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Experimental study on the deformation microstructures and crystallographic preferred orientation of glaucophane and epidote in deformed epidote blueschist at high pressure

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To understand the crystallographic preferred orientation (CPO) of glaucophane and epidote and deformation microstructures at the top of a subducting slab in a warm subduction zone, deformation experiments of epidote blueschist were conducted in simple shear by using a modified Griggs apparatus. Deformation experiments were performed under high pressure (0.9–1.5 GPa), temperature (400–500 °C), shear strain (γ) in the range of 0.4–4.5, and shear strain rate of 1.5×10^{-5}–1.8×10^{-4} s^{-1}. After experiments, CPO of minerals were determined by electron back-scattered diffraction (EBSD) technique, and microstructures of deformed minerals were observed by transmission electron microscopy (TEM). At low shear strain ($\gamma \leq 1$), the [001] axes of glaucophane were in subparallel alignment to shear direction, and the (010) poles were sub-normally aligned to the shear plane. At high shear strain ($\gamma > 2$), the [001] axes of glaucophane were in subparallel alignment to shear direction, and the [100] axes were sub-normally aligned to the shear plane. At a shear strain between $2 < \gamma < 4$, the (010) poles of epidote were in subparallel alignment to shear direction, and the [100] axes were sub-normally aligned to the shear plane. At a high shear strain where $\gamma > 4$, the alignment of the (010) epidote poles had altered from subparallel to subnormal to the shear plane, while the [001] axes were in subparallel alignment to the shear direction. TEM observations and EBSD mapping revealed that the CPO of glaucophane was developed by dislocation creep, somewhat affected by the cataclastic flow at high shear strain. On the other hand, the CPO development of epidote is considered to have been affected by dislocation creep under a shear strain of $2 < \gamma < 4$ but is highly affected by cataclastic flow with rigid body rotation under a high shear strain ($\gamma > 4$). Our experimental results indicate that the magnitude of shear strain and rheological contrast between component minerals plays an important role on the formation of CPOs of glaucophane and epidote.