

468001

MELBOURNE OFFICE

PETROLOGICAL REPORT M. 30/65

SPECIMENS FROM BASS NO. 1 WELL

M. Apthorpe

Melbourne

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OR_359A

SUMMARY.

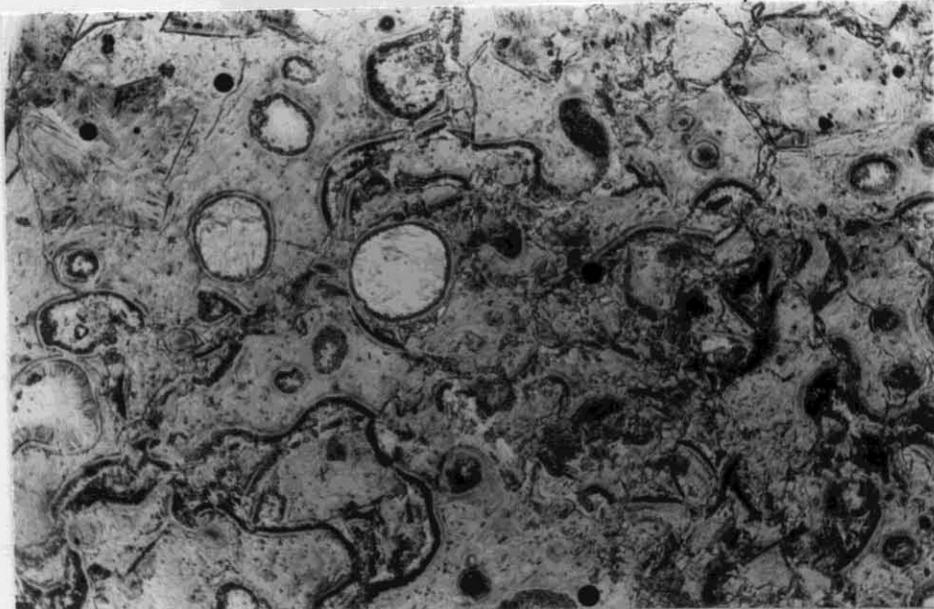
Seven specimens from Bass No. 1 Well were submitted for examination by Mr. B. M. Hopkins.

The specimens were from the following depths:

4226 ft.	Specimen No. M. 1431
5382	M. 1432
6412	M. 1433
6429	M. 1434
6950	M. 1435
6953	M. 1436
7697	M. 1437

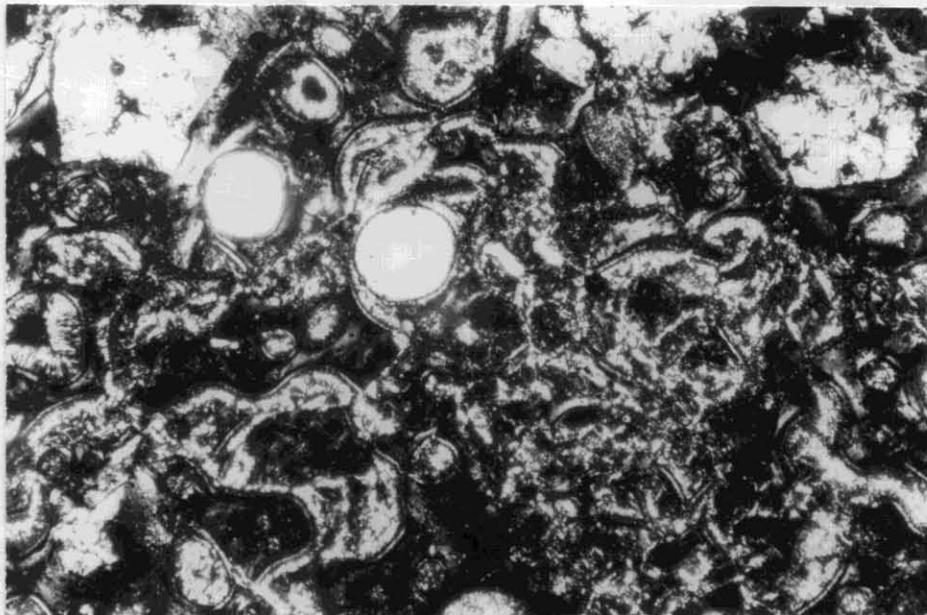
Two specimens examined earlier were described in Petrological Report M.26/65. They were a specimen of "tuff" from core 4 (2617-2647 ft.) (M. 1384), and a carbonaceous siltstone from 7717 ft. (M. 1403).

