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PETROLOGICAL REPORT NO. M.9/65

SPECIMENS FROM DDH.5 - BALFOUR, TASMANIA.

S. Whitehead

MELBOURNE APRIL, 1965.

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Eight specimens from diamond drillhole DDB.5 Balfour were submitted for petrological examination with emphasis as to the origin of the pyrrhotite occurring in the rocks.

Specimen No	Depth ft.
M.1201	190
M.1202	378
M.1203	400
M.1204	470.5 - 470.9
M.1205	600 - 600.4
M.1206	687.3 - 687.7
M.1207	818.6 - 819
M.1208	928.4 - 928.8

General Description:

The rocks are all similar in that they are metamorphosed siltstones and shales with fine bands or seams of carbonaceous material. They are now composed essentially of quartz and authigenic felspar (albite) with generally abundant sericite, lesser chlorite, a few scattered flakes of muscovite of clastic sedimentary origin, scattered crystals of authigenic tourmaline and irregular grains of ilmenite generally associated with partly recrystallized leucoxenic material probably rutile. There are rare very small grains of zircon and very rare apatite. Sulphide minerals and carbonates occurring both as disseminated grains and in veins are described separately below.

Cassiterite was observed in only one specimen (M.1202) where it occurs in veins associated with quartz, carbonates and

arsenopyrite.

Grain size of the rocks is uniformly small and is generally less than 0.1 mm.

Sedimentary banding steeply dipping and almost parallel to the drill core in specimen M.1206 to M.1208 is marked by carbonaceous material and by variation in the proportion of sericite. This has been disturbed in places -

(a) siltstone has invaded or been injected into adjacent shale probably before consolidation of the sediments.

(b) there has been later minor tectonic shearing causing some crumpling and disruption of bedding.

In specimen M.1205 from 600 ft. stronger recrystallization has resulted in a slightly coarser grain size (0.1 - 0.2 mm) and more frequent twinning of the plagioclase felspars which in the finer grained rocks are mostly untwinned. Chlorite and some tourmaline grains are larger but the latter are mainly confined to irregular patches and discontinuous bands of sericitic "shale" which are now more or less isolated in a coarser grained mosaic of quartz and felspar with minor sericite.

Tourmaline:

As noted above, all specimens contain authigenic tourmaline which occurs as isolated small (0.05 mm) blue to brown prismatic crystals generally distributed uniformly through the rock and with random orientation.

Some crystals include carbonaceous material but wherever tourmaline and pyrrhotite are associated the pyrrhotite was invariably later and partly surrounds and encloses tourmaline. It was not noted in veins.

Similar tourmaline has been observed in Balfour specimens described in a previous petrological report (M.19/64) and two

possibilities were suggested -

(a) the tourmaline was formed from boron absorbed by muds from sea water during and shortly after deposition.

(b) tourmaline was formed as a result of later introduction of boron from granitic intrusion.

In specimens from DDB.5 tourmaline is generally only a very minor constituent, but it increases progressively in the two deepest specimens M.1207 and M.1208 from 819 and 828.8 feet. In specimen M.1208 tourmaline has almost completely replaced parts of some shale bands indicating definite tourmalinization at this depth due to introduction of boron.

Note - Tourmalinized shreds or fragments (possibly former clay pellets) were noted in a surface specimen of quartzite from Balfour (report M.19/64).

Carbonates:

Traces of sideritic carbonate occur in some specimens generally associated with grains or aggregates of pyrrhotite.

As observed for tourmaline, this sideritic carbonate increases in the two specimens from below 800 ft. where it occurs as cloudy, irregular, very fine grained patches partly replacing rock-forming minerals and penetrating grain boundaries. In specimen M.1208 (928.5 ft.) discontinuous bands of this carbonate show a similar distribution pattern to those of carbonaceous material present in all other specimens but absent here, and this suggests the possibility that oxidation of carbonaceous material provided CO_2 for the formation of carbonate.

Small veins in specimen M.1202 (378 feet) carry cloudy sideritic carbonate (some associated with arsenopyrite) which has been disrupted, partly replaced and cemented by later coarse grained ankerite.

Sulphides:

These occur dispersed throughout the rocks and also in veins.

