The Alberhill and other clay deposits of Temescal Canyon, Riverside County, California

By S. N. Davieas and M. N. Bramlette
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Abstract

Clay is mined in open pits by several companies in the Alberhill district, and the refractory clays of relatively high alumina content are used largely for fire brick. The Alberhill Coal and Clay Company is the largest operator and has produced a little over 2,000,000 tons of clay, of which nearly half was the refractory type.

The clay occurs at the contact of the lower Tertiary and the Mesozoic basement complex. The weathered surface of basement rocks includes much clay of high iron and low alumina content, and the better clay occurs in the basal Tertiary sediments. The clay deposits vary rather abruptly in thickness and quality, and only local lenses contain workable deposits. Structural deformation makes dips of 10 to 20 degrees common and the clay strata therefore pitch under excessive overburden in short distances. Extensive deposits of thick alluvial fan deposits cover the clay-bearing strata over most of the area, and add to the overburden problems.

The apparent lack of clay deposits of good quality that would total several million tons of ore, and the geological conditions that would make exploration and mining difficult and expensive make this district unpromising.

Introduction

The examination of the clay deposits of Temescal Canyon forms part of the program to evaluate the clays of California and other States as possible ores for aluminum production.

The clay deposits of this district are located in Temescal Wash between Corona and Elsinore, in the western part of Riverside County, California. The largest deposits, so far as known, are centered around Alberhill, about 5 miles northwest of Elsinore. The paved State Highway 71 passes within less than a mile of most of the clay pits, and through the main pit area at Alberhill. A branch line of the Atchison, Topeka, and Santa Fe railroad follows the same route, and has sidings at the main clay pits.

The first mining was by the Elsinore Coal and Clay Co. for the low grade coal that is associated with the clay beds. Since 1897 these operations have been by the Alberhill Coal and Clay Co. The mining of coal was discontinued and this company has been the largest producer of clay from the district. Their production reached a maximum of about 100,000 tons annually in the early 1920-30 period, and was 54,704 tons in 1941. Their total production has been 2,165,000 tons but about half of this total was of lower grade, non-refractory clays. Only the more refractory clays, used largely for fire brick, are now being sold. Production figures of other operators are not available but their total perhaps exceeds 2,000,000 tons though most of this clay is of the less refractory types.

The mapping was done on aerial photographs by S. N. Davies, with a preliminary examination and brief later visits by M. N. Bramlette. Detailed examination and sampling of the clay beds is possible only in the operating and abandoned pits, as natural outcrops of the clay strata are virtually lacking in the district. The accompanying map was compiled from the central part of the aerial photographs, but necessarily involved some adjustment of alignments and distortion of scale.

Geology

The formations shown on the map include (1) an undifferentiated basement complex of Mesozoic metamorphic and igneous rocks; (2) early Tertiary (Paleocene?) sandstone and shale that rests on a deeply weathered surface of the basement rocks; (3) Quaternary alluvial fan materials; and (4) Recent stream alluvium. The clay deposits occur at the contact of the Tertiary with the weathered surface of basement rocks.

The basement complex includes slate, phyllite, quartzite, and interbedded meta-volcanic flows, and probably correlates with the Santa Ana formation of questionable Triassic age. These rocks are intruded by several types of plutonic rocks of probable Jurassic age, and are overlain locally by thin sandstone lenses and volcanic breccias that may be of Cretaceous age. Where the contact between the basement complex and the basal Tertiary clay and lignite beds is exposed, the basement rocks are deeply weathered. The residual products of weathering vary greatly with the type of basement rock, but exposures of this weathered surface developed on the intrusive rocks were not seen in this area.

The early Tertiary (Paleocene?) strata generally have clay and lignite beds in the basal part, resting directly on the weathered basement complex, and in places it is difficult to distinguish any contact between the residual clay of these basement rocks and the sedimentary clay of the basal Tertiary. Approximately 45 feet of basal Tertiary clay, lignite, and quartz sand with clay matrix are exposed in the main pit of the Alberhill Coal and Clay Co. The grade and chemical composition of this clay varies, but in general the clay of highest alumina content occurs in the basal part of these beds. The shale and sandstone above the basal clay and lignite beds are poorly indurated, micaceous, and generally of greenish gray to brownish gray color. Nearly white sandstone is common in an area to the south of the Hoist Pit (southeast of Alberhill on map). Conglomerates locally present in this formation were not lithologically distinguishable from the Quaternary terrace gravels. Fossils found in this formation were of little value, but collections by previous investigators indicated a probable Paleocene age.

The Quaternary fan deposits are unconsolidated conglomerate and sand, and evidently represent several distinct periods of fan accumulation. These fan deposits cover large areas of Temescal Canyon, especially on the southwest side and thus prevent mapping or exploration of basal Tertiary clay deposits in much of the area. Streams have been entrenched in the large fans along the front of the Santa Ana range and have locally, as at the Twin Springs locality, exposed the clay beds.

