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Atomic structures of planar defects in oxybiotite

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ABSTRACT

Atomic structures of planar defects found in oxybiotite from the Ruiz Peak ash flow, Jemez Mountains, New Mexico, were investigated using high-resolution transmission electron microscopy (HRTEM) and electron nano-beam chemical analyses. Two kinds of planar defects were observed. One defect contains more Si and Al than the host biotite. HRTEM images recorded along two directions indicated that this defect consists of an unbranched tetrahedral double sheet, as reported, e.g., in hexagonal $BaAl_2Si_2O_8$. The other defect is rich in Fe and Mg. Complete determination of the atomic structure was not successful, but this defect probably contains several octahedral sheets parallel to (001) of biotite. Investigation of the relationship between these defects and the polytypic features of the host biotite indicated that the tetrahedral double sheets shorten and the Fe/Mg-rich defects lengthen the period of the polytype unit including the defect. Increase of trivalent cations by oxidation of Fe^{2+} in the trioctahedral sheet destabilizes the structure of biotite, which is probably the cause of the formation of these defects. Such a defective structure may be a precursor of decomposition products of biotite by oxidation at high temperature, and our results emphasize the importance of re-examining the microstructures of the specimens previously investigated in experiments on oxidation and decomposition of biotite.