THE OCCURRENCE OF TIN AT THE DICKSTONE NO. 2 OREBODY, NORTHERN MANITOBA

by

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ABSTRACT

The Dickstone No. 2 Orebody, a small massive sulphide deposit situated in northern Manitoba, contains tin in amounts averaging 0.08% or 1.6 pounds per ton.

Most of the tin occurs as the oxide cassiterite. The cassiterite shows a considerable size range from < .001 mm. to 0.6 mm., with approximately 99% of all cassiterite present in grains larger than 0.1 mm. across. The larger cassiterite grains exhibit subhedral crystal forms, some of which show the effects of abrasion. Quartz, calcite and pyrite are most closely associated with the cassiterite.

A microprobe study of the cassiterites shows that the most common trace elements are indium, silver, neodymium, tungsten, iodine and lutetium. Calcium, antimony, and ytterbium occur moderately, while titanium, iron, zinc, tantalum and iridium occur infrequently.

Another tin-bearing mineral was encountered. Although not positively identified, this mineral is a calcium-titanium silicate, possibly sphene.

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The assistance and co-operation of Dickstone Copper Mines Ltd. and Hudson Bay Mining and Smelting, the present mine operator, are deeply appreciated.

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Chapter 1

INTRODUCTION

Purpose of the Study

The Dickstone Mine of Northern Manitoba, a massive sulphide deposit, contains quantities of tin averaging 0.08% or 1.6 pounds per ton in the No. 2 ore zone.[1] The present study was undertaken in order to determine the mode of occurrence of the tin, the spatial distribution of tin through the mine, the size distribution of the tin mineral(s), the trace elements present within the tin mineral(s) and the factors influencing the tin concentration.

Location and Access

The Dickstone Mine, located in Northern Manitoba, is situated at approximately north latitude 54°50'; east longitude 100°30' (Figure 1). The deposits are located on the north side of Beaver Tail Lake, twenty miles west of Snow Lake, Manitoba. The mine is accessible by a road which joins the Flin Flon - Snow Lake railroad west of Snow Lake.

General Geology

The mine is located within a Precambrian "Amisk-type" volcanic belt (named after a type area west of Flin Flon), extending from Wekusko Lake in the east for more than 130 miles due west, past Flin Flon into

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[1] Personal Communication: P. Martin, Chief Mine Geologist, Hudson Bay Mining and Smelting.

