Supplementary Information

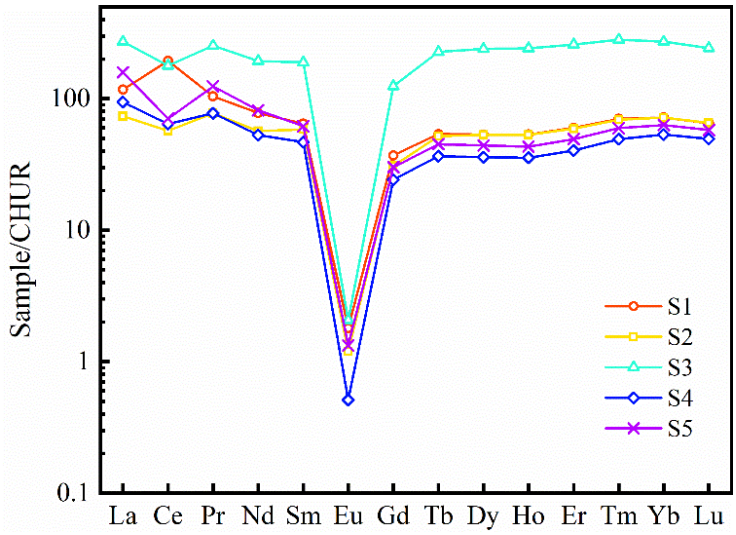

Figure 1S. REE pattern of samples normalized with CHUR (Taylor and McLennan, 1985). (S1: top soil; S2: alloterite layer; S3: isalterite layer; S4: fissured layer; S5: granite.)

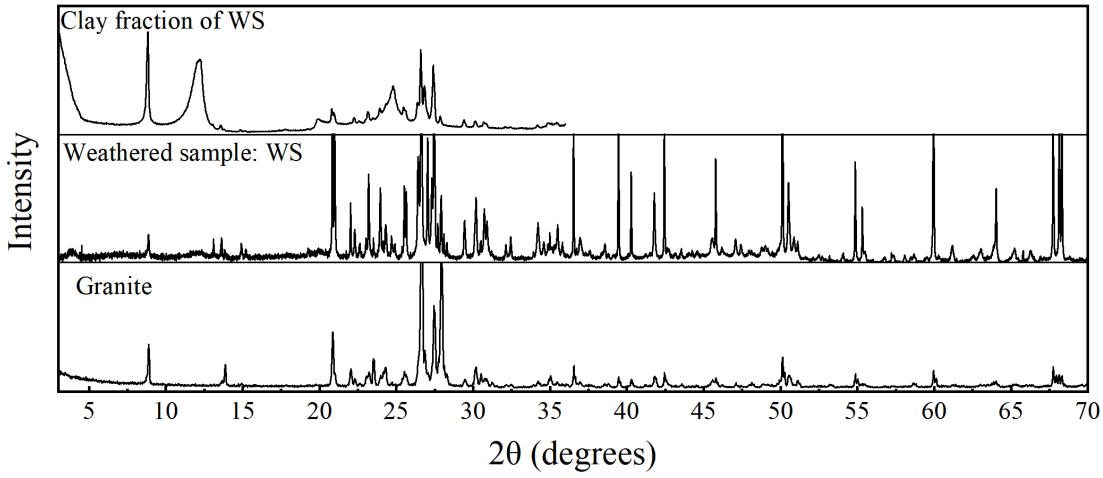

Figure 2S. The whole XRD patterns of granite, weathered sample and clay fraction.

Table 1S. Composition of biotite (Bt1-3) in granite, kaolinite and halloysite in weathered sample, which were analyzed by EPMA and EDS respectively.

wt%	K_2O	Na_2O	MnO	MgO	FeO	TiO_2	Al_2O_3	F	SiO_2	Total
Bt1	8.97	0.24	0.72	0.00	21.16	0.62	20.90	6.30	40.71	96.96
Bt2	9.01	0.27	0.77	0.01	22.16	0.78	20.79	6.58	40.19	97.78
Bt3	8.85	0.24	0.77	0.02	24.05	1.54	19.59	5.57	39.44	97.72
Kao	0.51				4.30		45.82		49.36	99.99
Hal	0.75				1.69		41.72		55.84	100

In granite, EPMA results suggest that biotites contain lots of FeO, about 21~25 wt% (Table 1). However, in weathered sample, EDS results suggest that clay minerals contain Si, Al, O, and sometimes extremely low Fe, suggesting the 10 Å peak of XRD represent 10 Å-halloysite.

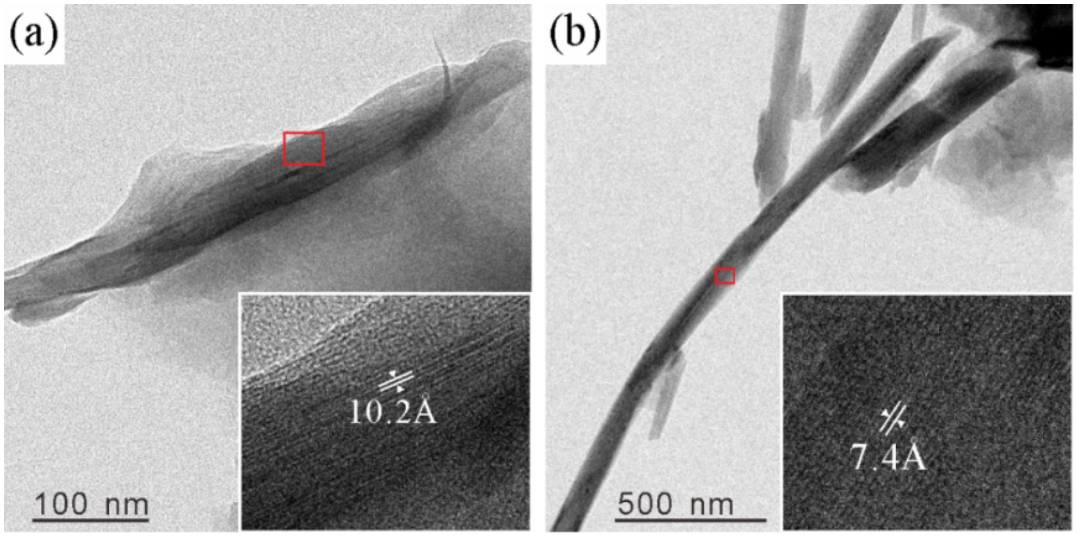

Figure 3S. TEM images of tubular halloysite. Two types of halloysite with different interplanar spacing, (10Å-halloysite and 7Å-halloysite) were recognized. Therefore, the wide peak at about 7.2 Å in XRD patterns was explained by kaolinite and 7Å-halloysite.

Table 2S. R factors for Ce L3-edge XANES spectra

Data	R factor	Weight of Ce(IV)	Weight of Ce(III)
WS	0.07	0.69	0.31
WS-Clay	0.06	0.80	0.20
Granite	0.03	0.16	0.84

R factors of LCF results. R factor = $\frac{(\text{data-fit})^2}{\text{data}}$

References:

Taylor, S.R., and McLennan, S.M. (1985) The continental crust: Its composition and evolution. Medium: X; Size: Pages: 328 p. Blackwell Scientific Pub.,Palo Alto, CA.