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COMMENTS

INTERSTRATIFIED CLAYS AS FUNDAMENTAL PARTICLES: A DISCUSSION

Key Words—Illite, Interstratification, Smectite, Transmission electron microscopy, Vermiculite, X-ray powder diffraction.

Recent reports by Nadeau *et al.* (1984a, 1984b) indicate that clay minerals, hitherto identified by X-ray powder diffraction (XRD) as randomly interstratified layer silicates, can consist essentially of elementary particles of the component minerals, as revealed by transmission electron microscopy (TEM). Consequently, the interstratified layers can be physical mixtures of very thin phyllosilicate particles. Whereas XRD suggests that diffracting particles of smectite and regularly interstratified illite/smectite and chlorite/smectite are about 10 layers thick, TEM shows them to be essentially 10 Å (one silicate layer), 20 Å, and 24 Å thick, respectively, and thus should not produce the observed diffraction patterns. To reconcile the two observations, Nadeau and co-workers postulate that the observed XRD patterns result from interparticle diffraction, the XRD layer sequence resulting from the parallel orientation of particles within aggregates. This led them to suggest that during diagenesis, smectite (10 Å) particles become unstable and dissolve, whereas "elementary illite" particles (20 Å) are formed. Populations of elementary illite and smectite particles in specimens then produce XRD patterns similar to those calculated for interstratified layers (Reynolds and Hower, 1970; Reynolds, 1980).

Although this scheme may satisfactorily explain the formation of mixed-layer illite/smectite, it does not explain the formation of interstratifications produced in our laboratory experiments and, perhaps, in soil weathering profiles. For example, extraction of potassium from mica interlayers may produce random or regular interstratifications of expanded and collapsed layers depending on treatments (Rausell-Colom *et al.*, 1965; Norrish, 1973). Similarly, sorption of potassium by expanded layers of vermiculite produces regularly interstratified layer sequences, whereas sorptions by smectite produce random interstratifications (Sawhney, 1967, 1969). In recent experiments using Transvaal vermiculite, we have observed that increased sorption of potassium produces regularly interstratified mica/vermiculite in the 2–0.2-μm size fractions and randomly interstratified structures in the <0.2-μm size fractions. TEM examination of the smaller size fraction showed individual layers, as observed by Nadeau *et al.* (1984a). Apparently, small particles may form mixtures similar to random interstratification by mechanisms advanced by Nadeau *et al.* (1984a), but formation of regularly interstratified layers in larger particles of the same mineral and in other naturally occurring minerals may require a different mechanism.

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REFERENCES

Nadeau, P. H., Tait, J. M., McHardy, W. J., and Wilson, M. J. (1984a) Interstratified XRD characteristics of physical mixtures of elementary clay particles: *Clay Miner.* **19,** 67–76.

Nadeau, P. H., Wilson, M. J., McHardy, W. J., and Tait, J. M. (1984b) Interstratified clays as fundamental particles: *Science* **225,** 923–925.

Norrish, K. (1973) Factors in the weathering of mica to vermiculite: in *Proc. Int. Clay Conf., Madrid, 1972,* J. M. Serratosa, ed., Div. de Ciencas, CSIC, Madrid, 417–432.

Rausell-Colom, J. A., Sweatman, T. R., Wells, C. B., and Norrish, K. (1965) Studies in the artifical weathering of mica: in *Experimental Pedology,* E. G. Hallsworth and D. V. Crawford, eds., Butterworths, London, 40–72.

Reynolds, R. C. (1980) In *Crystal Structures of Clay Minerals and Their X-ray Identification,* G. W. Brindley and G. Brown, eds., Mineralogical Society, London, 249–303.

Reynolds, R. C. and Hower, J. (1970) The nature of interlayering in mixed-layer illite-montmorillonites: *Clays & Clay Minerals* **18,** 25–36.

Sawhney, B. L. (1967) Interstratification in vermiculite: in *Clays and Clay Minerals, Proc. 15th Natl. Conf., Pittsburgh, Pennsylvania, 1966,* S. W. Bailey, ed., Pergamon Press, New York, 75–84.

Sawhney, B. L. (1969) Regularity of interstratification as affected by charge density in layer silicates: *Soil Sci. Soc. Amer. Proc.* **33,** 42–46.

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