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DEPARTMENT OF MINES AND TECHNICAL SURVEYS

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MINERALOGY OF VANADIUM-BEARING ORE FROM THE FAY MINE, ELDORADO MINING AND REFINING LTD., ELDORADO, SASKATCHEWAN

by

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EXTRACTION METALLURGY DIVISION

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SUMMARY

Pitchblende, and nolanite (iron vanadate), occur in ore specimens from the No. 09 stope of the Fay mine, in masses up to at least 14 mesh in size. Both minerals often contain intergrown hematite. Little or no pitchblende is associated with the larger nolanite masses.

Nolanite was also identified in a magnetic concentrate of current mill feed ore where it occurs in grains up to almost 200 mesh in size.

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INTRODUCTION

Uranium ores from the Eldorado Mining and Refining Ltd. Beaverlodge area mines contain about 0.1% V_2O_5, and less than 10% of the vanadium is dissolved in the present carbonate leaching circuit of the uranium mill at Eldorado, Sask. It is anticipated that the vanadium content of the ore will increase in future as mining operations progress to greater depth. Test work is therefore being carried out on current mill tailings to determine if an economic recovery of the vanadium can be effected.

In connection with these studies, Eldorado's Research and Development Division, Ottawa, requested that a mineralogical investigation be carried out on vanadium-rich ore being encountered at depth, for the purpose of identifying the uranium and vanadium minerals and determining the nature of their occurrence. Five small lump specimens were submitted for this purpose. The specimens were reported to have been selected by the mine geologist and to be representative of a high-grade vanadium zone in the No. 09 stope of the Fay mine.

In addition to the lump specimens, a magnetic concentrate was submitted by Mr. E.G. Joe of Eldorado Mining and Refining Ltd. for mineralogical study of the vanadium mineral constituents. The concentrate was reported to have been prepared, on a Jones magnetic separator, from current mill feed ore and to contain 0.35% V_2O_5.

The following report is based on a microscopic examination of the submitted lump specimens and magnetic concentrate.

MINERALOGY

Vanadium-rich Ore

Under the binocular microscope, the lump specimens are seen to consist mainly of fine-grained, thin, prismatic, brown crystals of acmite (pyroxene) and dark-grey, massive quartz, with occasional masses of steel-grey hematite, and a minor amount of sulphide minerals.

Autoradiographs of flattened surfaces of the lump specimens show that they contain strongly radioactive areas of varying size and shape. The radioactivity occurs in veins and irregular masses.

Pitchblende is the only radioactive mineral identified in the eight polished sections studied. It occurs partly as massive material in veins (Figure 1), often with a rim of hematite or intergrown with hematite (Figure 2). The veins often split (Figure 1), or pinch and swell, and the maximum width observed is about 0.2 mm (65 mesh). Irregular radioactive areas, consisting of intimate intergrowths of pitchblende and hematite with included gangue mineral, are also present (Figure 3) and reach a maximum size of approximately 14 mesh. Less strongly radioactive areas consist of pitchblende-

hematite intergrowths in which the proportion of pitchblende is lower. This type of intergrowth occurs as both irregular masses and as networks of sinuous veinlets which fill intergranular spaces in gangue (Figure 4). Occasionally, a small proportion of nolanite is present in the pitchblende-hematite intergrowth.

In some sections, most of the radioactivity is due to euhedral to sub-rounded grains of pitchblende which occur in quartz gangue in irregular masses and discontinuous seams (Figures 5 and 6). The individual pitchblende crystals are 15 to 20 microns in diameter and often are fractured or brecciated. They occur in varying concentrations in the gangue, often with closely associated laths of hematite and, occasionally, a grain of nolanite (Figure 6). An area of euhedral pitchblende in gangue often grades into an area consisting of euhedral pitchblende enclosed in hematite (Figure 5). The masses of euhedral pitchblende reach a maximum size of approximately 20 mesh but in many occurrences only 3 or 4 crystals of pitchblende are present.

