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GEOLOGICAL SERIES

EXPLANATORY NOTES

ROEBOURNE
WESTERN AUSTRALIA

Sheet SF/50-3

International Index

WESTERN AUSTRALIA
INDEX TO GEOLOGICAL MAPS
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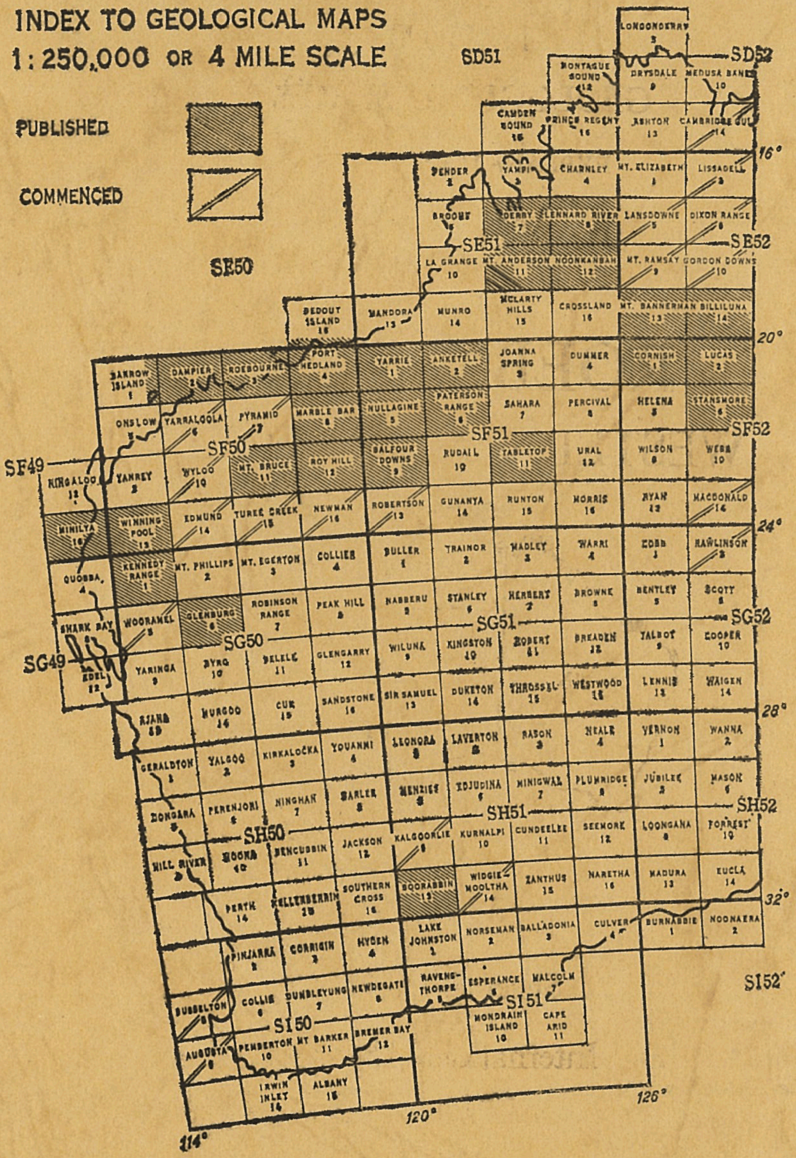

GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

1:250,000 GEOLOGICAL SERIES

EXPLANATORY NOTES

ROEBOURNE
WESTERN AUSTRALIA

Sheet SF/50-3 International Index

Compiled by G. R. Ryan

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DEPARTMENT OF MINES, WESTERN AUSTRALIA

Minister: The Hon. A. F. GRIFFITH, M.L.C.

Under Secretary: I. R. BERRY

GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

Director: J. H. LORD

Explanatory Notes on the Roebourne Geological Sheet

Compiled by
G. R. Ryan

INTRODUCTION

The Roebourne Sheet, SF 50-3, is bounded by latitude 20° and 21°S, and longitude 117° and 118°30'E. The area lies in the North-West Land Division of the State of Western Australia and the principal town is Roebourne, 13 miles inland by road from the port of Point Samson. Cossack, the original settlement at the mouth of the Harding River, was abandoned because of an inadequate water supply. Balla Balla Landing, also abandoned, once served as an outlet for copper concentrates from the mining centre of Whim Creek.

The North West Coastal Highway crosses the area from west to east, and connects Roebourne with the ports of Port Hedland, 126 miles to the east, and Onslow, 196 miles to the west. A metalled road joins the Highway at the Jones River, and serves the crocidolite-mining centre of Wittenoom Gorge, about 180 miles to the southeast.

The pastoral industry was established in 1863 and is devoted almost entirely to sheep. The following properties lie wholly or partly within the Sheet area: Woodbrook, Mt. Welcome, Cooya Pooya, Warambie, Sherlock, Mallina, Mundabullangana and Boodarie. Access within the area is generally very good because of the tracks used to service the numerous wells.

HISTORY OF INVESTIGATIONS

The first geological investigation in the area followed the early discoveries of copper. Woodward (1890), Calvert (1899), and Cadell (1899) made brief inspections. At about the same time A. G. Maitland and H. W. B. Talbot began a systematic survey of the geology of the adjacent Pilbara Goldfield (Maitland, 1908), and many of their conclusions apply to the Roebourne area.

In 1910 Woodward (1911) carried out a similar survey of the West Pilbara Goldfield, which includes the Roebourne area. Apart from brief inspections by officers of the Western Australian Department of Mines, there were no further detailed surveys until the Aerial, Geological and Geophysical

Survey of Northern Australia (A.G.G.S.N.A.) began work in 1935. This work was confined to known mineral deposits and the various reports are listed in the Bibliography. Adams (1944) examined chrysotile deposits within the area, and descriptions of iron and copper deposits are included in reports by Connolly (1959) and Low (1963).

In 1962 and 1963 the Geological Survey mapped the Roebourne Sheet area in conjunction with the adjacent Sheets of Dampier and Pyramid. Field work was carried out by G. R. Ryan, M. Kriewaldt, and W. Bock, under the direction of R. C. Horwitz. The Port Hedland Sheet area to the east was mapped in 1961 by Low (1965), and the Dampier Sheet area to the west has been described by Kriewaldt (1964a). Petrological and palaeontological determinations were made by A. F. Trendall and H. S. Edgell respectively, both of the Geological Survey of Western Australia.

PHYSIOGRAPHY

The area is low-lying, and consists of extensive plains from which project low hills of Precambrian rocks. Broadly, four units may be distinguished:

(a) In the east a wide sandy plain extends from the hills east of Whim Creek to the Turner River.

(b) From Whim Creek westwards to Roebourne a similar plain skirts the foothills, but is of clay with a gilgai type surface.

(c) A low-lying tract of tidal marshes, mangroves and sand dunes fringes the coast from Point Samson eastwards to the edge of the Sheet area.

(d) Tumbled hills, the highest of which stands about 600 feet above sea level, occupy the western part of the area and form the peninsula upon which Point Samson lies; then skirt the coastal plain eastwards towards Whim Creek, where they again project northeastwards almost to the coast; and continue as low isolated hills eastwards along the southern edge of the area.

A prominent feature is the bold massive outcrop of gabbro which forms Depuch Island. Bezout Island, Jarman Island, and Picard Island are also composed of crystalline rocks, whereas the other islands are dissected remnants of cemented coastal deposits upon which sand has accumulated.

The physiography reflects the geology of the rocks which form the Precambrian basement. Granite and gneiss underlie the plain areas, slate forms the low isolated hills in the southeastern sector, and altered basic volcanic rocks and jaspilite formations form the more upstanding ridges to the west. The highest hills are composed of basic intrusive and extrusive rocks of Proterozoic age.

The lower reaches of several rivers cross the Sheet area from south to north. They flow only after the torrential cyclonic rains experienced in the summer months and have a braided pattern typical of this type of drainage. For most of the year they consist of permanent or nearly permanent water-holes scattered along the sandy and cobbly river beds. The rivers rise to the south in the Nullagine Plateau of Jutson (1950), known locally as The Tableland. They originated on an earlier land surface and have been superimposed. Several fine water gaps may be seen, along the Harding River in particular. Subsequent drainage is demonstrated by the Jones River west of Warambie Homestead, and obsequent streams in this area drain southwards into the Jones River from the dip slope of the Proterozoic basalts.

The rivers do not persist to the sea but debouch on to extensive tidal flats as much as 4 miles inland from the coast. Tidal inlets are incised into these flats and the rivers themselves are incised into the coastal plains. The coast is fringed by a belt of sand dunes of various ages, around which sand shoals and mangrove swamps have formed. North of Mallina Homestead the Peawah River has been diverted by the encroachment of seif dunes; and old drainage lines along the eastern bank of the Yule River are similarly covered. Veevers & Wells (1961) consider that similar dunes in the Canning Basin are Pleistocene in age, which suggests that the present drainage of the Roebourne area has changed little since then.

The coastal plain is a pediplain left by the retreating scarp of the Nullagine Plateau, and the soil, gravel, and boulder beds left thereon are residual deposits, the size of which varies with distance from the scarp.

Relicts of a land surface, probably Tertiary, form mesas of pisolite and planed tops to some of the higher hills and ridges. The mesas adjoin these planed surfaces in places, forming a profile which is continuous from one to the other. Between Cape Lambert and Point Samson pisolite lies at sea level, whereas west of Mt. Welcome the mesa tops lie about 100 feet above plain level. Intervening mesa levels delineate a profile sloping gradually down to the north.

GEOLOGY

The oldest rocks in the area are thought to be the folded and metamorphosed volcanic and sedimentary rocks of the Roebourne Group (Ryan, 1964). They occupy fold belts between large granitic domes. Both Maitland (1908) and Noldart & Wyatt (1962) have suggested that similar domes in the Pilbara Goldfield to the east might represent, at least in part, an older basement, but there is no evidence to support this view. Kriewaldt (1964a) has compared the domes with the 'mantled gneiss domes' of Eskola (1949).