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THIN SECTION M. 1431 (X. 150)

Grey-green vesicular palagonite. A confused mass of glass and collapsed vesicles is visible in lower half of photograph. Two intact vesicles in the centre are filled with calcite.



THIN SECTION M. 1431 (X. 150)

Crossed Nicols

Same as above. Although glass is mainly isotropic, small birefringent areas occur particularly around collapsed vesicles. Fibrous birefringent chlorite is prominent in collapsed vesicles and in pseudomorphs after *olivine* (top left and right).

SPECIMEN NO. M. 1431.

Palagonite (Altered volcanic glass).

Depth: 4226 ft. (sidewall core)

Hand Specimen:

Vesicular material, varying from hard, dark green, with a resinous lustre in some places, to a lighter green, softer, friable and altered in others. Calcite fills some thin veins and vesicles.

Thin Section:

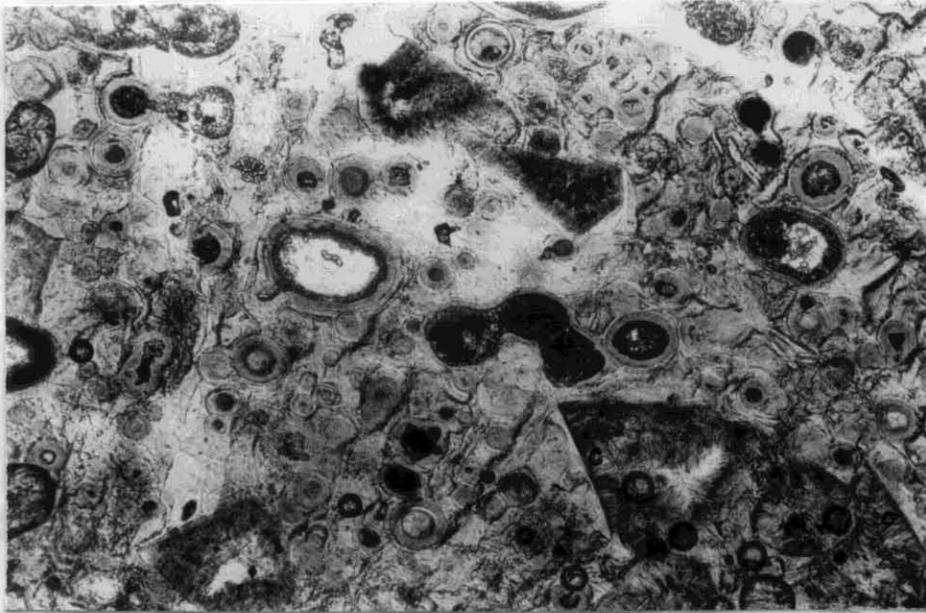
Highly vesicular and spheroidal palagonite shows much devitrification and crystallisation to chlorite.

The altered glass is a light olive-buff colour, crossed by fine irregular shrinkage cracks and dotted with small spherical and oval bodies of darker glass. In a few places the vesicles have collapsed, forming confused areas in which fragments of banded vesicle walls are the only textural element.

The palagonite is almost isotropic, but in some areas, particularly around glassy spheroids and vesicles, shows very low interference colours and has an undulatory extinction. This effect is probably due to local strain in the glass.

