OCCURRENCE OF PINK ZOISITE (THULITE) IN THE UNITED STATES*

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ABSTRACT

Pink zoisite (thulite) is known from 12 States with several occurrences in each of five States. The average indices of refraction are: $\alpha = 1.695$, $\beta = 1.698$, $\gamma = 1.706$.

INTRODUCTION

In two papers, Northrop[1] recently has listed four localities in the United States for thulite, the pink variety of zoisite, namely: in Maryland, Connecticut, New Mexico, and North Carolina. The Geological Survey, United States Department of the Interior, has information of several additional localities and these are here placed on record to make available a fuller list of localities of this attractive mineral.

Thulite is known to occur in 12 States, with several localities in each of California, Nevada, North Carolina, Pennsylvania, and Washington. The determined indices of refraction of thulite from a number of the localities listed are given at the end of the paper.

LOCALITIES

California

Numerous boulders of a silicate rock containing pink thulite occur near the south end, on the east side of Saline Valley, Inyo County.[2] A thin section of a specimen, kindly furnished by Dr. Joseph Murdoch, shows much thulite with abundant euhedral crystals of sphene and some epidote.

Bright pink crystals ($\alpha = 1.688$, $\gamma = 1.698$) in pegmatites at Crestmore (*Am. Mineral.*, **26,** 375 (1941).

Connecticut

At Haddam, in Middlesex County, on the top of Walkley Hill, across the Connecticut River from the famous Gillette quarry, thulite occurs as a band nearly a foot thick in the Middletown gneiss close to its contact with the Haddam tonalite gneiss. Associated minerals are epidote, labra-

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[1] Northrop, S. A., Thulite in New Mexico: *Am. Mineral.*, **20,** 805–807 (1935); Analyses of thulite, *ibid.*, **21,** 73 (1936).

[2] Pabst, Adolf, Minerals of California: *Division of Mines, Bull.* **113,** 297 (1938). First described as bustamite by Murdoch, Joseph, and Webb, R. W., Bustamite from Inyo County, California: *Am. Mineral.*, **21,** 69–70 (1936).

dorite, and quartz. The occurrence was described by Foye,[3] and is one of the localities cited by Northrop.

Georgia

The occurrence of thulite at Stone Mountain in De Kalb County, was reported informally by Dr. Alfred C. Hawkins. Dr. Frank A. Daniel of Atlanta, kindly supplied a specimen of pegmatite containing thulite from the Ethel quarry of the Ethel Granite Corporation, situated about two miles northeast of the carving on Stone Mountain.

A thin section shows a few isolated grains of thulite, with very low birefringence, scattered irregularly through the plagioclase feldspar.

Idaho

Thulite was listed from the Seven Devils district, Adams County, by Shannon,[4] who states that the feldspars of the altered granite, notably at the Arkansaw and Helena mines, have a decidedly pinkish tinge due to the development of thulite. R. S. Cannon of the Federal Geological Survey, has furnished a number of specimens from the Helena mine, which show the thulite filling small veins and occurring as scattered small masses in altered diorite.

Maryland

Specimens of thulite were obtained from a pegmatite dike in a quarry of hornblende schist formerly operated by Alphaeus H. Wright on Stony Run at Hampton, Baltimore, in 1895.[5] This occurrence was listed by Northrop and is described by Ostrander and Price[6] as the Wright quarry. The bright pink thulite, with gray zoisite shading off into light and dark green epidote, occurred in cracks and veins in oligoclase.

Montana

Massive, fine-grained pink thulite occurs disseminated through a highly metamorphosed epidotized carbonate rock in the Philipsburg district. Specimens were collected by E. N. Goddard of the Federal Geological Survey in 1939.

[3] Foye, W. G., The occurrence of thulite at Haddam, Connecticut: *Am. Mineral.*, **11,** 210–213 (1926).

[4] Shannon, E. V., The minerals of Idaho: *U. S. Nat. Museum, Bull.* **131,** 322–323 (1926).

[5] Lee, J. W., Occurrence of zoisite and thulite near Baltimore: *Am. Jour. Sci.*, 4th ser., **11,** 170–171 (1901).

[6] Ostrander, C. W., and Price, W. E., Jr., Minerals of Maryland: published by *The Natural History Society of Maryland*, p. 14 (1940).

New Mexico

Thulite from New Mexico was described by Northrop from just south of Pilar Post Office (village formerly known as Cieneguilla), Taos County, on the east bank of the Rio Grande. The occurrence is about three miles northwest of the Harding mine at which there is abundant purple muscovite and close to the occurrence of the deeper colored muscovite from about a mile or so southwest of Pilar (Cieneguilla), described by Schaller and Henderson.[7] Northrop describes the thulite as occurring in a quartz vein traversing schist and in places the thulite has penetrated and apparently replaced the schist. Actinolite is a rare associate. The percentage of manganese (as MnO_2) in the thulite is given as 1.62.

