Experimental study on the deformation fabrics of epidote blueschist and implications for seismic anisotropy

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To understand deformation fabrics and seismic anisotropies of subducting oceanic crust, deformation experiments of epidote blueschist were conducted in simple shear at high pressures (P = 0.9–1.5 GPa) and temperatures (T = 400–500 ºC) by using a modified Griggs apparatus. Starting material is a natural epidote blueschist with a grain size of average 30 µm. Samples were deformed at constant shear strain rate of $\dot{\gamma} = 10^{-5}$–10^{-4} s^{-1} and a shear strain of γ = 0.6–4.5. The experimental results showed a fabric transition of glaucophane with increasing shear strain. For the samples deformed with a low shear strain ($\gamma \leq 1$), glaucophane [001] axes were aligned subparallel to the shear direction and the (010) poles aligned subnormal to the shear plane (type-1 crystallographic preferred orientation, CPO), indicating a dominant slip system of (010)[001]. For the samples with a shear strain ($\gamma > 2$), however, the [001] axes of glaucophane were aligned subparallel to the shear direction and the [100] axes aligned subnormal to the shear plane (type-2 CPO), indicating a dominant slip system of (100)[001]. Samples with a shear strain of $1 < \gamma \leq 2$ showed a transitional fabric of glaucophane. Type-1 CPO of glaucophane has hardly been reported so far, while type-2 CPO of glaucophane has often been observed in natural blueschists. Epidote also showed a change in CPO with increasing shear strain. Epidote showed mostly non-systematic fabric for the samples with a shear strain ($\gamma < 2$). Samples with a shear strain ($2 < \gamma < 4$) showed that the (010) poles of epidote were aligned subparallel to the shear direction and the [100] axes aligned subnormal to the shear plane, indicating a slip system of (100)[010]. In contrast, a sample with a shear strain ($\gamma > 4$) showed that the [001] axes of epidote were aligned subparallel to the shear direction and the (010) poles aligned subnormal to the shear plane, indicating a slip system of (010)[001]. Our results showed that both glaucophane and epidote CPO transition occur with increasing shear strain, indicating a change in seismic property of epidote blueschist with increasing strain. It is found that trench-parallel seismic anisotropy in subducting oceanic crust can be attributed to the type-2 CPO of glaucophane in the slab dipping at $\theta \geq 45º$.