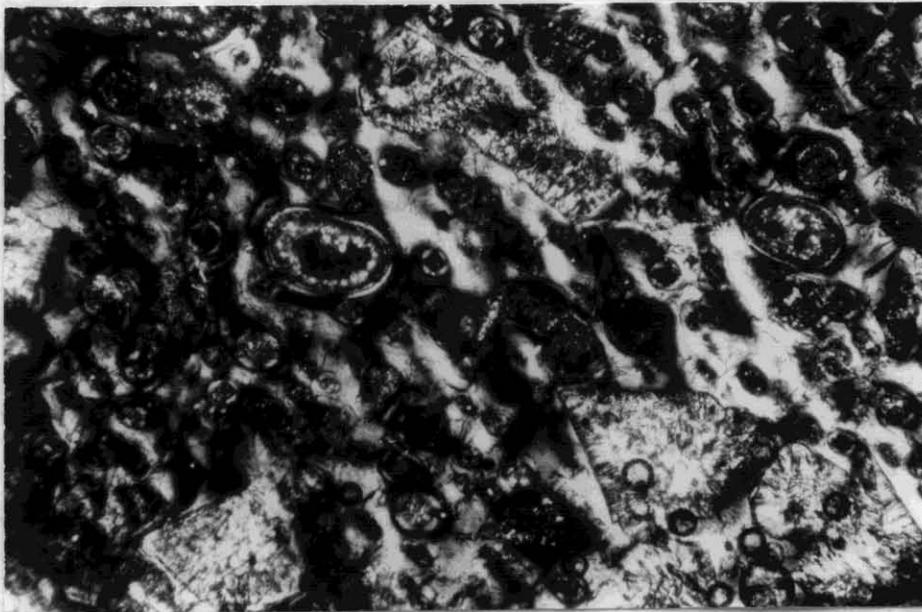
Euhedral pseudomorphs after olivine, up to 0.4 mm in length, are now composed of radiating bands of chlorite. Their mode of alteration is identical to that of many of the glassy spheroids. Bands of fibrous grey-green chlorite, 0.008 - 0.016 mm wide, form ^aradiating lining. The central area of the spheroids is filled with a clear fibrous mineral similar in optical properties to the zeolites. This mineral is often developed in optical continuity over the chlorite.

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THIN SECTION M. 1431 (X. 150)

Palagonite with spheroidal bodies showing radial bands of chlorite (C) and dark patches of devitrified glass. Chlorite pseudomorph of olivine at lower right. Dark rings are bubbles in the thin section.



THIN SECTION M. 1431 (X. 150)
Crossed Nicols

Same as above. Note large amount of anisotropic palagonite in this part of the section.

← 5 cm →

Another form of alteration within many spheroids is a complete devitrification of the glass to form a uniform dark brown turbid mass. Some writers have suggested that this appearance is due to the separation of minute particles of magnetite on devitrification. This could not be confirmed from the spheroids, but finely granular opaque material, probably magnetite, occurs sporadically in other altered parts of the palagonite.

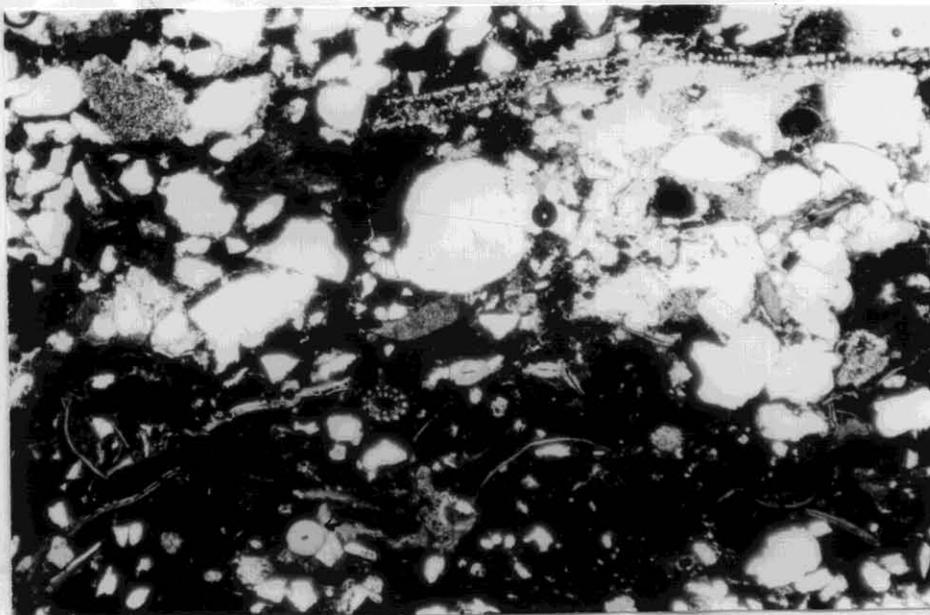
The alteration within the olivine pseudomorphs is a combination of a radial chlorite lining with dark devitrified patches, the two frequently being extremely mixed. These dark patches also occur sporadically in the body of the glass itself.

