

CASSITERITE IN SAN DIEGO COUNTY, CALIFORNIA.

By WALDEMAR T. SCHALLER.

A small handful of cassiterite crystals was found in the northern part of San Diego County, Cal. (fig. 22), in the spring of 1915, and the locality was visited by the writer in July, in order to see if it offered any hope of finding cassiterite in quantity. Mr. Roy Carson was kind enough to act as guide, and the writer wishes to thank him for his many courtesies. The locality lies in an arid region, best reached



FIGURE 22.—Index map showing position of cassiterite locality in San Diego County, Cal. The rectangle indicates the gem tourmaline field of southern California, throughout which are found pegmatite dikes similar to the one described in this paper.

by horseback from Oak Grove, although a wagon road, now in bad condition, leads from Oak Grove to a point within a mile of it. The present owners of the claims (Messrs. Roy Carson, E. L. Haney, and D. H. A. Fiske, of Pasadena), expect to do further development work in 1916.

The original material, extracted from a single pocket in a flat-lying pegmatite dike,¹ is all the cassiterite so far obtained, and an examination of the locality has failed to offer any hope of finding more in large quantities. The deposit illustrates well the irregular way in which the rarer minerals occur in the granitic pegmatites of southern California.

¹ The term dike as used in this paper carries no implication as to dip, which may be more nearly horizontal than vertical.

Although the present developments have been disappointing, the cassiterite found exceeds in quantity all the occurrences of tin ore in place previously known in San Diego County. These are as follows: F. J. H. Merrill¹ has stated that small grains of cassiterite have been obtained by placer miners from the black sand of the mountain gulches, chiefly from the east slope of Laguna Mountain, in the southern part of the county. Additional reported occurrences are in Pine Valley; on the south end of Viejas Mountain, east of Alpine; and in the Defiance copper district, north of the Santa Margarita grant. The writer² has described small black crystals of cassiterite, a few millimeters thick, associated with albite, quartz, stibio-tantalite, and green and pink tourmalines, obtained from the gem pegmatite dike at the Himalaya mine, Mesa Grande, and with topaz from the Little Three gem mine, Ramona. The original San Diego County included the tin mines at Temescal, now in Riverside County.

The pegmatite dike which yielded the cassiterite crops out on the east side of Chihuahua Valley, about 2 miles south of the boundary line between Riverside and San Diego counties and about 10 miles east of Oak Grove, in the SW. $\frac{1}{4}$ sec. 12, R. 3 E., T. 9 S., San Bernardino meridian. Three claims, the San Diego, Panama, and Exposition, cover the outcrop of the dike. There are at least two other parallel dikes on the claims which have not yet been developed. The place was discovered and located in 1905 by Mr. Bert Simmons, of Oak Grove. The claim, then called the Blue Tourmaline, was worked extensively in 1906, by open cuts and several short tunnels, the main object of search being gem tourmaline.

The country rock of the region is granitic and belongs to the group intermediate between granite and diorite. The specimens collected contain quartz, orthoclase, plagioclase, biotite, and hornblende, and pending further study may be termed granodiorite. Many of the hornblende and biotite crystals are from 0.5 to 1 centimeter across.

A system of parallel faults, of which the major ones are over 50 miles in length, cut across the country in a northwesterly direction (about N. 40°-50° W.), and the locality described lies about halfway between two of these larger faults. It is probable that other as yet undetermined dislocations lie between the two mentioned. A northwest fault line probably determines the east side of Chihuahua Valley, and the dike containing the cassiterite occurs less than a mile east of this supposed fault line. Numerous pegmatite dikes, striking parallel to the fault-lines, crop out on the east side of Chihuahua Valley.

¹ Merrill, F. J. H., *Geology and mineral resources of San Diego and Imperial Counties*: California State Mineralogist's Rept., 1913-14, p. 39, 1914.

² Schaller, W. T., *The gem tourmaline field of southern California*: U. S. Geol. Survey Prof. Paper 92 (in preparation).

The western fault of the two mentioned determines the east side of Smiths Mountain, and extends from a point north of Aguanga, in Riverside County, southeastward through Oak Grove, Puerta Cruz, and Warners Hot Springs (Agua Caliente), probably forming the east side of the valley occupied by Warner's ranch. The eastern fault line, whose exact location is not known, passes through San Jacinto and Hemet, skirting the west and southwest edge of the San Jacinto Mountains, and through the Coahuila Valley and Coyote Canyon.

The remarkable parallelism of strike of nearly all the pegmatite dikes of this region with the larger fault lines is very suggestive of a possible genetic relation. Similar pegmatite dikes occur at Pala, and a detailed study of this locality has indicated that the fissures now filled with pegmatite are part of a large system of dislocations prominently developed in San Diego County.

The exposed length of the pegmatite dike in which the cassiterite was found is nearly half a mile, and the thickness from 6 to 8 feet. The pegmatite rock is more resistant to erosion than the granodiorite country rock, and the dike therefore projects slightly above the ground. It strikes about N. 35° W. At the north end of the claims the natural exposure of the dike seems to show it dipping slightly toward the northeast; at other places it lies almost horizontal, and at still other places a slight but decided dip toward the southwest is observable.

The pegmatite dike is of the type of the compound, unsymmetrical dikes whose different parts are thought to be due to differentiation processes rather than to multiple injections of material into reopened fissures.

The upper portion of the dike ("top rock"), from 2 to 3 feet thick, is a mixture of a coarse granular aggregate of quartz and feldspar with coarse graphic granite, in both of which occur biotite, muscovite, and black tourmaline. At one place a horizontal layer of graphic granite 4 inches thick was seen in the granular aggregate.

The lower portion of the dike ("bottom rock"), about 3 feet thick, is a finer-grained granular quartz-albite rock with numerous wavy bands of garnets, which in their general trend lie horizontal, being parallel to the dip of the dike.

The middle part, between the top rock and bottom rock, is called the pay streak by the miners, for it is in this part that the minerals of value are found. The pay streak ranges from 1 foot to 3 feet in thickness and is the coarsest part of the entire dike. In it occur numerous cavities or pockets which yield an abundance of large and well-crystallized minerals—quartz, feldspars, and micas—as well as other minerals found only in this part of the dike, such as lepidolite, transparent blue tourmalines, cassiterite, and columbite. The

pocket from which the cassiterite was obtained lies just above the banded bottom rock and is about a foot high and 3 feet wide. The irregular masses and imperfect crystals of cassiterite were found in one side of the pocket in a mass of partly broken, cleaved, and loose orthoclase, directly associated with albite. The loose crystals of cassiterite contain partly embedded tabular albite crystals. About a hatful of small blue tourmalines was also obtained from this pocket. In a similar pocket, about 25 feet distant, a few crystals of columbite were found.

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