Careful conscientous job -
a bit rough in spots.
J.S.

URANOAN-THORIANITE FROM THE REXSPAR PROPERTY,
KAMLOOPS DISTRICT, BRITISH COLUMBIA

Not an appropriate title

by

WILLIAM CHARLES JONES

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PREFACE

Although the Rexspar property has been sporadically prospected for lead, silver and fluorite since the turn of the century, it was not until recently that radioactive minerals were discovered closely associated with the fluorite. Sixty two fluorite specimens from forty three localities were previously tested for radioactivity by the author but none was detected. The Rexspar deposit therefore appears to be a rather remarkable type of occurrence. Was pure fluorite from Rexspar tested ??

The purpose of this investigation was to determine the radioactive constituents and their relation to the other minerals.

Location and History of the Property

The Rexspar property,formerly known as the Smuggler, is located in the Clearwater and Foghorn Creek map area, Kamloops District, British Columbia and is approximately seventy five miles north of the city of Kamloops and three miles west of Birch Island Station on the C. N. R. main line. The C. N. R. parallels the North Thompson River which flows south west across the map area. The area was first mapped in 1919 by D. A. Nichols of the Geological Survey of Canada and more detailed mapping has been conducted since that time.

In 1920 the fluorite showing was examined by the Munitions Resources Commission in hopes of it being of commercial size and grade to be used in the steel, chemical and ceramic industries. Subsequent analyses of the fluorite revealed intimately intergrown celestite which rendered it useless. From 1926 to 1927 the property was actively prospected for lead and silver and a few adits were driven on quartz veins and lenses 2½ feet to 30 feet in thickness. These also proved non-commercial. In 1929, test pits were sunk on a subsoil deposit of manganese below the lowest adit but again the deposits were not of sufficient size or grade to be commercially exploited.

General Geology

The map area lies on the eastern margin of the Interior Plateau and is one of uplifted and dissected mountainous country. The North Thompson and Clearwater rivers lie in deeply incissed valleys which have left valley walls rising steeply for 1500 feet on either side with more gentle slopes above.

The oldest rocks exposed in the area are a metamorphosed sedimentary series which are presumed to be Pre-Cambrian in age. They outcrop mainly in the eastern portion of the area, have a general bearing of N55E/35-50SE and consist of quartzite, quartz schist, mica schist, phyllite, slate and limestone. Overlying this series is the Lemieux Creek formation which bears N15W/40-60W and is composed of dark grey limestone and black argillite. Its relation to the older sediments is unknown. Specimens of brachiopods and bryozoa reveal it to be probably Carboniferous in age.

Intruding the above two formations is the Fennell greenstone batholith which forms the largest portion of outcrop in the area. This rock was at first thought to be extrusive due to the presence of pillow structures and breccia fragments but because of its relationship to the older rocks, it is now known to be an altered dioritic intrusion. It was probably emplaced in Triassic time.

Intruding all the above mentioned rocks are stocks, dykes and sills of medium to coarse grained granodiorite which is well exposed along Clearwater River. Aplitic(?) dykes and sills exposed in the area are believed to be closely related to it.

The Skull Hill formation composed of amygdaloidal andesitic lavas unconformably overlies the granodiorite. It occurs only as small and sparsely distributed outcrops. Unconformably(?) overlying the Skull Hill formation is a series of somewhat vesicular basaltic lavas and intercalcated sediments called the Mann Creek formation which is exposed along Clearwater River and Mann Creek.

The area shows evidence of extensive glaciation and many of the valley floors are covered with a thick mantle of glacial debris.

Fluorite Vein

The fluorite outcrops on top of a knoll at elevation 4200 feet, this being above and south of the old adits. The formations exposed represent the upper contact of a Triassic(?) granitic intrusion and Pre-Cambrian(?) sediments. The sediments are metamorphosed to such an extent that they are difficult to distinquish from the igneous rock.

