EGU22-594, updated on 16 Aug 2022
https://doi.org/10.5194/egusphere-egu22-594
EGU General Assembly 2022

Time-space evolution of an ancient continent, a window to crustal evolution: Insight from granitoids of Singhbhum Craton, eastern India

Aniruddha Mitra[1] and Sukanta Dey[2]
[1]Indian Institute of Technology (Indian School of Mines) Dhanbad, Department of Applied Geology, Dhanbad, India (ani.mitra09@gmail.com)
[2]Indian Institute of Science Education and Research, Department of Earth Sciences, Mohanpur, Nadia, India (sukanta.dey@iiserkol.ac.in)

Singhbhum Craton, eastern India, exposes an array of Paleoarchean granitoids (e.g., TTGs and diorites, transitional TTG, and K-rich granite) ranging in age from ~3.53–3.25 Ga, thus making it a suitable archive for understanding crustal architecture and dynamics during that era. Granitoids cover the core of the craton as a composite dome and are fenced by keels of contemporaneous iron ore bearing greenstone belts from east, west, and south giving rise to a dome-and-keel architecture. Change in granitoid chemistry and isotope signature over time and space can provide a window into the change of crustal evolution mechanism as well as geodynamics of the crust formation if put into a robust tectonic framework. Most of such earlier studies addressed the secular evolution of granitoid chemistry and isotopic changes as an expression of a shift in tectonic paradigms. This tectonic shift is explained broadly as a response to a progressively cooling earth. However, the timing of the transition (advent of a new tectonic setting) varies globally; hence, each craton needs to be studied separately and without any prior bias.

Spatial variation represented by contour diagrams from the cratonic core show two distinct areas exposing dominantly 3.35–3.25 Ga high-silica, low-magnesiam, high K_2O/Na_2O (K/Na>0.60) granitoids of shallow crustal origin, indicated by their low pressure-sensitive ratios (eg. Eu/Eu*, Sr/Y, Gd/Er, La/Yb). These two areas are surrounded by older intermediate granitoids (>3.35 Ga TTGs). Based on the spatial distribution, it is being suggested that these spatial arrangement of granitoids are related to “partial convective overturn (PCO)” process where the >3.35 Ga TTG basements were subjected to greenstone load while they were soft. As a result some part of the newly formed softer >3.35 Ga TTG crust melted as these overburdens helped in bringing the TTGs to a potential melting depth. The greenstones then sank into the partially molten TTGs along steep-dipping sinistral shear zones by forming synformal keels. The moderate- to- low-pressure TTG-derived partial melts then rose to the shallower level and formed the 3.35–3.25 Ga high-silica, low-Mg# potassic granitoids.

Preserved rock record in the Singhbhum Craton indicates that the granitoid magmatism started at ~3.47 Ga with emplacement of high-silica, low alumina tonalite, characterized by low Sr/Y, $(Gd/Er)_N$,

$(La/Yb)_N$, Eu/Eu* and Sr. The 3.47 to 3.32 Ga TTG record from the Singhbhum Craton show a progressive increase in Al_2O_3, Sr/Y, $(Gd/Er)_N$, $(La/Yb)_N$, Eu/Eu* and Sr and decrease in Na_2O. The increase in the pressure-sensitive ratios reached peak during 3.32 Ga and then started decreasing until ~3.28 Ga followed by another increase during ~3.28 to ~3.25 Ga before ceasing of Paleoarcehan magmatism in the Singhbhum Craton. Such variation in geochemical tracers is explained in terms of episodic crustal thickening by periodic mantle upwelling and associated delamination along with time-progressive changes in bulk chemical composition of the continental crust from mafic to felsic.