The only vanadium mineral observed in the specimens studied is nolanite (iron vanadate). Most of the nolanite occurs in irregular, coarse to fine, masses and veins up to at least 14 mesh in size. These masses usually contain small proportions of intergrown hematite and gangue mineral but contain little or no pitchblende (Figure 7). Occasional fine grains or crystals of nolanite, generally less than 150 mesh in size, occur in the hematite-pitchblende veins

or associated with euhedral pitchblende (Figure 6). In rare occurrences euhedral pitchblende is present in nolanite (Figure 8).

Hematite occurs occasionally in concentrations up to about 14 mesh in size, in which the hematite is the only opaque mineral present and occurs in a lacy network as intergranular filling in gangue. Usually, however, hematite is intergrown in varying proportions with pitchblende or nolanite. Considerable hematite occurs as very fine grains disseminated in quartz gangue. When hematite is associated with coarse masses of nolanite it usually occurs as prismatic crystals which are concentrated at the edges of the nolanite (Figure 7) and in projecting tongues of nolanite.

A minor amount of sulphide minerals is present in the specimens and occurs as very fine grains generally in gangue but also in nolanite and hematite. Pyrite and a smaller proportion of chalcopyrite are the main sulphide minerals in the ore.

Magnetic Concentrate

Microscopic examination of the Jones separator magnetic concentrate shows that it consists mainly of grains of gangue minerals with only a small proportion of the grains containing metallic minerals. The main metallic mineral present is hematite and it usually occurs intergrown with gangue mineral but some free grains are also present. Anatase, too, occurs free or associated with gangue. Coarse grains consisting of goethite-magnetite intergrowth are present and they

often contain inclusions of gangue mineral or pyrite. Pyrrhotite is the most abundant of the sulphide minerals in the concentrate but chalcopyrite and pyrite were also noted. Trace amounts of ilmenite and spinel are present. A considerable amount of tramp iron contamination is present in the concentrate. A strongly anisotropic brownish-grey mineral was observed in the polished sections in grains up to approximately 200 mesh in size. The identity of this mineral could not be established by x-ray diffraction since it yielded no pattern even after being ignited.

Many small particles believed to be nolanite occur in grains of gangue mineral but due to the fine size of the inclusions it was not possible to confirm their identity in all instances. However, nolanite was positively identified in five grains, in which the nolanite areas ranged in size from approximately 12 x 44 microns to 60 x 90 microns. The nolanite occurs as prismatic grains which are often bent (Figure 9) and also as aggregate of grains (Figure 10) and is intergrown with varying proportions of gangue mineral and, at times, hematite. In some of these occurrences an unidentified bluish-grey mineral is intimately intergrown with the nolanite (Figure 10). This mineral appears to be identical with a vanadium mineral of unknown composition which was previously observed in intimate association with nolanite in samples from the "Pitche" claims, west of Beaverlodge Lake.

PHOTOMICROGRAPHS

The following photomicrographs of polished sections illustrate the occurrence of pitchblende and nolanite. A 200-mesh screen opening is outlined on each photomicrograph.

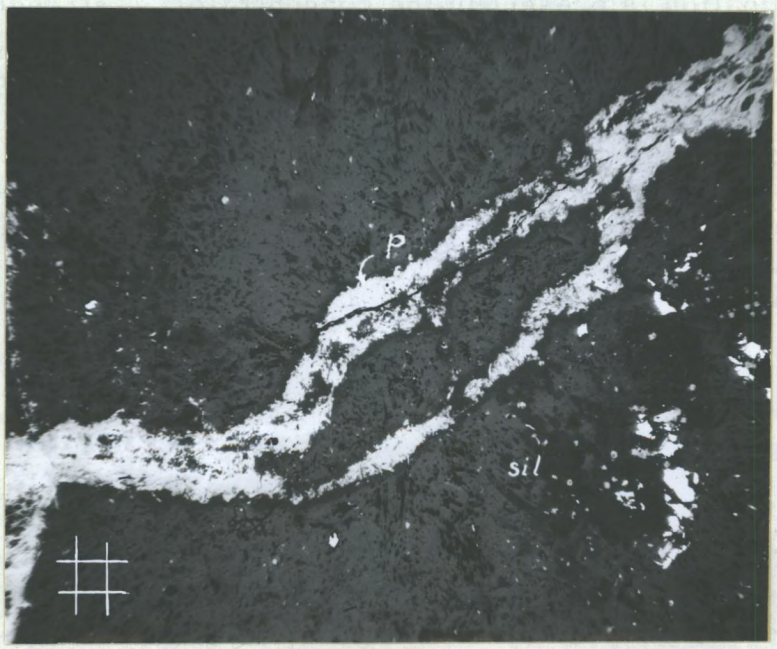

Figure 1. Vein of pitchblende (p) in siliceous gangue (sil). X55.