True vesicles, that is, those not filled with glass or chlorite, are relatively uncommon. Most are filled with coarsely crystalline secondary calcite, usually as a single crystal.

The specimen is very similar to the palagonite matrix of Core 4 (Specimen M. 1384 - see Petrological Report M. 26/65). Core 4 consisted of glassy basaltic fragments in a base of green palagonite similar to, but less altered than, the specimen under examination. A sidewall core at 4160 ft. appears to be essentially identical to specimen M. 1431.

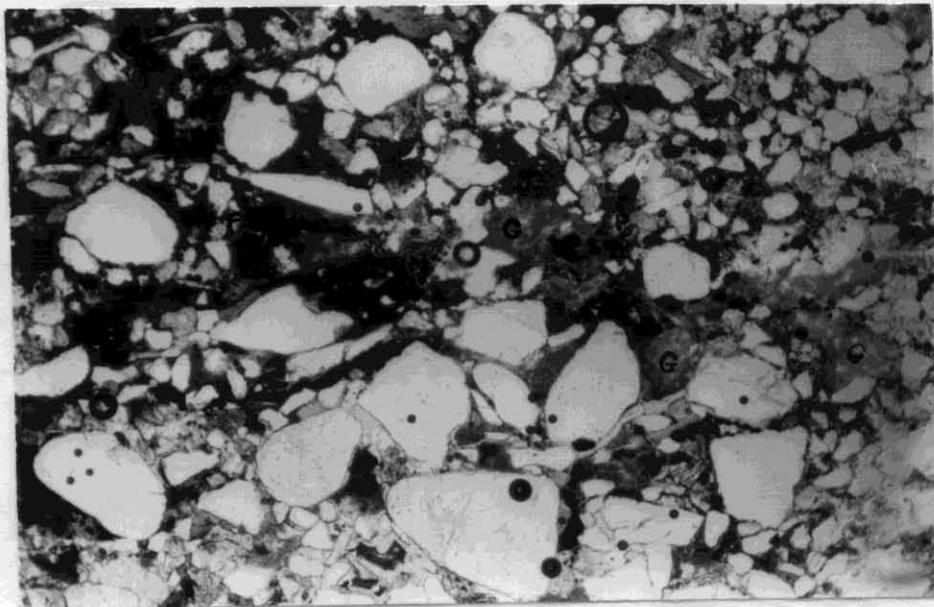
There appears to be little doubt that the eruption was submarine. Whether palagonite is formed by the direct action of seawater on molten sideromelane, or whether by the action of steam generated by contact between these two elements, and whether these two processes can in fact be separated, is very doubtful.

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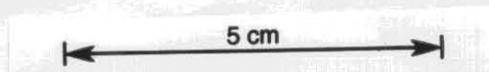
THIN SECTION M. 1432 (X. 50)

Quartz, shell and other organic fragments, and small colite in a dark organic cement.



THIN SECTION M. 1432 (X. 50)

As above. Note the presence of pyrite-filled foraminifera (F), crystalline pyrite (P) and grains of partly altered glauconite (G). Dark circles are bubbles in the thin section.



SPECIMEN NO. M. 1432

Glaucanitic carbonaceous sediment.

Depth: 5382 feet.

Hand Specimen: Dark grey medium-grained sediment, with poorly sorted quartz grains in a matrix of altered glauconite and dark organic material. Elongate lenses of quartz-rich and glauconite-rich sediment locally parallel the bedding. Small calcitic fragments of shells, bryozoa and foraminifera are scattered fairly abundantly through the specimen.

Thin Section:

Poorly sorted quartz and feldspar grains are set in a matrix of brown organic material, altered and part-altered glauconite, crystalline pyrite, and minor calcitic organisms and oolites.

