DUMORTIERITE FROM IMPERIAL COUNTY, CALIFORNIA

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This once rare mineral is now found at an ever increasing number of localities, which are tabulated, with references to their description, and to the mineral in general, in the University of Nevada Bulletin, Vol. XXII, No. 2, issued March 15th, 1928, entitled "On the Mineral Dumortierite," to which the reader is referred. This valuable paper also describes in detail the only mined deposit of commercial value, near Oreana, Nevada, the output of which is used, together with andalusite, in the manufacture of spark plugs, and many hundreds of tons are shipped yearly to Detroit for that purpose.

In California, at least three localities are known by specimens of dumortierite: (1) in Temescal Canyon, Riverside Co., (2) near Dehesa, San Diego Co., and (3) from Imperial Co., in the Colorado desert, with which the specimen here described belongs. From this general locality specimens have come for a long time, but all apparently as loose pieces picked up on the desert, and the locality names usually given merely indicate the nearest settlement, perhaps miles away, such as Ogilby, Calif., 15 miles north-west of the Colorado River; Yuma, Ariz; Picacho, Calif., 20 miles by air line north of Yuma, etc. The parent ledges, so far as known to the writer, have not yet been found, although prospectors have combed the region for this now valuable mineral. In the October number of this Journal (Vol. **14**, pp. 373–381) Eldred D. Wilson described a deposit in place, near Quartzsite, Arizona, some 45 miles North-north east of Clip, Arizona, an old locality name given for the mineral, supposed to have been across the river from Picacho; but since Quartzsite is a long way from the Imperial County locality and separated by the river, it seems hardly possible this could be the original source.

My specimen was obtained from Mr. L. H. Dykes, of Coachella, Calif., now a student of geology at the University of California at Los Angeles. It is a piece of a large boulder, weighing 35 pounds, which he had found in a desert wash some 12 miles north-east of Ogilby and carried on his back a long distance across the desert to his car. Recently he has brought in another boulder of the same size, from the same general locality, 12 inches by 9 by 6, which is

beautifully facetted, with a dark brown desert polish on all but the bottom side.

Mr. Dykes has provided the following preliminary notes on the lay of the land, geology, etc., while the writer merely records a cursory study of the first specimen, but expects to go with him to visit the locality, hoping that Mr. Dykes will continue his work in greater detail. That part of the desert, with its lack of roads and water, heat, strong winds and drifting sand, is not exactly a health resort, even in winter, hence when he says in his outline "field-work was limited and only major features were noted," one can sympathize.

Summarizing Mr. Dykes says: The area lies between the Southern Pacific R. R. on the south and the Black Mt. on the north; the Colorado river bounds it on the east and the old Mecca-Blythe road on the west, an area of about 225 sq. miles (See Fig. 1). The Black Mt., south-west from the river, is a low basalt-covered mountain, trending N.W.-S.E., and is about 12 miles long, in places 4 miles wide. The basalt now covers the nearly flat top and the sides with boulders. From the mountain a large alluvial plain slopes south and south-west, its flat surface broken by small volcanic vents at the south end as well as by the Cargo Muchacho Mts., and the plain is cut by numerous desert washes, trending generally with the slope.

Black Mt. is composed mainly of schists, with a gentle dip; these are covered with a basic flow, now remaining as a thick covering of boulders; the lava is fine-grained, and many vents and fissures are found. Not far from the N. W. end of the mountain there are acid massive intrusions, mainly monzonite and granite ("B" Fig. 1), while at the west end are acid effusives ("E" Fig. 1), and shallow dikes and sills, which are probably older than the basalt. The latter perhaps are contemporaneous with that of the Mohave Desert (late Tertiary or younger). There is some evidence of a series of faults along the south-west face of Black Mt., and in the old crystallines on the north side, while in the Cargo Muchacho Mts. torsion and compression are evident in the rocks. These consist of highly folded schists, intruded by medium grained plutonics, while the schists are highly pegmatized in places, and kyanite is found at several localities, especially at the American Girl Mine ("D" Fig. 1), and at the Vitrefrax property, 1½ miles S. W., where the mineral occurs near the contact between schist and plutonic.

The alluvial plain is composed of material washed down from the mountains. Its surface is covered with a mantle of rock fragments and stream-washed materials, the whole composed of plutonics, volcanics, schists and gneisses. A well, now sinking 3 miles N. of

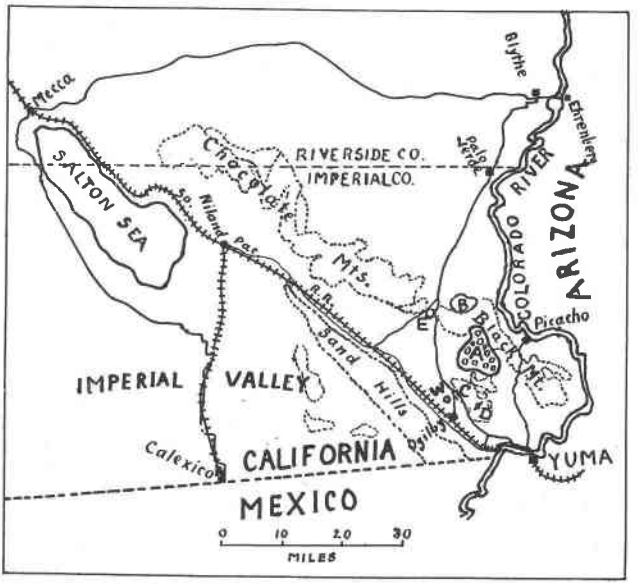

FIG. 1. Orientation Sketch. (A) area of dumortierite boulders; (B) area of acidic intrusives at N. W. corner of Black Mt., mainly monzonite and granite; (C) Cargo Muchacho Mts.; (D) American Girl Mine; (E) area of shallow intrusives and extrusives at W. end of Black Mt., (W) well, 3 miles N. of Ogilby.

