



Mineralogy and Geochemistry of beach sediments associated with the Precambrian crystalline rocks (Vijayan Complex) of Sri Lanka; perspective for heavy minerals

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Authors

Chaturanga Sandaruwan, Madurya Adikaram, Nadeesha Madugalla, Amarasooriya Pitawala Hiroakilshiga and Tharanga Udagedara

Abstract

Southeastern landmass of Sri Lanka is laid on the Vijayan Complex (VC) rocks, a Precambrian basement characterized with specific geological features since the mineralized contact zone of the Highland–Vijayan boundary is nearby. However, the coastal sedimentation of such a basement is rarely interpreted. Hence, the mineralogy and geochemistry of surface sediments exposed along 45 km long southeast (SE) coast were studied to find the compositions and to interpret the terrestrial compartment. Studied beach faces expose as sandy siliciclastic sediments with scatter depositions of black and red coloured heavy sediments, as 10–15 cm beds, within 1–3 km from deltaic environments. X-ray diffraction analysis of such heavy placers indicate the presence of predominant ilmeneite, almandine garnet, zircon, monazite and ferrihydride. The sediments from other areas are rich in lighter minerals of quartz, albite and magnesium-calcite representing the average beach sediment mineralogy of SE coast. Upper continental crust normalized X-ray fluorescence data show an enriched tendency of Zr (9.8) > V > Nb > Th > TiO₂ (6.2) > Cr (2.5) > MnO > Fe₂O₃ > As > Y > Zn and

depleted tendency of $Pb (0.8) > CaO > P_2O_5 > Sr > Sc > Cu (0.1)$ indicating the leachability of depleted elements and strong recycling processes of High Field Strength Elements (HFSE). Hierarchical cluster analysis and Pearson correlation matrixes indicate the presence of four geochemically related sample clusters. These analyses further showed that the cluster 1 relates to heavy sediments deposits with higher terrigenous influences while cluster 4 relates to siliciclastic sediments with higher marine influences. Hence, geochemical anomalies of cluster 1 to 4 show decreasing abundances for HFSE and opposite tendencies for CaO, Sr, I, Br, and F confirming the mineralogical results. Higher terrigenous influenced sediment samples evident for the presence of solid phases of titanium carriers (As–V–TiO₂), phosphorus–HFSE carriers (Pb–Th–P₂O₅–Y–Cl–Nb–Zr), authigenic carbonates (Sr–Br–CaO) and Fe–Mn coatings (Zn–Cr–MnO–Fe₂O₃–Cu). Compatibility variable ratios of Th/Sc, Zr/Sc, TiO₂/Zr, Cr/Th and V/Th respectively show 15.16, 364.38, 20.85, 2.95 and 9.73 values for these coastal sediments. Based on the published international and VC average lithological data, the present study concluded that the primary sources for the sedimentation have felsic signatures showing relations to granitic gneisses and granitic intrusive rocks of the VC. Apart from the terrestrial provenances, the coastal area has been affected by lower secondary influences of anthropogenic, marine inorganic and organic matters.

Keywords

Beach placers, Geochemistry, Mineralogy, Provenance and Southeast coast of Sri Lanka