

Three-component mixed-layer illite/smectite/kaolinite (I/S/K) minerals in hydromorphic soils, south China

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ABSTRACT

To understand clay mineral transformations in hydromorphic conditions in the red earth sediments in Xuancheng, south China, clay mineralogy was investigated using X-ray diffraction (XRD) and high-resolution transmission electron microscopy (HRTEM). The XRD results indicated that clay minerals in the hydromorphic soils were illite, kaolinite, smectite, vermiculite, and mixed-layer illite/smectite and illite/smectite/kaolinite. Changes of the kaolinitic reflections under the various conditions suggested that the kaolinitic phase is a mixed-layer structure having kaolinite layers randomly interstratified with illite and smectite layers. HRTEM observation showed that 10 Å illite layers interstratified with both 15 Å smectite layers and 7 Å kaolinite layers in clay particles, confirming the occurrence of illite/smectite/kaolinite (I/S/K) three-component mixed-layer clays. The lattice fringes of the I/S/K clays appeared corrugated and vanishing, and also exhibited variable thickness along a lattice fringe, which were consistent with changes from illite to smectite, from smectite to kaolinite, and from illite to kaolinite, respectively. Hydromorphic conditions in the Xuancheng soils led simultaneously to the direct transformation of illite to kaolinite and the transformation of illite to smectite to kaolinite in the pedogenic processes, and the formation of I/S/K three-component mixed-layer clays as intermediate products of these processes.

Keywords: I/S/K mixed-layer, hydromorphic soil, net-like red earth, weathering