Canadian Mineralogist
Vol. 12, pp. 360-363 (1974)

BRANNERITE ASSOCIATED WITH NATIVE GOLD AT THE RICHARDSON MINE, ONTARIO

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INTRODUCTION

This note records what is believed to be the first association of brannerite and native gold recognized in Canada, and one of the few known in the world. Brannerite has been reported previously from only four localities in Canada, in as many different geological environments and all within the Precambrian Shield, and is best known as one of the important ore minerals of uranium in the quartz pebble conglomerate ores of the Elliot Lake uranium district, Ontario (Roscoe 1969), although its origin there is still a matter of controversy. Brannerite is also a minor, though not insignificant, ore mineral in certain hydrothermal deposits of the Beaverlodge uranium district, Saskatchewan (Little *et al.* 1972). Additionally, it is reported from a metamorphic complex in Lanark County, Ontario (Moddle 1957) and from a pegmatite at Middle Foster Lake, Saskatchewan (Traill 1969). Its occurrence with the gold at Eldorado, Ontario has been noted briefly by Steacy *et al.* (1973) and this note amplifies that description. The association of brannerite and native gold in polymetallic, hydrothermal types of deposits in California, France, and Morocco is recorded, respectively, by Pabst & Stinson (1960), Geffroy (1963), and Jouravsky (1952). World occurrences of brannerite and analytical data for numerous specimens are tabulated by Ferris & Ruud (1971).

The historic Richardson mine was the first gold mine in Ontario and one of several gold mines developed late in the last century in a skarn zone bordering the Deloro stock, a roughly circular granitic intrusion about 6 miles in diameter, that straddles the boundary of Madoc and Marmora townships, near Madoc. Wilson (1965) notes that the stock intruded Precambrian limestone, argillite, gabbro and rhyolite and concludes that "the zone of marginal mineralization surrounding the Deloro intrusions indicates that the mineral deposits have a genetic relationship to them". The rather surprising presence of radioactivity at the Richardson mine was first recognized and reported by Boyle & Steacy (1973) who encountered an auriferous thucholite in mine specimens collected by Vennor (1870) and preserved in collections at the Geological Survey of Canada. Subsequent enquiries uncovered two additional auriferous, radioactive specimens from the mine, the one from the Royal Ontario Museum (No. 8429) presented to them by Dr. A. P. Coleman, and the other from the National Museum of Natural Sciences, Ottawa (No. Be 92) from the acquired collection of Dr. Robert Bell, a former Director of the Geological Survey of Canada. The latter specimens carry no discernible hydrocarbon, but contain brannerite as their principal radioactive constituent, with which native gold is intimately associated. Low radioactivity at the Richardson mine was later confirmed by tests

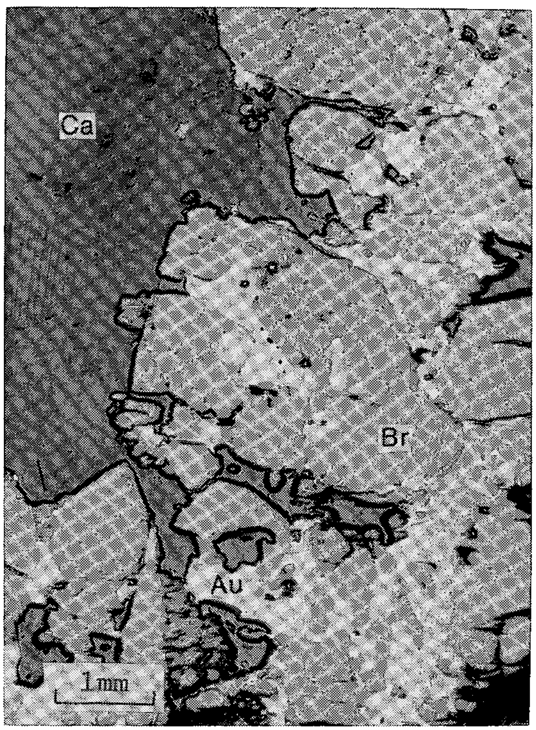

FIG. 1. Photomicrograph of polished section of specimen No. Be 92 showing brannerite (Br) veined and replaced by calcite (Ca) and native gold (Au).

with a radiation counter on the mine dump, but no radioactive minerals were found.

