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Diffusion creep in low-grade metacherts from the metamorphosed accretionary complex

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To clarify the dominant deformation mechanism in continental middle crust at an arc?trench system, we used an SEM-EBSD system to measure the lattice-preferred orientations of quartz grains in fine-grained metachert from the low-grade (chlorite and chlorite?biotite zones) part of the Ryoke metamorphic belt, SW Japan. Quartz c-axis fabrics show no distinct patterns related to dislocation creep, although the strain magnitudes estimated based on deformed radiolarian fossils are high enough that a distinct fabric might be expected to have formed during deformation. Fabric intensities are very low, indicating a random distribution of quartz c-axes. Quartz grains are equant and polygonal, and free from intracrystalline plasticity. These observations suggest that the dominant deformation mechanism in the metacherts was grain-size-sensitive flow (diffusion creep accompanied by grain boundary sliding) instead of dislocation creep. Fabric intensity (M-index: Skemer et al., 2005) for metacherts increases with increasing quartz grain size and decreases with increasing three-dimensional strain magnitude that estimated by Rf-phi analysis using radiolarian fossil as a strain marker. If the fabric intensity could represent the contribution of diffusion creep on a bulk rock deformation, it may suggest that strain rates of metacherts with high fabric intensity are much faster than those with low one.
References: Skemer P, Katayama I, Jiang Z, Karato S (2005) Tectonophysics, 411, 157?167.

Keywords: quartz, metachert, deformation mechanism, diffusion creep, grain boundary sliding