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Structure and formation mechanism of low-angle grain boundaries in chlorite

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Abstract

The structure and formation mechanisms of low-angle grain boundaries (LAGB) in chlorite have been investigated using HRTEM to resolve each cation sheet in chlorite. The LAGB are abundant in two hydrothermally formed ferromagnesian chlorite specimens. Abundant LAGB, which are almost parallel to (001), divide chlorite grains into packets many tens of nanometers thick. They are initiated or terminated in a grain, indicating they are not formed as conjunctions of two grains growing independently. The boundaries consist of the (001) surface of a chlorite layer at one side and terminating chlorite layers at the other side, so that the grain boundary involves a series of misorientation of several degrees. Periodic rows of triangular regions surrounded by two (001) chlorite surfaces and one edge of the terminating layer along the boundary are formed along the LAGB. Distinct crystalline structure inside these triangles is not observed and brucite-like interlayers are absent at the (001) surfaces between triangular-shaped regions, indicating local compositional change along the boundaries. To explain the origin of this microstructure, a formation mechanism of these LAGB is proposed involving termination of the growth of one brucite-like interlayer on a (001) TOT layer surface during layer-by-layer growth.