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New insights into the mechanism for chloritization of biotite using polytype analysis

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ABSTRACT

Near-atomic-resolution transmission electron microscopy was used to investigate the chloritization mechanisms of biotite in a granitic rock and to reveal polytypic details of the resulting chlorite. Comparison of stacking sequences in $2M_1$ and longer period biotite polytypes with sequences in areas containing chlorite layers revealed that typically, two biotite layers transform to one chlorite layer, losing two potassium interlayer sheets and two tetrahedral sheets. In some cases, more than two biotite layers are replaced by one chlorite layer. Less commonly, a potassium interlayer sheet is replaced by a brucite-like sheet. One biotite layer is transformed to one serpentine layer via loss of a potassium interlayer and a tetrahedral sheet in places. Based on the relative frequency of the two chlorite layers to one biotite layer vs. one biotite layer to one chlorite layer mechanisms, the net result of chloritization is a considerable volume decrease along **c***. Near-atomic-resolution images recorded down [010], [310], or $[3\bar{1}0]$ revealed that the chlorite polytype in the biotite-chlorite interstratifications is predominantly II*bb*. However mixtures of I*bb*, I*ab*, II*ab*, and II*bb* also occur. The "*aa*" stacking sequences were never found. Chlorite polytypes may be determined in part by the chloritization mechanisms and in part by relief of local shear by *a*/3 displacements.