The granitic domes, other intrusives, and sedimentary and volcanic rocks of the Roebourne Group, have been included in the Pilbara System (Noldart & Wyatt, 1962; Ryan, 1964). At Wodgina, in the Marble Bar 1 : 250,000 Sheet area, a lithium-bearing pegmatite similar to those southeast of Roebourne gave an age in excess of 2,700 million years (Wilson and others, 1960): so the Pilbara System is of Archaean age. (In Western Australia the time boundary between the Archaean and Proterozoic is provisionally placed at about 2,500 million years.) The Pilbara System is overlain with strong angular unconformity by the 'Nullagine Series' of Maitland (1908), which is of Lower Proterozoic age (Leggo and others, 1965). Only the oldest members of this succession, belonging to the Fortescue Group of MacLeod and others (1963), are present within the area. They are cut by basic intrusives of probable Precambrian age.

The only younger rocks in the Sheet area are loosely consolidated or unconsolidated terrestrial sediments of Cainozoic age. The geological history is summarized in Table 1.

ARCHAEAN: PILBARA SYSTEM

Roebourne Group

Two contemporaneous environments are represented in the Roebourne Group (Ryan & Kriewaldt, 1964). Volcanic rocks and chemical sediments predominate between Whim Creek and the western edge of the Sheet area, but south and east of Whim Creek they pass to a much thicker succession which consists principally of fine-grained detrital rocks with some interbedded volcanic, siliceous, calcareous, and ferruginous beds. The thicker clastic succession is poorly represented on the Roebourne Sheet area and has been mapped principally on the adjacent Pyramid Sheet area (Kriewaldt & Ryan, in press).

The volcanic succession has been divided into three stratigraphic assemblages which are, from top to bottom:

Cleaverville Formation—banded iron formation and pelitic rocks.

Regal Formation—basic volcanic rocks with acid igneous rocks and thin intercalated sedimentary rocks.

Altered chemical sediments, pelitic rocks, acid and basic volcanic rocks, and some coarser detrital rocks.

In the Pyramid Sheet area, the clastic succession has been divided into three units (Kriewaldt & Ryan, in press), and the stratigraphy may be summarized as:

Top Greywacke, shale, calcareous shale, chert, sandstone.

Shale, slate, thin chemical sediments, with greywacke, acid igneous rocks, and locally developed basic volcanic rocks.

Sandstone, shale, greywacke.

TABLE 1. SUMMARY OF GEOLOGICAL HISTORY—ROEBOURNE 1: 250,000 GEOLOGICAL SERIES

	Period	Event		Rocks formed
CAINOZOIC	Quaternary	Erosion and deposition; changes in sea level.		Alluvium, residual deposits, colluvium, flood silt, aeolian sand, beach sand.
				UNCONFORMITY
	?			*Bossut Formation;* kunkar.
		?——?——?——?		?——?——?——?
	Tertiary	Erosion, deposition, and cementation.		Pisolite.
				UNCONFORMITY
PROTEROZOIC	?	Minor folding and faulting. Basic igneous intrusion.		Dolerite dykes and sills, gabbro intrusives; *Cooya Pooya Dolerite.*
		Detrital sedimentation, minor explosive activity.	Fortescue Group	Tuffaceous sandstone, tuff, agglomerate.
		Volcanic extrusion, early detrital sedimentation. Contemporaneous subsidence.	Fortescue Group	*Mt. Roe Basalt*, basal arenite, boulder agglomerate.
		EROSION		UNCONFORMITY
ARCHAEAN	Pilbara System	Folding and faulting. Acid and basic intrusion, metamorphism.		Granite, gneiss, gabbro, metasomatic rocks; pegmatite, quartz veins, mineral deposits.
		Chemical and detrital sedimentation, minor igneous activity and folding; turbidity currents.	Roebourne Group	*Cleaverville Formation;* shale, calcareous shale, siltstone, greywacke; dolerite sills or tuff; turbidites.
		Contemporaneous vulcanicity and chemical and detrital sedimentation; acid and basic hypabyssal intrusion; folding; turbidity currents and bulk transport of magma and unconsolidated sediment.	Roebourne Group	*Regal Formation;* banded chert, dolomite, shale, siltstone, greywacke and acid rocks; pyroclastic rocks; porphyry, dolerite sills and dykes; turbidites and mixed igneous and sedimentary rocks; local disconformity.
		Detrital sedimentation, from unknown source. Possibly from area now occupied by granite domes.	Roebourne Group	Sandstone, shale, siltstone.

Of these units only the lower and the upper are well exposed on the Roebourne Sheet area. The top unit of the clastic succession is correlated with the Cleaverville Formation, and the middle unit of the clastic succession is correlated broadly with the Regal Formation and the underlying altered volcanic and sedimentary rocks. More detailed descriptions of the lithology, stratigraphy, and correlations within the Roebourne Group are given in Ryan & Kriewaldt (1964) and Ryan (1964; 1965). A summary of the stratigraphy is given in Table 2.

Volcanic succession

The volcanic succession occupies a number of synclinoria, folded between granite and gneiss domes and ridges, which lie in a rough *en echelon* pattern between Whim Creek and the western edge of the Sheet area. The lowermost stratigraphic unit adjoins the granitic domes, and has been metamorphosed and intruded by granite in many places. It consists of banded chert formation, altered dolomite and calcareous schist, interbedded pelite and basic volcanic rocks around Roebourne; but to the east, from the George River to Mt. Brown, the same stratigraphic position is occupied by a suite of acidic rocks, including fine-grained breccia and green coloured granular and aphanitic siliceous rocks. Similar rocks are associated with porphyry at the Ilingotherra Hills, and are thinly interbedded with slate at Whim Creek.

Sandstone and conglomerate are developed locally south of Cleaverville townsite. They overlie a local disconformity, but to the west pass laterally to an unbroken succession of finer-grained detrital rocks and altered calcareous rocks more typical of this stratigraphic unit (Horwitz, 1963). The sandstone is overlain by banded chert, which is in turn overlain by the Regal Formation.

The *Regal Formation* consists predominantly of basic volcanic rocks, including pillow lavas, massive green amphibolite with pale-coloured spheroidal bodies, and rocks with clusters of acicular crystals of bastite after pyroxene. Chert, dolomite, ferruginous dolomite, quartz-amphibole schist, and garnet gneiss are intercalated thinly with the volcanic rocks.

Acid volcanic rocks and detrital and pyroclastic rocks are more common in the syncline west of Andover Homestead, where the formation has an estimated thickness of 10,000 feet, compared to the more typical thinner succession to the north. Intrusive, and concordant, bodies of porphyry are more common in this area, and also towards Whim Creek.

Relicts of the Regal Formation lie in a complex of serpentinite, amphibolite, and intrusive gabbro south of Roebourne. Serpentinization of the basic rocks of the Regal Formation is widespread between here and Whim Creek;

TABLE 2. STRATIGRAPHY OF THE ROEBOURNE GROUP—ROEBOURNE 1: 250,000 GEOLOGICAL SERIES

<table>
<tr><th>Map Symbol</th><th>Thickness (feet)</th><th colspan="3">Rock Unit</th><th>Thickness (feet)</th><th>Map Symbol</th></tr>
<tr><td>Ai</td><td>0–2000</td><td colspan="2">Cleaverville Formation. Correlated with Gorge Creek Formation.</td><td rowspan="3">Greywacke. Tentatively equated with George Creek Formation. Slate, calcareous shale, etc.</td><td rowspan="3">0–1000 (est.)
0–2000 (est.)</td><td rowspan="3">Ar
Ar</td></tr>
<tr><td>Ae</td><td>0–10,000</td><td colspan="2">Regal Formation. Equated with Warrawoona succession.</td></tr>
<tr><td>Al</td><td>0–500(est.)</td><td colspan="2">Ultrabasic rocks</td></tr>
<tr><td>As</td><td>500–2000</td><td>Metamorphosed sedimentary rocks. Equated with Warrawoona succession.</td><td>Granular siliceous rocks</td><td>Pelite, psammite, calcareous rocks, etc.</td><td>?</td><td>As</td></tr>
<tr><td rowspan="2">Am</td><td rowspan="2"></td><td colspan="3">Granular amphibolite</td><td></td><td></td></tr>
<tr><td colspan="2">Zone of metasomatism</td><td>Slate
Sandstone</td><td>± 15,000
± 15,000</td><td>Arr
Ars</td></tr>
</table>

and the serpentinites south of Roebourne may represent altered lavas in which the alteration has completely masked the original composition of the rock.

The *Cleaverville Formation* conformably overlies the Regal Formation, probably with some interfingering. It occupies synclinal axes in the western part of the area, but is missing east of the Sherlock River, possibly through erosion.

Banded chert, acid rocks, serpentinite, and ?skarn rocks crop out as isolated low hills in the extreme southeastern corner of the Sheet area. They are tentatively equated with the lowest part of the volcanic succession. They have irregular dips and strikes, but foliation in a small outcrop of gneiss in this area has a gentle westerly dip; and the gneiss apparently lies below them.

Clastic succession

The lowest unit in the clastic succession is represented by the sandstone and shale sequence south of Toweranna. It is overlain to the north by shale and slate, which in turn are overlain by an assemblage of acid, calcareous, and detrital rocks that appears to represent the lowest unit in the volcanic succession. The Regal Formation is the highest stratigraphic unit in this area, and it passes eastwards to slate at Whim Creek.

Scattered outcrops of slate, shale, siltstone, and calcareous shale, which are equated with the slate at Whim Creek, are present between the Peawah River and the Yule River, and to the northwest of Mt. Berghaus. Quartz greywacke, with interbedded pelite, crops out at Mt. Berghaus. The greywacke beds contain graded bedding, small-scale cross-bedding, swarms of clay pellets, and signs of bottom erosion; all indicate deposition by turbidity currents. The greywacke is thought to be the uppermost member of the clastic succession (Ryan, 1964).

