Clay deposits of the Tierra Colorado district, southern Orange County, California

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Abstract

The clay of this district is being mined for fire brick by the Vitrefrax Corporation. Much of the clay contains 35 percent or more of alumina and between 1 and 2 percent of iron oxide. Production is largely from an underground mine as the best clay deposit known in the district occurs on the side of a steep hill with more than 100 feet of sandstone overlying most of it.

The good clay deposits occur at the base of an Eocene sandstone formation, and overlie mottled clays with a high iron content that are residual deposits formed on an old weathered surface. Mapping indicates that the clay deposits are very lenticular, though all occur at the same stratigraphic position, and they grade laterally into sandy clay and quartz sand. Topographic relief and the dip of the strata preclude finding large areas where the clay strata have relatively little overburden.

It is concluded that exploratory drilling would be expensive due to rapid increases in overburden, and offers little promise of proving reserves of several million tons of clay. Small mines and prospects between this district and the Alberhill district were briefly examined but were not promising enough to warrant any mapping of the areas.

Introduction

The examination of the Tierra Colorado clay mine district forms part of the program to evaluate the clays of California and other states as possible ores for aluminum production.

The Tierra Colorado clay deposits are located in the valley of Cristianitos Creek and its tributary Cabino Canyon. The area is on the Rancho Mission Viejo that is a northern part of the old Santa Margarita ranch, in southern Orange County, California. The clay is trucked over an unsurfaced road for 4½ miles from the mines northward to State Highway 74, and west on this highway for 5 miles to the Atchison, Topeka, and Santa Fe Railroad at San Juan Capistrano. The Vitrefrax Corporation is the only operator and most of the clay is used for fire brick made in their Los Angeles plant. The Pacific Clay Products Co. was the first operator in the district, and later the clay was mined by C. O. Newton for the Vitrefrax Corporation. This company took over the mining in 1937, and has produced largely from an underground mine. The annual production for the past five years has varied between about 10,000 and 20,000 tons, and the total production of the district has been only a few hundred thousand tons.

The mapping was done on aerial photographs by S. N. Davieas, with a preliminary examination and brief later visits by M. N. Bramlette. The clay beds rarely form natural outcrops, and their examination was therefore limited largely to the mines and prospect pits. The accompanying map was compiled from the central part of

the aerial photographs, but necessarily involved some adjustment of alignments and distortion of scale. Supplementary notes briefly mention additional clay deposits to the northeast of the district, that were not examined in detail being obviously unpromising for this project for various reasons.

Geology

The formations in the area are Cretaceous, Paleocene (?), and Eocene sandstones and shales, and Quaternary stream deposits. Poor exposures and lack of fossils make difficult the mapping and assignment of age to the formations of the limited area. The essential part, however, is the mapped contact at which occur the discontinuous clay deposits. The main units shown on the map are therefore the strata underlying and overlying the clay "horizon". The underlying sandy shales and sandstones are shown on the map as the upper Cretaceous "Chico" formation, though a relatively thin unit of sandy shale, sandstone, and conglomerate between the clay and the more typical Cretaceous is perhaps of Paleocene age. The massive, white sandstone overlying the clay strata is Eocene. Terrace gravel and sand of probable Quaternary age is mapped in no great detail, and Recent alluvium is mapped in the main canyons.

The eldest formation in the area is an upper Cretaceous sandstone, sandy shale, and mudstone formation. The name Chico has previously been extended to this formation merely on the age equivalence. It consists of interbedded brown and greenish-brown micaceous sandstone, sandy shale, and mudstone, with occasional conglomerate lenses. Outcrops are poor and slumps common in the more shaly parts of the formation, and concretions are common in this part. Sandstone beds are from 1 to 10 feet thick and in general are harder than the Eocene sandstone.

About 50 feet of sandy shale and sandstone with a prominent, basal conglomerate overlies unconformably (?) rocks of more typical Cretaceous aspect. The contact is an erosional unconformity or disconformity but no structural discordance was evident. The strata are perhaps Paleocene though no fossils were found in them, and because it is thin this unit was not mapped separately from the "Chico" formation. The upper part of these rocks, immediately beneath the clay "horizon" is highly weathered and includes much residual clay of poor quality. Much of this clay is mottled pink and red and this fact presumably accounts for the name Tierra Colorado clay district.