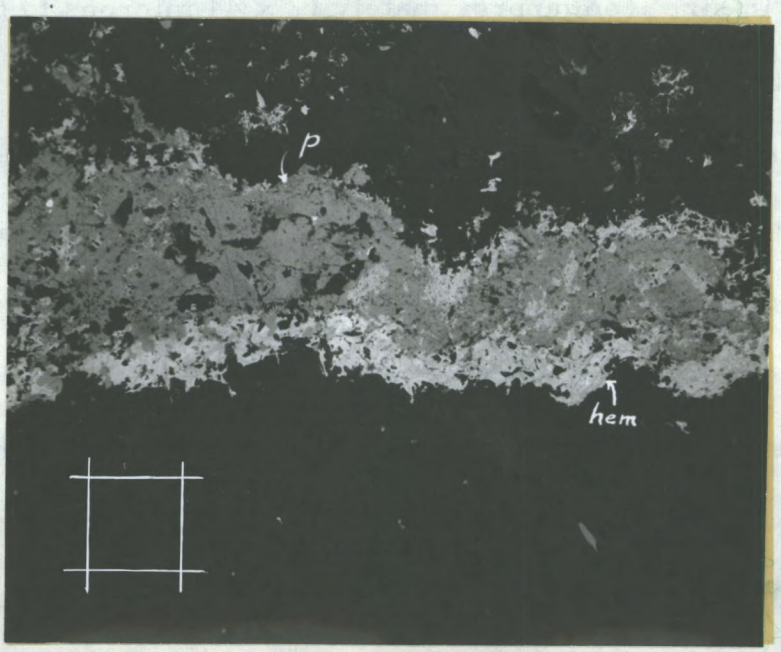

Figure 2. Vein of pitchblende (p) intergrown with hematite (hem). X160.

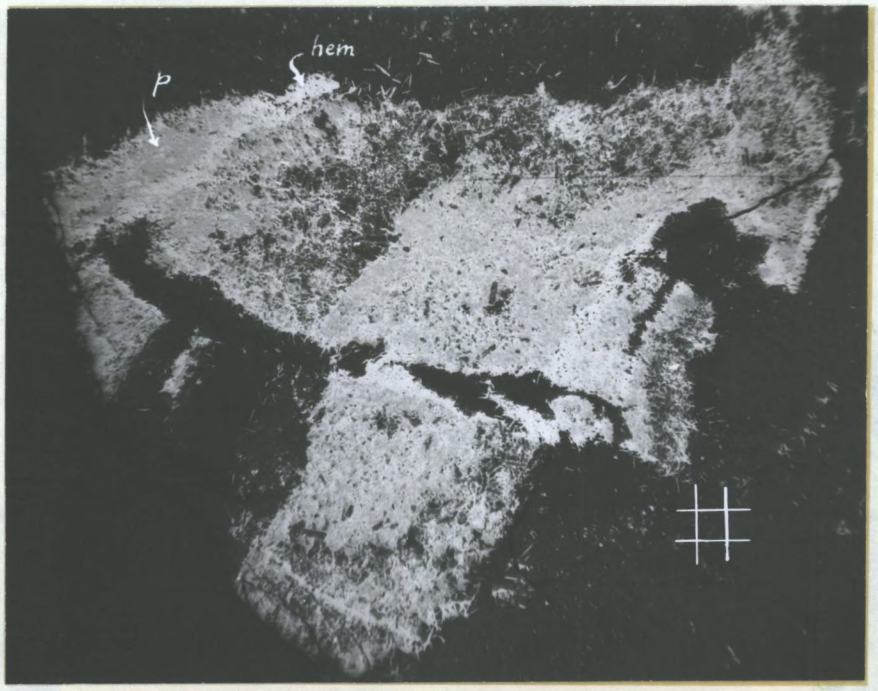

Figure 3. Irregular radioactive area containing intimate intergrowth of pitchblende (p) and hematite (hem). X55.

