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The Magnet Cove Rutile Company Mine, Hot Spring County, Arkansas

by

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Hot Spring County, Arkansas.

Abstract

The Magnet Cove Rutile Company mine was mapped by the U. S. Geological Survey in November 1944. The pits are on the northern edge of Magnet Cove and have been excavated in the oxidized zone of highly weathered and altered volcanic agglomerate. The agglomerate is composed of altered mafic igneous rocks in a matrix of white to gray clay, a highly altered tuff. The agglomerate appears layered and is composed of tuffaceous clay material below and igneous blocks above. The agglomerate is cut by aplite and lamprophyre dikes. Alkalic syenite dikes crop out on the ridge north of the pits.

At the present stage of mine development the rutile seems to be concentrated in a narrow zone beneath the igneous blocks of the agglomerate. Rutile, associated with calcite and pyrite, occurs as disseminated acicular crystals and discontinuous vein-like masses in the altered tuff. Thin veins of rutile locally penetrate the mafic igneous blocks of the agglomerate.

Introduction

The pits of the Magnet Cove Rutile Company (previously known as the pits of the Titanium Corporation of Malvern, Ark., or the pits of the Titanium Alloy Corporation of Arkansas) are in sec. 18, T. 3 N., R. 17 W., Hot Spring County, Ark. They were studied by the U. S. Geologic Survey; plane table mapping was begun November 10 and completed November 24, 1944; the area was revisited in February 1945. The elevations used in contouring are based on U. S. Coast and Geodetic Survey bench mark H-140 located on the concrete bridge over Cove Creek on Highway 270.

The distribution of rocks found in the mapped area is shown on the accompanying plate. No attempt was made to map in detail the various types of igneous rocks found in blocks within the pits. Where fine-grained mafic rock is indicated on the map, the rock mass is dominantly that type although varieties of coarser grained rocks included in or intrusive into the fine-grained rock are present in many places.

Prior to 1942, mining operations in sec. 18 recovered rutile only from the weathered zone wherein the pyrite associated with the ore has been altered to limonite. Operations during and subsequent to 1942 have been in the unoxidized zone. By 1944 mining operations by scraper, shovel and drag line had developed a poorly drained uneven surface; the high areas are held up by hard unaltered igneous rock, and the low areas are underlain by comparatively soft clay.

Geology

General geology

Magnet Cove is an elliptical basin-shaped area roughly 3 miles long and 2 miles wide midway between Malvern and Hot Springs, Ark. The Cove is underlain by a series of rare alkalic rocks intruded into Paleozoic shale and novaculite. The rim of the Cove is formed principally by resistant alkalic dikes, and the higher elevations within the Cove are underlain by alkalic or metamorphic rocks. Some of the low areas within the Cove are eroded in soft pyroclastic rocks.

The Magnet Cove Rutile Company pits are located on the northern edge of the Cove immediately south of the rim rocks of the alkalic syenite. A thick residual soil, developed from the highly altered and much-weathered pyroclastic and intrusive igneous rocks, masks the bedrock geology of the area except where mining operations have stripped the soil cover or where unaltered igneous rocks are present on the rim rock north of the pits. The pits have been excavated in the residual soil and expose unweathered blocks of igneous rock embedded in gray to white clay. Clarence S. Ross[1/] refers to

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1/ Ross, C. S., Occurrence and origin of the titanium deposits of Nelson and Amherst Counties, Virginia: U. S. Geol. Survey Prof. Paper 198, p. 24, 1941.

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the rocks exposed in the pits as volcanic agglomerate and suggests an explosive vent in the immediate vicinity as the source.

At places along the northern edge of the West pit, fragments and rounded pebbles of a variety of sedimentary and igneous rock types occur at the base of the soil layer and above the weathered and altered igneous rock. This layer is probably of alluvial origin, although it may be in part talus derived from the ridge to the north. Where the layer of transported rock fragments is not present, the contact between the soil and underlying weathered rock appears gradational.

Sedimentary rocks

The underlying sedimentary rocks can be seen in two areas where they are not buried by talus or alluvium. The first area in the northeastern corner of the map is underlain by shale which has been altered considerably by the alkalic syenite dike to the south. The altered shale is a light-gray, dense, hard, brittle rock that in natural exposures still shows some of its sedimentary structure. It is probably a part of the Stanley shale of Pennsylvanian age, as the Arkansas novaculite which normally underlies the Stanley shale is exposed about half a mile north.[2/]

2/ Parks, Bryan, and Branner, G. C., A barite deposit in Hot Spring County, Arkansas: Arkansas Geol. Survey Inf. Circ., (map) 1932.

