The Composition of Kaolinite—An Electron Microscope Microprobe Study

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Abstract: Electron microscope microprobe analysis (EMMA) has been applied to the determination of the elemental compositions of the kaolinite particles (Mg, Al, Si, K, Ti and Fe) contained in the 0 · 2 – 0 · 3 μm e.s.d., the 0 · 9 – 1 · 0 μm e.s.d, and the 1 · 9 – 2 · 0 μm e.s.d. fractions of an English kaolin and an American kaolin. Particles with masses as small as 10^{-13} g were analysed. An EMMA-4 instrument (A.E.I. Ltd.) equipped with linear fully focussing spectrometers was used. The ratio method of analysis was employed. The operating procedures used to obtain the required high experimental precision in the measurement of Al:Si atom ratio are discussed.

Statistical analysis of the results gives the estimated mean and spread of the Al:Si atom ratios. In the English kaolin the mean Al:Si atom ratio differs from the ideal 1:1 at the 0 · 05 significance level. There is evidence for a variation in composition from kaolinite particle to kaolinite particle in the 1 · 9 – 2 · 0 μm fraction of each kaolin. In the 0 · 9 – l · 0 μm fractions, the mean Fe:Si atom ratio was close to 0 · 002 showing the presence of iron in the kaolinite structure. The mean K:Si ratio was about 0 · 002 which would be equivalent to 1 unit muscovite layer associated with a 0 · 175 μm thick kaolinite particle. In the American clay the Ti:Si atom ratio was 0 · 002 suggesting that some 12 per cent of the 'titania' found by conventional chemical analysis was associated with the kaolinite particles either as titania itself or as an isomorphous substituent.

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