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CLAYS and CLAY MINERALS at a glance

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A COMPARATIVE STUDY OF THE DIAGENETIC ALTERATION OF CLAY MINERALS IN MESOZOIC SHALES FROM PAPUA, NEW GUINEA, AND IN TERTIARY SHALES FROM LOUISIANA, U.S.A.

Gradual change from 60% montmorillonite/40% illite randomly interstratified clay mineral at 3500 ft depth to 20% montmorillonite/80% illite at 10,200 ft can be observed in a complete section of Mesozoic shales at Barikewa in New Guinea. The top at 10,544 ft of a similar complete Mesozoic section in the nearby Omati borehole contains 20–40% montmorillonite in randomly interstratified montmorillonite/illite. From 10,800 ft downward there is only 10–20% expandable material. Consequently, depth of burial rather than stratigraphic level controls the proportion of expandable material present. Similar diagenetic alterations occur in the Wilcox Formation, Louisiana, also controlled by burial.

The amount of illite 2M polymorphs in the Papuan samples is usually less than 5 per cent, the illite 10 Å peak sharpness ratio is about 1·4. Corresponding values for the Louisiana samples are 43% 2M polymorphs and about 2·0 sharpness ratio. Chemical analysis of the Papuan shales show low MgO and K_2O values when compared with the Louisiana samples. The latter sediments contain some chlorite, the former hardly any. Differences demonstrate a higher proportion of relatively unweathered material in the American samples.

Increase of chlorite content, increase of magnesium content and decrease of kaolinite content from 12,368 ft down in the Louisiana samples suggests a change in sedimentary pattern.

THE NATURE OF CLAY SOILS FROM THE MEKONG DELTA AN GIANG PROVINCE, SOUTH VIETNAM

Soil samples from near Long Xuygen, South Vietnam, considered to be typical of the clayey alluvial soils of the Mekong Delta, were investigated to determine the soil mineral content and soil type. The soils are of fairly uniform composition, consisting mainly of clay minerals and quartz, the predominant clay minerals including illite and chlorite with lesser amounts of kaolinite and smectite. The small hydrous iron oxide content, indicated X-ray fluorescence background intensity, verified that the soils are not latosols but are clayey estuarine soils amenable to future development as arable land.

The method of specimen preparation enabled direct quantitative analysis of the soil samples by X-ray diffraction with the aid of the results of mechanical analysis and the previous analyses of comparable soil samples from the Delta and nearby areas. A method for the quantitative determination of quartz was used that is independent of the powder crystallite orientation. A study of surface replicas of the soil samples by electron microscopy was made to illustrate the fabric of the soil. The undisturbed soil fabric consists mostly of somewhat randomly oriented large domains of clay minerals with some blocky quartz particles. Nanno-fossils were present in all samples.

OPTICAL AND ELECTRON MICROSCOPIC INVESTIGATION OF SHEAR INDUCED STRUCTURES IN LIGHTLY CONSOLIDATED (SOFT) AND HEAVILY CONSOLIDATED (HARD) KAOLINITE

A review of fabric studies of clays suggests the need for relating those fabric characteristics which are revealed at the two levels of magnification provided by optical and electron microscopy, and a technique to achieve this has been developed and is described within the context of the initial stages of a long term study of the interrelation between fabric and engineering behaviour. Two kaolinitic clays with contrived fabrics were prepared by controlling particle size, moisture content and pH of suspension, and consolidation load and were subjected to shear loading to failure. Resin impregnation techniques

which permit the kaolinite to be cut into thin sections for transmission electron microscopy have been optimized with the object of minimizing fabric strain and damage during ultratomy.

The fabrics of the hard and soft ambient material are qualitatively compared by means of electron micrographs and are explained in terms of the preparatory procedures adopted for fabric control. The fabrics of the two types of shear induced structures are also qualitatively compared and explained in terms of the original fabrics and the subsequent shear loading.

SCANNING ELECTRON MICROSCOPY OF CLAYS AND CLAY MINERALS

B. F. Bohor and Randall E. Hughes 49

The scanning electron microscope (SEM) proves to be ideally suited for studying the configuration, texture, and fabric of clay samples. Growth mechanics of crystalline unites—interpenetration and interlocking of crystallites, crystal habits, twinning, helical growth, and topotaxis—also are uniquely revealed by the SEM.

Authigenic kaolins make up the bulk of the examples because their larger crystallite size, better crystallinity, and open texture make them more suited to examination by the SEM than most other clay mineral types.

I.R. SPECTROSCOPIC EVIDENCE FOR INTERACTION BETWEEN HYDRONIUM IONS AND LATTICE OH GROUPS IN MONTMORILLONITE

J. D. Russell and A. R. Fraser 55

At low levels of hydration, exchangeable D^+ in montmorillonite interacts with lattice OH groups and quantitatively converts AlMgOH groups to AlMgOD. Hydroxyl groups coordinated to two Al ions undergo a slower exchange, the extent of which is restricted by octahedral Fe^{3+} ions.

The OH stretching vibration of AlMgOH groups in montmorillonite is assigned an unusually high frequency (3687 cm^{-1}) compared with that of the same group in phengites (3602 cm^{-1}).

I.R. STUDIES OF SOME INTERSTRATIFIED MINERALS OF MICA AND MONTMORILLONITE

S. Shimoda and J. E. Brydon 61

I.R. band shifts in the 830, 750 and 530 cm^{-1} regions that occur in interstratified layer silicates on heating were used to characterize the nature of the component layers. Two specimens showed shifts characteristic of 1M illite and montmorillinite. Another specimen was similar to 2M illite even though the proportion of expanding layers was 0·4. The shifts for rectorite and allevardite resembled those of paragonite and 2M illite.