The two brannerite-gold-bearing specimens are much alike and their separate origins and histories provide credence of a common source. They are composed of slightly pinkish, crystalline calcite with muscovite, brannerite, tourmaline, pyrite, native gold and minor uraninite. The muscovite, as compact, fine-grained masses, constitutes about one-third of the NMNS specimen, and less of the other. Tourmaline, as black masses and stringers, was noted only in the ROM specimen. Brannerite occurs within the calcite, muscovite and tourmaline as discrete black grains, a few of which appear euhedral, and as irregular masses up to 1.2 cm. The mineral is metamict but after ignition in vacuo at about 900°C for seven minutes it yields a brannerite *x*-ray diffraction pattern. Pyrite, as discrete grains, crystals, and masses up to 1.5 cm, is relatively abundant in the ROM specimen but almost lacking in the NMNS specimen. Native gold occurs macroscopically in both specimens and is almost invariably associated with the brannerite, although small grains are isolated in the calcite. Uraninite is a minor constituent associated with and, in part, veining the brannerite.

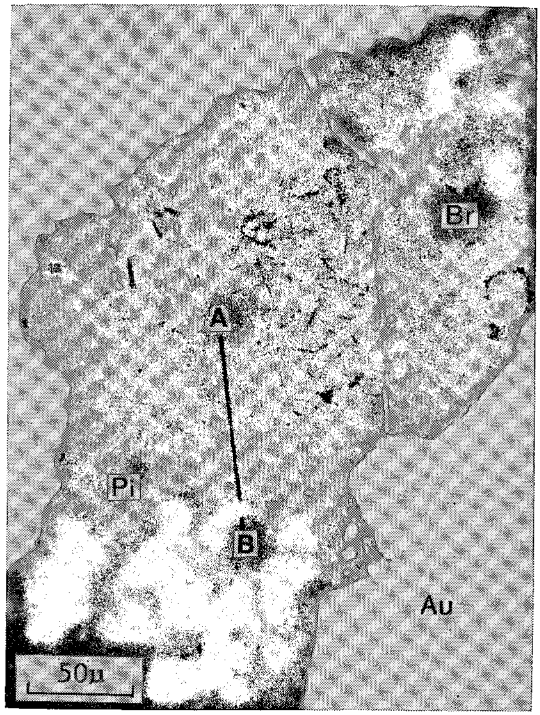

FIG. 3. Photomicrograph showing vein-like mass of pitchblende (Pi) in brannerite (Br). A smaller pitchblende vein may be seen at the upper right. Line A-B is the electron probe traverse of Figure 4.

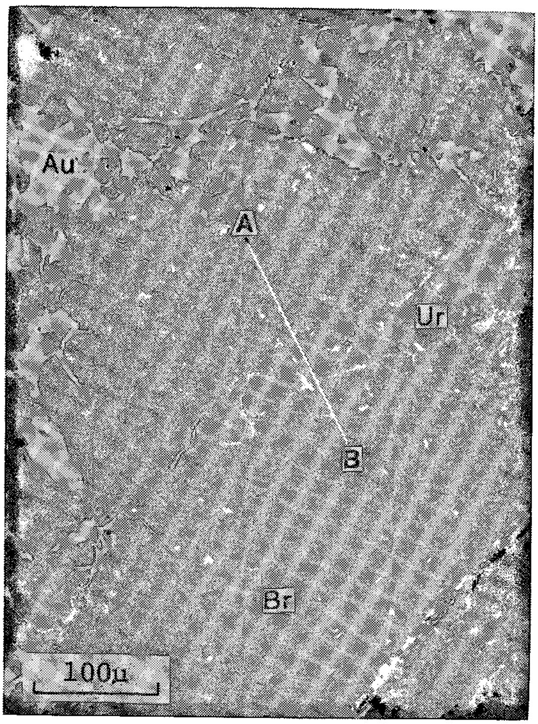

FIG. 2. Photomicrograph showing veinlet of uraninite (Ur) in brannerite (Br) and replacement of both by native gold (Au). Line A-B is the electron probe traverse of Figure 5.

A polished section of the NMNS specimen, prepared for microscopic study and microprobe analysis, shows much of the brannerite to be brecciated and cemented by calcite and veined and replaced by native gold (Fig. 1). Under moderate magnification (Fig. 2) the brannerite appears relatively uniform, except for small, generally rounded grains of anatase or rutile scattered throughout. At higher magnifications (Fig. 3) some brannerite appears less homogeneous with wispy masses of slightly higher reflectivity being discernible, particularly adjacent to some of the uraninite veinlets. Following energy dispersive analysis to ascertain the principal elements, the more homogeneous brannerite was analyzed using an electron beam of 20 microns, and was found to show a fairly limited range of composition (wt.%): U 45-50; Ti 19.5-22.0; Th 1.2-2.2; Ca 3.0-3.4; Fe 1.5-2.0, with U and Ti varying antipathetically. Two varieties of uraninite are associated with the brannerite. A thorium-free variety, which may be classed as pitchblende (see Lang *et al.* 1962,

