology, geochemistry and petrogenesis of calc-alkaline lamprophyre from Mysuru area, Western Dharwar Craton (WDC), Southern India. The titanite U-Pb SHRIMP dating of Mysuru lamprophyre from WDC gives a crystallization age of 820 ± 15 Ma. The investigated dyke is characterized by the presence of amphibole phenocrysts set in the groundmass of feldspar, apatite, titanite, spinel and sulphides. It also shows the presence of few localized clinopyroxene xenocrysts with Cr_2O_3 content > 1 wt%. High K_2O/Na_2O (> 1) and Th (7.6 – 10.5 ppm) reveals shoshonitic affinity. Absence of any correlation between SiO_2 and $^{87}Sr/^{86}Sr_{(820)}$ and εNd_{820} rules out the possibility of crustal contamination. The dyke shows enrichment in LILE (e.g: Rb, Ba, Sr) and depletion in HFSE (e.g: Nb, Ta, Ti, Zr, and Hf) with high Gd_N/Yb_N (> 2.5) and Sm_N/Yb_N (>3.1) ratios that indicates its highly fractionated nature along with the presence of garnet in the source. It has high Mg# (56-65), moderately enriched Sr ($^{87}Sr/^{86}Sr_{(820)}$ = 0.70425-0.70530) and negative Nd (εNd_{820} = -4.3 to -6.3) isotopic composition. Such geochemical and isotopic features suggest a genesis either from enriched mantle (EM I) type lithospheric mantle reservoir akin to Neoproterozoic carbonatites from Southern Granulite Terrain or through metasomatism from a subduction derived fluids/melt. The enriched LILE, LREE, as well as Sr-Nd isotope concludes the formation of Mysuru lamprophyre from subduction modified lithospheric mantle. Furthermore, high Th/Yb and superchondritic Nb/Ta-Zr/Hf ratios also confirm subduction induced metasomatism of the mantle source. The LILE budget (eg. K, Ba, Rb) of the melt is regulated by hydrous phases such that the presence of phlogopite in equilibrium with the melt produces high Rb/Sr (>0.03 = Primitive Mantle) along with the positive correlation between Ba/Nb and Ba/Zr. Thus, the Mysuru lamprophyre was generated by low degrees (5-10%) of melting of phlogopite bearing mantle peridotite that was previously modified by subducted slab derived melt at the depth of the spinel – garnet transition zone. The emplacement of the Mysuru lamprophyre can be related to the widespread continental rifting between ca. 825 and 740 Ma, marking the initiation of Rodinia breakup.