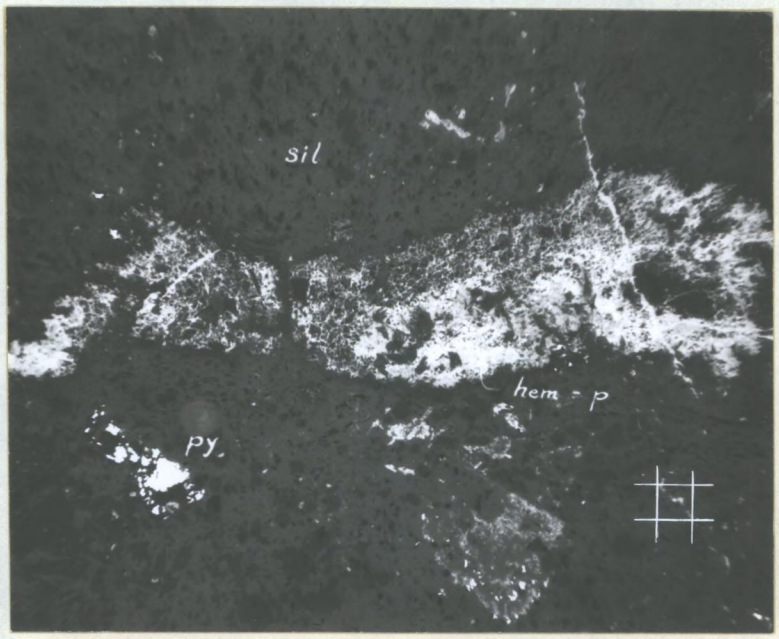

Figure 4. Weakly radioactive vein composed of hematite-pitchblende intergrowth (hem-p) filling interstices in siliceous rock (sil). Partially replaced pyrite (py) is present in the gangue. X60.

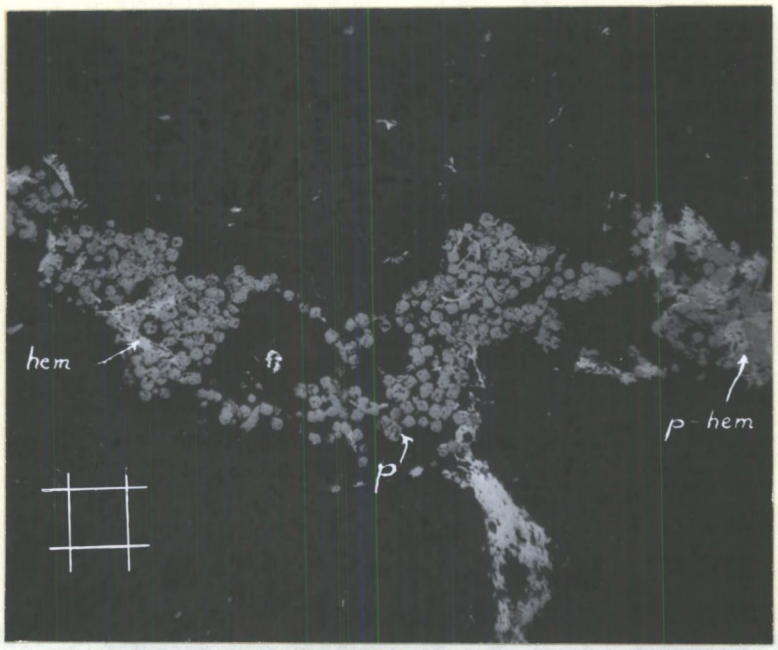

Figure 5. Radioactive seam containing euhedral pitchblende (p) with a few laths of hematite (hem), and an intimate intergrowth of pitchblende and hematite (p-hem). X100.