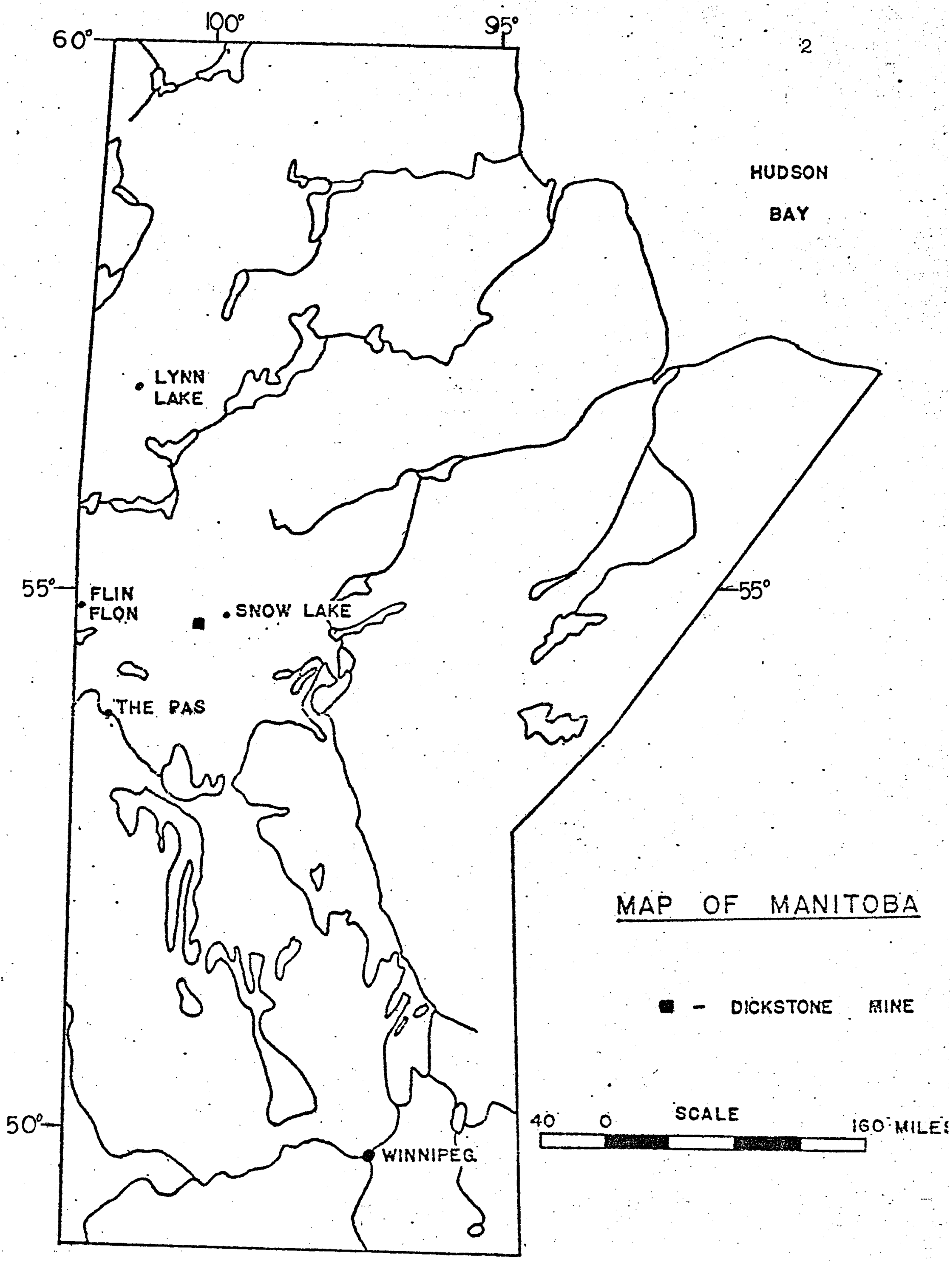

Figure 1: Location Map

Saskatchewan. The southern limit of this greenstone belt (which averages 30 miles in width) is covered by Paleozoic sedimentary rocks while the northern limit is bounded by the Kisseynew gneisses which represent highly metamorphosed equivalents of original sedimentary and minor volcanic rocks (Coates, et al., 1970).

The sulphide ore body is tabular, varies from 1 to 10 feet wide (average: 4 feet), strikes approximately north - south, dips near vertical and plunges 70° to the south.[1] The ore is composed primarily of pyrite, sphalerite, chalcopyrite, and pyrrhotite in a granoblastic intergrowth. Accessory minerals are quartz, arsenopyrite, and rarely calcite, scapolite and anhydrite. The sulphides vary from very fine grained chalcopyrite and sphalerite with rounded pyrite phenocrysts to coarsely crystalline bands of sphalerite, pyrite, and chalcopyrite and pyrite. Banding is usually encountered where there has been some folding of the footwall and likely represents plastic flow of the sulphides.[2]

The intrusive nature of the sulphides is evidenced by sharp contacts with the enclosing rock, inclusions of foliated footwall and hanging wall, and the penetration of sulphides into cracks in the country rock. These intrusive features may have been caused by remobilization of the sulphides after emplacement.[3]

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[1] Personal Communication: P. Martin, Chief Mine Geologist, Hudson Bay Mining and Smelting.

[2] Personal Communication: P. A. Cain, Vice-President, Mining, Sherritt Gordon Mines Ltd.