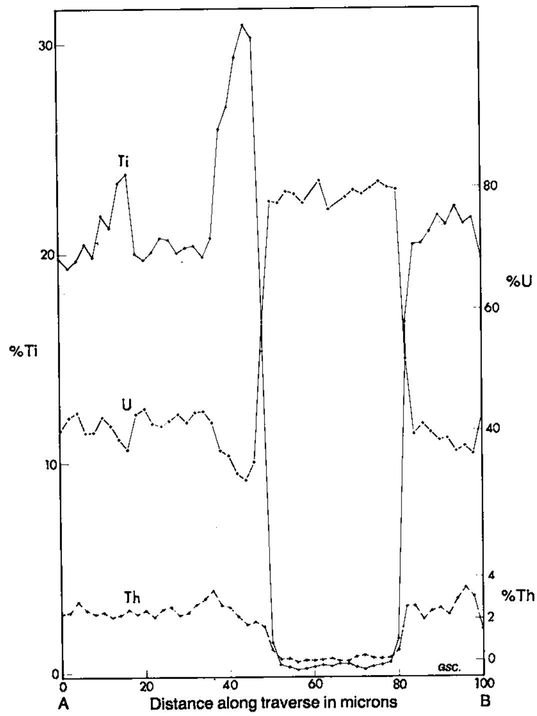

FIG. 4. Electron probe traverse across pitchblende vein in brannerite (line A-B of Fig. 3) showing contents of titanium, uranium and thorium obtained from measurements at 2 micron intervals. The marked enrichment of titanium in the brannerite at the margin of the pitchblende vein is due to the irregular development of a titanium-rich phase, which is light grey in Figure 3.

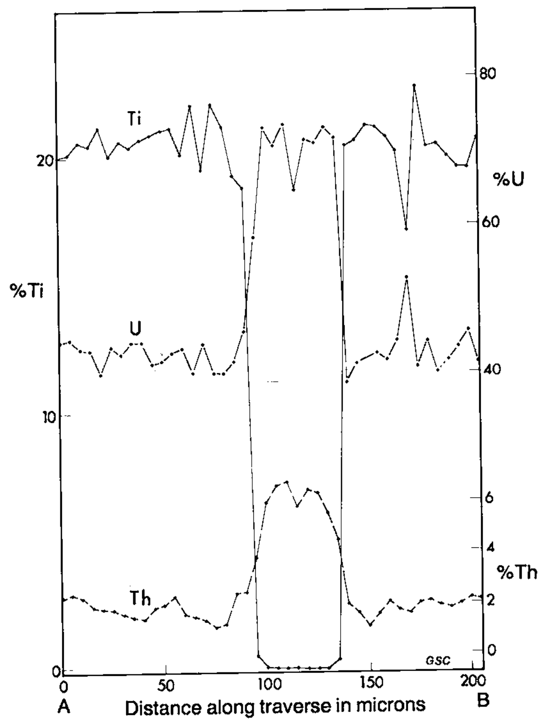

FIG. 5. Electron probe traverse across uraninite veinlet in brannerite (line A-B of Fig. 2) showing contents of titanium, uranium and thorium obtained from measurements at 5 micron intervals.

p. 44) occurs as irregular, diffuse, vein-like masses (Fig. 3) which are evidently of secondary origin, derived through the local alteration of the brannerite. A traverse (Fig. 4) across one such mass, using a 1 micron diameter beam, shows the development along one border of a ragged titanium-rich phase in the brannerite. In contrast, a thorium-rich (~6% Th) variety occurs within the brannerite as fracture fillings (Fig. 2) with sharp borders that exhibit no chemical enrichment (Fig. 5). Native gold occurs in the section mainly replacing the brannerite (Figs. 1 and 2), with the larger masses having scalloped margins against the brannerite. A little gold also occurs in both the uraninite and pitchblende (Figs. 2 and 3). The gold has a uniform composition (Au 99.8, Ag 0.2) throughout the section, and it is obviously late in the paragenetic sequence, as it is in most gold deposits.

We wish to thank Dr. J. A. Mandarino of the Royal Ontario Museum, Toronto, and Mr. Louis Moyd of the National Museum of Natural Sciences, Ottawa, for providing the two specimens. Identifications by x-ray diffraction were kindly performed by Mr. G. F. Pringle of the Geological Survey of Canada.

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Manuscript received January 1974, emended February 1974.