A second and smaller outcrop of rock believed to be of sedimentary origin is exposed at the top of the ridge near coordinates 3100 N. and 2050 E. The mass crops out as limonite-stained angular fragments and is entirely surrounded by nepheline syenite. Fresh specimens of the rock are light buff to brown, hard, brittle, fine-grained and contain small irregular iron-stained cavities. The rock is either highly altered novaculite or shale, formed from the Arkansas novaculite or the Stanley shale.

Agglomerate:-The agglomerate consists of blocks of igneous rocks and crystalline calcite ranging from 2 feet by 4 feet to a mass 75 feet by 500 feet embedded in a matrix of gray to white clay. Ross[3] mentions small blocks of

3/Ross, C. S., op. cit., p. 24.

of metamorphosed novaculite and slate in the agglomerate, but these rocks were not definitely identified at the horizon exposed in the pits during the present study.

The matrix for the blocks that make up the agglomerate is slightly gritty, friable, white to gray, fine-grained clay. Ross's[4] microscopic

4/Ross, C. S., op. cit., p. 24.

identification of relict glass shards completely altered to clay minerals indicates that the clay matrix was originally volcanic tuff. The clay appears slightly granular under a hand lens, but shows no structure. In certain areas and especially within a few feet of the igneous blocks, the matrix is almost pure potassium feldspar and much harder than elsewhere in the pit. It is possible that at one time the potassium feldspar was much more abundant in the matrix and has been subsequently altered to the clay minerals. The clay, especially the zone a few feet from the igneous blocks, carries a higher concentration of rutile than the igneous blocks and is of commercial importance.

The blocks of the agglomerate are dominantly dark-gray to black, fine-grained rock containing various amounts of pyrite as crystals or small irregular aggregates. This rock is similar to that mapped as monchiquite a few hundred yards to the west of the present map area by J. Francis Williams,[5]

5/ Williams, J. Francis, The igneous rocks of Arkansas: Arkansas Geol. Survey, Ann. Rept. for 1890, vol. 2, pp. 163-343 and map.

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but it is called fine-grained mafic rock pending thin section study. This rock is common on the floor of the pits and may be equally abundant, but owing to its weathered condition is difficult to recognize. At a few places a coarse-grained olive-green igneous rock is found as inclusions or perhaps intrusions into the fine-grained mafic rock.

A medium-grained, dark-gray lamprophyre block, 75 feet by 500 feet, is exposed in the northern part of the West pit between coordinates 2300 N. and 2500 N. and 2100 E. and 2500 E. This rock weathers spheroidally, and only a few unweathered residual boulders have been exposed by mining operations. The block, now divided into two masses by mining, appears to have its maximum dimensions in a horizontal plane like the rest of the igneous blocks in the agglomerate. The boundaries of this rock mass are indefinite because in weathered areas the lamprophyre appears similar to other igneous blocks.

Smaller blocks of coarse-grained or porphyritic rocks, maximum dimension 20 feet by 30 feet, occur sporadically within the West pit. These blocks are small compared with the lamprophyre block in the northern part of the West pit and could have been derived from sources more distant than those yielding the larger masses. The smaller blocks are generally so altered that it is difficult to collect hand specimens. A coarse-grained feldspar rock is present in the walls of the pits at coordinates 2500 N.- 2090 E., and at 1950 N. -3250 E.

Rounded masses of coarse-grained calcite occur in the eastern half of the West pit. These may be cavity fillings as calcite veins are present in the altered tuff, but it seems more likely that they are blocks in the agglomerate which were derived from older metamorphic masses of calcite. Very large masses of similar coarsely crystalline calcite are present at a number of localities within Magnet Cove.

Dikes:-A number of distinct rock types occur as dikes in the area mapped. According to J. Francis Williams,[6] the principal dike in the mapped area is a

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6/Williams, J. F., op. cit., map.

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nepheline syenite. The rock is generally coarse-grained where exposed by south-trending drainage in the northeastern quarter of the map. Williams also mapped a coarse-grained leucite syenite south of the crest of the rim rock but, although the rock was noted as float, it was not differentiated in the present mapping. The boundaries of the leucite syenite could not be determined with any degree of accuracy without a greater investment of time than appeared to be justified.

Monchiquite was mapped by Williams on the south side of the nepheline syenite dike in the drainage just west of the present mapped area. The rock cropping out in this drainage, however, is a very fine-grained, black mafic rock with irregular crystalline aggregates of pyrite. An outcrop of a similar rock at coordinates 2550 N. and 1435 E., and an altered fine-grained ferromagnesian rock at coordinates 2800 N. and 2615 E. suggest the continuation of this rock mass to the east although outcrops are nonexistent in the intervening area.

