Clays and Clay Minerals, 1971, Vol. 19, pp. i–ii. Pergamon Press. Printed in Great Britain

CLAYS and CLAY MINERALS at a glance

Volume 19 **September 1971**

Scientific Contributions 209–260
News 261

DODECYLAMMONIUM–MICA COMPLEXES – I FACTORS AFFECTING THE EXCHANGE REACTION

E. E. Mackintosh, D. G. Lewis and D. J. Greenland 209

Dodecylammonium chloride (DAC) is used as a reagent to displace potassium from a wide range of mica minerals. Displacement is rapid and essentially complete for trioctahedral micas even in dilute solutions (0·02 N DAC) at low suspension concentrations. Increasing the suspension concentration, or the concentration of potassium in the extracting solution decreased the extent to which potassium could be displaced before equilibrium was established. Under standardized conditions of temperature and suspension concentration, the rate of potassium displacement increased as the particle size decreased although complete displacement was more difficult to achieve for the finest fraction ($< 2\,\mu$) than for the coarser particles.

The trioctahedral samples were shown to be more susceptible to potassium depletion by DAC than dioctahedral material. Within the range of trioctahedral samples examined the rate of reaction was found to be closely related to the fluorine content of the sample. Data obtained for the more resistant dioctahedral specimens was not sufficiently detailed to enable any similar relation to be established.

DIAGNETIC DEVELOPMENT OF KAOLINITE

C. D. Curtis and D. A. Spears 219

Experimental solubility data for gibbsite and kaolinite are reviewed and applied to the problem of gibbsite stability within the natural environment. It is concluded that free alumina compounds formed (only) in lateritic soils will tend to silicify spontaneously in all sedimentary environments. This metasomatic reaction should be accompanied by massive volume expansion: unusual textures are to be anticipated.

Petrographic and field descriptions of a number of ancient kaolinitic sediments (some with, some without free alumina) are reviewed. It is concluded that silicification of hydrated aluminum oxides was an important mechanism of kaolinite formation in ancient sediments and that free alumina compounds persist only as a result of the unusual volume expansion associated with kaolinite formation.

CRISTOBALITE AUTHIGENIC ORIGIN IN RELATION TO MONTMORILLONITE AND QUARTZ ORIGIN IN BENTONITES

J. H. Henderson, M. L. Jackson, J. K. Syers, R. N. Clayton and R. W. Rex 229

Three kinds of opal-cristobalite, differentiated by the sharpness of the 4·1 A XRD peak, were isolated from the Helms (Texas) bentonite by selective chemical dissolution followed by specific gravity separation. The $\delta^{18}0$ value (oxygen isotope abundance) for these cristobalite isolates ranged from approximately 26 to 30‰ (parts per thousand), increasing with increased breadth of the 4·1 A XRD peak. Opal-cristobalite isolated from the Monterey diatomite had a $\delta^{18}0$ value of 34‰. These $\delta^{18}0$ values are in the range for Cretaceous cherts (approximately 32‰) and are unlike the values of 9 to 11‰ obtained for low-cristobalite (XRD peaks at 4·05, 3·13, 2·84, and 2·49) formed hydrothermally or isolated from the vesicles of obsidian. The morphology pseudomorphic after diatoms, observed with the scanning electron microscope, was more apparent in the opalcristobalite from the Monterey diatomite of Miocene age (approximately 10 million yr old) than in the spongy textured opal-cristobalite from the Helms bentonite, reflecting the 40 million yr available for crystallization since Upper Eocene.

The oxygen isotope abundance of Helms montmorillinite ($\delta^{18}0 = 26$‰) indicates that it was formed in sea water while the $\delta^{18}0$ values of the associated opal-cristobalite indicate that this SiO_2 polymorph probably

https://doi.org/10.1346/CCMN.1971.0190401 Published online by Cambridge University Press

formed at approximately 25°C in meteoric water. Although both cristobalite and montmorillonite in the bentonite were authigenic, the crystallization of the SiO_2 phase apparently required a considerably longer period and occurred mainly after tectonic uplift.

