

FIELD TRIP TO WICHITA MOUNTAIN AREA,
SOUTHWESTERN OKLAHOMA, HELD IN CONJUNCTION
WITH THE EIGHTH NATIONAL CLAY CONFERENCE,
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by

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A map of the Wichita Mountain area with the stops indicated by number is shown in Fig. 1.

The party left the Lockett Hotel, Norman, Oklahoma, at 7.30 a.m. and proceeded to Mt. Scott in the Wichita Mountain Wild Life Refuge area.

Drive to top of Mt. Scott for stop and view of Wichita Mountains.

Drive west from Mt. Scott to junction of first road leading to the north entrance to the wild life refuge, thence to Meers, Oklahoma. At Meers turn east and proceed three-fourths mile along county road.

STOP 1

Cut on north side of road, west slope of gravel-capped hill. Center south line SE 1/4 section 28, T. 4 N., R. 13 W., $\frac{3}{4}$ mile east of Meers Post Office.

Field Description

The deposit is a waxy gray clay derived by *in situ* alteration of olivine gabbro. In the Meers area all the Precambrian bedrock exposures are of gabbro and anorthosite. Across the road on the south is completely fresh and unaltered olivine gabbro, which is a normal rock type and probably is the parent rock of the clay.

Typical gabbro fabric still is preserved in the clay, as shown particularly by the ophitic arrangement of titaniferous magnetite crystals. The magnetite is largely unaltered whereas pyroxene, feldspar, and olivine have been converted to clay.

Where clay of this type is present in the northern area of the Wichita Mountains, it underlies boulder conglomerate and granite wash of early

Permian age. Formation of the clay probably is related to weathering of the Precambrian gabbroic bedrock at this unconformity.

Laboratory Results

x-Ray diffractograms (Fig. 2, no. 1) of the clay material showed it to be a well-crystallized calcium montmorillonite mixed with a well-crystallized kaolinite. Some halloysite may be present also. In addition there is an inter-layered clay material that gives a broad x-ray diffraction peak at about 40 Å when the sample is air dried. The approximate center of this broad peak moves to a longer spacing upon treatment with glycerol.

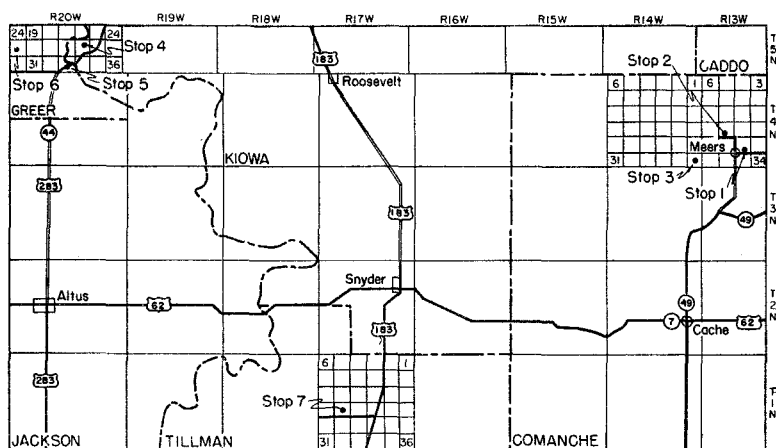


FIGURE. 1—Map of the Altus-Snyder-Meers area, southwestern Oklahoma.

STOP 2

Cut on north side of road, east slope of hill, adjoining Meers cemetery. Center south line section 20, T. 4 N., R. 13 W., 1 mile north, $\frac{1}{2}$ mile west of Meers Post Office.

Field Description

The deposit is a waxy clay, mottled greenish-gray and maroon, probably derived by weathering of Precambrian gabbro. Granite boulders and granite wash overlie the clay as at Stop 1. The irregular stringers of maroon clay evidently represent concentrations of finely divided hematite dust. Fine-grained white calcite encrusts small openings in the clay, and a few grains of magnetite are present. This clay is similar to that at Stop 1.

Isolated outcrops of unaltered gabbro may be seen to the northeast and across the road to the south.

