Geochemistry of Fe-Ti-P gabbro in Achankovil Tectonic Zone, South India: implications for intra-plate magmatism

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The final phase of amalgamation of the Gondwana supercontinent witnessed collision of continental blocks along transcrustal shear/suture zones. Two major shear/suture zones were identified in southern India: the Palghat-Cauvery Shear Zone in the north and the Achankovil Shear Zone (ACSZ) in the south. A peculiar sub-alkaline to alkaline olivine absent gabbroic plug (1.5 km by 0.5 km) trending ENE-WSW, bounded by a strike slip fault plane trending NNW-SSE has been mapped in ACSZ. Systematic mineralogical and geochemical studies were performed on this gabbroic intrusion to understand its petrogenesis and tectonic significances. The gabbro is mesocratic, medium-to coarse-grained and has a megaophitic texture. The rock contains plagioclase, clinopyroxene, calcic- and sodic-calcic amphibole and ilmenite with accessories of apatite, calcite and phlogopite. Textures indicate subvolcanic emplacement and are probably of moderate pressure crystallization conditions. The samples show metaluminous and high-K calc-alkaline signatures. They have very low Mg# and are depleted in Ni and Cr. The rocks are characterized by high abundances of large ion lithophile (LIL) elements such as Ba, Rb and Sr and high field strength (HFS) elements such as Zr, Nb and Ta. Chondrite normalized rare earth element (REE) patterns show LREE enrichment with a slight positive Eu anomaly. The primitive mantle normalized trace and REE patterns reveal absence of strong negative Nb-Ta-Ti anomalies. The trace and rare earth element compositions of major silicate phases and bulk rock reveal magma/melt sources from an enriched mantle. The data are plotted very close to the field of alkaline basalt on Nb/Y vs Zr/TiO_2 binary diagram. The enrichment of Fe, Ti and P in this gabbro might be a primary feature related to the source composition. The bulk rock data together with data of clinopyroxene and amphibole when plotted in discrimination diagrams show intra-plate/rift-related tectonic environment of magma genesis. We consider that this rift-related intra-plate origin of alkaline igneous activity in ACSZ is a manifestation of magmatism associated with continental rifting. South India forming an unambiguous section of East Gondwana continent has a vital role in the renovation of this mega continent.