THORITE FROM CALIFORNIA, A NEW OCCURRENCE AND VARIETY

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ABSTRACT

The occurrence of green thorite is not recorded in the literature nor has thorite from California been previously described. The mineral is widely distributed in the major gold placers of California and is probably derived from the weathering of Jurassic granites. Physical and optical properties and a chemical analysis are presented.

INTRODUCTION

Thorite ($ThO_2 \cdot SiO_2$) has been described from several localities in the United States, notably from Henderson Co., N. C. (auerlite) (1), Llano Co., Texas (mackintoshite and thorogummite) (2), and from Blueberry Mountain, near Boston, Massachusetts (organite) (3). In addition it has been reported from the Lake Champlain district of New York (4) and from the old Trotter Mine at Franklin Furnace, New Jersey (5). The purpose of this paper is to describe and record a variety of green thorite which is widely distributed in California. As far as is known, the existence of green thorite has not been previously recorded nor has thorite from California been described.

OCCURRENCE

Thorite occurs in California as a very minor constituent in the gold placers of the central part of the state, but particularly along the Feather, Yuba, American, Mokelumne, Tuolumne and Merced Rivers which lie between Oroville in Biggs Co. on the north and Snelling in Merced Co. on the south, a distance of approximately two hundred miles.

The writer's field work and sample collecting have been confined to this area, but samples of black sand concentrates from other placer gold mining operations ranging from the Scott River near Callahan in Siskiyou Co. to Atolia in San Bernardino Co. have been examined, and in all cases thorite is present. In addition thorite occurs along the beaches near Monterey, and after very severe storms it is reported† that a thin layer of the mineral is sometimes found concentrated on the surface of the beach just above the water line.

SOURCE

In all of the placers in which thorite has been found, the watersheds of the streams contain exposures of granitic rock which is identified by

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the California Geological Survey as Jurassic. This is the only formation which is common to all of the watersheds, and based upon a limited amount of field work, there appears to be a general correlation between the area of Jurassic granite exposed and the concentration of thorite in the placers. Thus even though there is no direct evidence that thorite is present in the Jurassic granite, it is strongly inferred that this formation is the source of the thorite. The age of the mineral as calculated from the approximate formula,

$$\text{Age} = \frac{\text{Pb}}{\text{U} + 0.36\text{th}} \times 7600 \times 10^6 \text{ years}$$

is only twenty-one million years, and it is assumed that the comparatively young calculated age is the result of the removal of lead by leaching.

Associated Minerals

The principal minerals in the heavy mineral (black sand) concentrates from all of the areas from which samples have been examined to date include magnetite and ilmenite, which generally account for over 90 per cent, the balance, besides thorite, consisting chiefly of garnet, chromite, hematite, ferromagnesian minerals, zircon, rutile, monazite, and pyrite. Locally, as for example in the Inyo and Atolia districts, scheelite is present in small amounts, and one sample from the Scott River district contained cinnabar and a mineral tentatively identified as thorianite.

Description of Thorite

The thorite occurs mostly as small rounded grains and broken fragments although partially rounded, but clearly recognizable tetragonal crystals of both long and short prismatic habit are not uncommon. The grains vary in size from less than 0.1 mm. to about 0.6 mm. and are typically translucent and light to dark bluish-green. A small proportion are in whole or part yellow-green, greenish-yellow, greenish-orange, and reddish-orange (orangite), and it is believed that the yellow and orange colors are the result of hydration and oxidation. The specific gravity of the mixed grains is 6.36.

In transmitted light, grains having a thickness of 0.03 to 0.07 mm. vary in color from nearly colorless to pale yellow, pale green, and various shades of greenish-yellow and orange yellow. The typically bluish-green grains are isotropic (metamict) whereas the altered yellow and orange grains are in part isotropic and in part anisotropic with a finely fibrous internal structure. The indices of refraction are extremely variable even within the same grain. Measurements made in white light with a recently calibrated set of high-index liquids showed that most of the grains had indices of refraction ranging from 1.82 to 1.86, but a few of the yellow and orange grains had indices of refraction as low as 1.76 to 1.79, whereas some of the darker green grains were as high as 1.87. The maximum birefringence is 0.005 to 0.015.

Chemical Composition

A small amount of a nearly pure thorite was separated from a black sand concentrate obtained from the LaGrange Gold Dredging Company which operates on the Tuolumne River near LaGrange, California. The thorite was separated from the bulk of the associated minerals with a hand magnet and Frantz isodynamic separator. The resulting product consisted almost wholly of thorite, zircon and rutile, all of which are essentially nonmagnetic or diamagnetic. This concentrate was then further separated by placing it in a beaker containing hot, concentrated Clerici solution and allowing the solution to cool and solidify. As a result the zircon and rutile which have a specific gravity of approximately five or less floated to the top as the density of the liquid gradually increased. The thorite remained at the bottom. The thorite was finally recovered by breaking the beaker and shaving off the bottom of the solidified mass. This final thorite concentrate contained a very small amount of zircon and rutile and was cleaned to final purity by hand picking.

A chemical analysis of the clean thorite concentrate was made by the National Bureau of Standards, the results of which are shown in Column 1 of the following tabulation. Column 2 shows the analysis given in Column 1 after recalculating the U_3O_8 to UO_2 and the Fe_2O_3 to FeO. A recalculation of the analysis shown in Column 2 to 100 per cent is given in Column 3.

	1	2	3
CaO	nil	—	—
MgO	0.01	0.01	0.01
PbO	0.09	0.09	0.10
FeO	—	0.57	0.59
Fe_2O_3	0.63	—	—
Al_2O_3	1.25	1.25	1.29
ZrO_2	0.07	0.07	0.07
TiO_2	0.10	0.10	0.10
ThO_2	69.36	69.36	71.61
UO_2	—	8.10	8.36
U_3O_8	8.43	—	—
Rare Earths	0.52	0.52	0.54
SiO_2	15.96	15.96	16.47
H_2O	0.82	0.82	0.86
Total	97.24	96.85	100.00
Sp. G.	6.36 (20°/45° C.)		

The summation of the analysis in Column 1 is low. A spectrographic analysis failed to disclose the presence of elements other than those shown in the chemical analysis in more than trace amounts, and based upon analyses of other samples of thorite as recorded in the literature, it seems probable that the silica determination is low. The state of oxidation of the uranium and iron was not determined, but in view of the predominantly green color of the thorite, it is believed that these elements are chiefly present in their lower valence form. Hence the mineral is *uranoan* thorite. The high specific gravity is probably attributable to the absence of appreciable water of hydration.

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