The fluorite vein occurs in the metamorphic rocks and outcrops a total length of 750 feet in a north-east direction. It reaches a maximum thickness of 50 feet at the centre but since it dips at a low angle to the north-west, its actual thickness must be quite small. A further 100 feet of country rock containing disseminated fluorite occurs on either side of the vein. Minerals megascopically visible in the vein include fluorite, fragments of country rock, pyrite and celestite, the fluorite forming by far the largest percentage of the total aggregate.

Table of Formations

Quaternary	Recent	Alluvium
	Pleistocene	Glacial till, gravel and silt
Unconformity		
Tertiary		Mann Creek formation
	Unconformity(?)	
		Skull Hill formation
Unconformity		
Mesozoic	Post-Triassic(?)	Granodiorite, etc.
	Intrusive Contact	
	Triassic(?)	Fennell batholith
Intrusive Contact		
Palaeozoic	Carboniferous(?)	Lemieux Creek formation
Relations Unknown		
Pre-Cambrian(?)		Metamorphic Sedimentary series

Hand Specimens

Several small irregular fragments and sections of drill core and a larger fragment of approximately 10 cubic inches in volume were examined under a low power binocular microscope. They consist of a medium grey rock composed of rounded feldspar breccia fragments in an aphanitic ground mass of the same colour. The rock is traversed by minute veinlets of dark purple fluorite, metallic lustred mica and irregular fragments of pyrite. A variety of secondary minerals coats areas of the specimens, the following having been identified by X-ray powder photographs:

size, shape, relation to fractures

Meta-torbernite: $Cu(UO_2)_2P_2O_8 \cdot 8H_2O$; bright green; tetragonal; perfect (001) cleavage.

Too skimpy

Meta-autunite(?): $Ca(UO_2)_2-(PO_4)_2 \cdot xH_2O$; lemon yellow; perfect (001) cleavage.

Goethite: $\alpha^{-}Fe_2O_3 \cdot H_2O$; reddish brown; crystalline; appeared translucent in strong reflected light.

Mineralographic Inspection

Four specimens of representative material and grains from a panned tip were mounted in bakelite and super polished. Crystals of thorianite from Balangoda, Ceylon were prepared in the same way.

The metallic minerals identified in the polished sections were:

Pyrite: FeS_2. Pyrite occurs as large, fractured, anhedral crystals and irregular fragments scattered throughout the host rock and as veinlets. They range in size from a few microns to fragments covering the entire field under medium power.

Rutile: TiO_2. Rutile was identified by X-ray powder photographs. It occurs as irregular fragments from 5 microns to 450 microns in diameter scattered throughout the gangue and as blebs and fissure fillings in the pyrite. It appears to have been deposited later than the pyrite but its genetic relationships to the other minerals is undeterminable. could not be determined.

Chalcopyrite: $Cu_2S \cdot Fe_2S_3$. Chalcopyrite occurs as minute blebs in the pyrite. One fragment 55 microns in diameter was observed. This mineral is probably replacing pyrite (Uytenbogaardt, P. 111). ?

Covellite: CuS. One small area of covellite was observed. It was replacing chalcopyrite along fractures.

Pyrite comprises approximately 95% of the metallic minerals and rutile about 4%.

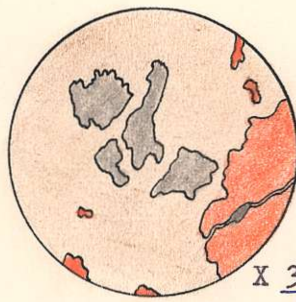
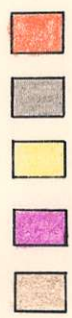


Fig. 1
Typical Mineral Assemblage



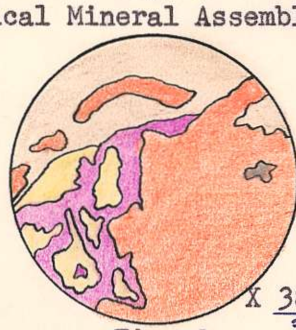


Fig. 2
Chalcopyrite Replacing Pyrite and Covellite Replacing Chalcopyrite

Petrographic Inspection

Four thin sections of representative material were ground and mounted in Canada balsam.