The refractory clays that are mined occur as local deposits in strata that include sandy clay, lignitic clay, and quartz sand at the base of the Eocene sandstone, and that overlie the sandy and ferruginous residual clays. On the map this is shown as the clay "horizon" because it occurs both above and below a stratigraphic horizon, or because the clays may be nearly absent at this horizon. These beds commonly include only a quartz sand with a clay matrix and the stratigraphic horizon was mapped largely on the evidence of the weathered surface of mottled clay in the underlying rocks. The age of the clay beds is not evident in this district, but the period of extreme weathering followed by lignite deposition would seem to correlate with the similar conditions in Temescal Canyon and at several intermediate areas where fossil evidence indicates a Paleocene age.

An Eocene sandstone formation, that has formerly been inappropriately included in the Tejon formation, overlies the clay strata. It is characteristically a nearly white, massive bedded sandstone with lenticular pebble beds, and some interbedded sandy shale. The sandstone is highly feldspathic and is more friable and less

micaceous than underlying formations, and the massive beds make outcrops more common and prominent. Fossils reported from the middle part of this formation, south of the area mapped, indicate a middle Eocene age for at least that part of the formation. The basal part may include lower Eocene or even Paleocene strata.

The rocks of the area have a regional dip to the west, with superimposed minor folds and many small faults. An anticlinal nose is shown in the swing of dips to slightly east of south in Gabino Canyon; south of here the dips are generally to the southwest with only minor variations due to drag along faults. Two anticlines and synclines south of San Juan Creek are shallow structures that die out rapidly to the south.

Faulting is important in limiting the extent of the clay strata particularly north of Gabino Canyon in Cristianitos Canyon. The largest fault in the area is on the east side of the canyon, and has a displacement of about 100 feet. The eastern side is up and the clay beds and underlying weathered zone have been removed by erosion on this side. A second long fault along the bottom of the canyon limits the outcrop area of the clay to the west, as the clay beds on the east side are in contact with overlying sandstone that is on the downthrow side to the west. Displacement on this fault perhaps does not exceed 50 feet.

Numerous minor faults were mapped. Doubtless others are present where the outcrops are inadequate to determine them, as many small displacements are evident in some exposures and mine openings. Two of these minor faults are important in the underground mine. The one between adits no. 3 and no. 4 has a maximum displacement of 25 feet. It consists of a series of small fractures dipping from vertical to 80 degrees east, and the east side has moved down. Both adits no. 3 and no. 4 are terminated at a second fault. The workings have not penetrated the fault plane far enough to determine the amount of movement but drill holes south of the fault indicate that the north side is downthrown. The inferred fault west of the drill holes may have a displacement of over 50 feet.

Clay deposits

The high alumina clay mined in this district for fire brick approaches kaolinite in composition, with alumina averaging between 34 and 38 percent and iron oxide between 1 and 2 percent. It occurs as local deposits that grade laterally into more sandy clay and quartz sand, but occurs at a single stratigraphic position at the contact of the Eocene sandstone with Paleocene (?) and Cretaceous strata. Immediately underlying this clay is a zone of deeply weathered residuum which includes mottled ferruginous clays that are less refractory and relatively low in alumina content. Overburden of Eocene sandstone ranging up to several hundred feet makes underground mining necessary for the best clay deposit found in the district.

The Vitrefrax Corporation is the only operator in the district, and their present production is nearly all from the underground mine on the south side of Gabino Canyon. Adit no. 3 is 1,800 feet long with a down grade of 12 percent to the south, and adit no. 4 is 1,200 feet long; both terminating at a fault. The mining is by drifts or rooms and pillars, and much of the remaining clay in this mine will be obtained by reducing the pillars. About 75,000 tons have been mined to date. The clay varies from 2½ feet to 15 feet in thickness and is known as the K-20 clay. The floor is sandstone with a clay matrix and the roof is sandy clay and lignite. The K-20 clay varies laterally into a clay with pisolitic texture that is termed peabone. The clay is used for fire brick and the peabone is not mined as it causes

shrinkage and rupturing of the brick. The lateral limits of the clay mined are determined, therefore, by gradation into the pisolitic clay or by increase in the amount of quartz sand. No relationship between chemical composition and the presence or absence of the pisolites is apparent except a tendency to a higher iron content in the peabone, and also a slightly higher alumina content. The K-20 and peabone clays approach closely to the composition of pure kaolinite.

