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Orthogonal Tectonic and Magmatic Fabrics in a Layered Granite-Gneiss at Remal Dam Site, India: Implications for Fabric Generation and Superposition

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The Remal granite-gneiss is situated close to the tectonic boundary between the Singhbhum Craton and the Rengali Province in the state of Odisha, eastern India. This granite-gneiss contains two prominent fabric elements - a sub-horizontal to gently dipping felsic fabric S_{ign}, believed to be of igneous origin that predates a sub-vertical gneissosity S_1 which is of tectonic origin. S_{ign} layers have a non-uniform, arcuate geometry and grain-size within the layers show systematic variations. S_1 is defined by metre-scale segregations of biotite-poor and biotite-rich domains whose orientations are constant. S_{ign} layers are arranged rhythmically in cross-section and either curve into parallelism with or truncate against layers above and below; the entire assembly resembles cross beds developed in sediments. Some of the layers develop trough cross-bedding similar to those seen in mafic intrusions such as the Skaergaard Complex, indicative of slumping of a crystallizing mush along an inclined depositional plane at the time of crystallization. The S_{ign} layers are composed of quartz, K-feldspar and plagioclase with abundant graphic intergrowths and myrmekite, and lack any evidence of compaction. Plagioclase grains are often zoned, and dihedral angles between mineral grains is significantly different from the equilibrium value of 120°, testifying to the preservation of the igneous nature of this fabric without significant solid state modification. In contrast, S_1 is sub-parallel to localized mylonite zones within the granite-gneiss composed of chlorite and epidote, indicative of deformation under greenschist facies conditions. The mylonitized zones contain prominent dextral shear sense indicators and is believed to have originated due to the amalgamation of the Rengali Province with the Eastern Ghats Mobile Belt along the east-west trending, sub-vertical Brahmani Shear Zone further to the south. The S_1 gneissosity appears to have developed as a result of this deformation event. EBSD analyses of quartz grains within the granite-gneiss reveal distinct variations in the distribution of <c> axes in different domains. Close to the mylonite zones, deformation of quartz has been dominantly accommodated by basal <a> slip with a dextral shearing overprint while away from these zones and S_1, the <c> axes are distributed in clusters without any systematic pattern. The persistence of an earlier igneous layering, despite the subsequent development of a gneissosity concomitant with localised mylonitisation, indicates that the later deformation event has not obliterated the earlier formed igneous fabric. The study also demonstrates that development of a gneissosity does not necessarily require deformation operating at moderate to high temperature, and can stabilize even under greenschist facies conditions.