A variety of rock types crops out along the southern margin of the Sheet area between the Peawah River and the Yule River. Green to grey shale and quartz greywacke, probably derived from porphyry (Trendall, 1964; Ryan, 1965) crops out near the Peawah River, and here concordant bodies of porphyry and amphibole-serpentine-magnetite rock are present. Farther east there are outcrops of green-coloured granular and aphanitic rocks which resemble members of the Regal Formation. These rocks probably represent an extension into the clastic succession of products of the adjacent vulcanicity.

INTRUSIVE AND METASOMATIC ROCKS

The oldest known intrusive in the area is an altered dolerite dyke that is truncated by the disconformity near Cleaverville townsite (Horwitz, 1963).

Many similar dolerites crop out within the Regal Formation. They are comparable to the 'younger greenstones' of the Pilbara Goldfield (Maitland, 1908) and of the Kalgoorlie area in the southern part of Western Australia. They are typically more massive and less sheared than the enclosing lavas, as well as being somewhat coarser in grain. A medium-grained massive amphibolite crops out in many places between the Sherlock River and Balla Balla Landing. It is apparently concordant, but similar bodies that crop out within the Regal Formation are thought to be intrusive, though no intrusive contact has been seen. Amphibolite also crops out east of Toweranna, and is contiguous in strike with an amphibolite on the Pyramid Sheet area which is one of a number of such bodies that intrude the clastic succession (Kriewaldt & Ryan, in press).

Small bodies of porphyry are present in many places, notably at the Ilingotherra Hills and between Warambie Homestead and Whim Creek in the Regal Formation. Most of them are concordant, and although some are definitely intrusive, others may be extrusive. The similarity between the feldspar and quartz of the porphyry and detrital grains of feldspar and quartz in greywacke south of Mallina Homestead has led Trendall (1964) to suggest that bulk flow of acid igneous rock, possibly with admixed sediment, has taken place. The porphyry bodies are folded with the Roebourne Group.

Large irregular masses of dolerite and gabbro crop out between Mt. Welcome, Mt. Hall, Mt. Gregory, and the western edge of the Sheet area. The basic rocks have intruded the Roebourne Group, although in some cases the contact between gabbro and altered members of the Roebourne Group is gradational. The gabbro has been intruded by granite.

The gabbro, dolerite, granite, amphibolite, and serpentinite form part of a metamorphic and intrusive complex which occupies much of the area between the East Harding River, Roebourne, and the western boundary of the Sheet area. The complex is bounded on the south by granite, gneiss, and mylonite, and on the north by the Roebourne Group. It contains a wide variety of metasomatized rocks, hybrid rocks, and recognizable relicts of the Roebourne Group in addition to the intrusive rocks. The lithological variety cannot be differentiated at a scale of 1 : 250,000 so that the complex is represented as hybrid and 'metasomatic rocks' in order to distinguish it from the lower-grade metamorphic rocks of the Roebourne Group.

Metasomatism, dynamic metamorphism, and igneous intrusion are common at the contact of the Roebourne Group with the large domes of granite and gneiss about which it is folded. However, regional metamorphism is generally of very low grade.

The granite and gneiss complex of the domes crops out in few places, but underlies the extensive plains between Roebourne and Whim Creek and between the Peawah River and the eastern edge of the Sheet area. Massive granite in the core of the domes passes to granitic gneiss at the edges. The granite of the cores is weakly foliated and leucocratic, and is generally non-porphyritic. However, there are smaller bodies of intrusive melanocratic granite which carry hornblende or biotite and contain xenoliths. Granite porphyry intrudes shale at Toweranna and leucocratic granite intrudes the Regal Formation southwest of Sherlock Homestead. The smaller intrusive granites are distinguished from the large granite domes because of their obvious intrusive relationships, their slight differences in mineralogy, and the presence of xenoliths. They appear to be slightly younger, and may have been derived by remobilization either of an older basement, or of the lower part of the Roebourne Group (Ryan, 1965).

The largest body of intrusive granite lies south of Mallina Homestead. It is a hornblende granite with abundant xenoliths, and locally is of dioritic composition. Contaminated hornblende granite is associated with the metamorphic complex south of Roebourne. Jarman Island and Picard Island are composed of tonalite, and small bodies of tonalite porphyry crop out between Point Samson and Roebourne. The tonalite is probably related to the hornblende granite.

Dykes of aplite, pegmatite, and granite cut serpentinite, gabbro, and amphibolite between Mt. Hall and Mt. Gregory. Granite is so common in the valley floors in this area that it is thought to be continuous below the outcropping basic and ultramafic rocks at shallow depth.

CORRELATION

The two laterally equivalent successions of the Roebourne Group are lithologically similar to the Warrawoona succession (volcanic) and Mosquito Creek succession (sedimentary) of Noldart & Wyatt (1962): but there is no sign of the erosional break which separates the Warrawoona succession from the Mosquito Creek succession in the type area (Maitland, 1908; Finucane, 1939). This erosional break does not appear to be as widespread as has been thought, and is apparently represented by continuous sedimentation in the clastic succession southeast of Whim Creek (Ryan, 1964).

Nevertheless the Roebourne Group can be correlated roughly with successions in the type area (Table 3). The Cleaverville Formation is lithologically similar to the jaspilite member of the Gorge Creek Formation of Noldart & Wyatt (1962), and the greywacke at Mt. Berghaus is the equivalent of similar rocks on the adjacent Port Hedland Sheet area which Low (1965) has correlated tentatively with the Gorge Creek Formation. The Gorge Creek Formation is part of the Mosquito Creek succession, so that

TABLE 3. STRATIGRAPHIC CORRELATIONS IN THE PILBARA SYSTEM

	Roebourne Sheet		Port Hedland Sheet	Marble Bar Sheet	
	Volcanic Succession	Clastic Succession			
Roebourne Group	*Cleaverville Formation*—jaspilite, pelite.	Pelite, psammite	*Gorge Creek Formation*—jaspilite, psammite, pelite.	Pelite, psammite UNCONFORMITY	Mosquito Creek succession
	Regal Formation—basic and acid volcanic rocks.	Pelite, minor volcanic rocks	Basic and acid volcanic rocks	Basic and acid volcanic rocks	Warrawoona succession
	Altered sedimentary and volcanic rocks	? ?	Altered sedimentary and volcanic rocks		
	?	Psammite, pelite ?	?	?	

the uppermost units in both the volcanic and the clastic successions in the Roebourne Group can be correlated with the upper Mosquito Creek succession of the type area.

The Regal Formation and underlying altered sedimentary and volcanic rocks, and their equivalents in the clastic succession, are correlated with the Warrawoona succession.

LOWER PROTEROZOIC

Fortescue Group

The *Mt. Roe Basalt* (Kriewaldt, 1964b) is the oldest Proterozoic formation present. Its outcrop is restricted to three areas, where is occupies faulted shallow basins overlying the Pilbara System. It consists of basaltic and andesitic amygdaloidal, vesicular, and columnar lavas with intercalated sedimentary and pyroclastic rocks.

At Mt. Roe, near Andover Homestead, and from there to the Sherlock River, a variable thickness of volcanic rocks dips generally to the south, though dips are reversed locally by faulting. This passes upwards to agglomerate and tuffaceous sandstone. A similar succession is found between Dixon Island and Mt. Anketell, where the lavas are capped by more than 100 feet of coarse boulder agglomerate which includes elements of granite and jaspilite.

Sandstone, shale, and claystone are intercalated with the lavas of the outlier at Whim Creek. Similar beds lie at the base of the lavas between Mt. Ada and Mt. Oscar. Here they are involved in faulting which was apparently contemporaneous with deposition. They include elements derived from the Cleaverville Formation and older members of the Roebourne Group.

Up to 1,000 feet of coarse-grained, tuffaceous, micaceous sandstone overlies the Mt. Roe Basalt south of Mt. Ada. At the base, about 50 feet of coarse agglomerate marks the passage from the sandstone to the underlying volcanic rocks. The sandstone is a correlative of the *Hardey Sandstone* (MacLeod and others, 1963; Kriewaldt, 1964b).

Intrusive Rocks

At Depuch Island, Peawah Hills, and Mt. Spinifex, gabbro and dolerite form bold hills of tumbled black rock fragments, some of spectacular size. Although none of these basic bodies can be seen to intrude Proterozoic rocks, they are similar to the Cooya Pooya Dolerite which crops out along the southern edge of the Sheet area from Lockyer Gap to the Sherlock River, and which intrudes the Fortescue Group. Quartz, possibly of secondary origin, is present in these rocks which Glauert (1911) compared with the quartz diabase of the Kalgoorlie region. Saussurite is also common. Serpentine has been observed in a thin-section of the Cooya Pooya Dolerite.

Dykes, sills, and small stocks of quartz-bearing dolerite, uralitized in many places, cut the Mt. Roe Basalt, the Cooya Pooya Dolerite, and the Archaean rocks. They tend to occur in association with faults. They are the youngest crystalline rocks known within the area.

CAINOZOIC

TERTIARY

Pisolite

Isolated outcrops of limonitic pisolite containing fossil wood fragments and clastic material are found west of the Harding River from Cape Lambert to a point 4 miles southwest of the Weerianna mine; on the east bank of the Peawah River near Mallina homestead; and on either side of the Yule River south of Portree homestead. The pisolite is comparable to the Robe Pisolite of de la Hunty (1965) in appearance and composition, and probably in origin; and to the Poondano Formation of Lindner & Drew (in McWhae and others, 1958). Low (1965) considered the Poondano Formation to be homochronous with the Tertiary Oakover Formation, and Noldart & Wyatt (1962) observed ferruginous pisolite at the base of the latter formation.

