

CLAYS and CLAY MINERALS

at a glance

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TRANSMISSION ELECTRON MICROSCOPY OF FINE-GRAINED PHYLLOSILICATES IN ULTRA-THIN ROCK SECTIONS

P. P. Phakey, C. D. Curtis and G. Oertel

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A method is described for preparing electron-transparent sections of fine-grained argillaceous rocks suitable for making transmission micrographs. A sediment and a slate are used as examples. Sections perpendicular to bedding or cleavage yield diffraction patterns with clearly defined 00 l reflections. These allow immediate identification of 7, 10 and 14 Å structures. The combination of detailed textural information with structural identification of individual phyllosilicate particles affords a powerful method for the investigation of late diagenetic and early metamorphic changes in sediments.

EXTINCTION BEND CONTOURS IN ELECTRON MICROSCOPY OF CLAY-SIZE MICA-VERMICULITES

M. Gal and C. I. Rich

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Extinction bend contours, observed in Cs-treated mica-vermiculites by transmission electron microscopy, give information on the morphology and crystal orientation and continuity in individual particles of clay size. Inter-layer Cs apparently stretches that part of the silicate sheet in closest proximity and when exchange by Cs is incomplete, warping of the particle occurs. Warping favors the appearance of bend contours in transmission electron microscopic images of the particles. These contours terminate at crystal boundaries within a particle. A specimen tilting stage is useful in bringing the contours into view and in "exploring" individual particles.

IRREVERSIBLE COLLAPSE OF MONTMORILLONITE

Gözen Ertem

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A number of variable charge montmorillonites was prepared. One portion of each sample was extracted with ammonium chloride, while a second portion was first saturated with calcium chloride, washed, and then extracted with ammonium chloride. In both cases, the number of cations displaced by ammonium chloride was determined. The number of calcium ions displaced from Ca-saturated samples was higher than the sum of the number of lithium and calcium ions displaced from Li, Ca-mixed samples. The differences, increasing towards Li-rich end of the series are assumed to be due to protons liberated from the reaction of lithium ions with either structural hydroxyl groups or residual water molecules, as has been shown by other investigators. Supplementary X-ray and i.r. data lend support to this idea.

A SEPIOLITE-RICH PLAYA DEPOSIT IN SOUTHERN NEVADA

Keith G. Papke

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Sepiolite is seldom reported in playa deposits, even though it is generally believed to form in a highly saline, alkaline environment. Its rareness suggests that unusual conditions are necessary for formation of sepiolite. Sepiolite is a major constituent of a near-surface playa bed 4 ft thick in the Amargosa Desert, southern Nye County, Nevada. Associated materials include dolomite and small to trace amounts of quartz, feldspar, montmorillonite, illite and volcanic glass. The dolomite, averaging about 2 μ in size, makes up about 40% of the bed. The overlying beds and the underlying ones down to a sampled depth of 13½ ft are montmorillonitic (saponite) clays with moderate to trace amounts of sepiolite; dolomite is abundant in all these clays except in the uppermost several feet, where calcite is a major constituent. Ground

water in this area contains abundant magnesium compared with that in the rest of the Amargosa Desert. An initial high concentration of magnesium in the playa lake water probably promoted the development of sepiolite and dolomite. Concentration of dissolved salts through evaporation of water is believed to have started chemical precipitation of dolomite, and this precipitation and the continued evaporation later caused deposition of sepiolite.

A FERROAN NONTRONITE FROM THE RED SEA GEOTHERMAL SYSTEM

James L. Bischoff

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A smectite rich in ferrous iron and low in aluminum occurs abundantly in the Red Sea Geothermal Deposits, and appear to be forming at present. Chemical analyses and Mössbauer spectra indicate the mineral is intermediate in composition between nontronite and the as yet undescribed trioctahedral ferrous iron end member.

FORMATION OF AN INTERSTRATIFIED MINERAL BY EXTRACTION OF POTASSIUM FROM MICA WITH SODIUM TETRAPHENYLBORON

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Interlayer K was extracted with sodium tetraphenylboron solution from a powdered sericite heated to the temperature of dehydroxylation and quenched to room temperature. By this procedure, sericite of the $2M_1$ type was changed to an interstratified mineral. The X-ray diffraction properties of this interstratified mineral are similar to "rectorite".

MONTMORILLONITE COMPLEXES WITH DIOXANE, MORPHOLINE AND PIPERIDINE: MECHANISMS OF FORMATION

G. W. Brindley and Atsumu Tsunashima

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The adsorption of dioxane, morpholine and piperidine from dilute aqueous solutions by Li-, Ca-, and Cu-montmorillonite is measured by means of a differential refractometer. This instrument measures small differences in the refractive indices of two liquids and provides a useful method for determining the amount of organic material removed from solution by the clay. Corrections are required for the effect of desorbed cations on the differen-

tial refraction measurements. Neutral molecules are absorbed in amounts related to the exchange capacity of the clay probably by cation-dipole interactions. The results are consistent with the formation of complexes Li^+-R and $R-Ca^{2+}-R$ for the three organic materials used; Cu^{2+} ions behave like Ca^{2+} ions for dioxane, but form

R \diagdown
 $Cu^{2+}-R$ complexes with morpholine and piperidine.

R \diagup

Under acid conditions, morpholine and piperidine form organic cations RH^+ which take part in cation exchange reactions and which are dominant at pH below about 5. Neutral molecule absorption also occurs by virtue of the presence of RH^+ ions on the clay which form RH^+-R complexes (hemi-salt formation). When this last mechanism of absorption occurs, the total absorption is approximately twice that when a cation-dipole reaction or cation exchange alone operates. One-dimensional Fourier 001 syntheses of complexes in equilibrium with aqueous organic solutions indicate that water molecules are associated with the clay-organic complexes to the extent of about $5H_2O$ /unit cell.

THE RELATIONSHIP BETWEEN THE HYDRATED AND DEHYDRATED STATES OF AN HALLOYSITE

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A study of the mineralogical changes taking place during the loss of interlayer water in an halloysite has been carried out in order to clarify the relationship between the most hydrated and least hydrated states of the mineral. A number of samples of halloysite which together exhibit a variety of average interlayer water capacities were obtained by the conditioning of a largely hydrated sample with different atmospheres of known relative humidities. Profiles were obtained of X-ray peaks which characterize the interlayer water capacities of halloysite samples. An attempt has been made to analyse these profiles into a sum of peaks attributable to the fully hydrated and dehydrated states of the mineral. Such an analysis does not satisfactorily explain the profile shapes. A mechanism of interstratification of hydrated and dehydrated kaolin layers in which there is a tendency towards the segregation of these layer types gives a more satisfactory explanation of these profile shapes. It is concluded that dehydration takes place through an interstratification in which there is a partial segregation of the two basic layer types. This conclusion implies that halloysites with all average interlayer water contents between 0 and 2 molecules per unit cell may exist and that fully hydrated halloysite and dehydrated halloysite are the end members of a continuous series of hydration states.