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A 94-layer long-period mica polytype: A TEM study

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Abstract

A 94-layer long-period mica polytype was studied by transmission electron microscopy (TEM). This is the longest periodicity found up to now in micas ($c \approx 95.9$ nm). It was observed in a fragment of a Mg-rich annite (biotite) crystal from dacite rocks of Džep, Serbia. The crystal region containing it extends about 800 nm along 1/**c***.

One-dimensional lattice fringe images obtained by bright-field (BF) illumination allowed identification of the very long-period polytype. The latter was characterized by selected-area electron diffraction (SAED) and high-resolution transmission electron microscopy (HRTEM). It is an inhomogeneous polytype belonging to the subfamily-*A,* based on the $2M_1$ structural series. Its 94-layer stacking sequence is: $[(2\bar{2})_3 20\bar{2}(2\bar{2})_3\bar{2}2(2\bar{2})_2\bar{2}2(2\bar{2})_3\bar{2}2(2\bar{2})20\bar{2}(2\bar{2})\bar{2}2(2\bar{2})_3\bar{2}2(2\bar{2})_2\bar{2}2(2\bar{2})_4\bar{2}2(2\bar{2})_2\bar{2}2(2\bar{2})_3\bar{2}2(2\bar{2})_4\bar{2}2(2\bar{2})_2\bar{2}2]$. The fringe contrasts of the BF images were correlated to the stacking sequence determined from HR images. The correlation verified that the same sequence occurred eight consecutive times. Analytical electron microscopy (AEM) revealed that the chemical composition of the 94-layer mica polytype is similar to that previously observed in randomly stacked and faulted areas of the same crystal. No remarkable chemical variation occurs between the 94-layer polytype and its adjacent crystal regions, the latter containing non-periodic stacking faults.

Keywords: Polytypism, biotite, electron microscopy, chemical analysis