The pisolite is thought to represent ferruginized valley fill, and the distribution delineates drainage lines of probable Tertiary age.

QUATERNARY

Kunkar

Widespread deposits of impure calcareous concretionary material form a dissected plain between Toweranna and the eastern margin of the Sheet area. They are formed upon calcareous and basic members of the Roebourne Group and are considered to have derived magnesia and lime from these rocks. Similar deposits are found along present-day drainage channels; and may be seen in the process of deposition where lime-rich waters are exposed to evaporation in the Jones River west of Inthanuna Pool. Kunkar also forms encrustations in the red clay of the high-level plain (see below); and the cement of loosely consolidated gravel and boulder beds of older scree slopes. The lime cement of the Bossut Formation may be related.

Lime and magnesia mobilisation and deposition began in Tertiary or Pleistocene time and continues at the present day, forming cementations, encrustations, and sheets in the contemporaneous sediments. The kunkar deposits can be related in every case to underlying calcareous or basic rocks, or to waters draining such rocks. The oldest of these deposits may be comparable with the Oakover Formation, of late Tertiary age, as they form a dissected profile which predates the Pleistocene high-level plain.

Bossut Formation

Lime-cemented dune sand, beach sand, and beach conglomerate of the Bossut Formation crop out in several places from Cape Lambert to Boodarie Landing. It is most extensively exposed northeast of Mundabullangana homestead. Dune bedding is common and old dune lines may be distinguished in places. Similar deposits on the adjacent Sheet areas of Dampier and Port Hedland were correlated with the Coastal Limestone of Fairbridge (1953) by Kriewaldt (1964a) and Low (1965). Following Johnstone (1960), Low named them the Bossut Formation.

A sample of beach conglomerate from east of Cape Thouin contained fauna of inconclusive age. Fairbridge suggests a late Pleistocene age for the Coastal Limestone and a similar age has been adopted for the Bossut Formation.

Alluvial and Eluvial Deposits

The coastal plains are composed of up to 150 feet of red clay, silt and sandy clay, forming a high-level plain into which the present-day drainage channels have cut deeply. Disposed along these channels are levees and sheets of silt, which are themselves dissected, though in some places they merge with the creek alluvium. They are also associated with river benches intermediate in level between the creek bottoms and the high-level plain. Similar deposits have been recognized on the adjoining Dampier Sheet area (Kriewaldt, 1964a). Successfully younger stages of deposition are also apparent in the coastal deposits and in the slope deposits which flank the hills.

Boulders, cobbles, and scree predominate on the slopes and grade outwards into the argillites of the plain. The oldest unit, exposed in gullies incised into fossil scree slopes, is cemented by calcareous, ferruginous, or argillic interstitial material. The younger uncemented deposits overlie these, and form river benches and levee-type embankments in places along the upper reaches of creeks. Scree and coarse creek deposits comprise the youngest sediments.

Washed river sand and gravel has been obtained from wells and bores far removed from present river channels on the high-level plain. Turner River No. 5 Bore penetrated 149 feet of clay and sandy clay. Microfossils from a sample taken near Cape Thouin were identified as of late Pliocene or Pleistocene to Recent age. No marine fauna was seen.

The actual composition of the plain varies from dark clay with gilgais over basic rocks to sandy clay and gravel over granite. The plain is believed to be residual, left by the degradation of underlying rock. It is veneered in places by sand and gravel, which increase in particle size towards the outcrop.

TABLE 4. CAINOZOIC DEPOSITS ROEBOURNE 1: 250,000 GEOLOGICAL SERIES

	Age	Map Symbol	Thickness (feet)	Formation	Description	Geomorphology	Remarks
QUATERNARY	Recent	Qr	0–50?	Alluvium	Silt, sand, gravel, and pebbles; beach deposits, aeolian sand, and scree.	In present-day drainage channels, along the coast, and on slopes.	Merges with older alluvium in places.
		Qa	0–10	Older alluvium	Silt and sand, aeolian sand, flood silt, lightly consolidated in places.	On older flood plain and river terraces, disposed along present-day drainage channels, and coast.	Coastal deposits contain *Anadara* aff. *thackweyii*
	Recent to Pleistocene?			Claypan	Sand, silt, silty tussocks and claypans.	Principally at a level slightly lower than the high-level plain.	Thought to have been formed by simultaneous erosion of, and deposition on, high-level plain.
	Pleistocene	Qp	0–150±	Residual deposits	Red and mottled clay, sandy clay, and silt, with sheet kunkar; and local veneer of sand and gravel. Talus and scree cemented by kunkar.	Pediment; high-level plain formed by retreating scarp. Dissected, and overlain by younger deposits in places.	Sandy lenses are good aquifers. Clay contains pollen and microfossils, but no marine organisms.
	Pleistocene	—	0–100?	*Bossut Formation*	Lime-cemented sand and shell conglomerate.	Cemented beach conglomerate, beach sand, and sand dunes.	Correlated with *Coastal Limestone*. Possible aquifer.
	Recent to Pleistocene	Qk	20+	Kunkar	Impure calcareous deposits and incrustations, with some siliceous nodules.	Forms dissected profile, topographically above high-level plain between Toweranna and Yule River. Also forms along drainage channels and as sheets in high-level plain.	Chemical deposits, still forming at present day, from lime-rich waters derived from basic or calcareous rocks. Older kunkar formed on calcareous rocks and may be correlative of kunkar on *Oakover Formation.*
TERTIARY	? Pliocene	T	20–50	Pisolite	Limonitic, goethitic, hematitic pisolite, with detrital grains and fossil wood.	Ferruginized valley-fill, deposited along ?Pliocene drainage channels. Dissected mesas of ?Pliocene land surface.	Correlated with *Poondano Formation* and *Robe Pisolite*. Contains iron ore.

6264—J33

The flood silt deposited along drainage channels overlies a dissected profile of the plain, and towards the coast coalesces to form extensive silt plains up to 10 feet thick. Accumulations of the mollusc *Anadara* aff. *thackweyii* are found in this silt along the edges of the tidal flats. Comparable beds in South Australia contain a similar fauna (Horwitz, 1962; Sprigg, 1952). These *Anadara* deposits are themselves dissected, and they merge into tussocky claypan country consisting of silty grassed hummocks which rise several feet above a hard claypan. The claypan itself is mostly covered by silt. Associated with both the claypans and the silt beds are seif dunes and belts of lightly vegetated red sand. The westward migration of these dunes is evidenced by the westward deflection of the Peawah River north of Mallina homestead.

In the Canning Basin similar dunes are considered by Veevers & Wells (1961) to have been formed during the Pleistocene. If the dunes of the Roebourne area are of similar age, then the unconsolidated flood deposits from which they derive sand must also be of the same age. On the other hand, an age of 2,000 years was obtained from specimens of *Anadara* by radiocarbon dating. This work was carried out by the Department of Industrial and Scientific Research in New Zealand, on specimens obtained from the Dampier Sheet area. The coast is marked by three roughly parallel dune series whose relative ages are indicated by the degree of dissection and vegetation. The oldest is associated with a sandy high-level plain which is the coastal equivalent of the red clay. It has been dissected by tidal and fluviatile activity and forms prominent breakaways bordering the tidal flats; and is covered in places by *Anadara*-bearing silt. Younger dunes have formed successively to seaward, in places truncating older dune lines. The youngest merges with the beach and shoal sand of the present coast. The Cainozoic units are listed in Table 4.

STRUCTURE

The major tectonic elements of the area are the two broad granitic domes which underlie the plains. The Roebourne Group is folded between these domes, and incorporated in them to some extent. Dips are generally steep, but vary from overturned in the axes of synclines to gentle where the Roebourne Group dips off the flanks of the granite. The doming is attributed to the rising of the granitic material, and there is no evidence of lateral cratonic movement. The domes may consist entirely of primary granite magma with assimilated Archaean rocks; they may be palingenetic granite derived from the lower clastic members of the Roebourne Group; elements of an older basement; or a combination of any of these (Ryan, 1965).

The dominant folding in the Archaean trends east to northeast, with a marked left hand offset in places, which is thought to have been caused by cross-folding. Two sets of foliation are exposed in the gneiss in the bed of the Sherlock River, and Cadell (1899, p. 181) states that 'The older and coarser banding has a north-south strike . . . and at right angles to this there are zones of secondary and much finer foliation'. Noldart & Wyatt (1962) also noted two directions of deformation within the Pilbara System.

A succession of large folds in the Roebourne Group between Dixon Island and Andover homestead consists of tight synclines and rather broader domes and ridges with granite cores. The principal synclinal axes strike southeast at Dixon Island and Point Samson, and easterly at Mt. Ada. The metamorphic and intrusive complex south of Roebourne occupies a shallow faulted basin flanked, and probably underlain at shallow depth, by granite and metasomatized rocks. Northeast-trending synclines north of Mt. Negri and south of Whim Creek are intersected by folds which trend roughly north; and a northerly fold direction, superimposed on the predominant easterly trend, is also apparent west of Mt. Dove, approximately along the course of the Yule River.