Poorly sorted quartz ranges from well-rounded grains up to 0.8 mm in diameter to abundant angular material 0.1 mm and less in size. The degree of roundness increases with increase in size. Most quartz grains contain strings of tiny globular inclusions, biotite crystals and needles of rutile. Feldspar, mainly in the form of untwinned angular grains, is a minor constituent. Its presence supports the theory that the sediment is derived from a granite probably not a great distance away.

Other detrital material includes occasional grains of well-rounded zircon and tourmaline, and bent muscovite plates.

Shell fragments of brown calcite are common. A few small foraminifera, including buliminidae, rotalid forms, and globigerinidae, have their tests partially or completely pyrite-filled. Small spherical bodies of pale brown calcite, with a nucleus of a single pyrite crystal, occur sparsely through the rock. They average 0.08 - 0.1 mm across, and although undoubtedly

oolitic in nature, are internally structureless.

Glauconite pellets up to 0.4 mm in diameter are abundant. They are greenish to dark brown in colour, heavily stained by the brown organic cement, and most are probably partly altered in composition. Many grains are irregular in outline owing to compaction between quartz grains. Shrinkage cracks outline the boundaries of some pellets. In the thicker parts of the slide the pellets are masked by the strong colour of the brown organic cement.

The amorphous cement is abundant, and contains much finely crystalline pyrite.

SPECIMEN NO. M. 1433**Grit.**

Depth: 6412 feet.

Hand Specimen:

Unsorted coarse grained grit consisting largely of angular quartz, with lesser highly altered white felspar, and black shale fragments. The matrix is composed of finer grained quartz and a little dark cement, but the rock is very loosely consolidated.

Thin Section:

Very coarse grained angular quartz (1-5 mm in diameter), crossed by streams of minute bubble inclusions, forms most of the thin section. A few grains are fractured and optically disrupted probably during transportation, but most are unstrained. Grains are barely in contact, and as cement is patchy, the rock is highly porous. There is none of the solution and welding along grain boundaries seen in the deeper sandstone. Inclusions in the quartz are small biotite crystals and rutile needles, and the grit is largely granite-derived.

Weathered orthoclase fragments are moderately abundant. Other large grains present include one of aplitic and vein quartz, a fine grained quartzite (?) fairly heavily altered to clay, and a folded sheared carbonaceous shale. Tourmaline occurs as small angular grains, greenish-brown or blue.

The matrix is composed of angular quartz and felspar, 0.05 - 0.2 mm in size, set in a thin amorphous brown organic cement. In places the cement is almost absent.

Although the source rock of the grit is largely granite, other rock types, including highly deformed carbonaceous shale, and sandstone, are

present. Some of the fine-grained quartz matrix may also be derived from sediments rather than from granite.

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SPECIMEN NO. M. 1434

Fine grained sandstone.

Depth: 6429 feet.

Hand Specimen:

Fine grained pale grey sandstone, even-grained, with small flakes of mica along horizontal bedding planes. Thin filament-like bands of carbonaceous material form a planar, almost horizontal bedding. Thin lenses of dense black organic material occur in some carbonaceous bands.

Thin Section:

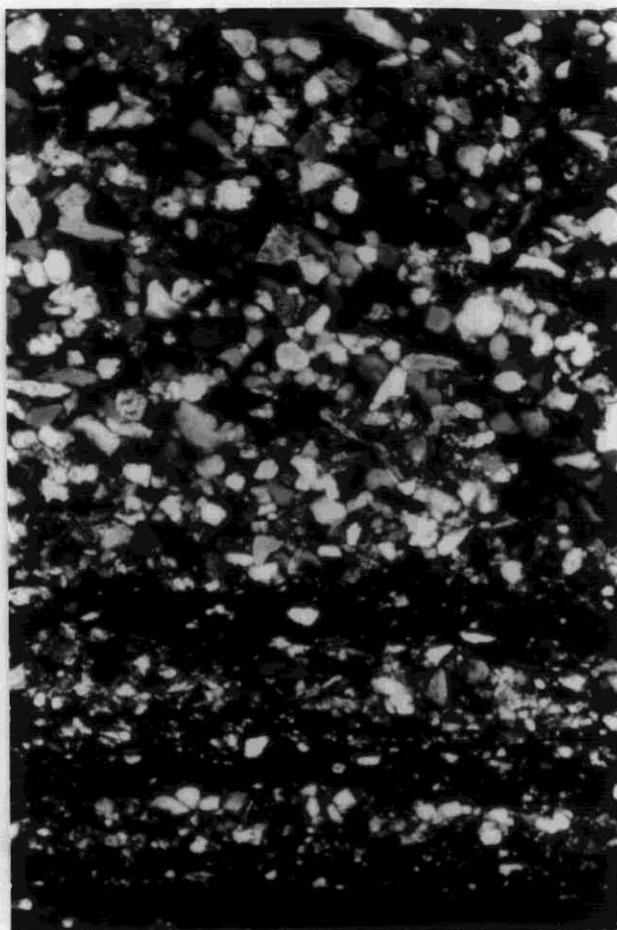
Fine grained quartz sandstone, with very small amounts of feldspar, detrital muscovite, tourmaline and organic material. As with the deeper sandstones, the grain size is uniform (0.1 - 0.15 mm), cement is entirely absent, and sorting excellent. However, many grains are highly angular, and although in some degree this may be due to partial solution and re-growth of the quartz under compaction, this is insufficient to account for the shape of all grains. Despite the welding together of most grains, the porosity visible in thin section appears high.

Minor detrital constituents include poorly terminated muscovite flakes, angular tourmaline and a little twinned feldspar. Many grains of uncertain composition are recrystallised to a very fine grained mosaic, and partially altered to sericite.

Organic matter is present as thin brown subhorizontal films coating grains. These films are usually less than 0.01 mm wide, highly irregular in detail, extending laterally for less than 0.5 mm, and often associated with red brown spores.

Secondary alteration is confined to minute amounts of clay and finely granular carbonate replacing the quartz.

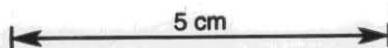
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THIN SECTION M. 1435 (X. 50)

Crossed Nicols

Typical texture of interbedded sandstone and carbonaceous shale.



SPECIMEN NO. M. 1435

Sandstone with minor shale.

Depth: 6950 feet.

Hand Specimen:

Fine grained pale grey sandstone with irregular cross bedding, interbedded with thin wavy bands of carbonaceous shale.

Thin Section:

Fine grained, well sorted current bedded sandstone, with a fairly high heavy mineral content. Interbedded with the sandstone are streamers and thin bands of carbonaceous shale, which usually terminate the current bedding of the sand.

The sandstone layers are composed of angular to sub-rounded quartz, minor angular feldspar, sericitised grains of ? feldspar, dark amorphous or flakey carbonaceous material, and abundant accessory zircon and tourmaline.

There is almost no cement present, the quartz grains being welded together along blurred common boundaries. The grain size is even and fine, averaging 0.05 - 0.1 mm. Slight strain within many grains is normal. Most grains have no conspicuous inclusions, apart from a little fine specular material, mostly alteration products. Some quartz grains are crowded with needles of zircon, and their appearance suggests a recent derivation from granite. This is supported by the presence of fairly small, highly angular feldspar grains, including oligoclase, microcline and orthoclase, in small but significant quantities.

Many grains have recrystallised to a cryptocrystalline mosaic with very low interference colours, the composition being indeterminable.

Accessory minerals include a little muscovite, amorphous opaque minerals, possibly ilmenite altering to leucoxene; and a little pyrite. Fine grained detrital tourmaline and zircon are both abundant. While the angular and euhedral nature of the tourmaline suggests its recent derivation from the granite, the well rounded zircons appear to be derived from the reworking of older sediments, probably along with considerable amounts of the more rounded quartz.

Bedding is poorly defined in the sandstone layers. It generally takes the form of crossbedding which is truncated by wavy carbonaceous bands. The crossbedding is defined by concentrations of heavy minerals (opaques, tourmaline, zircon) in certain laminae; and of traces of organic material in others. The two seldom occur together, suggesting a continual slight variation in the velocity of the depositing currents.