[3] Ibid.

History and Production

The property, situated on 15 claims in the Morton Lake - Herb Lake district of Manitoba, lay idle from 1948 to July, 1966 when Hudson Bay Mining and Smelting acquired a working option. The property was brought into production on November 2, 1970 with H. B. M. S. to receive 75% of the net profits from production. A strike resulted in the mine being shut down on January 27, 1971 after three months of production. Production was resumed in late June with the termination of the strike (Fielder, 1971).

The No. 2 zone, containing cassiterite, has been mined at a rate of 350 tons per day since it went into production in the fall of 1970. The ore reserve (No. 2 zone) as of January 1, 1972, was 275,000 tons grading 2.04% Cu and 7.9% zinc.[1]

The ore is shipped by rail to Flin Flon where it is treated in the H. B. M. S. concentrator and smelter.

Laboratory Methods

Twenty-four fist-size grab samples were collected throughout the mine for use in the present study (Figure 2). In addition to these "representative" ore samples, two samples each of high grade copper (No. 19, 21) and zinc (No. 20, 22) ore were collected. These samples were analyzed by atomic absorption for copper, zinc, and tin. Ten samples were also analyzed for lead, but, because of the low concentrations encountered (20 - 70 ppm), these analyses were terminated (Table 2).

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[1] Personal Communication: P. A. Cain, Vice-President, Mining, Sherritt Gordon Mines Ltd.