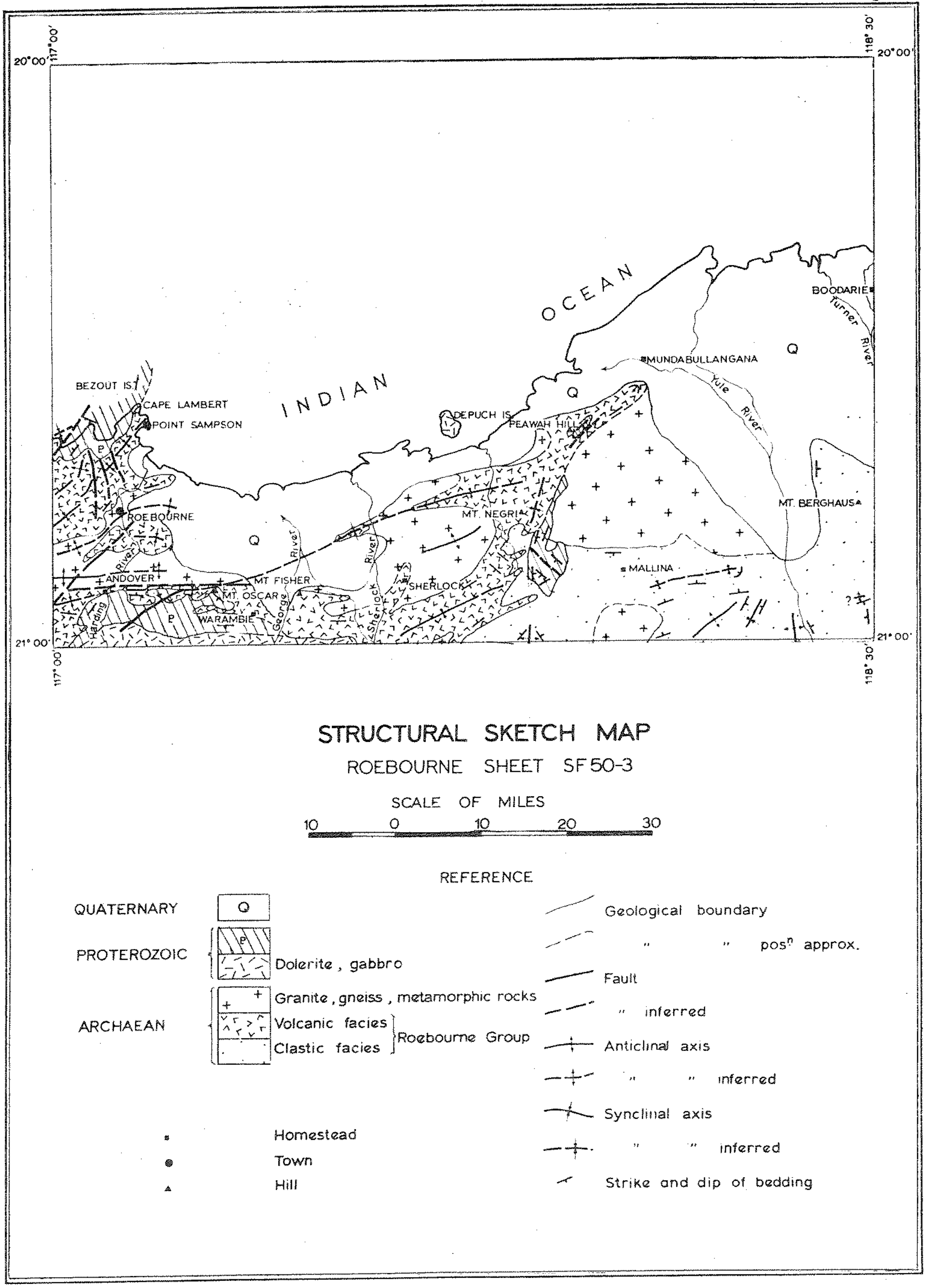
A number of faults, which strike northwesterly, have displaced the syncline which lies between Roebourne and Mt. Anketell. To the south an apparent continuation of this zone strikes southwest, and basic igneous activity has been located along it.

A major tectonic lineament, marked by shearing, mylonitization, and cataclasis, separates a truncated syncline of the Roebourne Group from granite and gneiss along a line from west of Andover Homestead eastwards to the Jones River, where superficial deposits obscure the outcrop. It is thought to be a zone of near-vertical movement, along which granite rocks have moved upwards relative to the southern block of volcanic and sedimentary rocks.

Proterozoic rocks are insufficiently preserved for a determination of Proterozoic tectonic trends. They occupy flat, faulted basins at Dixon Island and Whim Creek; and in the principal area of outcrop, between the Harding River and the George River, they dip gently south, except between Mt. Ada and Mt. Oscar, where faulting and irregular dips are common. Fault subsidence during deposition is apparent from at least two localities.

The Mt. Roe Basalt, the lowermost formation in the Fortescue Group, is almost entirely restricted in occurrence to the centres or flanks of underlying Archaean synclines. This, coupled with the evidence of contemporaneous subsidence, points to a continuation into the Lower Proterozoic of movement initiated during the Archaean Pilbaran Orogeny (Kriewaldt, 1964b).

Fig 1


20°00'
117°00'
118°30'
21°00'
INDIAN
OCEAN
BEZOUT IS.
CAPE LAMBERT
POINT SAMPSON
ROEBOURNE
ANDOVER
MT FISHER
MT. OSCAR
WARAMBIE
Harding River
George River
Sherlock River
SHERLOCK
MT. NEGRI
DEPUCH IS.
PEAWAH HILL
MUNDABULLANGANA
Yule River
Turner River
BOODARIE
MT. BERGHAUS
MALLINA
Q
P
STRUCTURAL SKETCH MAP
ROEBOURNE SHEET SF 50-3
SCALE OF MILES
10 0 10 20 30
REFERENCE
QUATERNARY
PROTEROZOIC
Dolerite, gabbro
ARCHAEAN
Granite, gneiss, metamorphic rocks
Volcanic facies
Clastic facies
Roebourne Group
Homestead
Town
Hill
Geological boundary
" " posn approx.
Fault
" inferred
Anticlinal axis
" " inferred
Synclinal axis
" " inferred
Strike and dip of bedding

ECONOMIC GEOLOGY

Copper was first discovered southwest of Roebourne in 1872, and subsequent discoveries created much interest in the area. However, the apparent potential was never realised, and only the Whim Creek copper lode remained as a significant producer. Many small metallic and non-metallic deposits have been exploited with varying success; but mining was at a standstill in 1962, apart from an attempt by the Depuch Mining and Shipping Co. to revive Whim Creek, and sporadic working of beryl-bearing pegmatites by aboriginals south of Mt. Hall. However, the area has proved to be well endowed with excellent groundwater supplies which has permitted the establishment of a thriving pastoral industry. Summaries of mineral production are given in Tables 5 and 6.

TABLE 5. ROEBOURNE 1: 250,000 SHEET

RECORDED PRODUCTION OF MINERALS OTHER THAN GOLD TO 31ST DECEMBER, 1963*

Mineral	Locality	Production	Value	Remarks
		Tons	£	
Chrysotile	Roebourne	4.29	253	
	Sherlock	816.09	19,592	
Copper ore	Roebourne	2,573.00	37,658	
	Whim Creek	77,541.00	66,109	Only from 1899
Cupreous ore	Whim Creek	11,394.53	115,779	489 tons in 1963
	Roebourne	41.15	696	
Beryl	Roebourne	104.71	16,036	
	Whim Creek	3.39	600	
Tanto-columbite ..	Roebourne	8.47	16,424	
Tin	Roebourne Pilbara	3.56	1,759	Production shown jointly
Lead ore	Whim Creek Roebourne	180.05	7,732	Production shown jointly

(*) Figures supplied by Statistics Branch, Mines Department.

TABLE 6. ROEBOURNE 1: 250,000 SHEET

RECORDED GOLD PRODUCTION TO 31ST DECEMBER, 1963*

Mining Centre	Alluvial, Dollied, Specimens	Milled or Smelted		Total
		Ore treated	Gold	
	Fine oz.	Tons	Fine oz.	Fine oz.
Mallina	..	141.60	128.44	128.44
Roebourne	18.76	4,343.71	2,241.93	2,260.69
Weerianna	..	3,536.15	3,349.81	3,349.81
Toweranna	2.62	3,987.80	5,199.86	5,202.48

(*) Figures supplied by Statistics Branch, Mines Department.

MINERAL DEPOSITS

By 1909 activity in the West Pilbara Goldfield was declining, and in that year Woodward (1911) made a comprehensive examination of the area. The next intensive survey was that of the Aerial, Geological and Geophysical Survey of Northern Australia between 1935 and 1940. Brief reports have appeared in publications of the Department of Mines from time to time.

The mineral deposits of the Sheet area may be classified as follows:

Auriferous quartz lodes and magnetite lodes associated with intrusive and metasomatic rocks.
Cupriferous lodes in slate.
Antimony-bearing gold-quartz lodes in slate.
Chrysolite lodes in ultrabasic rocks.
Pegmatites.
Pisolites.

Lodes associated with metasomatism

Copper and cobalt-bearing gold-quartz lodes occur near Roebourne where they occupy short irregular fissures in metamorphosed lower members of the volcanic facies of the Roebourne Group. The most important lodes are those of the Weerianna, Carlow Castle, Good Luck and Fortune groups, which have been described by Finucane and others (1941). At Toweranna quartz reefs lie in an outcrop of granite porphyry which has intruded slate (Telford, 1939a).

Assays of up to 18% TiO_2 have been obtained from a group of magnetite bodies west of Mt. Gregory (Finucane & Telford, 1941). Similar ferruginous bodies crop out about 6 miles north-northwest of Whim Creek (Jones, 1965). Southwest of Mt. Gregory the Andover lead lode lies in metasomatized rocks. Maitland (1919) gives the following assay of a sample taken from open cuts along the lode:

lead 67.17%; copper 0.42%; silver 3 oz 18 dwt per ton.

Copper deposits in slate

The copper deposits of Whim Creek and Mons Cupri, and several small showings of copper in the vicinity, are localized at the contact of slate with underlying siliceous rocks of the Mt. Brown type (see p. 8). Quartz is rare and iron oxides (pseudomorphic after sulphide) constitute the dominant gangue minerals. Lead mineralization is present in the copper lodes, and there is also a small lead-silver lode, the Comstock, south of Mons Cupri. Assays of three samples of ore from the Comstock lode were as follows (Maitland, 1919):

lead, 41-57%; silver, 8-66 oz per ton; gold, trace.

The Whim Creek lode has been one of the largest producers of copper in Western Australia. Descriptions have been given by many, of whom Woodward (1911), Finucane & Sullivan (1939), and Low (1963) are the most comprehensive.