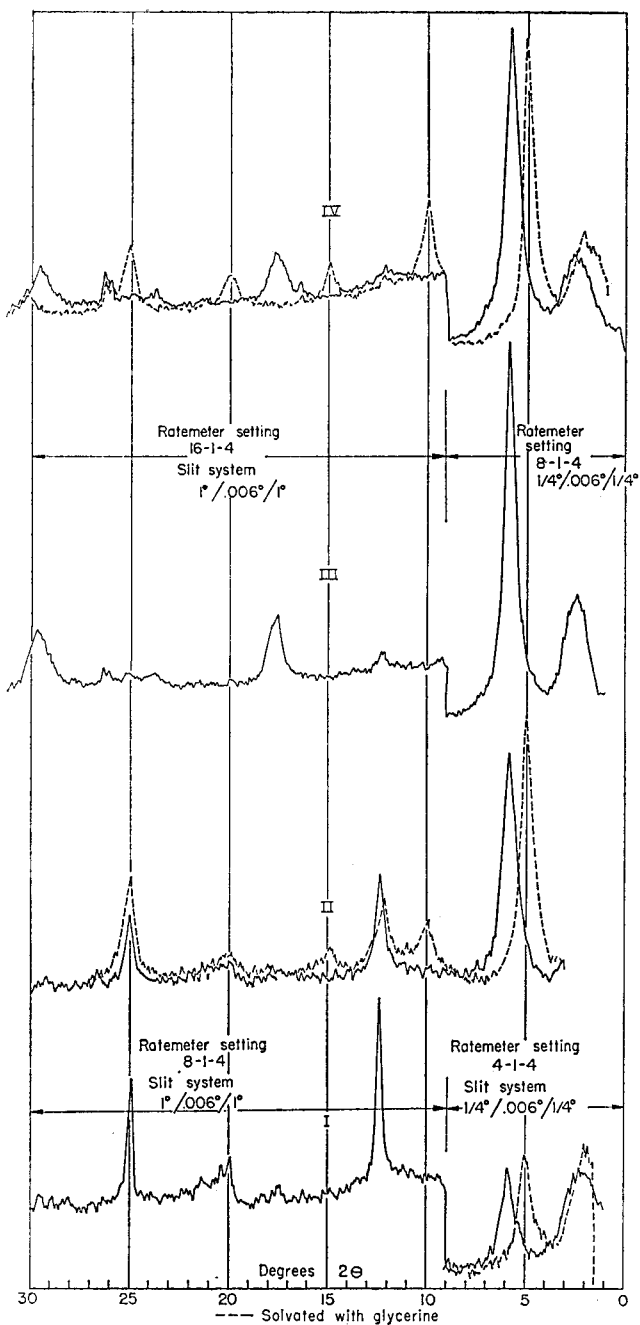


FIGURE 2.—X-Ray diffractograms. I. Clay from Stop 1. II. Clay from Stop 2. III. Fine fraction of clay from Stop 2, collected at relative centrifugal force of 3000 G. IV. Finest fraction of clay from Stop 2, collected at relative centrifugal force of 13,000 G.

Laboratory Results

The clay collected at Stop 2 is an unusually pure calcium montmorillonite mixed with a well-crystallized kaolinite (Fig. 2, no. II). It is similar to the clay found at Stop 1, but the montmorillonite is more concentrated. The kaolinite particles are appreciably larger than the montmorillonite and are separated easily by sedimentation when the raw clay is suspended in water. The montmorillonite remains in suspension and may be separated by decantation. The diffractogram shown in Fig. 2, no. III is that of the fine fraction separated by sedimentation and decantation followed by collection in a centrifuge bowl at 3000 g. The fraction that overflowed the centrifuge bowl at 3000 g but was collected by sedimentation at approximately 13,000 g is also essentially a pure calcium montmorillonite together with some interlayered material which produced a broad diffraction peak at about 36 Å. Diffractogram no. IV on Fig. 2 is of this material and shows the displacement of the 001 peak and the low angle peak by glycerol treatment.

STOP 3

Stream cut on tributary to Medicine Creek, Center section 36, T. 4 N., R. 14 W., on property of Mr. Frank Rush.

Field Description

The deposit is a white clay, derived by *in situ* hydrothermal alteration of anorthosite. A nearly vertical fault separates slightly altered anorthosite from clay along a sharply defined contact. Hydrothermal alteration of anorthosite in the Wichita Mountains generally yields clay of this type, but at most localities only a small part of the rock has been converted to clay.