Dikes of lamprophyre which weathers olive-green are found in the East pit near coordinates 2200 N. and 3200 E. and elsewhere along the walls of the pit. Other mafic dikes may be present in the walls of the West pit, but weathering and slumping obscure the bedrock. Williams[7] also mapped a leucite

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7/Williams, J. F., op. cit., map.

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tinguaite dike a few hundred feet south of the southeast corner of the map. Many of the mafic dikes referred to by Ross may be large blocks of igneous rock described earlier as blocks in the agglomerate. Field relations suggest that these blocks were in a consolidated condition before coming to rest in their present position. At 2185 N.-3220 E. an aplite dike is present in the highly weathered soil.

Structure

Structural features within the pit are obscured by the highly altered condition of the igneous rocks which form the walls. One small low angle normal fault was observed offsetting a mafic dike in the East pit. Exposures in the West pit suggest that the igneous blocks are concentrated in a layer overlying clayey tuffaceous material. The contact between these two layers, shown on the map, is believed to have had considerable importance in the localization of the rutile deposits. The elevation of the contact ranges from 408 feet at the north end of the West pit to 390 feet at the south end but is irregular in many places, especially where the unweathered fine-grained mafic rock masses are exposed in the central part of the pit.

Ore deposits

Rutile (TiO_2) is the dominant ore mineral at the Magnet Cove Rutile pits. Ross[6] states that leucoxene (anatase) is a prominent titanium-bearing

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6/ Ross, C. S., op. cit. p. 24.

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mineral in the deposit and reports lesser amounts of pseudobrookite. The Titanium Alloy Company of Arkansas[9] reported 3 percent rutile and 1 percent

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9/Oral communication January 15, 1943.

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leucoxene. The total TiO_2 content of the deposit is about 4 percent. The rutile occurs as slender acicular crystals matted together or as a massive aggregate of granular crystalline material. It is most abundant in the clay matrix especially in a zone a few feet beneath the unweathered fine-grained mafic blocks of the agglomerate. A few veins of rutile, 3/8 to 1/2 inch wide, in some places extend upward into the overlying agglomerate. The rutile in the clay occurs with calcite as isolated masses or as almost continuous vein-like deposits. The rutile is also generally associated with pyrite. According to the Titanium Alloy Company the ratio of pyrite to rutile is 3 to 1.[10] Dolomite and a potassium feldspar are locally present. Masses of

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10/ Oral communication January 15, 1943.

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calcite which have been removed from the shaft at coordinates 2135 N. and 2135 E. contain good concentrations of rutile. The calcite blocks were not observed in place because the shaft is filled with water, but the calcite appears to be similar to other large boulderlike masses that occur elsewhere in the pit.

An interesting association of rutile or brookite with quartz and dolomite was observed in vuggy masses at coordinates 1975 N. and 1740 E. The dolomite forms the outside of the vug, and rutilated quartz crystals occupy most of the central cavity. The well-crystallized titanium mineral occurs on the faces of the curved dolomite crystals and as small masses embedded in the dolomite. The history of the mass is unknown, for although it now rests on a coarse-grained igneous rock, it might have been carried there by the scraper in mining operations.

The large mass of coarse-grained feldspar along the north wall of the West pit at coordinates 2500 N. and 2090 E. contains a few small inclusions of a dark metallic mineral believed to be one of the titanium minerals. On the north wall of the East pit at coordinates 2230 N. and 3275 E. an aplite dike contains comparatively large masses of rutile. Scattered pod-like masses of rutile occupy a centrally located longitudinal parting in the dike. No other occurrence of rutile in partings was seen.

Mining for titanium in the Magnet Cove area started at the surface where weathering of the underlying material has greatly concentrated the resistant rutile. The concentration of rutile in the weathered or fresh igneous rock of the agglomerate is so slight that it is improbable that workable deposits would form from the weathering of this type of rock alone. As the original mining operation was successful, it is probable that much of the present pit was excavated in weathered white clay where the concentration of rutile is much greater. The present walls of the pit are of weathered or altered massive igneous rock of the agglomerate, and it seems possible that mining operations were continued only a slight distance into this barren material. This suggestion is in part substantiated by local miners who were employed in the original operation. They report that in the East pit a 15-foot face of rutile-bearing material was worked and that the enclosing material was white clay. This original operation continued until the underlying sulfide zone was reached.