

Appendix

Samples MMS-1 to 6

Sietronics numbers JS0437-1 to 6

Bulk samples were analysed by XRD and XRF. The XRD results were interpreted by SIROQUANT, adjusted manually to best fit the chemical data.

Clay fraction was run as received, after glycolation and after heating to 350°C.

a) Clay species.

All samples have the same suite of clays:

- major kaolinite
- major vermiculite except for MMS1 and 4
- minor mica, probably muscovite

b) Bulk samples

As well as the above clays, the bulk samples contain:

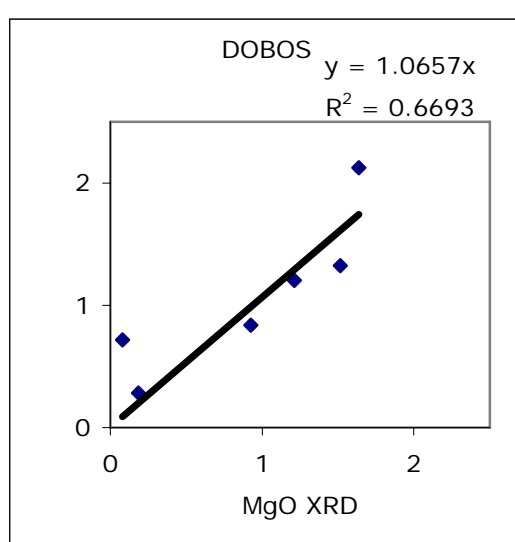
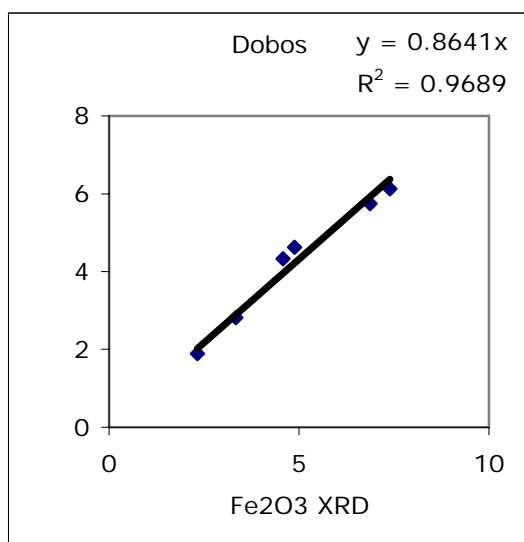
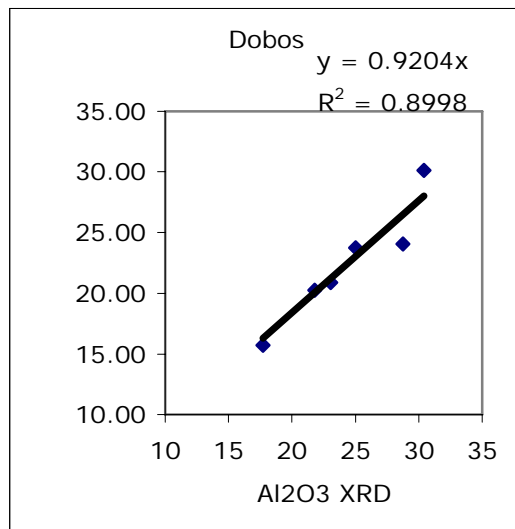
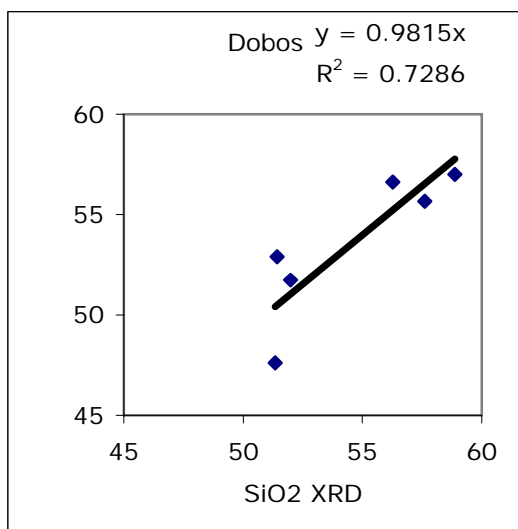
- major quartz
- minor goethite
- trace gypsum
- trace rutile

Table 1. Mineral percentages.