Antimony-bearing quartz lodes

Antimony and gold has been won from quartz reefs around Mallina homestead, and at Peawah, 4 miles to the stoutheast (Telford, 1939b). An antimony lode, the Star, has also been reported by Telford from a locality 5 miles northeast of Mt. Negri.

Chrysotile lodes

Seams of chrysotile are found in serpentinite and other altered basic rocks throughout the area. The fibre has been exploited near Sherlock homestead, and from several localities southeast of Roebourne (Adams, 1944; Finucane and others, 1939). Corundum is also found in serpentinite south of Roebourne; magnetite occurs in a concordant ultramafic body south of Mallina homestead.

Pegmatites

The serpentinites south of Mt. Hall near Roebourne contain many pegmatite dykes, and some of these carry quantities of beryl and spodumene, as well as lepidolite, zinnwaldite, tantalite, and other economic minerals in less abundance. The beryl has been exploited by a co-operative of aboriginals. It occurs in a finely disseminated form and Ellis (1962) considers it unlikely that the beryl can be mined on a large scale. Tantalite and cassiterite are won from the adjacent gullies by the aboriginals.

Pisolites

The pisolites of the area are similar to the Robe Pisolite of de la Hunty (1965) in the Hamersley Iron Province, but they are of insufficient tonnage to warrant attention; although more extensive deposits could exist below the plain near the Yule River.

Roebourne is the centre of a small semi-precious stone industry. Stones are obtained from the Cleaverville Formation (jaspilite), the Regal Formation and underlying sediments (jadeite, prase, serpentine, agate, carnelian) and from the Mt. Roe Basalt (agate), as well as localities outside the Sheet area.

Granite and gneiss, quartz float, dolerite, basalt, and pisolite provide abundant sources of aggregate, road metal, and ballast.

Between Bezout Island and the mainland there is a very strong magnetic anomaly which has been discussed in detail by Woodward (1911). It may be caused by a magnetite or basic body in the Roebourne Group; a basic intrusive similar to that at Depuch Island; or the Mt. Roe Basalt.

WATER

Stock water, used principally for sheep and horses, abounds throughout the area. The sand and gravel beds of the high-level plain, kunkar deposits, and cemented cobble and gravel beds near hills all provide suitable aquifers. Water is usually found at 40 feet or less, and is generally of excellent quality. Saline waters are found along the coast and in places were bedrock is shallow, though the water is rarely too salty for sheep. Fresh water is obtained from dune sand and the underlying Bossut Formation both at Point Samson and north of Mundabullangana, though supplies are limited. Water derived from basic rocks may be rich in lime. There are also many permanent or nearly permanent waterholes along the rivers. Sub-surface flow persists throughout the year along these rivers.

Water for the township of Roebourne is obtained from bores in deep alluvium near the town. The Port Hedland water supply is drawn from similar alluvium on the Turner River south of Boodarie Homestead, where large quantities of fresh water have been obtained. To date no consideration has been given to surface storage because no need has arisen, and in general suitable sites are rare. However, the Harding River offers several potential dam sites should greater supplies of water be required in the Roebourne area. At present domestic water for Point Samson is brought as ballast by ships calling at the port. At Whim Creek water is obtained from wells along the banks of creeks, and from the mine workings.

Table 7 shows some typical underground water supplies in the Sheet area, and the locations of about 285 known wells and bores are shown on Figure 2.

TABLE 7. TYPICAL UNDERGROUND WATER SUPPLIES—ROEBOURNE SHEET

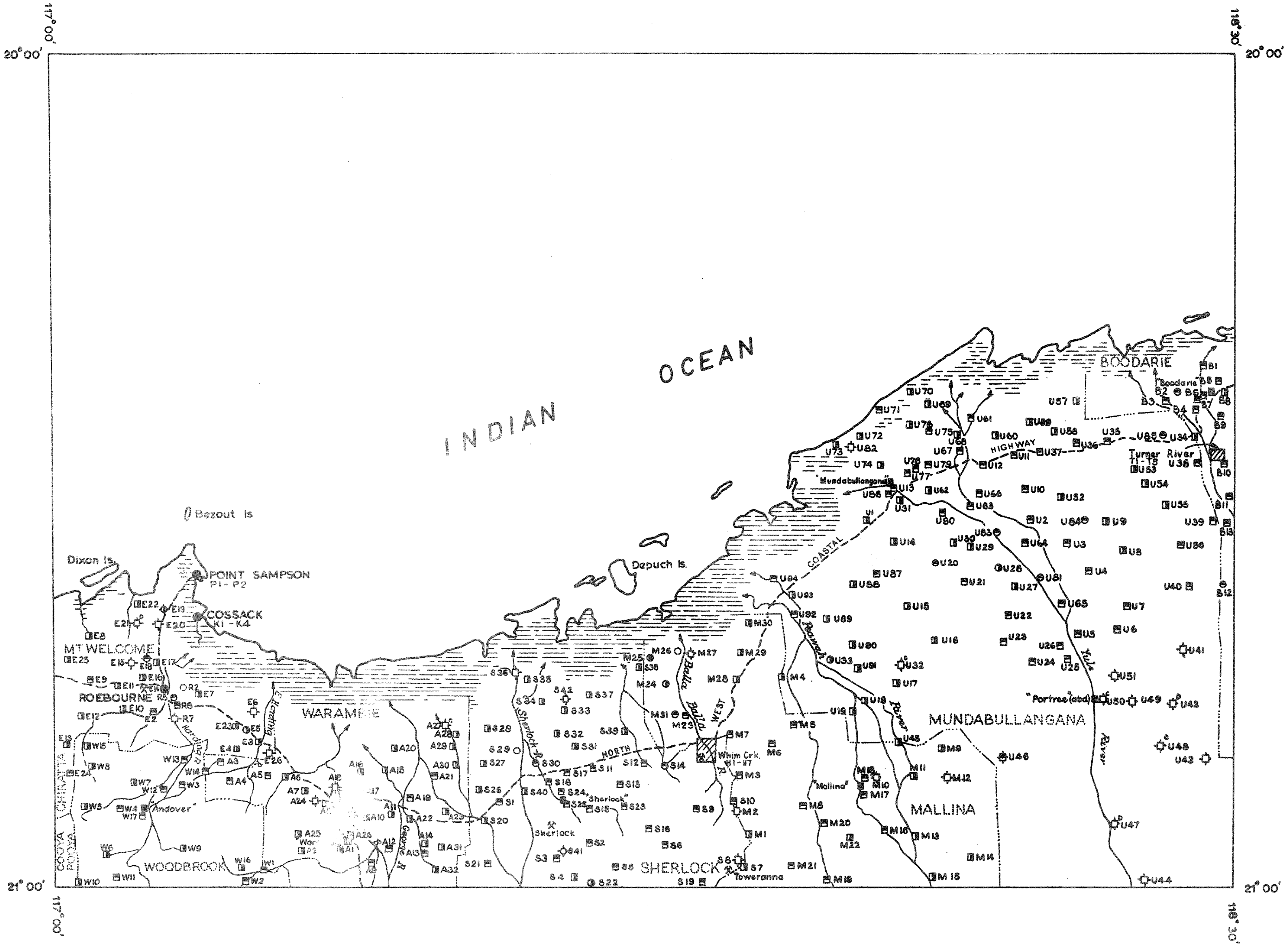
Name	No.*	Depth of Hole (Feet)	Depth to Water (Feet)	Quality	Aquifer
Roebourne Town—					
Town Supply Bore 2 ..	R5	64	23	Potable	Alluvium. Supply 5700 gph.
Port Hedland Town—					
Turner River Bore 3 ..	T6	85	30	Potable	Clayey sand, gravel. Supply 2800 gph.
Turner River Bore 5 ..	T8	149	30	Potable	Clayey sand. Supply 5000 gph.
Mt. Welcome Station—					
Rocky Creek Well ..	E8	16	8	Stock	Alluvium, kunkar
Shaw Well	E7	16	12	Stock	Red clay, sand

TABLE 7—*continued*

Name	No.*	Depth of Hole (Feet)	Depth to Water (Feet)	Quality	Aquifer
Woodbrook Station—					
Lead Mine Well ..	W7	23	20	Stock	Old mine shaft
Lockyer Well ..	W11	45	30	Potable	Alluvium over sandstone
White Quartz Well ..	W13	32	24	Potable	Alluvium
Woodbrook Well ..	W1	35	17	Potable	Alluvium, kunkar
Warambie Station—					
Andy Well	A6	58	27	Stock	Alluvium, kunkar
Terena Well	A20	19	12	Stock	Alluvium
Willie Well	A12	25	17	Potable	Alluvium, kunkar
Whithnell Well ..	A28	18	16	Stock	Alluvium
Koodipuntja Well ..	A32	36	21	Stock	Alluvium, kunkar
Sherlock Station—					
Ryan Well	S26	34	31	Potable	Red clay, sand
Good Luck Well ..	S2	35	19	Potable	Alluvium
Louden Well	S9	40	20	Potable	Alluvium
Croydon Deep Well ..	S19	92	70	Potable	Red clay
Mallina Station—					
Negri Well	M28	45	15	Stock	Alluvium
Gorge Well	M6	60	23	Potable	Alluvium
Homestead Well (N) ..	M18	57	50	Potable	Old mine shaft
Six Mile Well.. ..	M13	40	32	Stock	Alluvium, kunkar
Langenbeck Well ..	M14	50	29	Stock	Alluvium, kunkar
Mundabullangana Station—					
Victory Well	U71	10	7	Potable	Sand over Bossut Formation
Parracumurra Well ..	U36	34	30	Potable	Sandy clay over wash
Woolshed Well ..	U10	38	37	Potable	Sandy clay over sand and gravel
Progress Bore ..	U84	40	35	Potable	Sandy clay over sand
Ah Tie Well	U56	44	40	Potable	Sand
Johnson Well ..	U93	31	23	Stock	Alluvium
Walter Well	U15	80	35	Stock	Red sandy clay. Granite spoil
Munerina Well ..	U23	34	29	Potable	Sand, gravel, kunkar
Portree No. 4 Well ..	U46	56	28	Potable	Alluvium over gneiss
No. 17 Well	U6	43	36	Potable	Alluvium, kunkar
Boodarie Station—					
Garden Well	B7	37	31	Potable	Alluvium