The rock is cut by veins of pink granite one inch thick and by veins of prehnite [$\text{H}_2\text{Ca}_2\text{Al}_2(\text{SiO}_4)_3$] one to two inches thick. Prehnite itself is an alteration product of plagioclase-rich rocks and is commonly associated with diabase or "trap rock."

Laboratory Results

The clay fraction, formerly considered to be a "good white kaolin," was found to consist of a poorly crystallized kaolin clay and some illite, probably interlayered with the kaolin. The poorly crystallized kaolin is probably of the fire clay type. The diffractogram trace is shown as no. I on Fig. 3. The slightly altered anorthosite on the other side of the fault appeared to contain a calcium montmorillonite or vermiculite together with a small amount of micaceous material in the clay fraction. The clay fraction from the prehnite material contained some kaolinite and illite.

The following chemical analyses were made by the Oklahoma Geological Survey.

	Clay Fraction	Unaltered Anorthosite
SiO ₂	46.15	49.39
Al ₂ O ₃	36.43	28.95
Fe ₂ O ₃	1.83	2.05
CaO	1.23	15.31
MgO	0.21	1.27
K ₂ O	0.31	0.24
Na ₂ O	0.99	2.91
H ₂ O ⁺	12.18	0.17
H ₂ O ⁻	1.43	0.04
	100.76	100.33

STOP 4

Cut in Lugert granite along Santa Fe R. R. Center north line SE 1/4 section 27, T. 5 N., R. 20 W., on south edge of Lake Altus.

Field Description

At this locality the granite is cut by two diabase dikes, one of which is fresh and one altered heterogeneously, partly to kaolinite and partly to vermiculite plus some illite or other micaceous mineral. The kaolinite has been derived by alteration of plagioclase feldspar whereas the vermiculite has altered from pyroxene.

The granite rock is locally fractured, brecciated, and cut by faults. Along the north wall of the railroad cut are many slickensided granite surfaces that show horizontal movement accompanying a fault, the north side moving eastward relative to the south side.

In most parts of the Wichita Mountains the granites are largely unaltered, but here a small amount of clay has been developed from potassium feldspar in brecciated zones that have undergone slight hydrothermal alteration.

The selectivity of hydrothermal action on basic igneous rocks is well shown at this locality. The two diabase dikes are scarcely 100 feet apart, yet one is unaltered and the other is intensely altered to clay.

Laboratory Results

The altered diabase dike consists of a well-crystallized kaolinite, calcium (or magnesium) vermiculite, and some illite, with the illite occurring largely as an interlayered complex with the vermiculite. Kaolinite is concentrated in the relatively coarse size fraction (1–5 μ), the diffractogram of which is shown as trace II on Fig. 3. The vermiculite–illite material was found in the fine fraction (less than 1 μ) the diffractogram of which is shown as no. III on Fig. 3.

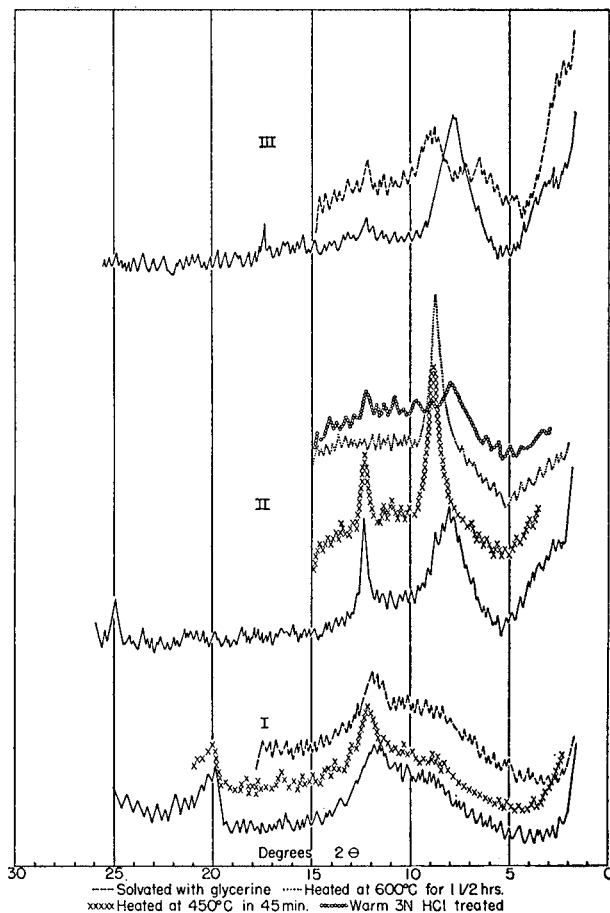


FIGURE 3.—X-Ray diffractograms. I. Clay from Stop 3. II. 1–5 μ fraction of clay from Stop 4. III. Fraction finer than 1 μ , clay from Stop 4.