Mineralogy and Textures:

(a). Microcline: Microcline occurs as well rounded fragments and anhedral crystals up to 8 mm. in diameter. Many are surrounded by rims of fluorite and contain fractures filled with fluorite. 25%. ?

(b). Matrix: Composed chiefly of minute breccia fragments which often assume a somewhat foliate or even trachytic texture. Since the colour and relief of the matrix is identical to the microcline, it is assumed that it is composed chiefly of microcline although some orthoclase may be present. 70%.

(c). Pyrite and Rutile(?): Occur as brecciated fragments cutting both microcline and matrix. 2-5%.

(d). Mica, Fluorite and Apatite Veinlets: Veinlets varying in size from hair-like stringers to $\frac{1}{2}$" in width of these minerals cut both microcline crystals and the matrix. Breccia fragments of microcline also occur scattered throughout them. Many of these veinlets are slightly fractured thus revealing a later stage of minor movement.

The mica occurs as anhedral to subhedral crystals of varying sizes which gives a somewhat seriate texture to the veinlets. Optical data reveal it to be phlogopite (light brown, pleochroic, 2V near 0, optically (-), characteristic lath-like acicular inclusions of rutile(?) crossing at 60° in basal sections).

Extremely small black crystals not surrounded by pleochroic haloes are scattered throughout the phlogopite. They are possibly rutile (see Fig. 3). Other black crystals of no definite form but surrounded by distinct pleochroic haloes occur throughout the phlogopite and are possibly the mineral uranoan thorianite which was later identified by X-ray powder photographs from a panned tip (see Fig. 4).

Fluorite occurs both with the phlogopite and as individual veinlets. It varies in colour from light purple to nearly black even within the same fragment, this undoubtedly being caused by small black crystals barely visible within the darkened areas. These crystals ~~are~~ may also ~~probably~~ be uranoan thorianite since radioactive minerals are noted for their darkening effect on many other minerals (see Fig. 3). Black crystals of possibly cubic or tetragonal outline also occur in the fluorite and since no darkened halo surrounds them, they are assumed to be probably rutile (see Fig. 5).

Subhedral crystals of apatite, fragments of wall rock, pyrite and rutile(?) and minute amounts of plagioclase feldspar and quartz also occur scattered throughout the mica and fluorite veinlets.

History of the Rock:

Without special study of petrologic relationships in the field it is very difficult to arrive at a satisfactory conclusion as to the origin and history of this rock. From the textures and mineralogy exhibited, two theories may be advanced:

1. The rock was possibly originally a highly feldspathic sediment which, under the influence of thermal metamorphism, has partially recrystallized with the consequent formation of the large metacrysts of microcline. Due to the competition for space under such conditions, good crystal outlines would not be assumed.

2. The rock was possibly originally a porphyry of feldspathic composition which has been severely sheared resulting in the breakdown of the microcline to form the fine grained ground mass and the rounding off of the larger microcline crystals.

Pyritization seems to have followed metamorphism and later, a period of shearing accompanied by mineralization (fluorite, mica, etc. veinlets).

Summary of Events

1. Metamorphism of original rock.

2. Pyritization.

3. Shearing and mineralization (apatite; rutile(?), uranoan thorianite(?), fluorite and phlogopite seem contemporaneous; plagioclase and quartz).

4. Minor shearing.

5. Development of secondary minerals

The presence of such characteristically high temperature minerals as listed above suggests a hypothermal origin even possibly approaching the pegmatitic stage.

DETERMINATION OF THE URANOAN THORIANITE

Radiometric Assays

1200 grams of material was crushed and screened to + 100 and -100 fractions. 1000 grams of the -100 material was superpanned and a combination middle and tail consisting mainly of feldspar, fluorite and mica, a tip of pyrite and the unknown mineral and an extra tip of the black mineral and a little pyrite were extracted. The +100 and -100 material, superpanner products and fine material which floated off during panning were assayed for radioactive materials using a scaling circuit type geiger counter.