Nevada

Three localities of thulite, all in metamorphosed limestones or dolomites, are described by Gianella,[8] namely:

The southern part of the Pine Nut Mountains, Douglas County. The reference 118°25′ west longitude given on page 5 of Gianella's paper, apparently is a misprint for 119°25′.

Singatse Range, about 11 miles NNE of the first locality, Lyon County.

Ryan Canyon, about 5 miles SE of Thorne, Mineral County.

According to a personal communication from T. B. Nolan of the Federal Geological Survey, thulite also occurs at Eureka, Eureka County, in the Rogers tunnel, 1,150 feet S. 80° E. from United States Mineral monument No. 1, Ruby Hill. Specimens collected by Mr. Nolan are very deep pink or red and much deeper colored than most thulite. The indices of refraction are the lowest of those measured, which may be ascribed to the absence of iron, thus accentuating the red color caused by manganese.

North Carolina

Thulite is developed at a number of localities in North Carolina.

The mineral occurs at numerous localities in the Spruce Pine region, and W. J. Alexander of Spruce Pine, and Bradley Johnson of Penland, have kindly furnished the following list of occurrences to which are added two localities at which thulite was collected by Miss Glass in 1936.

MITCHELL COUNTY—

Smith mine, within the corporate limits of Spruce Pine, on the hillside just above the Spruce Pine-Bakersville highway, about ¾ mile from the railroad station at Spruce Pine.

Pine Mountain mine on Pine Mountain, 3 miles northwest of Spruce Pine. Leave highway 19 at Minpro. One mile off the highway.

[7] Schaller, W. T., and Henderson, E. P., Purple muscovite from New Mexico: *Am. Mineral.*, **11,** 5–16 (1926).

[8] Gianella, V. P., Thulite in Nevada: *The Mineralogist* (Oregon), **4,** No. 12, 5–6 (1936).

Davis mine, 2 miles from highway 19 on top of Emily Knob, 4 miles northwest of Spruce Pine.

Putnam mine, 5 miles northwest of Spruce Pine, on highway 19, just above the highway where the Penland road intersects it. In this mine and in the Deer Flat mine, granular masses of coarse thulite several centimeters thick lie in oligoclase.

Deer Flat mine, near Penland.

DP2 and DP5 mines, near Penland.

Chestnut Flat mine, 3 miles northeast of Penland.

Flat Rock mine, as slender rose-red crystals in the feldspars.[9]

Press Buchanan mine, 1 mile from Hawk.

Hawk mine, 1 mile north of Hawk Post Office. Some of the oligoclase is colored pink by finely disseminated thulite.

Young mine, at Young Cove, 5 miles north of Bakersville. This thulite has slightly higher indices of refraction than most thulites, almost identical with those of one sample from Pend Orielle County, Washington.

Cloudland mine, at Green Cove, 6 miles north of Bakersville.

YANCY COUNTY—

Fanny Gooch mine, 8 miles west of Spruce Pine. Turn south off highway 69 at Newdale, in what is known as the Blue Rock section.

Spider mine, on the Blue Rock road, same vicinity as the Fanny Gooch mine. Fine-grained, massive, and aggregates of coarse prisms in quartz and feldspar.

No. 12 mine, H. Bailey property, just across the North Toe River from the DP2 and DP5 mines.

Northrop lists an analysis with 0.23 per cent of MnO, of a "rose-red zoisite" from the James's mica mine.

On several specimens from the Spruce Pine area, exact mine not known, thulite fills minute fractures in the oligoclase and between plates of muscovite. It also forms radiating groups, at least 4 centimeters long, of prismatic crystals, as masses of coarse prisms, and as fine-grained compact masses, frequently mixed with gray zoisite.

MACON COUNTY—

Small grains of thulite were found in 1936 by C. S. Ross and W. T. Schaller at Corundum Hill, near Franklin. The thulite occurs as pink prismatic aggregates in small lenses in altered oligoclase.

Pennsylvania

Thulite is recorded by Gordon[10] from Deshong's (Leshong's?) quarry, Leiperville (rose red to pale pink, with grossularite), and from Avondale, both in Delaware County. In two old analyses of thulite from Deshong's quarry, MnO is given as 0.43 per cent and as a trace. A "tiny patch" of pink zoisite was found by Wherry[11] in one of the albitite quarries in West Nottingham Township, Chester County, 2 miles northwest of Sylmar.

[9] Genth, F. A., The minerals of North Carolina: *U. S. Geol. Survey, Bull.* **74,** 51 (1891).