Pyrrhotite predominates and occurs mainly as highly irregular porous aggregates scattered through most specimens. It is more abundant in M.1204 (470.5 ft.) where it forms from 2-5% of the rock (rough visual estimate). It has crystallized late in the history of these rocks and encloses grains of the rock forming minerals, quartz, muscovite and also authigenic tourmaline.

In places, and particularly in specimen M.1208 aggregates of pyrrhotite are associated with and partly surrounded by siderite. In polished section M.1204 this associated siderite contains very minor traces of chalcopyrite but the time relationship between these minerals remains obscure.

Sphalerite occurs in a number of specimens in minute traces - one or two grains (0.02 - 0.04 mm) scattered through the rock. When associated with pyrrhotite it is invariably surrounded and enclosed by the latter sulphide.

A trace of slightly coarser grained sphalerite occurs in a discontinuous poorly defined quartz vein (? lateral secretion) in specimen M.1206.

Arsenopyrite occurs in a quartz carbonate vein in specimen M.1204 and this vein also contains the only cassiterite observed in these specimens.

Pyrrhotite occurs in veins in specimens M.1207 and M.1208.

Summary:

The rocks are metamorphosed siltstones and shales with bands of carbonaceous material and they possibly contained some fine grained syngenetic sulphide. Deformation of bedding has

has occurred both before consolidation of the sediments and by later tectonic shearing.

Authigenic tourmaline present in all specimens has definitely been formed by introduction of boron in specimens from below 800 ft.

Minor fine grained siderite has formed or been deposited in places and is more abundant in specimens from below 800 ft. particularly in M.1208. There is a possibility that CO_2 to form carbonate was derived from carbonaceous material by oxidation.

Pyrrhotite is of epigenetic origin and crystallized after the rock forming minerals, authigenic tourmaline and the very minor sphalerite.

Pyrrhotite is commonly associated with minor siderite but their relationship remains obscure. There is a remote possibility that pyrrhotite preferentially replaced irregular aggregates of siderite (they are very similar in form) but the evidence for this in specimen M.1208 is inconclusive and the suggestion should be regarded as very tentative only.