Temescal Canyon is a graben lying between the Santa Ana Mountains to the southwest and the Temescal Mountains to the northeast. Thus a block of lower Tertiary sediments is confined to the valley floor and is bounded by a series of faults, with those on the southwest side having much greater total displacement than those

on the northeast side. As very little mapping was attempted in the basement complex, these faults are shown on the map only where they cut the Tertiary rocks or limit their outcrop area. In general, the Tertiary rocks form a syncline, with subsidiary folds such as the small syncline north of Lake Elsinore. Presumably the general synclinal structure is related to the faulting that formed the main graben and, in part at least, may represent a large scale type of drag folding. The syncline is seen best on the map in the area between the Los Angeles Brick Co. pits and the Sloan pits of Gladding McBean Co.

Associated with the boundary faults of the graben are very many smaller faults that are well exposed in the clay pits. The faults in the main pit of the Alberhill Coal and Clay Co. have displacements of 4 to 25 feet. Some of the erratic dips, such as that at Twin Springs, probably reflect drag on unexposed faults.

Clay deposits

The refractory clay in this district occurs at the base of the Tertiary strata, with clays of higher iron content in the underlying weathered basement rocks. Sorting of the sediments now comprising the basal Tertiary produced only local deposits of relatively thick and pure kaolinitic types of clay, however, and these grade laterally into very sandy clay and sandstone. The refractory clay is white burning and is used largely for fire brick. The following analyses of clays from the Alberhill Coal and Clay Co. pits are quoted from the published report of Dietrich.1/

1/ Dietrich, W. D., The clay resources and the ceramic industry of California: Calif. State Min. Bureau, Bull. No. 99 (1928), p. 354.

	SH_5 Clay	SH_4 Clay	Select Main tunnel Clay	SH_2 Clay
Al_2O_3	42.21	34.58	26.26	28.85
Fe_2O_3	0.51	0.99	2.24	1.28
SiO_2	37.72	48.61	59.44	65.00
Loss	18.96	15.36	11.64	3.96
Other	0.86	2.24	0.61	2.21

The SH_5 clay is a plastic refractory clay that generally has a higher alumina content than that in the analysis quoted, and grades laterally into the bone clay (SH_4) that may or may not have pisolitic texture. One of the bone type (SH_3) samples shows an exceptionally high alumina content, and this type is commonly pisolitic and resembles bauxite. No gibbsite was recognized in this clay under the microscope, but perhaps some hydrate of alumina is present in it as is suggested by alumina and water content that are higher than in kaolin. The SH_5 and Select Main Tunnel clays have a higher content of quartz sand that is reflected in the analyses.

The residual clays vary in character, depending on the type of basement rock, but are generally red-burning types that are used only for sewer pipe, tile, and common brick. The Select West Blue clay is an altered volcanic flow and is a higher quality clay than the more common mottled clays that are formed from metasediments. Analyses of these clays are also taken from Dietrich's report (p. 355):

	Pink Mottle clay	West Blue clay
Al_2O_3	15.19	22.99
Fe_2O_3	7.75	1.82
SiO_2	68.57	68.57
Loss	4.69	5.20
Other	3.67	1.42

The bone type of clay, with or without pisolitic texture, is the only clay with a high alumina content that is generally free of much quartz sand. This clay occurs below the lignite beds and sandy clays, and seems to be an uppermost part of the residual clay. It varies in thickness from less than one foot to about ten feet but is generally 3 to 5 feet thick.

Mining in this district is largely from open pits. Power shovels are used only in removing overburden, except at the Emsco Harrington pit, where a lower grade clay is mined by the shovels. The clay is sorted by hand at the Alberhill Coal and Clay Co. and Los Angeles Brick Co. mines. To obtain the refractory clays in the lower strata of the pits of the Alberhill Company, the overlying clay is removed, sorted, and placed in stock piles for possible future sale. At present over 80 feet of overburden must be removed in their Main pit to reach the upper part of the white burning clays. In the 46 feet of these clay and lignite beds about half is not used and the other half is hand sorted. The maximum thickness of clay that might be used for aluminum production would thus be less than 25 feet, with more than 80 feet of overburden. About 2,165,000 tons of clay has been produced by the Alberhill Coal and Clay Co. but approximately half of this has been the low grade, non-refractory clays.

The Los Angeles Brick Co. pits are becoming increasingly difficult to mine due to the steep dip of the clay strata. They are attempting to mine along the strike of the beds, but due also to the topographic relief, the overburden is increasing. Their Highpower pit contains an unusually high alumina clay that resembles bauxite in the pisolitic texture. This bed is locally 10 feet thick at the maximum, and pitches at 20 degrees under overburden that is at present 80 feet or more in thickness.

