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CLAYS and CLAY MINERALS at a glance

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ELECTROLYTE CONCENTRATION–PERMEABILITY RELATIONSHIPS IN SODIUM ILLITE–SILT MIXTURES

James H. Hardcastle and James K. Mitchell 143

To examine the effects of clay swelling and dispersion on electrolyte concentration-permeability relationships of low clay content soils, flow experiments were conducted on a silt of fixed particle size distribution containing 0, 5, 7·5, 10 and 15 per cent clay (sodium illite, 2 μm fraction). Flocculated specimens were sedimented using both slow and rapid procedures. After compression each specimen was permeated successively with electrolyte solutions which caused (1) swelling of the clay fraction (0·10 N), and (2) dispersion (0·05 N). Absolute permeabilities varied with clay content, sedimentation procedure, compression rate, and electrolyte concentration; however, the form of this variation plotted against through-put volume was similar for all specimens containing electrolyte solutions causing only swelling of the clay. Increasing the hydraulic gradient above a critical value apparently increased the swelling slightly as evidenced by further reductions in permeability. The permeability of mixtures permeated with electrolyte solution causing dispersion of the clay was more complex and depended on clay content, the hydraulic gradients used to introduce the dispersing electrolyte soln, and the pre-dispersion gradients to which the specimens had been subjected. Permeability decreases were attributed to the last stages of swelling prior to dispersion and to pore plugging. Increases in permeability were the result of erosion of dispersed particles. Specimens previously subjected to the highest gradients while swelling dispersed more rapidly and had a greater tendency to erode. The effects of predispersion gradients diminished with increasing clay contents. It is concluded that both compositional and mechanical factors play an important role in determining electrolyte concentration permeability relationships for soils containing active clay minerals.

ELECTRON-OPTICAL INVESTIGATIONS ON MONTMORILLONITES—I. CHETO, CAMP-BERTEAUX, AND WYOMING MONTMORILLONITES

Necip Güven 155

Other layer silicates are consistently present as impurities in natural montmorillonite samples. They have a distinctly different morphology from the common montmorillonite particles. The selected area electron diffraction (SAD) of these impurities display unusually sharp spot patterns with triclinic, monoclinic and hexagonal symmetries. These impurities are most likely micas, which are easily detectable with X-rays in the coarser fractions ($>10\,\mu$m) of the samples.

The crystal structure model with the space group C2 for montmorillonite single layer has an unusual configuration of OH's and vacancies for a dioctahedral layer silicate. Our intensity calculations do not bring a conclusive evidence for distinguishing the two possible space groups C2 and C2/*m* on the observed SAD patterns of montmorillonite.

The SAD of the thin montmorillonite flakes in Cheto, Camp-Berteaux and Wyoming samples display uniform ring, circular arcs and spotty ring patterns, respectively. These patterns indicate different modes of association of crystallites or different arrangements of elementary layers within them.

PHOSPHATE TRANSPORT IN ILLITE DUE TO CONSOLIDATION

Charles A. Moore and Nahid Zouestiagh 167

The conditions were studied under which consolidation loading caused the release of phosphate from a saturated illite clay. P^{32} tracer techniques were employed to follow the

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movement of phosphate in composite samples composed of tagged and untagged portions. The samples, initially consolidated to 1·0 kg cm^{-2} stress were reconsolidated to 0·1, 0·5, 2, 4 and 8 kg cm^{-2} stress and the transport of phosphate was monitored by counting the radioactivity of 0·01-in. thick sections sliced parallel to the major principal plane. Corrections were applied for P^{32}–P^{31} self-diffusion. It was found that: (1) for low phosphate concentration there was no observable transport due to consolidation type flow; (2) for high phosphate concentration and for stresses less than or equal to the preconsolidation load there was no observable transport due to consolidation type flow; and (3) for high phosphate concentration and for loads above the preconsolidation load there was detectable transport of phosphate, presumably due to the consolidation flow. A mechanism based on self-diffusion plus uniform flow was able to semi-quantitatively explain the test results.

GAS SORPTION IN CLAY MINERAL SYSTEMS

L. A. G. Aylmore 175

Sorption isotherms for four gases (N_2, A, Kr and CO_2), commonly used in specific surface area and pore structure measurements, have been accurately determined on a number of clay mineral and oxide systems.

Specific surface areas obtained by application of the BET theory to these isotherms illustrate the extent to which the apparent cross-sectional areas for these sorbed gases vary with surface structure, exchangeable cation and microporosity.

V–n plots for nitrogen adsorption on these materials using nitrogen adsorption on crystalline materials of large crystal size as a standard isotherm provide appreciable ranges of linearity in each case. The specific surface areas obtained from these straight line plots agree well with the corresponding BET values. The linearity of these plots for illite clays indicates the absence of capillary condensation and that adsorption in slit-shaped pores takes place largely by the formation of physically adsorbed layers on the surfaces.

Much larger BET specific surface areas were obtained from carbon dioxide sorption at 196°K on goethite, hematite and gibbsite than from nitrogen, argon and krypton sorption at 78°K. It is suggested that enhanced sorption of CO_2 into microporous regions of the oxides, inaccessible to the other gases, occurs in a similar fashion to that frequently observed for coal and charcoal materials. *V–n* plots for CO_2 sorption in these materials using that for an illite clay as a standard isotherm, support this conclusion.

Considerably lower BET specific surface areas were obtained for carbon dioxide sorption on kaolinite than were obtained for nitrogen, argon and krypton sorption. The shape of the *V–n* plots for CO_2 sorption on kaolinite compared with illite suggest that an initial specific adsorption of CO_2 on the kaolinite is followed by a change in state with the completion of this layer, allowing normal multilayer formation to proceed.

A PREPARATIVE TECHNIQUE FOR ELECTRON MICROSCOPIC EXAMINATION OF COLLOID PARTICLES

R. S. B. Greene, P. J. Murphy, A. M. Posner and J. P. Quirk 185

Adsorption of clay particles from very dilute aqueous suspensions onto positively charged films (Cytochrome C) on carbon coated support grids has been used to obtain well dispersed samples of the particles suitable for detailed electron microscopic examination. The natural negative charge of the carbon coated grid was used for ferric polycations and precipitates.

HYDROTHERMAL ORIGIN OF THE CLAYS FROM THE UPPER SLOPES OF MAUNA KEA, HAWAII

F. C. Ugolini 189

The soils of the summit region of Mauna Kea are similar to the soils of the high mountain deserts and to the soils of cold deserts. Dramatic differences, however, exist between the soils of the summit and other neighboring cones and the soils of the glaciated terrain. The soils of some of the cones of the summit area are clay rich and contain phyllosilicate minerals; the soils of the glaciated terrain are sandy and contain X-ray amorphous clay. Montmorillonite and a Mg-rich trioctahedral mineral identified as saponite are the clay minerals of the summit. Because the summit area of Mauna Kea supported an ice cap at the time of the formation of the cones, the origin of the smectite minerals could have resulted from the alteration of the tephra by steam and water released in the melting of the ice. Hypogene fluids are, however, more likely to be responsible for the genesis of the phyllosilicate minerals.

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