Average Chemical Composition of Indian Shale Composite: Implication for chemical weathering and Provenance

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Shale, a fine-grained terrigenous clastic sedimentary rock, comprises of about 70% of the exposed sedimentary rocks. Chemical composition of shales, such as the Post Archean Australian Shale (PAAS) and North American Shale Composite (NASC) are widely used as proxies for source apportionment, chemical weathering, and provenance studies. This study estimates the average chemical composition (major, trace elements including REEs, and Sr and Nd isotope) of the Indian Shale Composite (ISC) using available data on various Archean and Proterozoic shale Units –representative of diverse geologic or geomorphic provinces– along with new data (of ten different units) analyzed in this study. Though the major oxide composition of ISC is very similar to NASC and PAAS, noticeable differences exists in trace element signatures. The average Chemical Index of Alteration (CIA) of ISC is 72±4 (n=358), which suggests moderate chemical alteration. The chondrite-normalized REE pattern of shales show slightly enriched LREE (La/Sm_N = 4) and relatively flat HREE (Gd/Yb_N = 1.4) patterns with a conspicuous negative Eu-anomaly (Eu/Eu*: 0.65-0.70; with the exception of Archean Dharwar shales) suggesting an origin from upper crustal granitoids. A distinct positive Ce anomaly observed only in the Archean shales indicate deposition of these fine siliciclastics in shallow oxic depositional environment during which the less soluble Ce^{+4} gets adsorbed on oxyhydroxides. The average Th/U ratio in Indian shales (3.9±2.7) is similar to that of bulk continental crust, but lower than PAAS (4.71). Our results suggest that the Al_2O_3, TiO_2, Zr, Th, Sc and REE abundaces in Indian shales generally preserve the respective source signatures. The $^{87}Sr/^{86}Sr$ (0.7218-0.8741) and $^{143}Nd/^{144}Nd$ (0.511520-0.511822) in selective Proterozoic shales suggest a dominantly upper crustal source. Tectonic discrimination diagrams (e.g., K_2O/Na_2O vs SiO_2 and La-Th-Sc) indicate derivation of sediments from uplifted basements and stable continental sources. Our estimated ISC composition is representative of the Indian sedimentary rocks and can be used to study weathering, provenance and related tectonic settings.