Angle-Resolved X-ray Photoelectron Studies of Cleavage in Chlorites

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Abstract: The cleavage of two single-crystal chlorites (a clinochlore and a penninite) has been studied using angle-resolved X-ray photoelectron spectroscopy (XPS). Both minerals cleaved in regions not typical of the bulk; the composition of the clinochlore was found to be especially non-uniform. The brucitic interlayer divided evenly between the pair of new surfaces exposed for two cleaves in the clinochlore, but was partitioned unequally in two cleaves in the penninite. The differences in apparent composition between the complementary pairs of surfaces are interpreted to show a marked preference of octahedral Al for the brucitic layer, in agreement with X-ray bulk structure refinements. For both chlorites, the layer charge was reduced in regions of easy cleavage, which also had a higher proportion of Si and less tetrahedral Al than the bulk chlorite. The percentages of tetrahedral aluminium deduced from the XPS surface analyses agreed satisfactorily with the percentages independently determined by consideration of the magnitude of anisotropy in the X-ray photoelectron diffraction (XPD) patterns. The XPD patterns from the clinochlore for rotation about axes parallel and antiparallel to the crystallographic a-axis were identical, showing that tetrahedral ordering was absent.

Key Words: Chlorite • Cleavage • ESCA • Photoelectron • Structure • XPS

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