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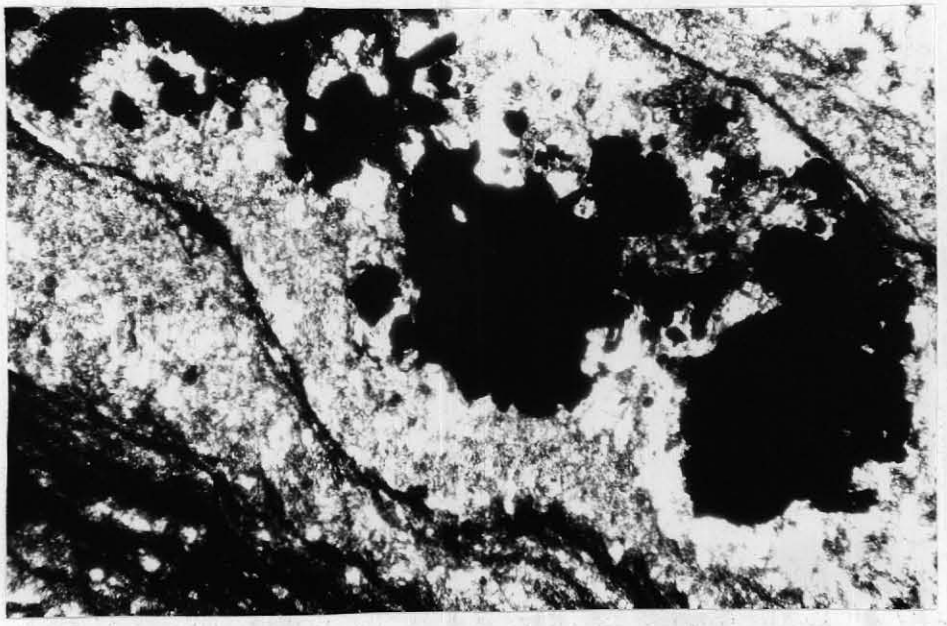
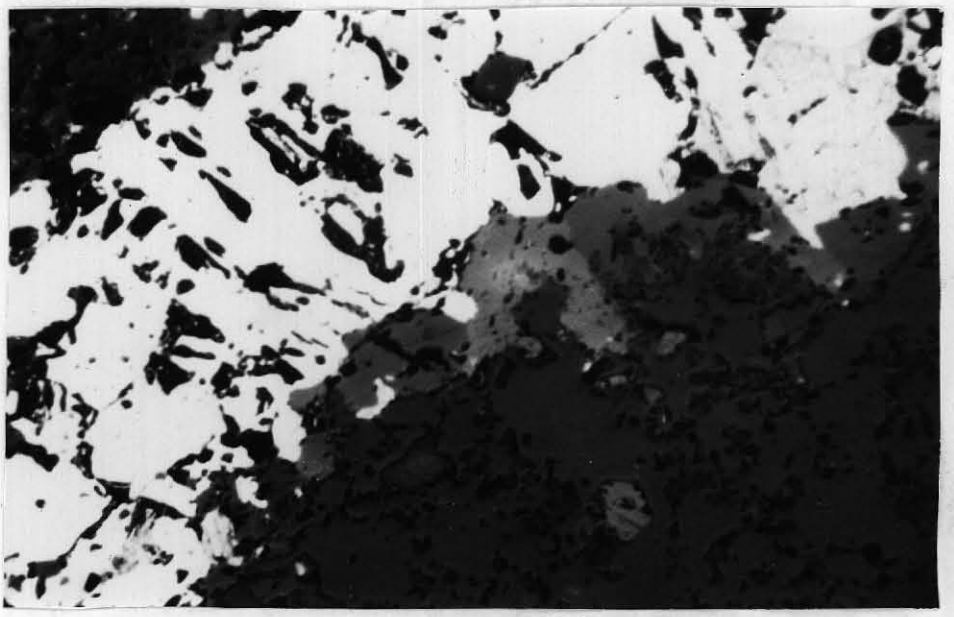
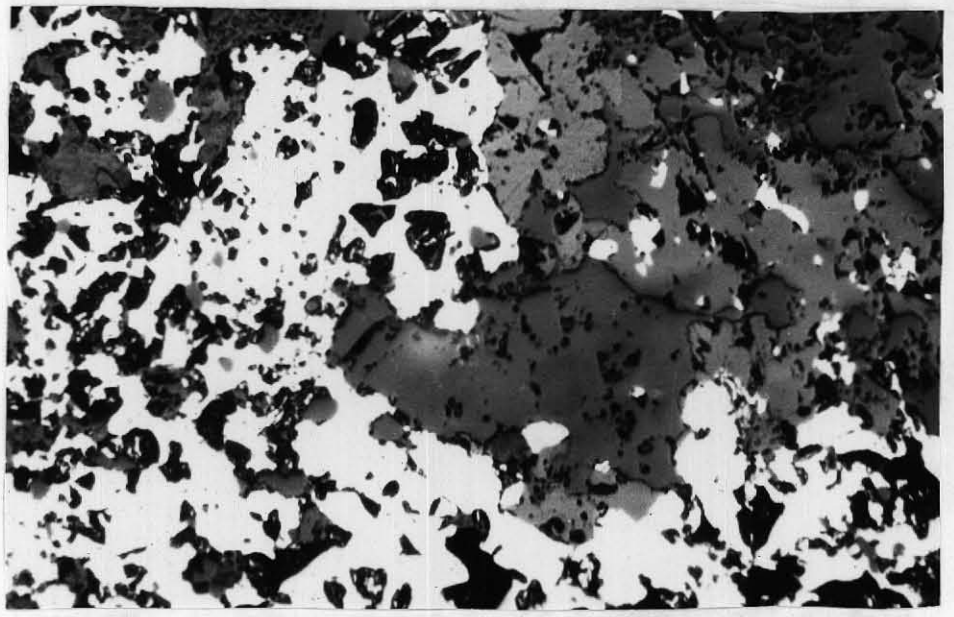
MELBOURNE
SGW/HH
30th April, 1965.



Thin Section M.1204B - 470.5 ft. (x 50).

Pyrrhotite aggregates (black) in quartz-sericite rock with fine bands of carbonaceous material (dark).