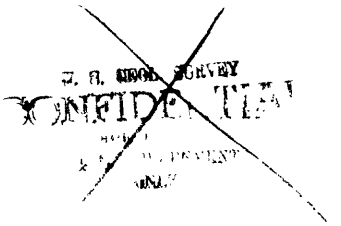
The Sloan pits of Cladding McBean Co. were abandoned due to the increase in overburden, with a maximum of about 10 feet of bone clay overlain by 30 to 40 feet of overburden. The Harrington pit of Emsco Refractories Co. cannot produce large tonnages without greatly increasing overburden that is already over 30 feet on the clay beds that include less than 15 feet of good refractory clay. The two pits between the railroad and highway, south of the Harrington pit (Map, No. 14 and 17) have only about 4 feet of high alumina clay with overburden of 10 to 30 feet. The Riverside Cement Co. prospect adit follows a bone clay that is 5 to 6 feet thick. This bed crops out just above basement rocks and is overlain by fan deposits that increase rapidly to 100 feet or more thickness. The pit of the Pacific Clay Products Co. in the northern part of the valley (Map, No. 16) is a residual mottled clay that would be of no value for alumina as it is very high in iron and probably low in alumina. In the West pit of this company, southeast of Alberhill, some pisolitic bone clay occurs as small lenses overlying the residual mottled clays, and overburden consists of about 30 feet of Eocene sandstone. The Morton pit north of Elsinore has been dug in the alluvium of the valley flat. Although no samples were available and the pit is now filled with water, the description by the former operator indicates that only about 18 inches of the clay was of the high alumina type and the overburden is 40 feet or more.

The clays of this district include both residual and transported or sedimentary types. The residual clays are generally mottled with a high iron content, but are variable depending on the bed rock from which they were formed. Only the uppermost few feet, immediately underlying the lignitic and sandy clays of the basal Tertiary, are of a high alumina type and this clay is commonly pisolitic. This seems to represent the high sesquioxide zone of the upper part of the usual lateritic profile of weathering. The clay of the immediately overlying lignitic and sandy strata is largely a high alumina (sedimentary) type that was apparently derived from the surface of the deeply weathered basement rocks, and redeposited in lenticular bodies of varying purity from admixed sand. Lack of fossils beneath the zone of weathering, and the meager fauna in overlying strata preclude a close dating of this period of intense weathering but suggest a Paleocene age.

Reserves

The many widely separated deposits of clay occurring at a single stratigraphic position make it seem probable that clay deposits aggregating many millions of tons are present in this district. The facts that these deposits are lenticular, are included with structurally deformed strata, and are covered with thick accumulations of overlying fan deposits make exploration and mining difficult and expensive. Exposures of the clay beds are virtually lacking except those opened by the pits, but these indicate that variations in thickness and quality are so rapid that projection of known clay beds can be safely assumed for only a few feet or tens of feet at most. The Alberhill Coal and Clay Co. has mined 2,165,000 tons of clay, of which about one half was a refractory clay of fairly high alumina and low iron content, and most of this was high in quartz sand. The total production of clay of probable value as an ore of aluminum is thus only a few hundred thousand tons. Consideration of the mine and prospect pits seems to indicate that less tonnage than the production to date may be included in the reserves. This property seems to be the most favorable one known, considering both the thickness of the clay deposit and the overburden problems. It therefore seems safe to assume the reserves represented in probable extension of deposits now being mined are not very large and may amount to only about a million tons of the refractory clay.

The unfavorable geological conditions for exploration would seem to make the cost excessive for any test drilling for new deposits.



GEOLOGIC MAP OF THE ALBERHILL – TEMESCAL CANYON AREA

GEOLOGY BY STEVEN N. DAVIESS JULY 1942

SCALE = APP. 1/24000

BASE FROM A.A.A AERIAL PHOTOGRAPHS

EXPLANATION

- Qal — QUATERNARY ALLUVIUM. Unconsolidated deposits in valleys and present stream channels
- Qaf — QUATERNARY ALLUVIAL FANS. Unconsolidated Conglomerate and Sand
- Te — TERTIARY EOCENE (PALEOCENE?). Coal and clay strata overlain by sandstone, Shale and Conglomerate
- bc — BASEMENT COMPLEX. Metamorphic and intrusive and extrusive igneous rocks
- X — PROSPECT
- MINE TUNNELS
- DRY HOLE
- CLAY PIT
- DUMP
- SLUMP

INDEX TO CLAY PITS

ALBERHILL COAL AND CLAY CO.
1. MAIN PIT
2. PINK MOTTLE NO. 1
3. PINK MOTTLE NO. 2
4. PINK MOTTLE NO. 3
5. HILL BLUE NO. 1
6. HILL BLUE NO. 4

GLADDING-McBEAN CO.
7. OLD SLOAN PIT
8. RED SLOAN PIT
9. NEW SLOAN PIT

LOS ANGELES BRICK CO.
10. PIT NO. 1
11. PIT NO. 23
12. HIGHPOWER PIT

EMSCO REFRACTORIES CO.
13. HARRINGTON PIT
14. UNNAMED

PACIFIC CLAY PRODUCTS CO.
15. DOUGLAS PIT
16. UNNAMED
17. UNNAMED
18. HOIST PIT
19. TWIN SPRINGS

OTHER
20. MORTON PIT
21. RIVERSIDE CEMENT CO.