Lithospheric structure deduced by olivine crystal-fabrics in peridotites

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Crystallographic preferred orientations (CPOs) of olivine within natural peridotites are commonly depicted by pole figures for the [100], [010], and [001] axes, and they can be categorized into five well-known fabric types: A, B, C, D, and E. These fabric types can be related to olivine slip systems: A with (010)[100], B with (010)[001], C with (001)[001], D with {0kl}[100], and E with (001)[100]. In addition, an AG type is commonly found in nature, but its origin is controversial, and could involve several contributing factors such as complex slip systems, strain types, or the effects of melt during plastic flow. We present all of our olivine fabric database published previously as well as new data mostly from ocean floor, mainly for the convergent margin of the western Pacific region, and we introduce a new index named *Fabric-Index Angle* (FIA), which is related to the P-wave property of a single olivine crystal. The FIA can be used as an alternative to classifying the CPOs into the six fabric types, and it allows a set of CPOs to be expressed as a single angle in a range between -90° and 180°. The six olivine fabric types have unique values of FIA: 63° for A type, -28° for B type, 158° for C type, 90° for D type, 106° for E type, and 0° for AG type. Our results show that although our database is not yet large enough (except for trench peridotites) to define the characteristics of the five tectonic groups, the natural olivine fabrics vary in their range of FIA: 0° to 150° for the ophiolites, 40° to 80° for the ridge peridotites, -40° to 100° for the trench peridotites, 0° to 100° for the peridotite xenoliths, and -40° to 10° for the peridotites enclosed in high-pressure metamorphic rocks. We show a relationship between FIA and calculated azimuthal anisotropy. Since the direction of higher P-wave velocity is subparallel to the direction of the Plate motion, it may be likely to assume that olivine fabric types are between 0° (AG type) and 90° (D type). It shows that azimuthal anisotropy increases from 0° to 90°, indicating its direct relationship to olivine fabric types. Consequently, variation of azimuthal anisotropy in the Pacific Plate could result from variation of olivine fabric types; the region of higher azimuthal anisotropy in mantle could be dominated by A to D types, whereas the region of the lower azimuthal anisotropy in mantle could be characterized by AG-type like fabrics.

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