[10] Gordon, S. G., The Mineralogy of Pennsylvania: *Acad. Nat. Sciences of Philadelphia, Special Publ. No.* **1,** 93 (1922).

[11] Wherry, E. T., Some minerals from Sylmar, Pennsylvania: *Am. Mineral.*, **3,** 47 (1918).

Virginia

Very attractive specimens of thulite are found in the pegmatite of the Wheatly mine, close to Moneta, Bedford County. One specimen, collected by W. T. Schaller, shows prismatic crystals, half a centimeter thick and several centimeters long, as well as much fine-grained massive material of a beautiful pink color. A thin section shows abundant thulite developed along the twinning lamellae of plagioclase feldspar with larger areas of almost pure material.

Washington

Massive thulite from Okanogan County has been known for some time.[12] The thulite rock is composed of a mixture of grains and prismatic crystals of thulite, plagioclase feldspar and a colorless pyroxene.

Near Metaline Falls, Pend Oreille County, in the northeastern part of the State, it was found in a pegmatitic mass of andesine feldspar and dark green chlorite near the peak on Timber Mountain. The thulite grades through pink epidote into straw colored epidote, in crystals as much as half a centimeter long. Thulite also occurs as fine-grained small spots and knife-edge seams in the muscovite phase of the Kaniksu batholith, in the west center of Sec. 29, T. 36 N., R. 43 E., in the south center of Sec. 32, T. 36 N., R. 43 E., and on the 3,500-foot contour on east slope of ridge in Sec. 35, T. 36 N., R. 43 E. The information on the occurrences in Pend Oreille County was taken by permission of the authors from the manuscript of the unpublished report "The Metaline quadrangle, Washington," by C. F. Park, Jr. and R. S. Cannon.

The thulites from Pend Oreille County have slightly higher indices of refraction with a greater birefringence than most thulites and apparently contain more Fe_2O_3, the pink thulite, grading off into green epidote.

Geologic Occurrences

Thulite occurs in the United States in:

Highly silicated contact-metamorphosed limestones and dolomites (Montana, Nevada, Washington?).

Altered granitic rocks and gneisses (Connecticut, Idaho, Washington).

In pegmatites (Georgia, Maryland, North Carolina, Pennsylvania, and Virginia).

In quartz veins (pegmatite?) and surrounding schist (New Mexico).

Its sporadic occurrences in pegmatites lie in a belt extending from

[12] Schaller, W. T., Gems and precious stones in 1915: *Mineral Resources, U. S., 1915*, part 2, 856 **(1916)**.

Delaware County, Pennsylvania, through Maryland, Virginia, North Carolina, to Stone Mountain in Georgia.

The attractive pink to rose-red color is probably caused by small quantities of manganic manganese, with insufficient quantities of ferric iron to neutralize the red color. The quantity of manganese present, judging by the few analyses available, is less than one per cent and usually less than half a per cent. The thulite from Pend Oreille County, Washington, and from the Young mine, Mitchell County, North Carolina, with slightly higher indices of refraction and higher birefringence, probably contain a little more Fe_2O_3.

Optical Properties

The indices of refraction of a number of samples were measured by Miss Glass with the following results. Many of the samples show the usual abnormal interference colors of zoisite and where observable, the pleochroism was consistently: X = pale pink or rose, Y = nearly colorless, and Z = pale yellowish. All the samples are optically positive with 2V variable, usually moderate, from about 30° to about 60°. Dispersion $r > v$. Usually parallel extinction, occasionally extinguishing at very small angles and possibly grading into pink clinozoisite. The measured indices of refraction are as follows:

Measured Indices of Refraction of Pink Zoisite (Thulite)

Locality	α	β	γ	$\gamma-\alpha$
California	1.690	1.693	1.700	.010
Montana	1.697	1.699	1.705	.008
Nevada, Eureka	1.685	1.688	1.700	.015
North Carolina, Hawk mine	1.690	1.691	1.699	.009
Putnam mine	1.690	1.692	1.698	.008
Deer Flat mine	1.690	1.692	1.699	.009
Chestnut Flat mine	1.695	1.698	1.704	.009
Corundum Hill mine	1.698	1.700	1.705	.007
Young mine	1.704	1.707	1.713	.009
Virginia, Moneta	1.691	1.695	1.702	.011
Washington, Okanogon County	1.690	1.692	1.699	.009
Pend Oreille County	1.705	1.707	1.712	.007
Pend Oreille County	1.705	1.710	1.719	.014
Pend Oreille County	1.703	1.705	1.725	.022

The average of the measured indices of refraction are: $\alpha = 1.695$ (limits 1.685–1.705) $\beta = 1.698$ (limits 1.688–1.710), $\gamma = 1.706$ (limits 1.698–1.725).