

CLAYS and CLAY MINERALS

at a glance

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MONTMORILLONITE-ORGANIC COMPLEXES— GAS CHROMATOGRAPHIC DETERMINATION OF ENERGIES OF INTERACTIONS

K. K. Bissada and W. D. Johns 197
Gas-solid chromatographic measurements of interaction energies were made for the systems ethanol and acetone with K-, Na-, Ba-, and Ca-montmorillonites. The results revealed an increased interaction energy in the order: K-mont. < Na-mont. < Ba-mont. < Ca-mont. Interaction energies ranged from about 14 kcal/mole for K-montmorillonite to about 30 kcal/mole for Ca-montmorillonite. A very good agreement was observed between experimental heats of adsorption values and theoretical values for the electrostatic attractive energy between the respective cations and polar molecules. These results confirm our earlier suggestions that complex formation takes place through cation-dipole interactions and that the polar molecules solvate the exchange cations in a manner similar to the hydration of cations in aqueous solutions.

SURFACE AREA OF VERMICULITE WITH NITROGEN AND CARBON DIOXIDE AS ADSORBATES

Josephus Thomas, Jr. and Bruce F. Bohor 205
Surface-area studies were made on several homoionic vermiculites with both nitrogen and carbon dioxide as adsorbates. These studies show that only very slight penetration occurs between individual vermiculite platelets. This is in contrast to an earlier investigation of montmorillonite where it was found that the degree of penetration between layers is quite high, particularly for carbon dioxide, and is governed by the size and charge of the interlayer cation. The inability of these adsorbates to penetrate substantially between vermiculite platelets is due primarily to this mineral's high surface-charge density. The extent of penetration of nitrogen and carbon dioxide at the edges of vermiculite platelets,

though slight, is influenced by the coordinated water retained within the sample at a given degassing temperature. Forces between layers are weakened with increasing water content, which permits slightly greater penetration by adsorbate gases. Thus, the surface area of vermiculite, as determined by gas adsorption, is larger than the calculated external surface area based upon particle size and shape considerations. In addition, "extra" surface is provided by the lifting and scrolling of terminal platelets. These morphological features are shown in scanning electron micrographs of a naturally occurring vermiculite.

MONTMORILLONITE DEPOSITS IN NEVADA

Keith G. Papke 211
Nevada has produced one-third million tons of montmorillonite clays; a major portion was natural adsorbent clay from the Ash Meadows district. Four properties, 3 with swelling and 1 with non-swelling montmorillonite, are currently producing. Detailed geologic and laboratory studies were made of thirty Nevada montmorillonite deposits. Pyroclastic and other volcanic rocks, mainly Miocene and Pliocene in age, were the host for most of these. The montmorillonite deposits are believed to have been formed in four ways: (1) eleven deposits by alteration of volcanic ash shortly after it settled in lacustrine basins; (2) two deposits by deposition of fine-grained clastic materials; (3) eleven deposits by hydrothermal alteration of a variety of rock types near structural channelways; and (4) six deposits by partial leaching and alteration of glassy, rhyolitic volcanic rocks by ground water. Montmorillonite is the predominant clay mineral in all the deposits except Ash Meadows, where saponite is present. Sodium is much more common as the exchangeable cation than calcium and/or magnesium. Kaolinite and illite are present in one-fifth of the samples; chlorite or mixed-layer material are rarely present. Quartz, cristobalite, feldspars, calcite and gypsum are common impurities.

SURFACE CONDUCTANCE AND ELECTROKINETIC PROPERTIES OF KAOLINITE BEDS

Philip B. Lorenz

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A technique was developed for forming clay beds of uniform porosity between 48 and 62 per cent. The surface conductance and streaming potential of sodium kaolinite were determined over a range of values. Zeta potential as calculated from the classical formula was about -30 mV at neutral pH and changed sign at pH 4. The surface conductivity of the sodium clay at various pH values was directly proportional to the zeta potential and from 12 to more than 30 times as large as the calculated electrokinetic surface conductivity. Similar measurements were made on kaolinite in the acid (hydrogen-aluminum) and calcium forms. The acid clay fitted the experimental correlation found for the sodium series, but the calcium clay, with less than one-tenth of the zeta potential of the sodium clay at neutral pH, had half of its surface conductance. The results are interpreted as showing that exchangeable ions on kaolinite are mostly in a condensed layer on the surface where the mobility determines surface conductance. The surface mobilities for Na, Ca, and H-Al are 20, 8 and 0 per cent of normal, respectively. Apparently hydrogen ion from the solution is very effective in replacing sodium, which exhibits its electrokinetic and conductive properties in proportion to its concentration on the surface.

TRANSFORMATION OF MONTMORILLONITE TO NICKEL-CHLORITE

G. C. Gupta and W. U. Malik

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Nickel-chlorite has been obtained by the co-precipitation of nickelous hydrous oxide and montmorillonite at an OH/Ni ratio of 2:0. Chemical analysis shows that 16 me of Ni is fixed per gram of clay. System without any free nickelous hydrous oxide is quite stable up to an investigated period of 6 months, shows impedance to collapse on heating to 550°C , and no expansion of 001 spacing on glycerol treatment. Different properties studied (X-ray diffraction analysis, thermal data, infrared absorption analysis, polarographic reduction behavior, and cation

exchange capacity measurements) confirm the complete transformation of montmorillonite to nickel-chlorite. "Seeding" of the hydroxide out of the "fixed" interlayer positions takes place on ageing the sample with free nickelous hydrous oxide. No montmorillonite could be detected by X-ray diffraction analysis in spite of this backward reaction.

ANAUXITE AND KAOLINITE STRUCTURES IDENTICAL

S. W. Bailey and R. B. Langston

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Single crystal X-ray diffraction patterns reveal that the structure of selected anauxite crystals is the same as the structure of macroscopic kaolinite crystals. Anauxite and kaolinite crystals are intergrowths on a domain scale of units in pseudotwin orientations. Individual domains in anauxite have the triclinic geometry of kaolinite, and give X-ray reflections that compare closely in intensity with those calculated from the atomic parameters of kaolinite. Large crushed crystals of anauxite give powder patterns identical with that of kaolinite. Because it has been shown recently that the chemical composition of anauxite is also identical with that of kaolinite, it is recommended that the term "anauxite" no longer be used.

A PURPLE-COLORED 1M MICA CLAY FROM SILVERTON, COLORADO

Pei-Lin Tien

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A purple-colored clay of 1M mica polymorph in association with lead-zinc ore was collected from an abandoned mine dump near Silverton, Colorado. Electron micrographs show that the crystallites of the clay are less than 2μ in size and have poorly developed hexagonal outlines. Differential thermal and i.r. absorption analyses indicate similarity with those of muscovite. The structural formula of the 1M mica polymorph is $(\text{K}_{1.45}\text{Na}_{0.02})(\text{Al}_{3.75}\text{Mg}_{0.19})(\text{Si}_{6.96}\text{Al}_{1.10})\text{O}_{20}(\text{OH})_4$. The purple color may be related to trace amounts of manganese in the clay.