Goldschmidt 2025 Abstract
https://doi.org/10.7185/gold2025.28903

Little Atlas of Archaean Migmatites – A Window into Early Crust Formation

JAANA HALLA

Finnish Museum of Natural History, University of Helsinki

While it is widely accepted that Earth's oldest crust consists of tonalite-trondhjemite-granodiorites (TTGs), formed through the partial melting of hydrated basaltic rocks, the nature of their source remains unresolved. This work assumes that TTG-related basalts are remnants of the original rock that melted to form the earliest crust and integrates field observations with theoretical models to test this hypothesis. Migmatite structures in TTG terrains evolve during partial melting as increasing melt fractions and strain alter crustal rheology. This atlas employs a morphological classification that differentiates between low-melt fraction metatexites and high-melt fraction diatexites, further subdividing them based on strain-induced melt redistribution. Field photographs from various cratons illustrate the effects of melt segregation, extraction, migration, and redistribution (SEMR) processes and the structural consequences of abrupt crustal strength reductions at specific melt fractions. The atlas identifies five migmatite zones that illustrate the interplay between melt dynamics and crustal evolution. In the Protolith Zone, basaltic melting begins below the 7% Melt Connectivity Transition (MCT), where minor, unconnected melt accumulates along grain boundaries, producing quartz–feldspar films and patches. As the melt fraction increases beyond the MCT, Metatexite Zone A develops; intergranular melt is extracted into thin foliation planes, forming narrow melt bands that evolve into continuous leucosome layers. With further melting and strain, Metatexite Zone B emerges at the 21% Framework Melt Transition (FMT). This stage produces layered, folded, and net-like structures, with local leucosomes. At the 41% Solid-to-Liquid Transition (SLT), the metatexite–diatexite transition zone is reached, where coherent protolith layers fragment into rafts and schlieren within a flow-banded diatexitic matrix. The melt fraction includes migrated melts and does not directly correspond to the degree of melting. Finally, at melt fractions exceeding 60% and under intense strain in the Diatexite Zone, massive diatexites with flow-banded textures, vestiges of metatexites, and schlieren develop. Migmatite structures preserve the record of partial basalt melting and serve as a natural laboratory for testing geochemical models of Archean crust formation. Understanding these structures is essential for selecting optimal sampling locations and ensuring that analyses capture their full complexity, providing reliable insights into early continental evolution.

Vein metatexite in Metatexite Zone A
West Troms Complex, Norway

Metatexite vestige within diatexite, Diatexite Zone
West Troms Complex, Norway