Geochronology and Geochemistry of Basalts: Empirical evidences from the Babina and Mauranipur greenstone belts of the Bundelkhand craton, India

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This work investigates bulk–rock Sm–Nd isotope compositions, major and trace element geochemistry of basalts from the Babina and Mauranipur greenstone belts, Bundelkhand craton, India, in order to determine the isochron age, tectonic setting, petrogenesis and the Paleoarchean mantle evolution. This investigation is the first of its kind to attempt to determine the isochron age of basalts. Geochemical characteristics of basalts are shown to be [(MgO)adj (≥7 wt.%)], [$(TiO_2)_{adj}$ (0.3–1.15 wt.%)], [$(SiO_2)_{adj}$ (43–57 wt.%)], and [$(Al_2O_3)_{adj}$ (0.43–16.69 wt.%)]. Sm–Nd isotopic analyses of basalts from the Babina greenstone belt provide Sm–Nd isochron age of ca. 3.4 Ga with εNd_t varying from +3.9 to +5.89. Isotopic characteristics of basalts from both the Babina and Mauranipur belts indicate that the basalts derived from a mantle source with long-term depletion. The observed trace element characteristics (Zr vs. Nb, Ta, U, and Hf) of basalts suggest no major post–magmatic alteration. Additionally, correlations between Cr, Ni and V suggest that these magmas might have originated through the fractionation of clinopyroxene and olivine. The Babina and Mauranipur basalts were enriched in the highly incompatible LILE (large-ion lithophile elements) relative to the moderately incompatible HFS (high field strength) elements which substantiate a suduction-related or within–plate environment. Komatiitic basalts show negative Nb anomalies in the absence of Zr anomalies on a multi–element normalized diagram, which could indicate derivation from a shallower mantle in an arc environment. Both basalts show flat to light-REE enriched patterns suggesting arc–like affinity. An initial εNd_t value from +2.0 to +5.6 for the basalts suggest existence of depleted mantle source at ~3.4 Ga. The foregoing results advocate that probable crustal assimilation during the evolution of these magmas and subduction prevailed during the Paleoarchean in the central Bundelkhand craton.