

Fe-kaolinite in granite saprolite beneath sedimentary kaolin deposits: A mode of Fe substitution for Al in kaolinite

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ABSTRACT

Fe-kaolinite has been detected in granite saprolite beneath sedimentary kaolin deposits in the Seto district of central Japan. Granite saprolite, which was found underneath sedimentary kaolin deposits formed in fluvial and lacustrine environments, had been subjected to kaolinization. The clay fractions of granite saprolite consist mostly of kaolinite with subordinate micaceous clay, quartz, and feldspars. Electron probe microanalysis (EPMA) showed that the kaolinite in clay fractions contained an average 3.30–3.72 wt% of Fe₂O₃, indicative of Fe-kaolinite. Fe+Si was inversely proportional to Al in Fe-kaolinite, indicating coupled substitution between Fe+Si and Al. The K₂O contents of Fe-kaolinite increased with increasing Fe₂O₃ up to 0.77 wt%, whereas K did not correlate with other elements, suggesting that K was not contained with the structure of kaolinite but was present in its interlayers. X-ray absorption near-edge structure (XANES) spectroscopy showed that about 60 to 70% of Fe in the clay fractions is ferric iron, and extended X-ray absorption fine structure (EXAFS) spectroscopy indicated that Fe is situated in octahedral sites replacing Al. Fe-kaolinite was likely precipitated by the infiltration of acidic groundwater with higher Fe and alkali contents into granite saprolite, accompanied by the intense kaolinization of sedimentary kaolin deposits.

Keywords: Kaolinite, coupled substitution, granite saprolite, ferric iron, EPMA, EXAFS, XANES, Japan