STOP 5

Cut along irrigation canal. NE 1/4 SW 1/4 SE 1/4 section 33, T. 5 N., R. 20 W.

Field Description

This canal conducts water from Lake Altus for irrigation use in Greer and Jackson Counties. In the cut through the low hill of Lugert granite are excellent exposures of the unconformity separating the Precambrian granite from onlapping sediments of the early Middle Permian Hennessey formation.

During Early Permian times the Wichita Mountains were gradually covered by redbed sediments (silts and clay) derived from an eastern or southwestern highland region. The granite hills doubtless stood as islands in the sea, contributing granite wash and granite conglomerate as local fringing tongues in the shale.

The unconformable surface is highly irregular. The clay sample here studied was cut from a 1.5 ft bed of reddish-brown shale in the Hennessey formation. At the locality sampled the bed lies 3 ft above the granite, but it disappears horizontally by overlapping the granite surface within 30 ft.

Laboratory Results

x-Ray diffractograms of the less-than-one-micron particle size fraction shown as trace I on Fig. 4 indicated that the clay fractions in the various samples of the Hennessey shale consisted mainly of illite together with chlorite, the two occurring generally as an interlayered mineral. The diffraction peaks shown at 28 Å (probably chlorite 001) and at higher spacings are noteworthy.

STOP 6

Exposures of upper Hennessey shale in badland gullies south of Elm Fork. NW 1/4 SW 1/4 section 25, T. 5 N., R. 21 W.

Field Description

Typical shale of the Hennessey formation is well exposed at this locality. The dominant shale is reddish-brown and slightly silty, weathering with a pronounced conchoidal fracture. It occurs as beds 2–5 ft thick, interstratified with pale grayish-green shale which is likewise silty and is commonly laminated. A few beds of pale buff fine-grained sandstone occur as intensely cross-bedded and ripple-marked thin lenses, and one bed of gypsum about 6 in. thick is in the lower part of the exposed section.

Silty reddish-brown and pale green shale characterizes the Wichita, Hennessey, Flowerpot, Blaine, and Dog Creek formations of Early and Middle Permian age in southwestern Oklahoma. The clay minerals are regarded as detrital particles brought in with silt-size quartz from a low but geologically persistent landmass that lay to the southeast. Thick gypsum, anhydrite, and salt evaporites within the Permian sediments show a characteristically arid climate for this period in the south-central United States.

The similarity of clay minerals at this locality to those at Stop 5, where Hennessey shale is adjacent to Precambrian granite, lends support to the geological observation that the Permian shales are mostly derived from a remote source, and that the Wichita Mountain granites made only small contributions to these shales.

