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A study on two-stage illite mineralization originating from episodic fluid injections in the hydrothermal alteration system of the Hoam granite, South Korea

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Two stages of illite mineralization are recognized in the hydrothermal alteration zone in the Hoam granite (26–27 Ma). Mineralogical and geochemical characteristics of the clearly distinguished illites at each site mean that they were mineralized from different fluid injections in distinct geological environments. First, illites in site-1 alteration zone (High K: $K_{0.84}$ per $O_{10}(OH)_2$) containing 99% of the $2M_1$ polytype and coexisting with pyrite were formed under a slow cooling system (>250°C), high fS_2, and a relatively acidic environment. The pseudomorphic texture means that the illites in site-1 alteration zone record the fluid conditions changing from low to high water–rock ratio conditions. The illites in site-2 alteration zone (High K: $K_{0.83}$ per $O_{10}(OH)_2$ and low K: $K_{0.63}$ per $O_{10}(OH)_2$) are characterized by the coexistence of polytypes ($2M_1$, 1M, and $1M_d$) and dominant secondary textures, indicating that they were formed in a rapidly cooling system and under continuously high water/rock ratio conditions. The existence of magnetite in site-2 alteration zone indicates a less acidic and fS_2 environment than in site-1 alteration zone. In addition, the enrichment of high field strength elements, large ion lithophile elements (especially Cs), rare-earth elements (REEs), and actinide elements of illite in site-2 alteration zone is the result of the influence of more evolved fluid than that of the illite-formation fluid. The behaviors of trace elements for each illite mainly depend on the constituents of the hydrothermal fluid, and these reflect different degrees of fluid evolution. Considering the mineralogical and geochemical properties of illites in site-1 and site-2 alteration zone, the illite alteration zones in the Hoam granite are generated by at least two episodes of hydrothermal illite mineralization, and these are originated not from continuous evolved fluids but episodic injections of fluid.