Evidence for semi-brittle flow in mantle-wedge serpentinites under high pore fluid pressure and their implications for deep low frequency earthquakes

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In southwest Japan, deep low frequency earthquakes occur at the base of the shallow serpentinized mantle wedge. In order to understand deformation styles of the mantle wedge serpentinite, we conducted structural and petrological analysis of a paleo-mantle wedge body that has experienced serpentinization at pressure–temperature conditions corresponding to source areas of low-frequency earthquakes, in the Sanbagawa belt, central Shikoku. The serpentinite body has a block-in-matrix structure that result from pervasive fragmentation. At outcrop and thin section scales, the distribution of blocks follows a power law distribution with exponent $2.32 < D < 2.37$ (2-D). The block has experienced complete serpentinization, characterized by randomly-oriented antigorite aggregates. The matrix also consists of antigorite, which was formed due to dissolution–precipitation process of the block in the presence of H_2O. Antigorite aggregates in the matrix along localized shear planes is characterized by a strong crystallographic preferred orientation with a dominant [010](001) slip system, suggesting dislocation glide on (001) planes. We suggest that deep slow earthquakes occur by semi-plastic deformation of the serpentinized mantle wedge, under low effective normal stresses.

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