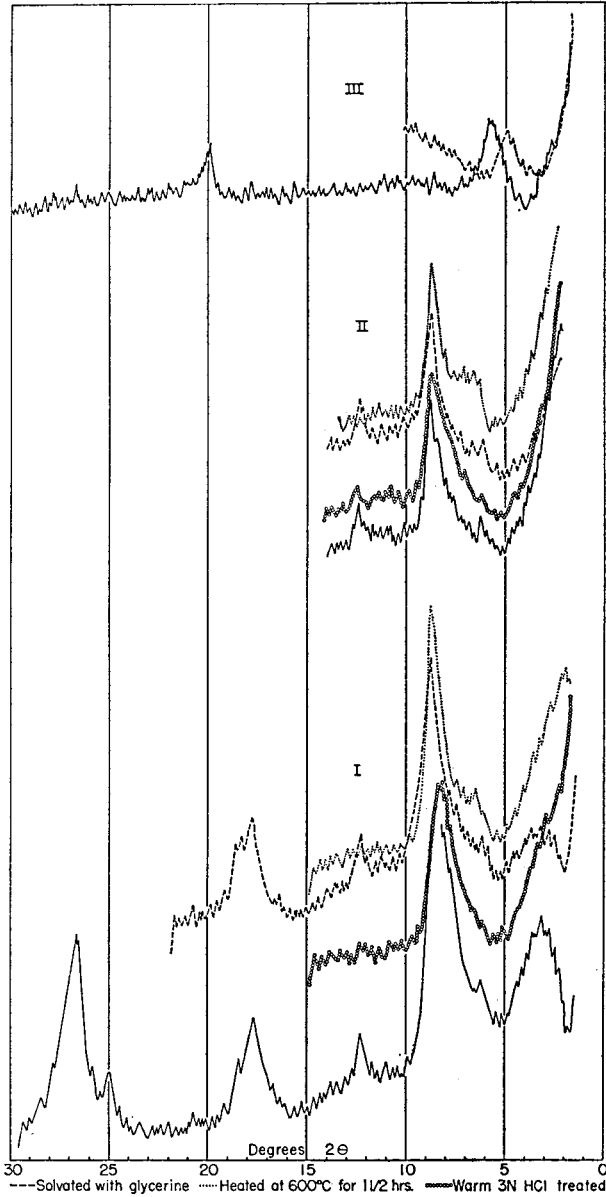


FIGURE 4.—X-Ray diffractograms. I. Fraction finer than $1\ \mu$, Hennessey shale, Stop 5. II. Clay from Hennessey formation, Stop 6. III. White clay from Stop 7.

Laboratory Results

The Hennessey clay samples collected at Stop 6 were similar in mineral composition to those at Stop 5. Diffractograms of Stop 6 material are shown as trace II of Fig. 4. Chlorite in the Stop 6 samples appears to occur in a more discrete form, *i.e.*, there appears to be less interlayered material than in samples collected at Stop 5. The distribution of clay minerals was quite uniform in the various particle size ranges at Stop 6.

STOP 7

Clay and volcanic ash from a late Pliocene or early Pleistocene lake deposit; center section 20, T. 1 N., R. 17 W. south of Manitou.

Field Description

About 10 ft of volcanic ash and clay derived from it is exposed in gully banks and ravines. It occurs at the base of a stream-terrace deposit resting on reddish-brown shales in the lower part of the Hennessey formation. No fossils have been found here in volcanic ash or clay, but from similar occurrences in western Oklahoma it is believed that the pyroclastics are of late Pliocene or early Pleistocene age and that the site of deposition was a lake on a high terrace flood plain of North Fork of Red River. Alternating cleanly separated layers of ash and clay show that the deposit is water laid.

At the base of the exposure is 2 ft of light gray clay, overlain by 1.6 ft of white volcanic ash interstratified with a conchoidally fractured cream-colored clay; at the top is about 4 ft of light-colored fine-grained volcanic ash that locally contains concretions of calcium carbonate.

Shards of volcanic glass in the ash beds are mostly clear and unaltered. Their mean index of refraction is 1.497, compared with a known range of 1.496 to 1.503 for ash in Oklahoma. Such ash contains approximately 72 percent silica, 12 alumina, 2 iron oxide, 1 combined lime and magnesia, 4 potash, and 3 percent soda, representing a silicate magma of normal granitic composition. The source of the volcanic ash probably was in now-extinct volcanoes of central New Mexico.

Laboratory Results

The lower and thicker light gray or white clay bed has been analyzed in the laboratory of the Oklahoma Geological Survey as follows:

SiO₂, 52.90; Al₂O₃, 27.04; Fe₂O₃, 3.88; TiO₂, 0.24; CaO, 1.05; MgO, 1.72; K₂O, 0.70; Na₂O, 1.04; loss above 105°C, 11.42; total, 99.99.

This lower clay or white clay bed was subjected to x-ray diffraction analysis and found to consist largely of amorphous material with a trace amount of a very poorly crystallized expandable montmorillonite-like clay mineral.

x-Ray diffractograms of the cream-colored clay, shown as trace III on Fig. 4, indicated this clay to be calcium montmorillonite, apparently derived from the volcanic ash.

X-RAY DIFFRACTION DATA

All the x-ray diffractograms shown on Plates 1 and 2 were obtained with copper K-alpha radiation using a Philips diffractometer. The rate meter setting was 8-1-4 and the slit system $1^{\circ}/.006^{\circ}/1^{\circ}$ unless otherwise specified.

ACKNOWLEDGMENTS

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