Dislocation microstructures in garnet: Thermal effect during deeper crustal seismic slip in orogen-boundary shear zone

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A considerable amount of information regarding the growth and evolution of old continents are preserved at the boundaries between the orogenic belts and pre-existing cratonic blocks. These are the areas of intense and repeated deformation, metamorphism and activities of crustal fluids. Apart from the precise estimation of the pressure-temperature-fluid evolution through time, one of the major existing challenges is to understand the deformation mechanisms operated in the deep to shallow crustal depths for such geologically complex areas. The Phulbani domain in the north-western part of the Eastern Ghats Granulite Belt, India (EGB) provides a good opportunity as it is juxtaposed in its north and west by the Archean Singbhum Craton and Bastar Craton, respectively. Recent petrological and geochronological works of our group on the metapelitic granulite-charnockite-granitic gneiss of this domain reveal the pressure-temperature-fluid evolution with time. Though this domain is differentiated from the Visakhapatnam domain situated further south-southwest, the overall evolutionary history is observed to be very similar in style and time of occurrence. The Si-poor aluminous granulites preserve exotic reaction textures implying prograde heating-dominated path culminating at UHT condition (~1000 ˚C at 8 Kbar) followed by a retrograde cooling-decompression path, both in presence of CO_2-rich fluids. The age of metamorphism and associated magmatism ranges between ca. 1000 Ma and 900 Ma, similar to that of the Visakhapatnam domain.
The Phulbani domain, however, is bound on its north by a pronounced east-west shear zone, known as the Ranipathar shear zone. This deep crustal shearing affected the pelitic granulite and granitic gneiss. The mylonitic garnet-bearing granite gneiss preserves east-west foliation-parallel ultramylonite layers. Moreover, broadly east-west and north-south oriented black veins occur in these rocks. Thick (cm-scale) to thin (mm-scale) veins have mesoscopic characters of a pseudotachylite, e.g. injection veins. The microscopic observations on the foliation-parallel veins reveal that the vesicular groundmass of the veins is composed of micron-scale quartz-feldspar-biotite with clasts of garnet, at places. These veins, in certain cases, contain mm-scale clasts of the host granite mylonite gneiss.

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