Perhaps the peabone could be used with the K-20 clay as a source of alumina in spite of a generally higher iron content, as it also has a higher alumina content. However, the thickness of clay including both the K-20 and peabone would average only about 10 feet, though the lateral extent might be considerably increased. Near the junction of Gabino with Cristianitos Canyon, the peabone and other high alumina clay range up to 20 feet thick. However, the clay dips into the rather steep hill so that overburden increases to over 200 feet in a short distance.

The K-12 open pit has produced some refractory clay of somewhat poorer quality than the K-20 clay. Peabone clay is exposed in the floor of this pit and is 6½ feet thick; chemical analysis shows it to be very high alumina clay. Overburden in this pit is about 30 feet and increases to about 100 feet in a short distance back of the pit, so that mining has been discontinued here. A small amount of clay has been mined from the K-6 tunnel, but this clay is of lower quality than the K-20 clay. Between the K-6 mine and the K-12 pit, the clay varies from a sandy white, plastic clay to a gray clay and peabone, with the greatest thickness at the K-12 pit where it totals about 12 feet.

Reserves

Much drilling would be necessary to determine the approximate tonnage of clay in this district. The rapid lensing of the clay bed or change laterally to very sandy clay and quartz sand make any projection of a known clay bed worthless if assumed for more than a few feet or tens of feet.

The Vitrefrax Corporation has done some drilling south of the fault against which the adits terminate. Location of these test holes is shown on the map, and the logs are as follows:

Test Hole No. 5		
Yellow sandstone and gray shale	0-175	feet
Brown clay	175-180	"
Red clay	180-195	"
K-20 (?) clay	195-208	"
Red clay	208-210	"
Test Hole No. 6		
Yellow sandstone and shale	0-150	"
Red Clay	150-155	"
Brown clay	155-165	"
Gray (K-20?) clay	165-175	"
Red Clay	175-182	"
Clay?	182-190	"
Test Hole No. 7		
Shale (?)	0-147	"
Clay	147-150	"
Gray sandstone	150-152	" *

*Probably did not reach the clay horizon

Test Hole No. 8		
Yellow sandstone and shale	0-240	"
Red sandy clay	240-245	"
Brown sandy clay	245-250	"
Gray sandy clay	250-255	"
Red sandy clay	255-275	"
Gray clay	275-283	"
Test Hole No. 9		
Sand and clay (?)	0-55	"
Red, gray, and black clay	55-130	"

Though no estimate for the district as a whole is justified with the data available, it seems evident that several million tons may be available by underground mining

Small mines and prospects between this district and the Alberhill district

Only a brief examination was made of some smaller mines and prospect pits between the Tierra Colorado and Alberhill districts. These all occur near the base of the Eocene or Paleocene strata and probably at the same stratigraphic horizon. The Arnold Mine on the Robinson ranch is located on the south side of Trabuco Canyon in Sec. 13, T. 6 S., R. 7 W., Orange County. The sandy clay and sandstone with a clay matrix are washed, and the high grade clay and sand are both sold. Production of this washed clay is not large. A small mine operated by C. O. Beardslee is located on the north side of Trabuco Canyon, in the north part of Sec. 11, T. 6 S., R. 7 W. Steep dip of the strata and rugged topography would make it difficult to obtain very large tonnages here. Some clay has been mined along the strike of very steeply dipping beds on the Serrano ranch, at a locality about 2½ miles south of the junction of Harding Canyon with Santiago Canyon on the Corona quadrangle. Gladding McBean Co. is mining a hard "flint" clay of refractory type on the Goat Ranch property, on the south side of Santa Ana Canyon, in Orange County near the boundary with San Bernardino County. Their Claymont Mine is a tunnel into the side of a very steep hill, and an open cut mine is located to the southeast high on the side of Sierra Peak. The quality of these clays permits the necessarily high cost mining. Some clay has been produced from the McKnight mine near the mouth of Tin Mine Canyon, southwest of Corona, in San Bernardino County. Very little good clay remains accessible here as the beds are dipping steeply.