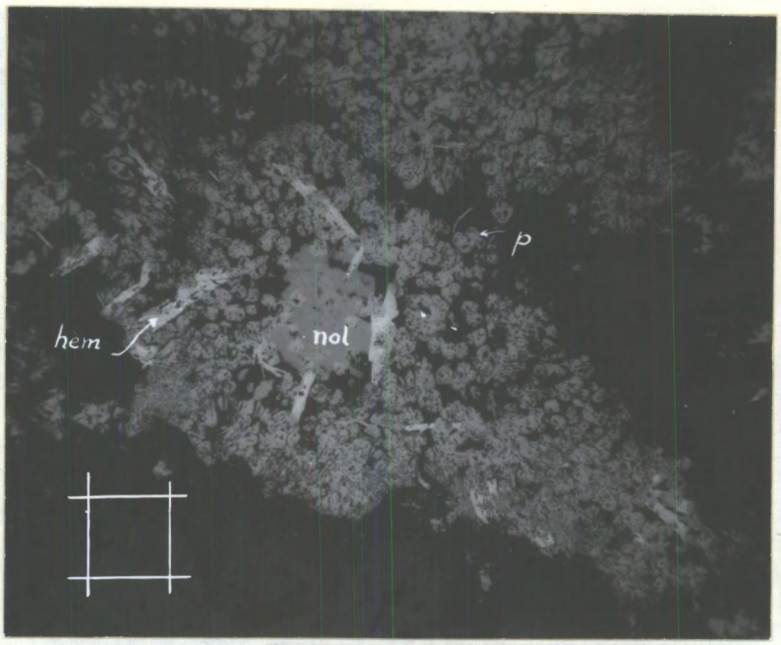

Figure 6. Concentration of euhedral pitchblende (p) with a core of nolanite (nol) and laths of hematite (hem). X140.

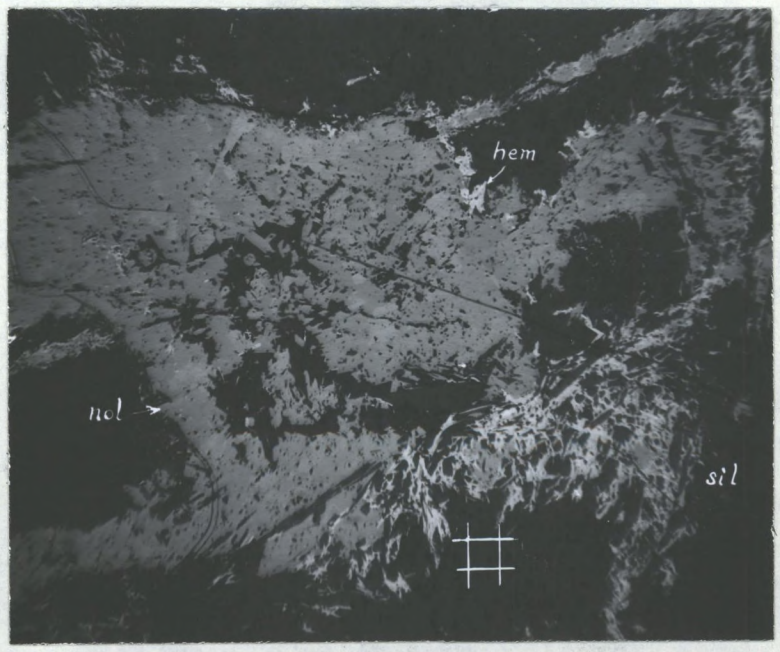

Figure 7. Irregular area of nolanite (nol) with associated hematite (hem) in siliceous gangue (sil). X53.

