ABSTRACT

The Holenarsipur Supracrustal Belt in Karnataka, India represents in many respects a typical Archaean Supracrustal Belt, formed within an extensive base of infracrustal gneisses and associated with tonalite-trondhjemite-granodiorite plutons. This work was undertaken to gain new insights into several problematic and conjectural aspects of origin of this belt, among which are: (1) origin and stratigraphic position of the Tattekere-Kumkumna Hosuru conglomerate-quartzite horizon, (2) representation of the belt as one single supracrustal sequence without stratigraphic, structural and tectonic break OR its division into two units: Dharwar and Sargur, separated by an angular unconformity, and (3) a tectonic model of evolution for this belt that successfully explains the regional structural and quantitative strain variation, lithology, granite-supracrustal relations and the unique trident-shaped outcrop pattern of the supracrustal belt.

The work incorporates new results from geological field mapping, multisensor satellite data analysis, detailed sedimentary petrography of the debated conglomerates and quartzites, regional quantitative analysis of palaeostrain and palaeostress and a detailed quartz microfabric investigation.

The conglomerate outcrops occurring around Kumkumna Hosuru village (12°50′27″N, 76°16′26″E) to the north of Hemavati River and around Tattekere village (12°49′21″N, 76°16′44.5″E) to the south of Hemavati River can be shown to represent disconnected outcrops of the same horizon on the basis of close proximity in their areal disposition, similarity in the trend of their outcrops, attitude of beds and petrographic characteristics including strong down-dip fabric of the clasts. The petrography of the conglomerates and the quartzites, their heavy mineral make-up and chemistry, and the demonstration of undoubted primary sedimentary structures in rocks of this association indicate a truly sedimentary origin for the conglomerate-quartzite association.

Dividing the entire belt into two supracrustal groups seems unjustified considering identical structural pattern in the southern and the northern sectors, conformity of the stratification planes in the metasedimentary rocks, probable near-basal stratigraphic position of the Tattekere-Kumkumna Hosuru conglomerate-quartzite horizon and the uniform strain variation pattern from south to north of the belt.

The intensity and nature of strain vary with the size of the strain markers and the viscosity contrast between the markers and the host material. Comparison of strain parameters in different parts of the supracrustal belt has been made with respect to the values obtained from deformed quartz/quartzite clasts in the quartzite as the strain markers. The intensity of bulk finite strain is high in the N-S arm of the belt, attaining its maximum value in the central part of the N-S arm around Tattekere and Kumkumna Hosuru villages and from there it decreases towards north. In the western arm, the finite strain amount is very low. The shape of the finite strain ellipsoids in different parts of the supracrustal belt, except near Sigaranahalli village (12°52′31″N, 76°13′46″E) in western arm, represents a bulk flattening strain. Near Sigaranahalli village, the strain is constrictional. The microfabric patterns of quartz crystals in the quartzites show a fairly strong asymmetric pattern along the eastern part of the supracrustal belt. This points to the presence of a ductile shear zone along the eastern part of the belt, an inference supported by a number of field criteria viz. occurrence of mylonitic rocks, S-C fabric in rocks and probable shear foliations in the N-S arm of the supracrustal belt. The external fabric asymmetry of the microfabric patterns with respect to the orientation of the finite strain axes represents left-lateral shearing

movement. Similar to bulk finite strain, the degree of lattice preferred orientation is significantly higher in the N-S arm compared to that in the western arm, indicating its direct relationship with the finite strain amount. The accumulation of high flow stress, as calculated from dynamically recrystallized grains of quartz in the quartzites along the N-S arm of the supracrustal belt further strengthens the inference of a N-S trending shear zone along the eastern part of the supracrustal belt. The value of flow stress around 28 MPa for average recrystallized grain size and up to ~33 MPa for individual grains indicate a shear zone of moderate intensity.

The Halekote Granite to the north of the supracrustal belt is an intrusive pluton. Classical field criteria and the strain variation pattern in the surrounding supracrustal belt suggest diapiric emplacement of the granite. The occurrence of well-defined foliation triple junction characterized by vertical constrictional strain argues against successive phases of folding. The finite strain variation pattern in the supracrustal belt suggests that the granite diapirism was tabular or ellipsoidal, with the long axis of intrusion trending roughly N-S and the emplacement obliquely (steep angle) SSE-ward instead of being exactly vertically upward. The N-S trending and left-lateral shear zone in the eastern part of the belt fits in with the proposed long axis of granite intrusion and the dome-up sense of movement of the diapiric body. The major tectonic event of SSE-ward, oblique (steep angle) diapirism, presumably operating as two equal shortening components roughly along 110-290° and 20-200° directions in N-S and western arms respectively and the subsequent transcurrent shearing along the N-S arm are perhaps the major factors responsible for the characteristic trident-like outcrop pattern of the supracrustal belt. During the period of Halekote Granite diapirism at 3.1-3.0 Ga (Beckinsale et al., 1982; Bhaskar Rao et al., 1983; Monrad, 1983; Stroh et al., 1983; Taylor et al., 1984; Meen et al., 1992), the supracrustal belt was subjected to progressive co-axial deformation resulting from concomitant sagduction of supracrustal rocks. Subsequently, the N-S arm of the supracrustal belt became the locus of non-coaxial heterogeneous deformation during left-lateral transcurrent shearing at 2.5 Ga (Bouhallier et al., 1993). It seems likely that the shear zone is related to the granite diapirism and did not develop independently. The entire Holenarsipur Supracrustal Belt is therefore considered to have undergone the same tectonic history beginning with Halekote Granite diapirism and ending with late Archaean transcurrent shearing at 2.5 Ga. The entire supracrustal belt should therefore be considered older than 3.1-3.0 Ga, representing a single supracrustal sequence. In that case, if Sargur-Dharwar classification remains valid in Dharwar Geology, the entire Holenarsipur Supracrustal Belt should be assigned to the Sargur Group.