1:250 000 GEOLOGICAL SERIES—EXPLANATORY NOTES

CORNISH

WESTERN AUSTRALIA

SHEET SF/52-1 INTERNATIONAL INDEX

DEPARTMENT OF NATIONAL DEVELOPMENT
BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

DEPARTMENT OF INDUSTRIAL DEVELOPMENT, MINES, FUEL & ENERGY, WESTERN AUSTRALIA
GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

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COMPILED BY R. W. A. CROWE

AUSTRALIAN GOVERNMENT PUBLISHING SERVICE
CANBERRA 1978

DEPARTMENT OF NATIONAL DEVELOPMENT

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GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

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ISBN 0 642 03826 0

Published for the Bureau of Mineral Resources, Geology and Geophysics
by the Australian Government Publishing Service

Printed by Graphic Services Pty Ltd, 516-518 Grand Junction Road, Northfield, S.A. 5085

Explanatory Notes on the Cornish Geological Sheet (Second Edition)

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(Geological Survey of Western Australia)

The Cornish 1:250 000 Sheet area is bounded by latitudes 20° and 21°S and longitudes 126° and 127°30′E. It lies within the northeastern part of the Canning Basin in the Great Sandy Desert of Western Australia, and is unpopulated.

Access to the northeastern part of the Sheet area may be gained along station tracks from either Lake Gregory homestead, 15 km to the east, or from Billiluna homestead, 75 km to the northeast. Distances from Lake Gregory homestead to Alice Springs and Halls Creek are 950 km and 295 km, respectively. An alternative route via Chungla Well to Christmas Creek station, across the Mount Bannerman Sheet area (about 210 km), exists, but the track was in poor condition in 1973. Access to the western part of the Sheet area may be gained via several seismic-survey lines which connect with tracks on Christmas Creek station to the north. Elsewhere in the Sheet area access is generally poor and is mainly restricted to a track which follows the old Canning Stock Route southwest as far as Gravity Lakes. The track is in fair condition only as far as Mount Romilly. Newer tracks have been put in by oil companies for seismic surveys and these give limited access to the rest of the Sheet area. All the tracks that were passable in 1973 are shown on the geological map.

The area lies north of the Tropic of Capricorn and has a hot summer with low rainfall and a cool dry winter. The average annual rainfall is 230 mm and the annual evaporation is 2.8 m (Australia, Bureau of Census and Statistics, 1972). The prevailing winds blow from the east and southeast. The area lies within the Canning and Mueller botanical districts of Beard (1969) who describes the flora.

Mapping bases available for the Sheet area include topographic maps at a scale of 1:250 000, aerial photographs flown in 1953 at a scale of 1:50 000, and in 1971 at a scale of 1:80 000. These are available from the Division of National Mapping, Department of National Resources, Canberra and from the Western Australia Lands and Surveys Department.

Physiography and geomorphology

The area consists of sandplain with abundant dunes, groups and ranges of sandstone buttes and mesas, and salt lakes in the northeast (Fig. 1).

Most buttes and mesas are 15 to 30 m above the plain level, but those near Godfreys Tank are up to 90 m high. Some ranges parallel major faults and contain fault-line scarps (e.g. Bishop Range and French Hills in the southeast, and Minnie Range in the north). Laterite caps mesas in the western Southesk Tablelands and the Roberts Range area. Elsewhere, however, the capping is either missing or largely eroded.

The longitudinal sand dunes are up to 15 m high, 25 km long, and the crest spacing ranges from several kilometres to less than 100 m. The dunes were formed by east and southeast winds (Veevers & Wells, 1961; Crowe, 1975).

Sand plains with few dunes occur in several parts of the Sheet area; the largest is centred around Gregory Salt Lake in the northeast, and others lie mostly on the western sides of the ranges and hills (Fig. 1).