Phase	MMS/1	MMS/2	MMS/3	MMS/4	MMS/5	MMS/6
Quartz	14	14	20	17	25	18
Kaolinite	73	51	44	67	21	34
Muscovite	3	4	3	6	9	8
Vermiculite	4	22	30	0	39	36
Goethite	5	7	2	8	4	3
Gypsum	0.2	0.1	0.5	0.1	0.5	0.2
Rutile	1	1.2	1.3	1.2	2.5	1.9

Comparison between XRD calculated chemistry and XRF chemistry

The vermiculite composition used was visually adjusted to yield the best fit between observed chemistry (XRF) and calculated chemistry from XRD. The vermiculite composition so derived does not look very probable, having insufficient Al or Mg or Fe for any known vermiculite (see Table 1). The presence of opaline silica or other PDM would significantly affect the interpretation. Otherwise the agreement is acceptable



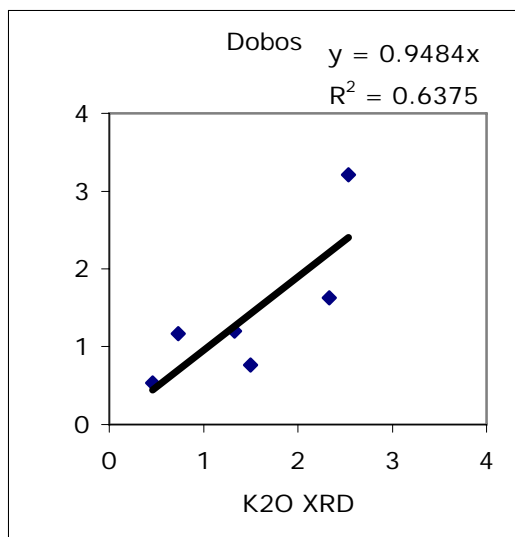


Figure 1. Comparison between XRD calculated chemistry and XRF results,

Table 2. Vermiculite/smectite composition from the literature and the composition used here to best fit the XRF data. Note the very low ($\text{Al}_2\text{O}_3 + \text{Fe}_2\text{O}_3 + \text{MgO}$) in the last column, indicating a real problem

	Al-verm Fordham	Mg-verm DHZ	smectite	verm best fit
SiO ₂	50.6	34	55.8	53
Al ₂ O ₃	20.8	15	28.6	15
TiO ₂	2			
Fe ₂ O ₃	16	8	0.4	3
MgO	2.4	23	2.03	4
CaO			2.23	
Na ₂ O	0.2		0.09	
K ₂ O	0		0.48	4
LOI	8	20	9.7	20
tot	100	100	99.33	99
Al+Fe+Mg	39.2	46	31.03	22

Cation Exchange Capacity

Five of the 6 samples have XRD vermiculite (MMS1, 2, 3, 5, 6). Sample MMS4 has no vermiculite and in this differs from the rest. XRD vermiculite vs. CEC correlates very highly for the 5 samples that contain vermiculite, with an implied CEC of the vermiculite of 90 meq/100g.

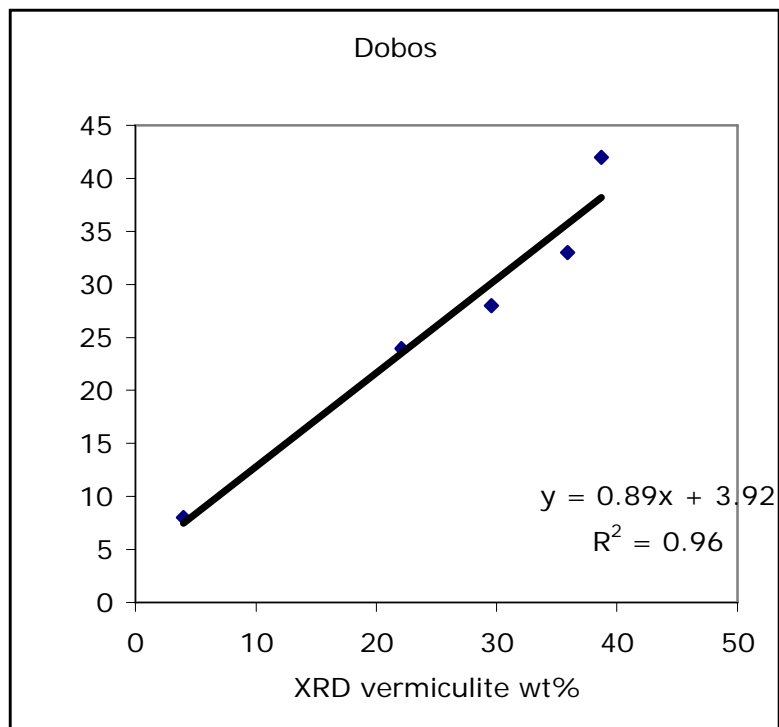


Figure 2. Relation between Vermiculite as determined by XRD and CEC.

Discussion

The identity of the swelling clay as vermiculite is based on its 15.4 Å basal spacing glycolated, its collapse to 10-Å on heating and the CEC results. The estimated proportion of the vermiculite in the bulk samples is confirmed by the cation exchange data

Conclusions

Although the exact character of the swelling clay remains uncertain, it seems unlikely that any of the six samples contain more than 40% of this phase.

There may be an amorphous phase undetected.

Kaolinite is ubiquitous, ranging from 20% to 75%.