Formational Mechanism of Red Soils in Linkuo Terrace: Physicochemical Properties of Inorganic and Organic Nanoparticles Determined by EXAFS Techniques

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The Linkuo terrace situated to the west of Taipei basin in northwestern Taiwan. The red soils were classified as three groups, such as laterites, lateritic red earths, and red earths. The SiO_2/Al_2O_3 molar ratios in the clay fractions (< 1 μm) of laterites should be less than 1.3. The SiO_2/Al_2O_3 molar ratios in the clay fractions of the other two groups ranged from 1.7 to 2.2 or higher (Zhao and Shi, 1986; Gong, 1986). The red soils developed on the Linkuo terrace are not known due to lack of proper dating tool for the quaternary deposits and dynamic systems of red soils. Therefore, information on the red soils, formational mechanism and physicochemical properties of inorganic and organic nanoparticles is severely lacking. From our nano-particle study indicated finer nano-particles (i.e., 1-25, 25-100, 100-450 and 450-2000 nm) of zeolite A consist higher Si and lower Al contents. With decreasing the particle size, the T(Si,Al)-O asymmetric and symmetric stretching vibrations shifted toward higher IR frequencies and the Si to Al molar ratio increased consistently from 1.8 to 5.2, which is attributed to the loss of the external linkage D4-R units of the structure. According to the results of zeolite A, we have to demonstrate that these fine nano-particles easily leached out during pedogenesis. Thus, the desilication in fine particle sizes and enrichment in sesquioxides in red soil developments should be related the concept to soil weathering. Fine particle sizes removed or leached more Si and enriched Al and Fe in coarser particle sizes to develop red soils in acidic soil environments

100-450 nm				25-100 nm			
2θ	d (Å)	(hkl)	Minerals	2θ	d (Å)	(hkl)	Minerals
12.28	7.20	001	Kaolinite	12.282	7.20	001	Kaolinite
17.93	4.94	002	Illite	24.85	3.58	002	Kaolinite
19.94	4.45	111	Chlorite				
24.85	3.58	002	Kaolinite				
33.20	2.69	104	hematite				
35.02	2.56		Kao. Illite				
35.66	2.51		Mag.Hem.				
54.12	1.69	116	hematite				
62.28	1.49		Mag.Hem.				

Bulk sample				450-2000 nm			
2θ	d (Å)	(hkl)	Minerals	2θ	d(Å)	(hkl)	Minerals
12.43	7.12	001	Kaolinite	6.08	14.52	002	Verm.
17.83	4.97	002	Illite	8.78	10.06	001	Illite
20.87	4.25	100	Quartz	12.37	7.15	001	Kaolinite
24.90	3.57	002	Kaolinite	17.77	4.99	002	Illite
26.67	3.34	101	Quartz	19.88	4.46	111	Chlorite
35.01	2.56		Kao.Illite	20.87	4.25	100	Quartz
39,52	2.28	102	Quartz	23.86	3.72	023	Illite
42.47	2.12	200	Quartz	24.89	3.57	002	Kao.
45.81	1.98	136	Illite	25.38	3.50		K. H.
50.13	1.81	112	Quartz	26.66	3.34	101	Quartz
54.84	1.67	202	Quartz	29.85	2.99	003	Chlorite
59.94	1.54	211	Quartz	31.28	2.85	010	Verm.
61.90	1.49	312	Illite	34.86	2.57		Kao. Illite
64.06	1.45	113	Quartz	37.81	2.37	003	Kaolinite
68.28	1.37	301	Quartz	39.48	2.28	102	Quartz
73.39	1.29	104	Quartz	42.47	2.12	200	Quartz
75.55	1.25	302	Quartz	45.27	2.00	136	Illite
				50.14	1.81	112	Quartz
				54.26	1.69	116	hematite
				55.39	1.65	103	Quartz
				59.91	1.54	211	Quartz
				61.63	1.50	312	Illite
				68.06	1.37	203	Quartz

Table 1 indicates that kaolinte, illite and quartz are major clay minerals in bulk sample (< 2000 nm); There are vermiculite, Illite, Kaolinite, quartz, Chlorite and hematite in 450-2000 nm size fractions; There are Illite, Kaolinite, Chlorite, hematite and magnetite in 100-450 nm size fractions; There is only Kaolinite, in 25-100 nm size fractions.

The homogeneous and thick of red soil features were weathered from fine sediments and weathered from gravels and find sands. These red soils developed from Linkuo terraces can be considered as lateritic red earths or red earths and do not reach the criteria of laterite.