Ogilby ("W" Fig. 1), gives some idea of the successive layers down to 91 feet, and corresponds closely to the logs of several shafts sunk on the plain further north.

From the surface we encounter:

5 ft. mixture of soil and fragments of schist, granite, quartzite etc.
36″ red hard pan, (clay, rock fragments, iron oxide).

11 ″ white volcanic ash (?) -determination uncertain.
2 ″ "cement rock," a medium to coarse grained pebbly sandstone, cemented by calcium carbonate.
10 ″ clean washed sand.
20 ″ sand and round pebbles.
3 ″ sand and boulders.
4 ″ "cement rock."

91 ″

At about 50 ft. from the surface (apparently near the base of the "volcanic ash") small fragments of the dumortierite rock were brought up.

Dumortierite

This is found as boulders scattered on the alluvial plain and on the south-west slope of Black Mt., ranging in size from an inch to over two feet in diameter. The center of the area ("A" Fig. 1) lies about 10 miles N. E. from Ogilby, and covers at least 20 sq. miles. There are two types of boulders: (A) those which are well rounded and with desert varnish; (B) which appear to be joint blocks, with little varnish, and have come from stressed rocks. Mr. Dykes thinks this suggests that the dumortierite occurred principally as a large formation, rather than as small isolated patches in the parent rock. Kyanite is found in many specimens and closely resembles that from the American Girl mine and the Vitrefrax property.

So much for Mr. Dykes summary. The writer may add that since prospectors have diligently searched the region for the parent ledges of this striking rock, and so far without success, the ultimate discovery is doubtful, and one can only speculate as to whether the ledges are buried under the plains, or under the basalt cover of Black Mt., or faulted down, or exist at some more distant and unexplored area.

Laboratory Description of the Specimen. The hand specimen is multicolored, the main part is composed of small quartz grains which may be in clear bands but are generally filled with a network of minute dumortierite crystals, which give a dark bluish color to the rock. Thin bands of aggregated prisms of pale green kyanite are intimately associated with the quartz-dumortierite, the two interleaved and interpenetrating, so that the relative age is uncertain. A few minute specks of pyrite are seen. The rock has an indistinct banding and when horizontally broken thin layers are exposed here and there, which consist of minute implanted crystals of a brilliant reddish orange color, determined as rutile, and intimately mixed with adjacent layers. Also thin layers of an orange colored calcite fill irregular cracks, plainly secondary, and perhaps are due to long burial in the wash material and the slow action of percolating moisture, like the "cement rock" mentioned in the well log.

The kyanite does not appear in the thin section used, but was

easily determined as such in the powder, as was the rutile. The latter crystals are perfect tetragonal prisms and pyramids, only 0.05 mm. long and 0.02 mm. wide, with a deep brownish red color. They have very high indices and bi-refringence, and are uniaxial positive. Knee-shaped twins were observed and a good titanium test was obtained with a blow-pipe. The quartz aggregate consists of polygonal, equal-sized, interlocking grains, much like a quartzite, but without strain. The clear bands, with but an occasional dumortierite crystal, have larger grains than those rich in that mineral, suggesting some reaction accompanying its formation. Some of the dumortierite crystals are larger than the average, (.09 mm. wide and .8 mm. long), but are mostly in slender long prisms arranged in a net-work through the quartz, without dominant direction individually, but often in bands, sometimes curved in almost a half circle. A rare flake of hematite or rutile may be seen, while small apatite crystals are common in the quartz.

The dumortierite crystals show good cleavages in the zone of the c axis and occasional cross fractures perpendicular to c. Basal sections, obtained where the rock section has cut through a prism at 90°, have roughly an hexagonal outline, and irregular cracks dividing it into six sectors. Whether this outline is due to twinning according to the aragonite law or merely parallel growth could not be decided owing to the minute diameter of the prisms. The deep blue color parallel to the prism zone is continuous from end to end, but with crossed nicols sometimes varies in the interference color, but this may be due to compensation by other crystals or quartz grains, above or below the one in question.

Optical Characters. These were determined by a combination of methods made necessary because of the minute size of the crystals. The thickness of the section was obtained from several quartz crystals making use of the Universal stage. β-α was determined upon a large accurately oriented dumortierite crystal and the pleochroism observed with an eye-piece dichroscope. The indices for α and β were determined by immersion. On a perfect basal section H_a was found with a fair degree of accuracy by using the ordinary stage and a high power fluorite objective, while γ-β was determined with the compensator. The results are tabulated below.

β .....by immersion.....	1.687	
α .....by immersion.....	1.668	
$\beta-\alpha$	0.019	
$\gamma-\beta$ by compensator and d (thickness) = .023 mm.	0.001	
$\beta-\alpha$ by compensator and thickness.....	0.0188	
The indices are therefore:		
γ	1.688	(β 1.687+$\gamma-\beta$ .001)
β	1.687	
α	1.668	
$\gamma-\alpha$	0.020	
$2H_a$ (conoscope).....	23°	
and 2V (from β=1.687).....	20½°	
2V from indices (Mallard formula).....	20°	

Pleochroism, $\parallel c=\alpha$, deep sky blue,
$\perp c=\gamma$ and β colorless, at least for a thickness = .023 mm.

From its mineralogical similarities to specimens found in place at many dumortierite localities, this rock also is evidently a product of contact metamorphism between schist and acid igneous rocks.