The carbonaceous bands are thin, discontinuous beds averaging about 1 mm in thickness. They are composed of very fine grained quartz, muscovite, and spore material, and are cemented by amorphous and thread-like dark brown organic material. Little heavy mineral material is present. Thin bands of interbedded sand and carbonaceous material indicate rapid changes in depositional conditions.

Very fine grained secondary carbonate partially replaces some quartz grains.

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SPECIMEN NO. M.1436

Interbedded sandstone and carbonaceous shale.

Depth: 6953 feet.

Hand Specimen:

Bands of light grey crossbedded sandstone are interbedded with dark grey shale in approximately equal proportions. The lenslike sandstone bands are frequently truncated to form a wavy, ripple-marked surface, on which irregular diverging and converging beds of shale have been laid down. A rapid and continual alteration of current velocity is suggested by the textural appearance, which is extremely striking. A much greater proportion of shale is present than in the preceding specimen three feet higher.

Rupturing of the shale bands by sinuous passages filled with sand is common. These sand eruptions are formed by the injection of wet sand through the very soft carbonaceous mud above, and are probably due to slight differential compaction during deposition.

Thin Section:

Interbedded sandstone and shale, very similar to those described in previous slides.

Fine grained angular quartz is welded together in the usual cement-free sandstone. Alteration of quartz grains to clay and a recrystallised mosaic of fine grained quartz is common. Felspar, muscovite, tourmaline, zircon and amorphous opaques are present as in M.1435 (6950 ft.). With increasing depth the visible porosity is gradually reduced as pressure solution welds the rock more tightly. Visible pore spaces in this thin section are few and very small in size.

The carbonaceous bands are composed of very fine grained detrital material cemented by deep brown organic material, as in M.1435. Flakes of muscovite, and orange spores, either spherical or deformed, are both abundant.

The boundaries between the two sediment types are microscopically wavy and irregular, but very sharply defined. Quartz grains have sunk into the soft carbonaceous layers beneath the junctions.

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5 cm

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THIN SECTION M. 1437 X. 50

Crossed Nicols

Texture across the coal band.

1. Typical sandstone - angular welded grains.
2. Fine grained carbonate band.
3. Coal band with minor detrital material.
4. Sandstone below coal band.



SPECIMEN NO. M. 1437

Sandstone with coal band.

Depth: 7697 feet.

Hand Specimen:

Light grey sandstone, medium to fine grained, well sorted, with bedding dipping at about 10° . A black band of coal some 3 mm wide is overlain by a light brown layer 1 - 2 mm wide, composed dominantly of carbonate. Dark organic material forms a patchy cement in the sandstone for about 5 mm both sides of the coal band.

Thin Section:

Fine grained quartz sandstone composed of welded grains set in a small amount of matrix of sericite and granulated, recrystallised quartz. Felspar, muscovite, tourmaline and opaque grains are still present in minor accessory quantities. In addition to the normal angular, green-brown tourmaline, blue grains and well rounded brown grains are present, suggesting several sources for the mineral. Zircon is no longer of importance as an accessory,

Clusters of finely crystalline secondary grey carbonate form a cement which replaces granulated quartz in places. This specimen contains the greatest quantity of carbonate seen in these specimens, but it is estimated at only about 3 - 5%.

The double band which is so prominent a feature of the hand specimen has a lower part composed of opaque coal containing randomly oriented grains of quartz and muscovite. The coal band passes upwards into a very dark brown organic material cementing well-bedded fine-grained detrital material. This zone passes rapidly into a band composed largely of dense granular grey carbonate, mixed with thin streaks of black and brown organic

material. It appears that the coal band formed a relatively impermeable barrier to carbonate-bearing solutions, which became concentrated and replaced much of the fine grained sediment directly above the coal.

Normal sandstone deposition resumed fairly abruptly, with coarse-grained quartz projecting down into the fine layer. Carbonate cements the basal quartz, but occurs in less than normal quantities above. Its place is taken to some extent by an opaque organic cement, which occurs in localised patches in the sandstone - the only instance in which this was observed.

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MELBOURNE
MA:MJP
December, 1965.