American Mineralogist, Volume 103, pages 993–1001, 2018

Non-hydrostatic stress field orientation inferred from orthopyroxene (*Pbca*) to low-clinoenstatite ($P2_1/c$) inversion in partially dehydrated serpentinites

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Abstract

The direction of the main compressional stress, at the origin of the orthoenstatite (Oen) inversion to low-clinoenstatite (LCen) lamellae observed in partially dehydrated antigorite-serpentinites, has been inferred based on the crystallographic orientation relationship between Oen host crystals and the LCen lamellae by means of electron backscattered diffraction (EBSD) combined with optical microscopy. This technique was applied to two samples: a transitional lithology (Atg-Chl-Ol-Opx) and a metaperidotite (Chl-Ol-Opx), both collected within 3 m from the serpentinite dehydration front exposed in Cerro del Almirez (Betic cordillera, South Spain). The metaperidotite displays a clear crystal-preferred orientation (CPO) of both Oen and LCen. The transitional lithology shows weaker CPOs. The metaperidotite contains LCen crystals representative of two possible variants of the Oen to LCen martensitic transformation with distinct orientations, which are consistent with a unique compression direction at ca. 45° to the normal to the foliation and to the lineation of the precursor serpentinite. In contrast, in the transitional sample, calculated compressional stresses display an almost random orientation. The observation of such a variation in the stress field recorded by two samples separated by <3 m rules out a tectonic origin for the stresses producing the LCen in these metaperidotites. We interpret therefore these stresses as resulting from compaction during dehydration. The present analysis implies that compaction-related stresses, though variable at the meter scale, may be organized at the centimeter scale during dehydration reactions of serpentinite.

Keywords: Clinoenstatite, stress field, martensitic transformation, serpentinite, dehydration reactions, non-hydrostatic stress