* See Fig. 2

Fig 2



WATER SUPPLIES

ROEBOURNE SHEET SF 50-3

SCALE OF MILES

10 5 0 5 10 15 20 25

REFERENCE

Main road	
Station boundary	
Pastoral station	MALLINA
Homestead	"Boodarie"
Mining centre	Whim Ck.
Town	ROEBOURNE
Stream (non perennial)	
Area of closely spaced wells and bores	Turner River
Well - quality potable	S26
quality stock	A17
abandoned	E26
abandoned, dry	U47
abandoned, collapsed	U82
Bore - quality not specified	S29
quality potable	R5
quality stock	M26
abandoned	S41

NOTE: Details for wells and bores shown on this sheet are available at the Geological Survey of Western Australia

6264

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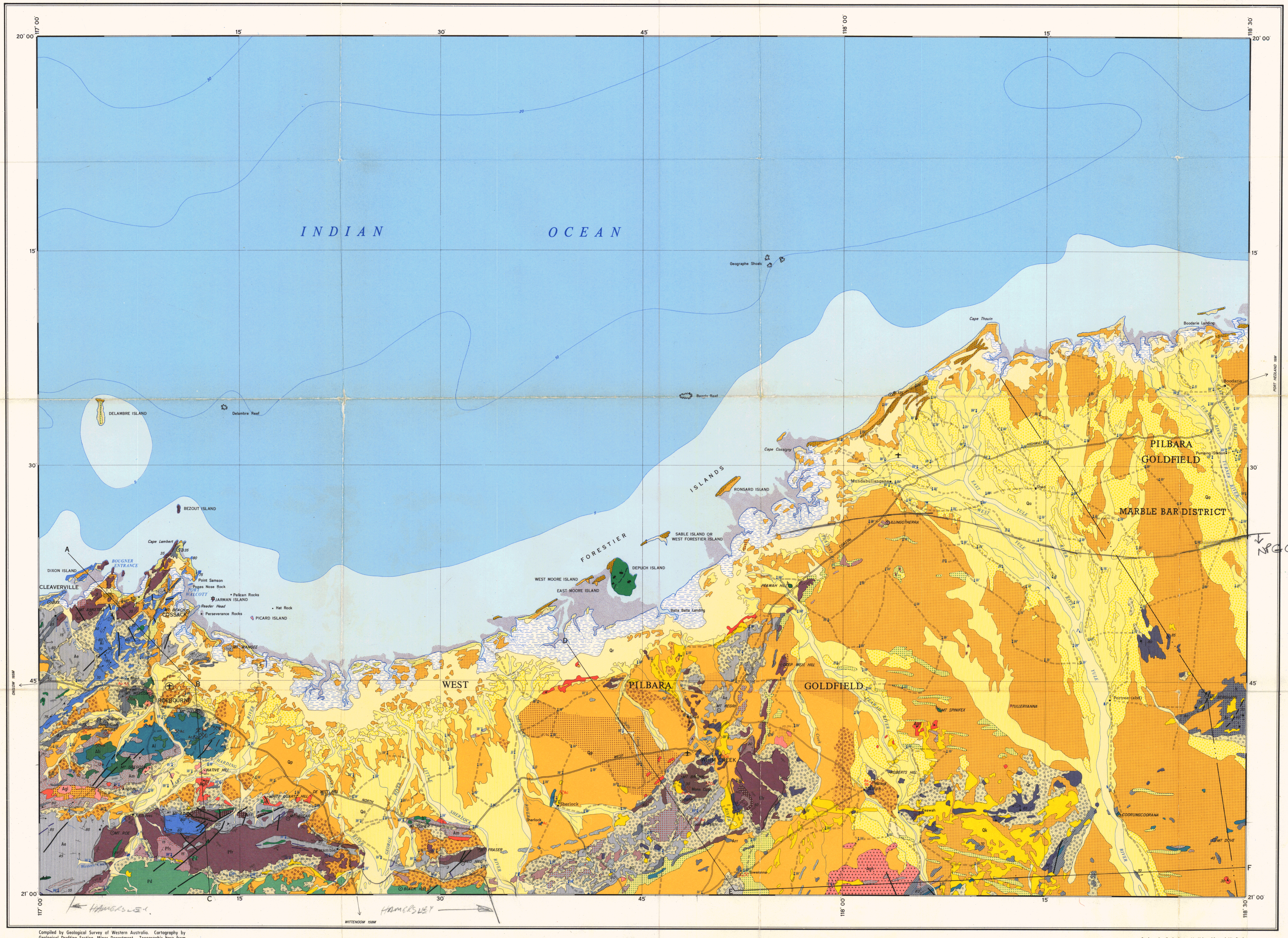
6264/7/70—300—O   ALEX. B. DAVIES, Government Printer, Western Australia

ROEBOURNE

AUSTRALIA 1:250,000 GEOLOGICAL SERIES

GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

SHEET SF 50-3



SYMBOLS

Geological boundary
Fault
Strike and dip of bedding
Vertical bedding
Dip and plunge of drag structures
Plunge of fold axis
Facing from sedimentary rocks
Facing from pillow lavas
Strike and dip of lavas
Vertical lavas
Strike of lavas, dip unknown
Strike and dip of bedding } air photo interpretation
Strike and dip of lavas } air photo interpretation
Strike and dip of foliation
Vertical foliation
Strike and dip of joints
Vertical joints
Strike and dip of banding
Strike and dip of cleavage

Highway
Formed road
Track
Homestead
Airfield
Landing ground
Trigonometrical station
Goldfield boundary
Lighthouse

Windpump
Well
Bore
Pool
Watercourse (non perennial)
Fathom line
Highwater area
Foreshore sand

Mine, or mining area
Prospect
Gold
Copper
Cobalt
Lead
Iron
Antimony
Beryl
Chrysotile
Spodumene
Vanadium

REFERENCE

CAINOZOIC

RECENT

Qr — Alluvium: Creek deposits, flood out deposits, silt on high tidal flats

Sand: Beach sand, mobile coastal and inland dune sand

Gravel: Downwash, scree, talus; slope deposits

Qa — Dune sand: Brown and white fixed coastal sand dunes

Dune sand: Red fixed inland sand dunes; sief dunes

Silt sand: Fluviatile flood deposits, levees; older alluvium; silt with Anadara aff. thackweyii

Clay, silt: Flood plain deposits of silty tussocks and claypans on dissected high-level plain

PLEISTOCENE

Qp — Red sandy clay: High-level sand plain with some older flood deposits and claypans

Clay, gravel: High-level clay plain with gravel veneer; pediment

Red sand, gravel: High-level plain over granite; pediment

Red clay: High-level plain of red and mottled clay and silt; gilgais; intermittent silt and gravel veneer; some sheet kunkar

Qk — BOSSUT FORMATION: lime-cemented beach conglomerate and dune sand (Correlated with COASTAL LIMESTONE)

Kunkar: Impure calcareous sheets and as incrustations, some opaline silica

? PLIOCENE

T — Pisolite: Ferruginous and lateritised valley fill and bedrock; with sand and fossil wood; lateritic gravel (Correlated with POONDANO FORMATION)

LOWER PROTEROZOIC

Dolerite: Altered quartz dolerite dykes } Intrude all Precambrian rocks

d — Dolerite: Altered dolerite stocks and sills } Intrude all Precambrian rocks

Pd — COOYA POOYA DOLERITE: Massive altered (serpentinised) dolerite sill Intrudes FORTESCUE GROUP Includes large rafts of disrupted and indurated sandstone

b — Basic intrusives: Massive, medium-grained to coarse-grained altered basic rocks intruding Archaean rocks only but considered to be of Proterozoic age

MT. BRUCE SUPERGROUP — FORTESCUE GROUP

Pfs — Tuff: Bedded, green sandy tuff with concentric structures up to 10mm

Sandstone: Coarse, poorly bedded tuffaceous micaceous sandstone (Correlated with HARDEY SANDSTONE)

Agglomerate: Boulder agglomerate with elements of granite and jaspilite

Pfr — MT ROE BASALT: Basic and intermediate amygdaloidal, vesicular, columnar lavas; pyroclastic and sedimentary rocks, basal arenites; contains distinctive flows with stellate clusters of feldspar phenocrysts

Shale, claystone

Sandstone

Porphyritic flow

Basal arenite

ARCHAEAN

q — Quartz

Pegmatite: Beryllium and lithium bearing pegmatites; Includes aplite and granite dykes

Agh — Melanocratic granite: Hornblende-rich intrusive rock ranging in composition from granite to tonalite and diorite, contains basic xenoliths

Ab — Gabbro: Medium-grained to coarse-grained, green or black and white intrusive, cut by granite; grades to amphibolite and ultrabasic rock in places

Agl — Leucocratic granite: Light-coloured equant, medium-grained massive, or weakly foliated quartz-feldspar rock, generally poor in ferro-magnesian minerals

Agn — Gneiss: Well foliated, banded coarse-grained granitic rock with relicts of older rocks, grades in places to hybrid and metasomatic rocks

Am — Hybrid and metasomatic rocks: Massive schistose, foliated banded and sheared acid, basic, and hybrid rocks; an assemblage of metamorphosed and metasomatised Archaean rocks intruded by granite, gabbro, and associated derivatives with many gradations between the various rock types

Ad — Dolerite: Massive intrusive dolerite, mildly sheared; folded with Archaean rocks