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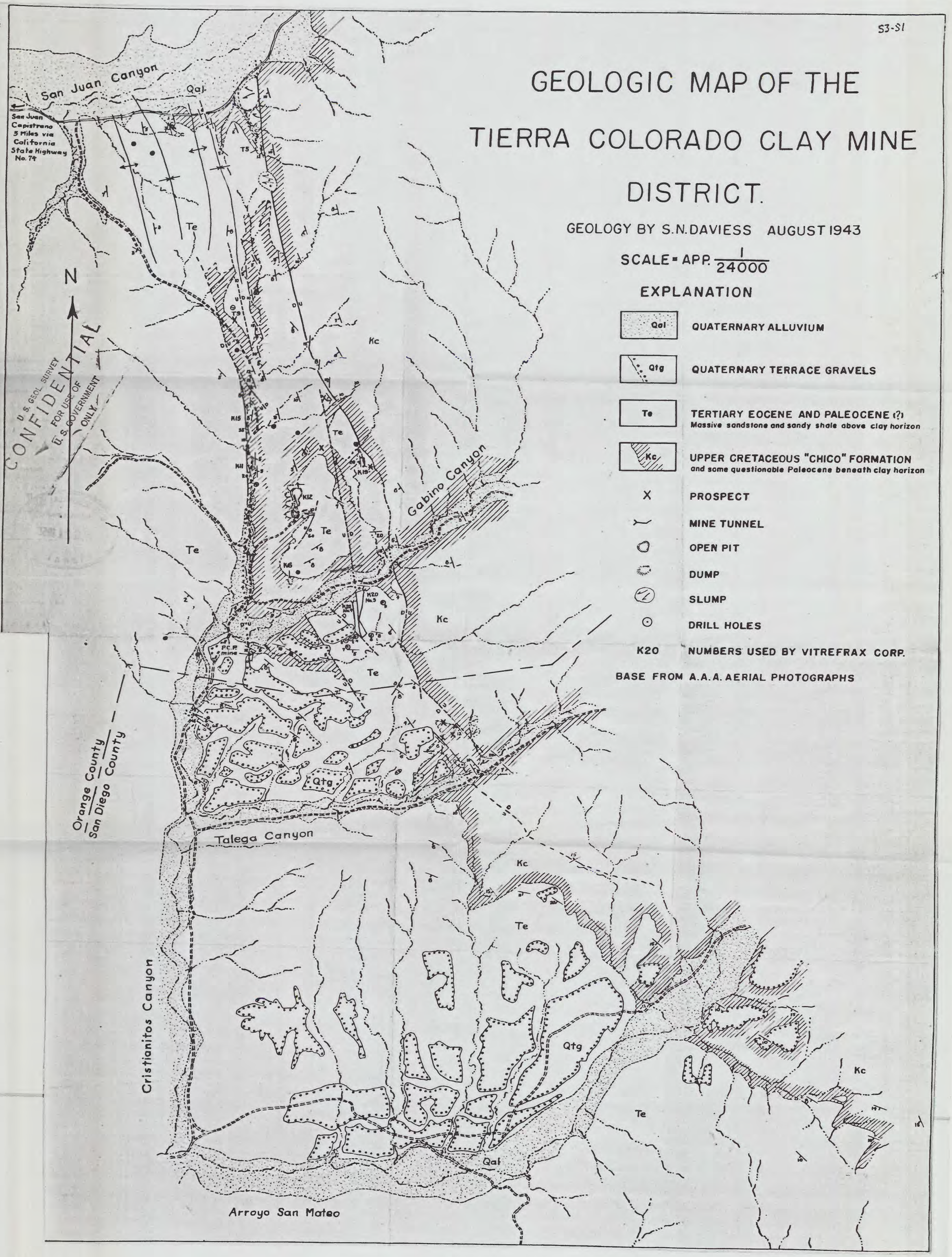
GEOLOGIC MAP OF THE TIERRA COLORADO CLAY MINE DISTRICT.

GEOLOGY BY S.N. DAVIESS AUGUST 1943

SCALE = APP. 1/24000



EXPLANATION

- Qal — QUATERNARY ALLUVIUM
- Qtg — QUATERNARY TERRACE GRAVELS
- Te — TERTIARY EOCENE AND PALEOCENE (?) Massive sandstone and sandy shale above clay horizon
- Kc — UPPER CRETACEOUS "CHICO" FORMATION and some questionable Paleocene beneath clay horizon
- X — PROSPECT
- MINE TUNNEL
- OPEN PIT
- DUMP
- SLUMP
- DRILL HOLES
- K20 — NUMBERS USED BY VITREFRAX CORP.

BASE FROM A.A.A. AERIAL PHOTOGRAPHS