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Fractal analysis and formation of schlieren migmatites owing to the interaction between pegmatitic melts and partially molten amphibolites in the Assam-Meghalaya Gneissic Complex, Northeast India

MS. DEEPSHIKHA BORAH, M.SC AND DR. BIBHUTI GOGOI

Cotton University

Schlieren refers to elongated, gradational bands of ferromagnesian minerals that are usually dark in colour. They are generally found in granites and melt-rich migmatites, often occurring as planar features, but also delineated as curved structural boundaries. The process-oriented origins for schlieren encompass both magmatic and metamorphic processes. Magmatic origins may be related to: (a) igneous layering through gravity settling, modal layering due to in-situ thermochemical diffusion and recrystallization, and multiple magma injections, especially due to incomplete mixing of magmas; (b) flow models, where dynamic magmatic flow against a rigid boundary causes schlieren formation; and (c) melt expulsion or melt-loss from mushes. Metamorphic origins of schlieren include: (a) restite model, involving genetically unrelated migmatitic xenoliths in host rock; (b) anatexis model, driven by variable degrees of in-situ partial melting of one or more protoliths; and (c) melt infiltration model, where schlieren originates due to melt infiltration from an external source during deformation.

This study investigates the origin of schlieren migmatites in the Assam-Meghalaya Gneissic Complex (AMGC), Northeast India. We postulate the formation of these compositionally defined structures due to melt infiltration and flow. Infiltrating melt passes pervasively through the whole rock volume, altering its macro- and micromorphology. During active deformation, this pervasive flow of melt through a network of interconnected pores parallel to the principal finite elongation, causes the resorption of relict phases, crystallization of new phases, and the progressive disintegration of earlier structures.

During the Pan-African Orogeny, regional deformation facilitated pervasive flow of external pegmatitic melts through the hot basement gneisses and amphibolites of AMGC, leading to their anatexis. This melt flow facilitated granular flow in the partially molten amphibolites owing to shear stress, hence disintegrating them into the characteristic tapered schlieren, while schollen formed in areas with minimal or no flow. This study applies fractal analysis to the planar, schlieren, and schollen amphibolite structures preserved in the study area. The analysis concludes that the complexity of the morphology of interface increases with increasing D_{box} values, with schlieren and schollen structures exhibiting the maximum D_{box} values, indicating greater complexity with respect to the planar amphibolite bands.