PILBARA SYSTEM — ROEBOURNE GROUP

Ai — CLEAVERVILLE FORMATION: Banded jaspilite, chert, hematite, shale, interbedded red shale and siltstone; some concordant green granular rocks (Correlated with GORGE CREEK FORMATION)

Ae — REGAL FORMATION: Intercalated altered basic volcanic rocks, pillow lavas, pyroclastic rocks; serpentinised basic rocks, calcareous and clastic rocks, chert, granular and aphanitic concordant green rocks; epidosite; and undifferentiated intrusive rocks

Dark coloured aphanitic rocks with spheroidal bodies; altered pyroxene and amphibole

Pale grey-green aphanitic rocks with acicular crystals of pyroxene replaced by bastite, some seams of chrysotile

Porphyry, blue to dark coloured aphanitic matrix, quartz and feldspar phenocrysts; some breccia and pseudo-conglomerate

Clastic rocks

Ar — Greywacke: Quartz-greywacke, siltstone, shale, turbidites

Slate: Chloritic slate, phyllite, shale; some siltstone, calcareous shale, thin ferruginous and cherty beds

Al — Ultrabasic rocks: Dark-coloured serpentinite; serpentinised basic rock, metadolomite, coarse-grained amphibolite, minor gabbro anorthosite, talc schist, chlorite schist; chrysotile seams

As — Metamorphosed sedimentary rocks: Calcareous sedimentary rocks, amphibole schists, skarn rocks; andalusite schist, clastic rocks; banded chert with prase, fuchsite schist, blocky quartz-epidote-dolomite rock, tuff and lava; local conglomerate

Granular siliceous rock; orange weathering, green to pale coloured with spheroidal and pebble-like bodies, quartz grains, chlorite wisps, clay pellets, some feldspar, pseudo-conglomerate and breccia at top; associated porphyry

Grey shale: siltstone, greywacke, calcareous shale, dolomite chert; green aphanitic and granular rocks

Granular amphibolite: Massive medium-grained altered basic rock; generally concordant

Arr — Slate: Chloritic slate, siltstone, minor greywacke

Ars — Sandstone: Medium-grained, bedded and massive, with interbedded shale and slate

Compiled by Geological Survey of Western Australia. Cartography by Geological Drafting Section, Mines Department. Topographic base from compilations by Lands and Surveys Department.

Published by Bureau of Mineral Resources, Geology and Geophysics, Department of National Development, Canberra, A.C.T.

Copies of this map may be obtained in Perth from the Geological Survey of Western Australia or the Bureau of Mineral Resources, Geology and Geophysics in Canberra, A.C.T.

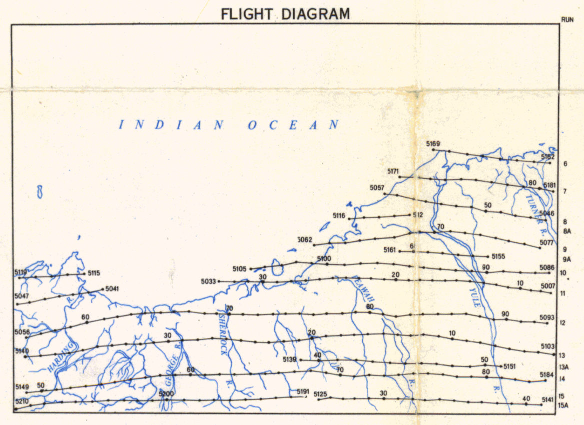
Geology by G. R. Ryan, M. Kriewaldt and W. Bock

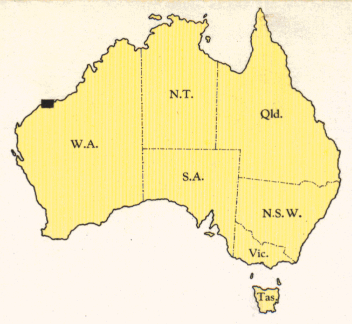
HON. A. F. GRIFFITH, M.L.C.
MINISTER FOR MINES
J. H. LORD, DIRECTOR, GEOLOGICAL SURVEY

SCALE 1:250,000

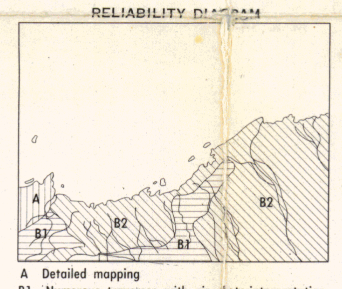
TRANSVERSE MERCATOR PROJECTION
ZONE 1 AUSTRALIA SERIES

FLIGHT DIAGRAM





RELIABILITY DIAGRAM



A Detailed mapping
B1 Numerous traverses with air photo-interpretation
B2 Air photo interpretation with a few traverses

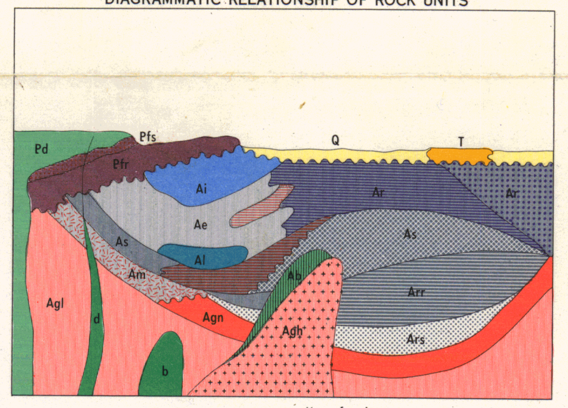
INDEX TO ADJOINING SHEETS

		BEDOUT ISLAND SF 50-16
DAMPIER SF 50-2	ROEBOURNE SF 50-3	PORT HEDLAND SF 50-4
YARRALOOLA SF 50-6	PYRAMID SF 50-7	MARBLE BAR SF 50-8

DECLINATION DIAGRAM

Annual change is negligible

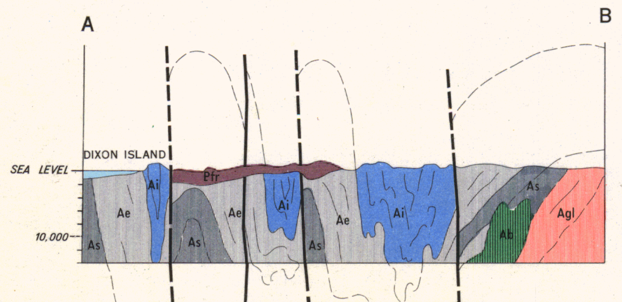
DIAGRAMMATIC RELATIONSHIP OF ROCK UNITS



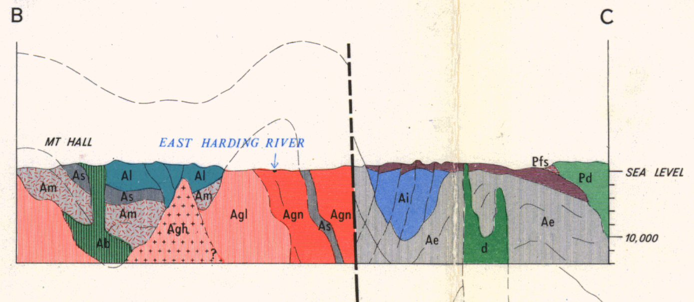
Unconformity

DIAGRAMMATIC SECTIONS

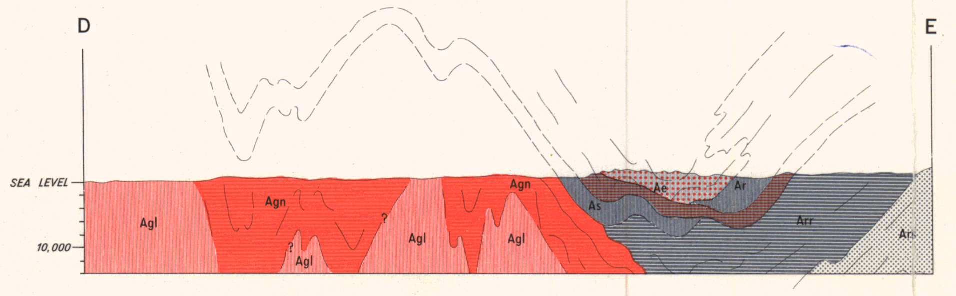
SECTION A - B



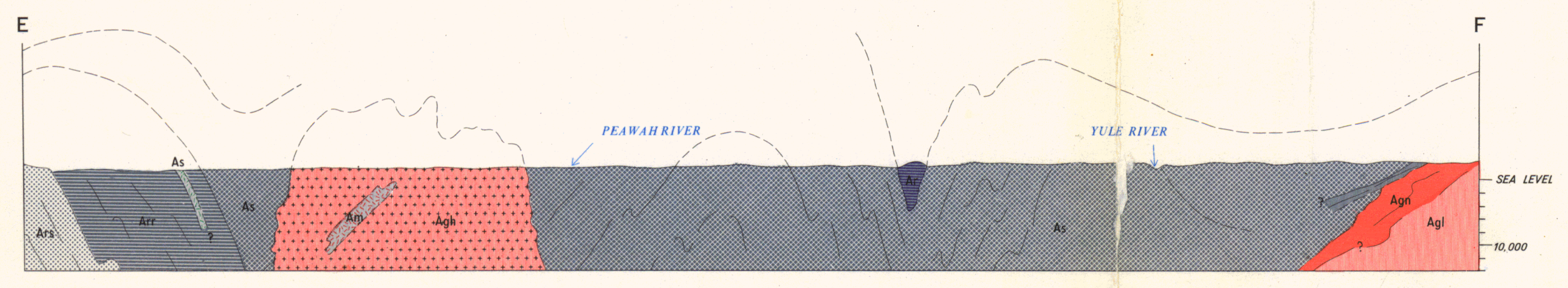
SECTION B - C



SECTION D - E



SECTION E - F



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ROEBOURNE
SHEET SF 50-3

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