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Structure of mixed-layer corrensite-chlorite revealed by high-resolution transmission electron microcopy (HRTEM)

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Abstract

Mixed-layer corrensite-chlorite in a glauconitic sandy-clayey rock has been investigated and the three-dimensional stacking structure of corrensite was determined for the first time using high-resolution transmission electron microscopy (HRTEM). We are also able to identify the corrensite-chlorite transition mechanism. The crystals consist of corrensite and chlorite packets excluding successive smectite layers, consistent with the result of XRD analysis previously reported for the same specimen. One-dimensional HRTEM imaging of corrensite with dark contrast corresponding to the cation sheets indicated two types of the smectite-like interlayers in corrensite, probably containing one atomic plane and without any distinct material, which results in the corrensite basal heights of ca. 26.5 and 24.4 Å, respectively, in TEM. Two-dimensional HRTEM imaging revealed that the polytypic stacking sequence in the chlorite-like layer [the two 2:1 layers and the brucite-like sheet (B-sheet) between them] in the corrensite unit is always II*bb* type. The intralayer displacements of the two 2:1 layers in the unit are well ordered to show a "two-layer" character, which can be regarded as combination of two different one-layer chlorite polytypes belonging to II*bb*. These regulated features of corrensite structure indicate that corrensite precipitated directly from solution probably in an environment with a high water/rock ratio, without inheriting smectite structures, during the smectite-to-chlorite transition. The number of the successive B-sheets in the corrensite-chlorite interstratification is always odd. Along with frequent observation of the transition from the smectite-like interlayer to the B-sheet and similarity of polytypic stacking sequence between corrensite and chlorite, this result strongly supports the transformation from corrensite to chlorite, by replacing the smectite-like interlayer with the B-sheet.

Keywords: Corrensite, chlorite, mixed-layer minerals, polytypic stacking sequence, transformation, HRTEM