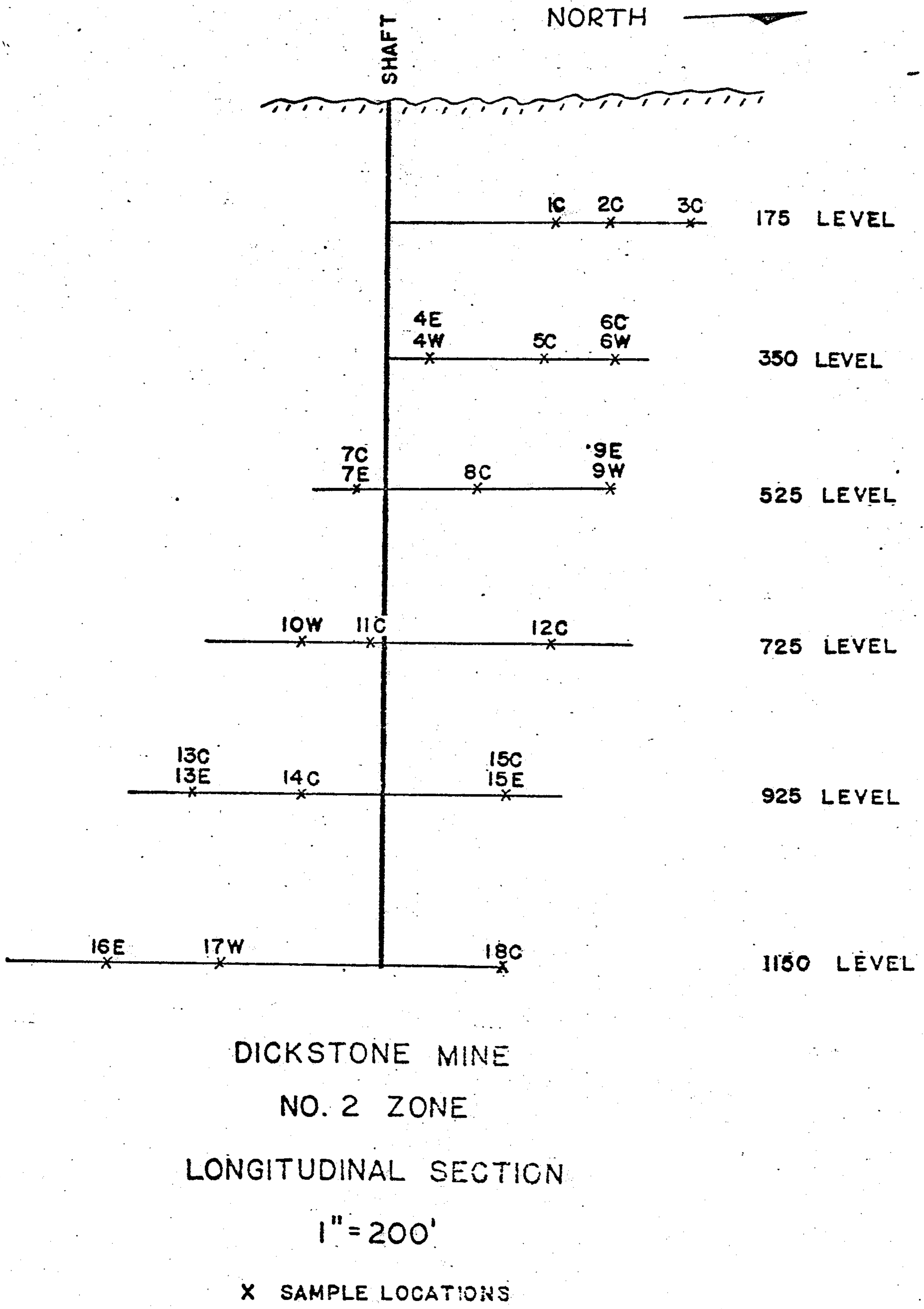

Figure 2: Sample Locations

A polished section of $1\frac{1}{4}$ inch diameter was made from each of the samples. These sections were studied in the MAC-5 electron microprobe at the University of Manitoba. Each polished section was scanned for concentrations of tin with the electron beam of the microprobe. In addition, as this instrument provides for the simultaneous scanning of two elements, scanning was done for either zinc, sulphur or iron to facilitate the identification of sphalerite, pyrite and pyrrhotite.

When a grain with an appreciable tin count was encountered, the electron beam could be set on the grain and a chemical analysis run on that particular mineral. The results were only qualitative since the microprobe had not yet been standardized, and were useful in determining only which elements were present and not their concentrations. Electron photographs of many tin-bearing grains were also obtained from the microprobe.

The polished sections were also studied with a reflecting microscope, the identification of cassiterite and of calcite in the gangue were confirmed by X-ray powder photograph methods.

Chapter 2

WORLD TIN OCCURRENCES

The most important tin mineral, both in abundance and economic importance, is the oxide, cassiterite (SnO_2). Cassiterite, a member of the tetragonal system, may occur as short prismatic crystals, massive aggregates (radially fibrous botryoidal crusts or concretionary masses), brown rounded pebbles with a concretionary structure, or fine sand-like grains (Berry and Mason, 1959). Cassiterite is amenable to concentration in placer-type deposits because of its hardness of 6 - 7, specific gravity of 7, and chemical resistance. In fact, the major producing tin deposits of the world are the placers of Southeast Asia which account for 60% of the world's tin production (Sainsbury, 1969).

Almost all cassiterite-bearing lode deposits are closely associated, both spatially and genetically with granitic intrusive rocks (biotite or biotite-muscovite granite) or, as in Bolivia, with shallow-seated volcanic rocks such as quartz latite or dacite.

According to Sainsbury (1969); "Most of the major lode areas of the world fall into one of two distinct types: (1) long, narrow belts of tin-bearing granites in a wider intrusive complex (Southeast Asia), or (2) more diffuse belts of younger granites in extensive areas of Precambrian rocks (Nigeria). Most of the major linear belts lie near continental margins or along major orogenic belts inland in which granite magma was generated." Thus, most primary tin deposits are localized along tectonic belts in which granite has been intruded.

