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Chemical and structural variations at augite (100) deformation twin boundaries

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ABSTRACT

It is commonly found that deformation twinning response to plastic deformation results in structural variations at a twin boundary (TB). Chemical heterogeneity at a TB, compared to the host, however, has rarely been reported. An augite sample with a high density of deformation twinning lamellae from Lofoten, Norway was examined using high-resolution transmission electron microscopy (HRTEM) and energy-filtered TEM (EFTEM) techniques to characterize both structural and chemical variations at a TB.

HRTEM experimental results combined with high-resolution image simulation unambiguously resolve the augite deformation TB structure as a half unit cell of orthopyroxene. EFTEM images at TB demonstrate that Ca is depleted, whereas Fe is enriched at this sub-nanometer scale (0.9 nm) interface. In addition, distance-least-squares (DLS) program was applied to verify that the TB structure is geometrically stabilized by substitution of Fe for Ca.

Keywords: Augite, deformation twinning, chemical variation, HRTEM, EFTEM