

## **Determination of layer stacking microstructures and intralayer transition of illite polytypes by high-resolution transmission electron microscopy (HRTEM)**

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### **ABSTRACT**

A detailed investigation of microstructures of authigenic illite has been carried out using high-resolution TEM. Near-atomic images of  $1M$  and  $2M_1$  polytypes of illite with incidence  $[100]$  and  $[110]$  were observed. We unambiguously determine  $1M$  illite in both individual particles and microtwinning domains. Newly formed  $2M_1$  domains are surrounded by former packets of  $1M_0$  or  $1M$  illite. Such intergrowth of different illite-polytypic domains on a scale of several layers suggests that they are metastable. The lateral-coherent  $1M$  and  $2M_1$  illite domains are aligned along the same orientation and crystallographically continuous normal to  $[001]^*$ . This is a new phenomenon observed for polytypic intergrowth and transition. The intralayer-stepwise change of stagger direction in a series of successive layers and consequently the interlayer-stacking angle change resulting in polytypic transition are hypothesized as an “intralayer-stepwise transition” model. It explains the process of illite polytypic transition in the solid state.

**Keywords:** Illite polytype, HRTEM, microstructure, intralayer-stepwise transition