Assay Results

Material	Weight	Counts/min.	% Radioactive Material
Middle and tail	2 gms.	16	.143
Tip	2 gms.	27	.235
Extra tip	.02 gms.	20	15-20 (approx.)
+ 100	18.5 gms.	51	.110
-100	18.5 gms.	114	.250
Float	2 gms.	30	.252

X-ray Determinations

The black grains concentrated in the extra tip (no distinct crystal outline) were X-rayed as were similar appearing grains picked from a supplied tip. The powder photograph of the former revealed a distinct pattern for thorianite plus a few weak extra lines which were possibly caused by the gummite-like alteration product of thorianite. Similar weak lines were observed on thorianite patterns from Balangoda, Ceylon and Lytton, B.C. and a definite alteration product was observed coating the Balangoda material (polished section). The material from the supplied tip revealed a ~~doubtful~~ mixed pattern of possibly rutile and thorianite.

Light purple fragments of fluorite containing darkened areas were X-rayed but the result was merely a weak pattern for galena(?) and an unidentifiable mineral.

Qualitative Spectrographic Analyses

A bulk spectrographic analysis of a portion of the panned tip revealed thorium but no uranium was detected. Since the spectra lines of uranium are very weak however, this method cannot be relied upon to discount the presence of uranium. Was a lead test for Ur done on this.

Particles of fluorite containing dark inclusions were similarly analysed. The results are as follows: Strong lines of Al, Fe, Si, Mg and Sr; weaker lines of Pb, Y, Ti, Ag, Na, Cu, Mn and V; trace of Be, B and Th. All of the above elements are common impurities in fluorite except V and Th. The presence of thorium suggests that the dark inclusions, identified as galena(?) and an unknown by X-ray photograph, contain a proportion of uranoan thorianite.

The mica, which was optically identified as phlogopite, was spectrographically analyzed as it resembled the vanadium bearing variety roscoelite which is common in radioactive deposits. No vanadium was detected however.

Fluorescence Tests

Beads of lithium fluoride, into which crushed samples of thorianite were dissolved, were prepared in loops in platinum wire. Grains from the panned tip were fused by means of lithium fluoride to a copper plate. The beads and plate were exposed to ultra-violet radiation. A bright green fluorescence characteristic of uranium was observed, this being the first good evidence that this element occurs in the thorianite.

Nuclear Track Plate Experiments

Five polished sections were exposed on 2"x7" Kodak Nuclear Track plates for periods of two and nine days. The 2 day exposures gave no results but the nine day exposures revealed indistinct, wide clusters of minute straight lines. Since no radioactive minerals were detected in the polished sections under the polarizing microscope and since the lines on the plate were indistinct, this method proved of little use in isolating radioactive particles. It indicates however that the radioactive mineral(s) are very fine grained.

