ABSTRACT

The Central Indian Tectonic Zone is a Proterozoic suture along which the Northern and Southern Indian Blocks are inferred to have amalgamated during the Proterozoic, forming the Greater Indian Landmass. In this dissertation, the metamorphic and geochronological evolution of rocks from the Gangpur Schist Belt, an orogenic domain sandwiched between the Singhbhum Craton and the Chhotanagpur Gneiss Complex at the eastern end of the Central Indian Tectonic Zone, is used to constrain crustal accretion processes associated with the amalgamation of the Northern and Southern Indian Blocks. Thermobarometric and geochronological data indicates that the rocks of the schist belt experienced major metamorphic episodes at ~1.56 Ga, ~1.45 Ga, and ~0.97 Ga. Detrital zircon ages suggest that the sediments in the southern part of the Gangpur basin were sourced from the Singhbhum Craton whereas those in the northern part were derived dominantly from the Chhotanagpur Gneiss Complex. A three–stage model of crustal accretion across the Singhbhum Craton—Gangpur Schist Belt/North Singhbhum Mobile Belt—Chhotanagpur Gneiss Complex contact involving Andean type arc–continent collision at 1.56 Ga culminating into Alpine type continent–continent collision at 0.97 Ga is proposed. The geological events recorded in the Gangpur Schist Belt and other units of the Central Indian Tectonic Zone only partially overlap with those in the Trans North China Orogen and the Capricorn Orogen of Western Australia, indicating that these suture zones may not be co-relatable.

The supracrustal rocks of the Gangpur Schist Belt contain tourmaline. The mineral is the principal repository of boron in crustal rocks and therefore useful for tracing B-cycling during prograde dehydration and retrogression of supracrustal rocks. The major, trace element, and B isotope composition of tourmaline from schists and quartzites of the Gangpur Schist Belt has been used to constrain the source of B and the physicochemical evolution of B-rich fluids during prograde dehydration metamorphism of the metasedimentary rocks. The $\delta^{11}B$ value of the tourmalines varies between -6‰ and -18‰, suggestive of a dominantly continental source for B. Tourmalines in schists, quartzites, and tourmalinites grew over a wide range of P-T conditions and record multiple episodes of metamorphic dehydration between 1.6 Ga and 0.95 Ga.

The Gangpur Schist Belt also hosts an association of muscovite- and tourmaline-bearing internally-zoned and un-zoned S-type pegmatites and granites. The major and trace element and Li-B isotopic compositions of muscovite and tourmaline from the pegmatites were used to characterize the geochemical and isotopic fractionation associated with their formation. The trace element concentration/ratio of muscovite from the wall, intermediate and core zones of the internally-zoned pegmatite plot as distinct clusters which, taken together form well-defined power-law type differentiation trends marked by enrichment of incompatible elements from the wall-zone, through the intermediate-zone to the core-zone. Fractional crystallization modelling reveals that the wall zone formed after ca. 69% crystallization, the intermediate zone after 85–95% and the core zone after ca. 99% crystallization leading to extreme enrichment of Rb and Cs. Lithium isotopic composition of muscovite and B-isotopic composition of tourmaline is suggestive of an important role of vapour exsolution in the formation of the pegmatites. Taken together, the geochemical and isotopic trends in the pegmatites can be explained by Rayleigh fractional crystallization operating in tandem with vapour exsolution.