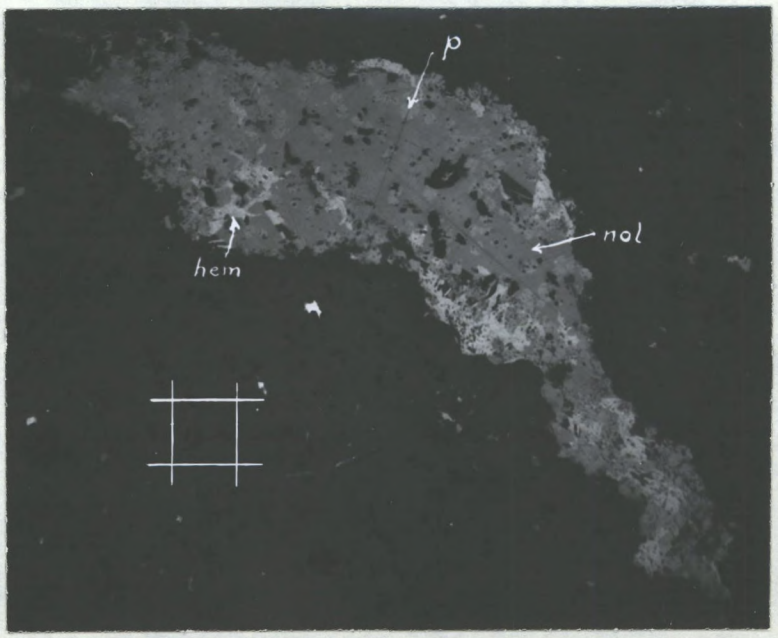

Figure 8. Nolanite (nol) containing intergrown pitchblende (p) and hematite (hem). X117.

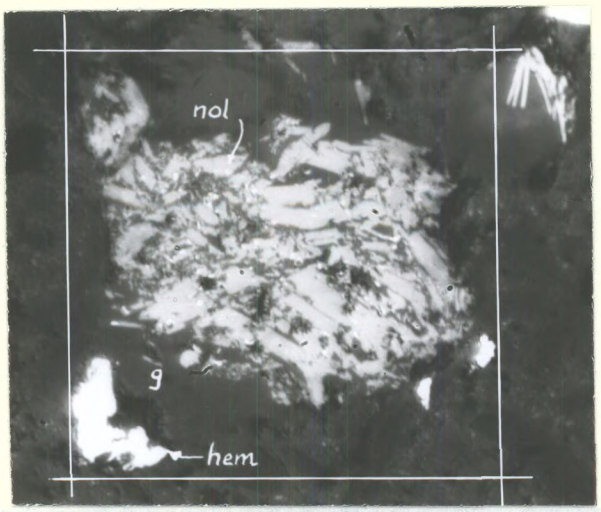

Figure 9. Grain in magnetic concentrate consisting mainly of nolanite (nol) and hematite (hem) in gangue mineral (g). X750.

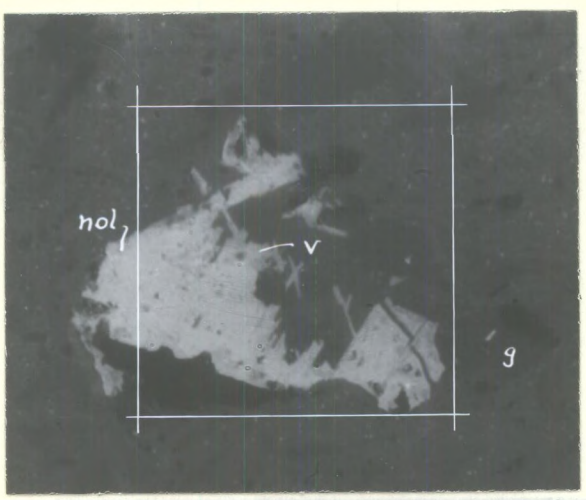

Figure 10. Grain in magnetic concentrate containing nolanite (nol), gangue mineral (g) and unidentified mineral (v). X550.

CONCLUSIONS

A microscopic study of five small specimens of vanadium-rich ore from the No. 09 stope of the Fay mine has shown that pitchblende and hematite are usually intimately associated with each other in the quartz-acmite rock, and occur in veins and irregular masses which reach a maximum size of about 14 mesh. Nolanite is the only vanadium mineral observed in the specimens studied and occurs in masses up to at least 14 mesh in size.

A magnetic concentrate of current mill feed material contains a small proportion of nolanite which is usually intergrown with gangue and at times also contains particles of hematite. A second, unidentified, vanadium mineral is also believed to be present in intimate association with nolanite.

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