In contrast to the results for cristobalite, quartz from the Helms and Upton (Wyoming) bentonites had $\delta^{18}O$ values of 15 and 21‰, respectively. Such intermediate values, similar to those of aerosolic dusts of the Northern Hemisphere, loess, and many fluvial sediments and shales of the north central United States (U.S.A.), preclude either a completely authigenic or a completely igneous origin for the quartz. These values probably result from a mixing of quartz from high and low temperature sources, detritally added to the ash or bentonite bed.

MICROSTRUCTURE AND PORE STRUCTURE OF IMPACT-COMPACTED CLAYS

Sidney Diamond 239

The microstructures of impact-compacted kaolinite and illite clays, after drying, were investigated by pore size-distribution measurements, X-ray orientation determinations and scanning electron microscopy. Clays compacted on the dry side of the optimum moisture content for maximum density exhibited a domain structure with adjacent domains largely separated by micrometer-size interdomain voids; clays compacted at or above the optimum moisture content showed a more nearly massive structure, large interdomain voids being absent. Parallel orientation was observed within domains, but neighboring domains were generally tilted with respect to each other. In kaolinite compacted on the wet side of optimum, regions of local parallel orientation could be identified at high magnification as domain units. A significant volume of 200 Å–800 Å dia. pores in this clay was identified with spaces observed between the kaolinite plates within domains for samples compacted on both the wet and dry sides of optimum. The subdomain structure was tentatively classified as "intergrown" in character. (001)/(020), (002)/(020), (001)/(060), and (002)/(060) orientation indices were calculated for the compacted kaolinite and compared with analogous measurements for fully-random and fully-oriented specimens of the same clay. The results indicated only a small degree of preferential orientation normal to the axis of compaction, with little difference between samples compacted either wet or dry of optimum. These results were consistent with scanning electron microscope interpretations, which suggested that the domains did not appear to orient themselves significantly under the influence of the compaction employed.

SWELLING CHARACTERISTICS OF COMPACTED, EXPANSIVE SOILS

N. V. Nayak and R. W. Christensen 251

The limitations of existing methods for the prediction of swelling behavior of compacted soils are examined. Both the purely theoretical approach and the purely empirical approach are found to be inadequate. The present study is based on a semi-empirical approach in which a model of swelling behavior is developed leading to equations relating swelling potential or swelling pressure of a compacted soil to its plasticity index, clay content and initial molding water content. The model is based on the concepts of the diffuse double layer, modified by introducing empirical constants to account for elastic swelling effects and other limitations involved in the direct application of double layer theory to real soils. The empirical constants are evaluated from the results of experimental investigations carried out on a large number of soil samples representing a wide variation of clay content as well as consistency limits.

It is shown that the predicted values of the swelling potential and swelling pressure based on the proposed model agree closely with the experimental results of this study and those reported in the literature. Furthermore, the equations developed in this study are of a more general nature and appear to be applicable to a larger range of soil types than those previously published.

TRANSFORMATION OF SERICITE INTO AN INTERSTRATIFIED MINERAL

Katsutoshi Tomita and Toshio Sudo 263

Sericite was K-depleted with molten $LiNO_3$. The sample was changed into an interstratified structure in the presence of a small amount of $LiNO_3$ after prolonged treatment, and in the presence of a considerable amount of $LiNO_3$ a similar structure was formed after about 3 hr of reaction. In the case of the presence of the proper amount of NaCl, a mixed-layer structure was easily obtained by treatment for a long period of time with a considerable amount of molten $LiNO_3$.

The interstratified mineral had a basal spacing of 22 Å–23·3 Å which was expanded to 25 Å–27·6 Å by treatment with ethylene glycol.

https://doi.org/10.1346/CCMN.1971.0190401 Published online by Cambridge University Press