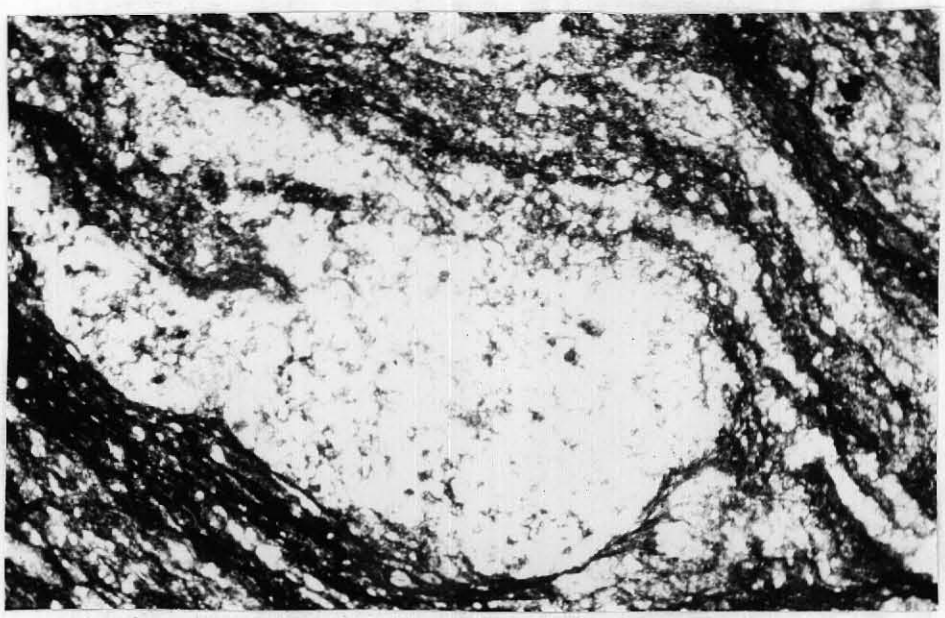




Polished Section M.1204A - 470.5 ft. (x 180).

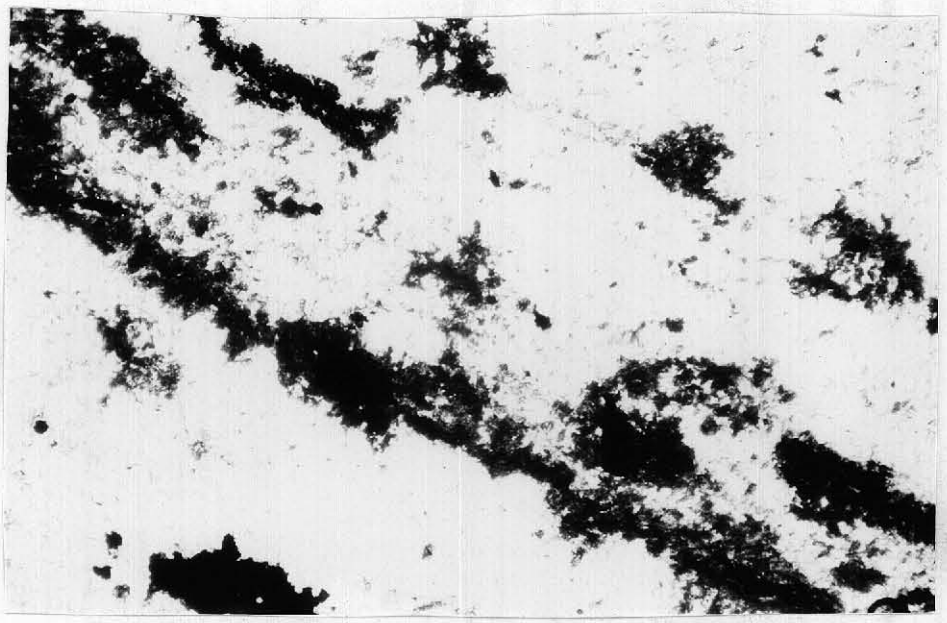
Pyrrhotite (white) and siderite (anisotropic - grey). Quartz, felspar etc. dark. Minor fine grained chalcopyrite is included in the siderite. Pyrrhotite encloses rock forming minerals including authigenic tourmaline.

Nicols partly crossed.



Thin Section M.1206 - 687.5 ft. (x 50).

Part of a siltstone intrusion into finely banded carbonaceous shale.



Thin Section M.1208 - 928.5 ft. (x 50).

Bands and concretionary patches containing very fine grained carbonate - possibly replacing carbonaceous material similar to that in specimens from shallower depth. Pyrrhotite (black) is associated with some carbonate.

