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Inefficient high-temperature metamorphism in orthogneiss

Timothy Chapman[1,*,‡], Geoffrey L. Clarke[1], Sandra Piazolo[2,†], and Nathan R. Daczko[2]

[1]School of Geosciences, The University of Sydney, New South Wales 2006, Australia
[2]ARC Centre of Excellence for Core to Crust Fluid Systems and GEMOC, Department of Earth and Planetary Sciences, Macquarie University, New South Wales 2109, Australia

Abstract

A novel method utilizing crystallographic orientation and mineral chemistry data, based on large-scale electron backscatter diffraction (EBSD) and microbeam analysis, quantifies the proportion of relict igneous and neoblastic minerals forming variably deformed high-grade orthogneiss. The Cretaceous orthogneiss from Fiordland, New Zealand, comprises intermediate omphacite granulite interlayered with basic eclogite, which was metamorphosed and deformed at $T \approx 850$ °C and $P \approx 1.8$ GPa after protolith cooling. Detailed mapping of microstructural and physiochemical relations in two strain profiles through subtly distinct intermediate protoliths indicates that up to 32% of the orthogneiss mineralogy is igneous, with the remainder being metamorphic. Domains dominated by igneous minerals occur preferentially in strain shadows to eclogite pods. Distinct metamorphic stages can be identified by texture and chemistry and were at least partially controlled by strain magnitude. At the grain-scale, the coupling of metamorphism and crystal plastic deformation appears to have permitted efficient transformation of an originally igneous assemblage. The effective distinction between igneous *and* metamorphic paragenesis and their links to deformation history enables greater clarity in interpretations of the makeup of the crust and their causal influence on lithospheric scale processes.

Keywords: Neoblasts, EBSD, recrystallization, strain, tectonometamorphism, microstructure; Understanding of Reaction and Deformation Microstructures