Economic tin deposits are unknown in Canada and the United States although tin is recovered as a by-product from mines which produce other metals. The Climax mine of Colorado produces tin from its molybdenum ores (Killeen and Newan, 1965). In Canada, tin is recovered, at the rate of 308 tons per annum, from the lead-zinc-silver-iron ores of the Sullivan mine of Southeastern British Columbia (Mulligan, 1966). This ore body contains an average of 0.06% tin, 90% of which occurs as cassiterite. The cassiterite occurs as small (.085 - 0.5 mm.) well-rounded grains surrounded by sulfide and/or gangue minerals (Mulligan, 1966). The tin content is highest along the outer margins of the central "barren" zone of pyrrhotite and pyrite, whereas the intermediate galena zone and the outer sphalerite zone contain very little tin ore. Other tin minerals present in minor amounts are the sulfides stannite, francheite, cylindrite, and teallite (Pentland, 1943).

Tin is also present at the Mount Pleasant Mine of New Brunswick. The tin occurs here as cassiterite and stannite in a greisen-type deposit associated with fluorite and base metal sulfide minerals near or in altered silicic dykes (Petruk, 1964).

Other occurrences of tin in Canada are in the lead-zinc-silver ores of Galena-Keno Hill, Yukon Territory, and the Snowflake Regal Silver deposit of British Columbia.

In the Precambrian Shield, tin is associated with lithium and beryllium minerals in muscovite-bearing granites and pegmatites and in fractional percentages in massive sulfide deposits in the Manitouwadge area of Ontario, the Noranda and Matagami areas of Quebec, the Normetal Mine of Quebec (Mulligan, 1966), and at South Bay and Kidd Creek, Ontario.

At Noranda and Matagami, copper-bearing sulfide deposits are characterized by high, but variable Co:Ni ratios, high tin contents (tin-rich pyrite), and appreciable amounts of arsenic, selenium and silver (Roscoe, 1965). "Fractional percentages of tin in pyrite, pyrrhotite and chalcopyrite in the deposits at Manitouwadge, Ontario and Normetal, Quebec emphasize the possibility of important tin concentration in sulfide deposits" (Mulligan, 1966).

A study of the occurrence of tin at South Bay Mines, Confederation Lake, Ontario (Bridge, 1972), was done at the University of Manitoba in conjunction with the present study. Tin occurs in the South Bay massive sulphide zinc-copper orebody in amounts averaging 0.31%. The only tin mineral present is cassiterite, which occurs as minute (5 - 50 microns), well-rounded grains, commonly subspheroidal in shape. The amount of cassiterite is not in direct ratio with the amount of sphalerite although it is with sphalerite that cassiterite makes its most intimate association. Ag, La, Yb, and W have a high frequency of occurrence as trace constituents of cassiterite while In, As, Zn, and Cs occur moderately and Sc, Nb, Cd, Pd, Mo, Ni, Cr and Ca occur infrequently (Bridge, 1972).

Chapter 3

MINERALOGY

Pyrite

Pyrite occurs at Dickstone as subhedral to euhedral cubes and dodecahedrons (Figure 3) and in massive aggregates. Most of the pyrite has been cut by later vein networks. These veins may be monomineralic (Figure 4) or polymineralic (Figure 5). Flow structure, evident in several locations within these veins (Figure 6), likely represents plastic flow of the sulphides under the effects of metamorphism.

The pyrite ranges from fine to very coarse grained and commonly shows the effects of corrosion by sphalerite and less commonly by chalcopyrite. The corrosion may occur along the vein borders which cut through the pyrite (Figure 7) or along the borders of individual pyrite crystals (Figure 8).

A close association between pyrite and the predominant tin-bearing mineral, cassiterite, is evident in many locations. The pyrite may completely enclose the cassiterite (Figure 10) or may just be adjacent to the cassiterite (Figures 10, 11, 13, 15, 17).

Sphalerite

Sphalerite, the zinc ore mineral at Dickstone, occurs primarily as massive aggregates (less than 1 mm. to several cm. across) which form a matrix for the pyrite crystals (Figure 3), but may also occur in veins