

CLAYS and CLAY MINERALS

at a glance

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Scientific Contributions	309-362
Notes	363
Membership List, The Clay Minerals Society	367
Letters to the Editor	405
News	411

GLOBAL CLUSTER MICROSTRUCTURE OF ENDELLITE (HYDRATED HALLOYSITE) FROM BEDFORD, INDIANA

Sidney Diamond and James W. Bloor 309

Scanning electron microscope observation of endellite from Bedford, Indiana, discloses the existence of globular clusters of quasi-tubular endellite particles radiating from common centers. Individual clusters are of the order of 10μ in overall diameter. The individual quasi-tubular particles are irregularly flattened in cross section, and some may be plugged at the ends. Conventional oven drying at 105°C results in partial unrolling and incomplete flattening of the quasi-tubular particles of some of the clusters. The globular cluster microstructure is taken to represent the result of in-situ crystallization from solution. If this is so, these hollow tubes cannot have arisen by the mechanism of repeated extrusion of concentric zonal crystallites as postulated by Chukhrov and Zvyagin.

RELATION BETWEEN CRYSTAL-LATTICE CONFIGURATION AND SWELLING OF MONTMORILLONITES

John C. Davidtz and Philip F. Low 325

Prompted by Foster's observation that free swelling is related to octahedral substitution, the authors determined the free swelling of six Na-montmorillonites with different amounts of octahedral and tetrahedral substitution. They found that the montmorillonites exhibited marked differences in free swelling. These differences were not related to differences in cation exchange capacity. Nor were they related to differences in ζ potential, which is a criterion of cation dissociation. Further, calculations indicated that they could not be accounted for by differences in double-layer repulsion or van der Waals attraction. Therefore, to see if dimensional changes produced by isomorphous substitution were responsible, free swelling was plotted against the b -dimension of the clay structure, which was calculated from its mineralogical composition. The result was a straight line with a negative slope. A similar result was obtained with Foster's data. In addition, free swelling was plotted against the degree of tetrahedral rotation in the clay structure, which was also calculated from its mineralogical composition. The result was a family of nearly parallel straight lines that were distinguished from each other by the amount of tetrahedral Al^{3+} in the clays identified with them. These results led to the proposal that the clay surface acts as a template for the structure of the adjacent water and that, as the configuration of the surface changes, the water structure changes accordingly. This causes a change in the free energy of the water and, hence, in the swelling of the clay.

PROTOTROPY IN KAOLINITE DURING PERCUSSIVE GRINDING

John G. Miller and T. Dixon Oulton 313

When kaolinite undergoes percussive grinding, pronounced changes take place in its i.r. absorption spectrum even in the earliest stages of the grinding when the lattice is not yet destroyed. In this report, attention is directed to the change in the stretching bands of the hydroxyl ions. A remarkably rapid effect on the band of the intralayer hydroxyl ions has been observed and is attributed to a permanent removal of the protons from these ions. Auxiliary measurements of X-ray diffraction, thermal water loss, and DTA were used to corroborate the spectroscopic evidence for this ready prototropy.

ION SELECTIVITY BY WEATHERED MICAS AS DETERMINED BY ELECTRON MICROPROBE ANALYSIS

J. le Roux, C. I. Rich and P. H. Ribbe 333

Electron probe micro-analysis studies on individual particles (40–60 mesh) of weathered micas treated with solutions containing equivalent amounts of Rb and Sr showed partial segregation of these elements. Rb was concentrated at particle and step edges, at cracks, and, in the case of partially K-depleted biotite, at boundaries of vermiculite and mica zones ("wedge zones"). The scarcity of wedge zones in mica from which nearly all of the K had been removed reduced the overall selectivity for Rb. The restricted exchange of interlayer Mg ions from vermiculite-like zones by a mixed Rb–Sr solution was observed in earlier studies with these micas. The proposed explanation for these results was a closing down of the interlayer space at the edge of the particle due to Rb concentration in these positions. This explanation is confirmed by the present study.

THERMAL REACTIONS OF SYNTHETIC HECTORITE

J. M. Green, K. J. D. MacKenzie and J. H. Sharp 339

The thermal reaction sequence of a synthetic hectorite (Laponite CP) was studied by X-ray diffraction, i.r. spectroscopy and thermal analysis. Although most of the interlayer water is removed at 200°C, a small steady weight loss occurs until dehydroxylation is complete at about 700°C, indicating that an anhydrous intermediate phase is not formed prior to dehydroxylation. Immediately after dehydroxylation, enstatite and cristobalite can be identified, but lithium silicates are formed only from lithium-saturated hectorite. Around 1200°C a glass is formed by reaction of the alkalis with cristobalite, and removal of silica from the enstatite produces some forsterite. An inhomogeneous mechanism of dehydroxylation is postulated by analogy with that proposed for talc.

CONDITIONS OF KAOLINITE FORMATION DURING ALTERATION OF SOME SILICATES BY WATER AT 200°C

A. Oberlin and R. Couty 347

When a mineral of the montmorillonite group, saturated

with Na cations, is placed in a dilute solution of hydrochloric acid, and maintained at 200°C, it should alter and produce the corresponding mineral of the kaolinite group, according to the following reaction: Triphormic clay + $H^+ \rightleftharpoons$ Diphormic clay + $SiO_2 + Na^+$. The formation of the diphormic clay should depend only on the value of the $[Na^+]/[H^+]$ ratio, for the various temperatures used in the process. In a number of experiments, a few minerals of various types were subjected to this alteration process, carried out under a wide variety of conditions, namely duration of the alteration treatment, clay and acid concentrations and value of the $[Na^+]/[H^+]$ ratio. Formation of kaolinite, was not found but instead either an amorphous gel, or a well-crystallized boehmite, or else no dissolution at all of the initial mineral. We have already shown that a feldspar, when subjected to an alteration under similar conditions, never produces kaolinite, but forms a poorly crystallized boehmite instead. This intermediate product is the only one able to fix silica in its numerous active sites, and thus produce kaolinite. In this investigation we sought to induce a formation of poorly crystallized boehmite, from montmorillonites, with a view to a subsequent growth of kaolinite. This was achieved by inserting layers of aluminum hydroxy-polymer between the layers of a montmorillonite, followed by an alteration conducted under the same conditions as previously. At the end of a 17 hr treatment, a number of fibers of poorly crystallized boehmite (pseudo-boehmite *b*) appeared. At the end of a 15 day period, large amounts of kaolinite were formed, and kaolinite alone remained at the end of one month. These experiments substantiate the need of some "storage" of the aluminum in an intermediate poorly crystallized mineral. This is an essential preliminary condition to any formation of clay. This clay can be formed only when the silica monomer can be fixed on active sites of the intermediate product.

INTERACTIONS OF CLAY MINERALS WITH ORGANIC POLYMERS. SOME PRACTICAL APPLICATIONS

B. K. G. Theng 357

An account is given of the interactions between clay-minerals and organic polymers with particular reference to their applications in agriculture, foundation engineering and industry.