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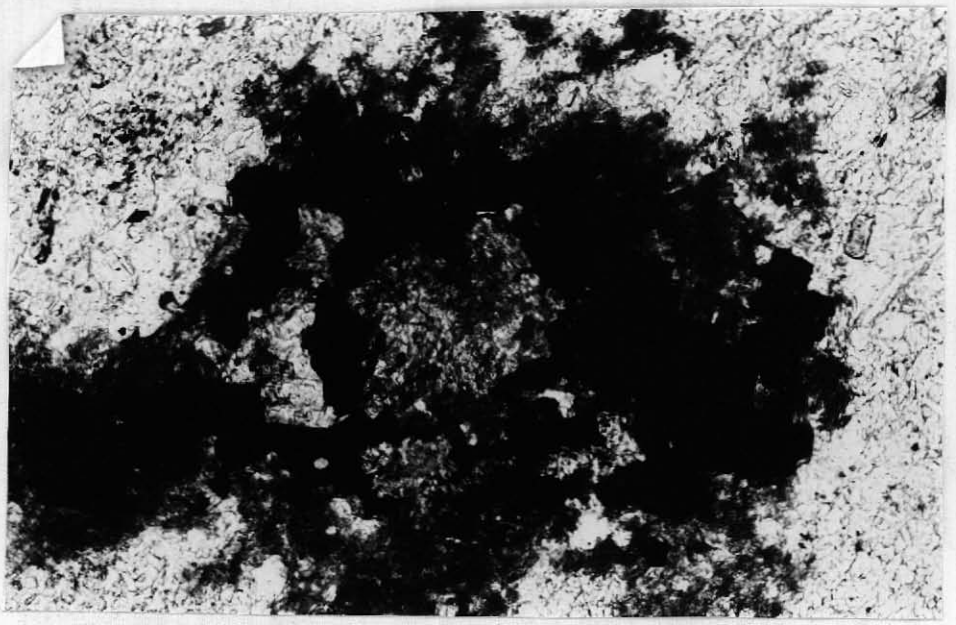
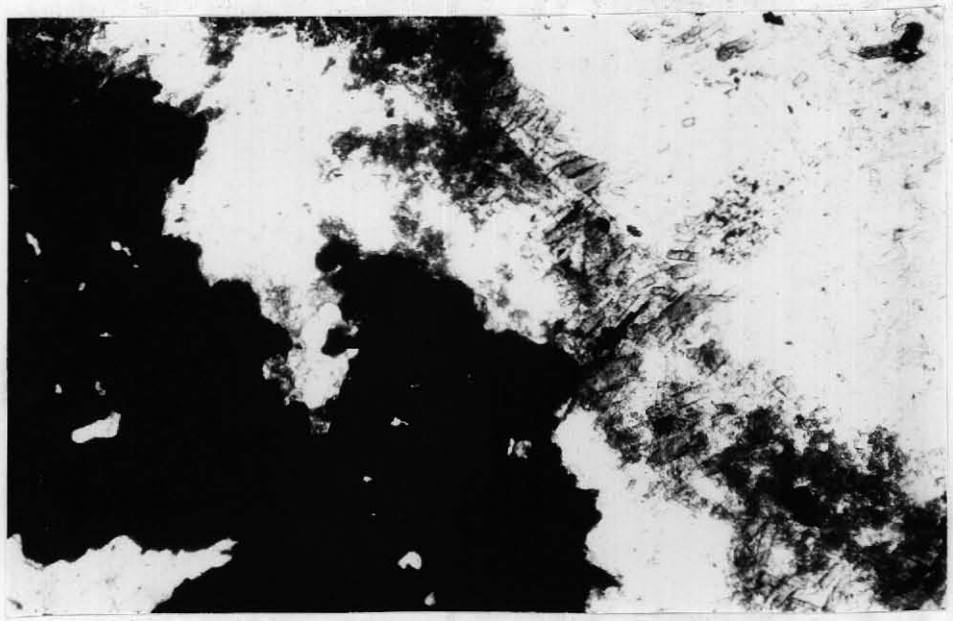


Thin Section M.1208 - 928.5 ft. (x 150).

Pyrrhotite (black) associated with cloudy sideritic carbonate (grey) in rock composed mainly of quartz, felspar and sericite (near white). Some sericite rich bands in this specimen have been tourmalinized.



Thin Section M.1208 - 928.5 ft. (x 150).

Part of a tourmalinized band (grey) and pyrrhotite aggregate (black).