CONCLUSIONS

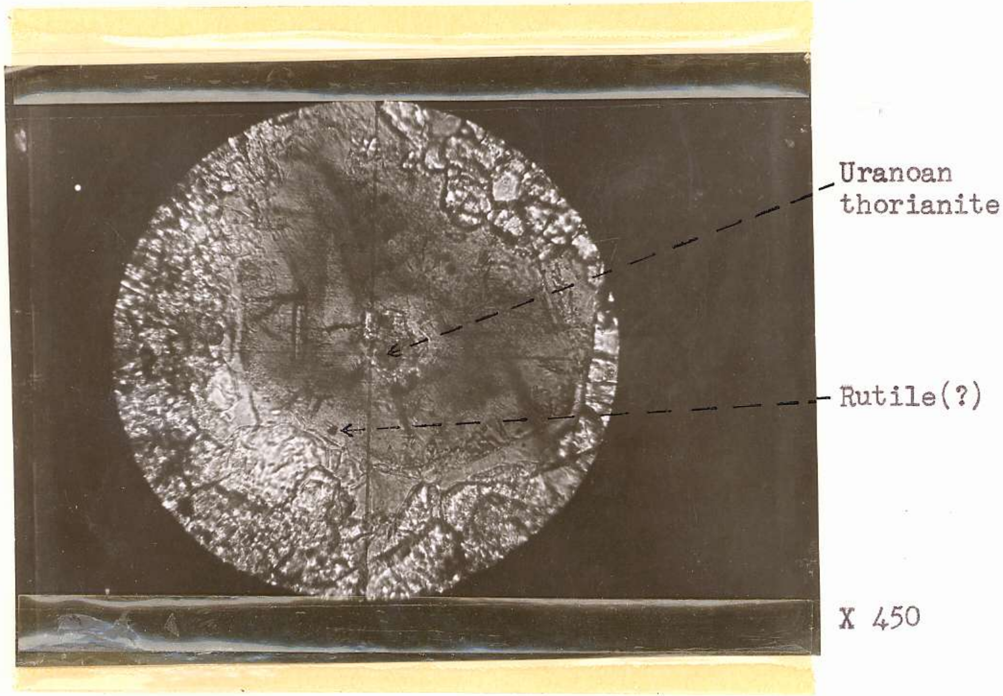
From the experimental evidence there is little doubt that the primary radioactive constituent detected in the Rexspar specimens is the rare mineral uranoan thorianite ($(Th,U)O_2 \cdot nUO_3 \cdot PbO$). This mineral is derived by a small percentage of uranium substituting for thorium cations in the isometric thorianite lattice.

Chemical assays for uranium and thorium conducted by the Department of Mining and Metallurgy revealed much higher concentrations of uranium than thorium in the Rexspar material.

The solution to the conflicting results might possibly be resolved by further mineralogical investigations and assays carried out on numerous samples taken from various zones in the deposit.

Fig. 3

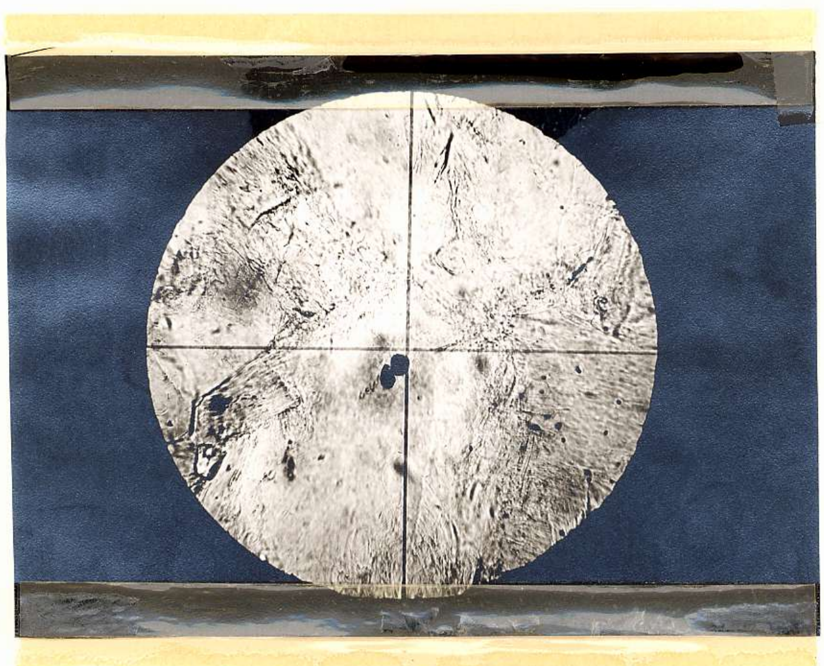
Uranoan Thorianite in Fluorite and Rutile(?) in Phlogopite



X 450

Fig. 4

Uranoan Thorianite(?) in Phlogopite. Note the dark halo



X 450

Fig. 5

Rutile (?)(black subhedral crystal in NE quadrant) in fluorite

X 450