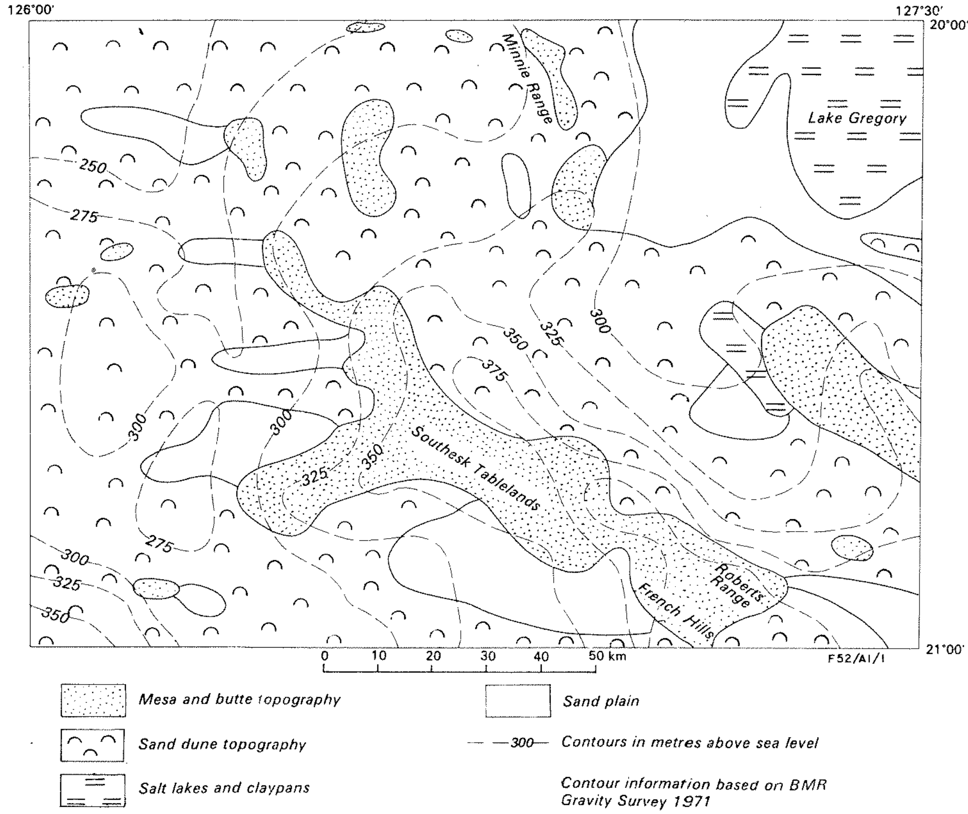

Fig. 1. Physiography.

Salt lakes and claypans are shown only in two areas on the physiographic map (Fig. 1), but smaller claypans occur throughout the rest of the Sheet area. Gregory Salt Lake consists of a maze of claypans, active and inactive drainage channels, and low ridges of calcrete capping exposures of Lake Gregory Beds. Linear ridges (shown as lineaments) near Delivery Camp Plain and Gregory Salt Lake in the northeast are thought to represent old channels or shorelines of the former lake system. Salt lakes and claypans around and to the north of Lady Edith Lagoon are developed on Blina Shale, and are probably the result of large amounts of clay being supplied from this formation on weathering.

The present drainage of the Cornish Sheet area consists mainly of small ephemeral creeks draining high ground and discharging into the surrounding sand plain. Gregory Salt Lake is the terminal drainage area for Sturt Creek from the north, and several smaller drainages such as Djaluwon Creek, which enters from the southeast. The lake usually contains water, but occasionally dries up. There is evidence that a well-developed dendritic drainage once existed in the area. To the southwest of Point Massie, old drainage channels preserved in the laterite capping of the now-dissected plateau can be readily seen on aerial photographs. On a larger scale, an ancient drainage system similar to that described by Bunting et al. (1974) probably existed in the area.

Previous investigations

Early explorers who travelled through the area included Gregory (1857), Warburton (1875), and Carnegie (1898). Carnegie noted sandstone hills in the Southesk Tablelands.

In 1906-07, Canning surveyed the Canning Stock Route between Halls Creek and Wiluna, and this traverses the area. Talbot accompanied Canning along the stock route and published an account of the geology (Talbot, 1910). Kidson recorded magnetic observations made in 1914 (Kidson, 1921). Jones (1922) traversed the stock route and reported a dome structure about 3 km east of No. 48 Well, and monoclinal folding about 3 km west of No. 50 Well.

Terry (1927) noted shaly sandstone with cappings of yellowish brown sandstone around Godfreys Tank and collected samples from Mount Cornish in 1925. He later summarized the exploration history of the Canning Basin (Terry, 1957).

Woolnough (1933), Mackay (1934), and Bremner (1940) made aerial surveys in the region, and Maddox (1941), Evans (1948), and Reeves (1949) made geological traverses for oil companies.

An aeromagnetic survey of the Sheet area was made in 1954 (Quilty, 1960). The BMR geological reconnaissance survey in 1955 (Wells, 1962; Casey & Wells, 1964) confirmed the presence of Permian rocks in the area and established, for the first time, the presence of Triassic sediments. From this survey, Casey & Wells (1956) produced a report on the operational problems encountered, and Casey & Nelligan (1956) discussed the land classification of the area and proposed new place names. White (1957) reported on the plant fossils collected and Dickins (1958) described the marine fossils.

Gravity surveys have been reported (Flavelle & Goodspeed, 1962), as have the results of an airborne magnetometer survey of the Canning Basin by West Australian Petroleum Pty Ltd (WAPET, 1966). Bouguer anomalies are shown on the face of the map.

Later, petroleum exploration has been carried out in the western part of the Sheet area by WAPET (1970; 1971a; 1972c; 1974), and in the eastern part by Mines Administration Pty Ltd for Associated Australian Oilfields N.L. (AAO) and Associated Australian Resources N.L. (AAR, formerly AAO) (Paten et al., 1972; Evans & Brown, 1974; AAO, 1972; AAR, 1974). The results were summarized by Drew & Evans (1975).

In August and September 1973 a joint party from BMR and the Geological Survey of Western Australia mapped the Sheet area (Yeates et al., 1975a). Ground and helicopter traverses were carried out and three stratigraphic holes drilled. Cores cut were examined by palynologists from Mines Administration Ltd (results in Yeates et al., 1975a). Plant fossils collected have been identified (White & Yeates, 1976).

STRATIGRAPHY

The stratigraphy of the Sheet area is summarized in Table 1.

PRECAMBRIAN

Precambrian rocks form the basement to the Canning Basin succession in the Cornish Sheet area. They may be similar to rocks that crop out in adjacent Sheet areas to the east and southeast. The top of the Precambrian is a weak seismic reflector.

ORDOVICIAN (O)

The probable presence of subsurface Ordovician rocks is inferred from seismic evidence and extrapolation from adjacent areas. Ordovician rocks that crop out in the Billiluna and Mount Bannerman Sheet areas to the north and north-east, respectively, consist of fossiliferous marine sandstone; those in the subsurface to the northwest of the Sheet area consist of fossiliferous marine sandstone; those in the subsurface to the northwest of the Sheet area consist of sandstone, siltstone, shale, dolomite, and limestone (WAPET, 1972b).

?LATE ORDOVICIAN TO EARLY DEVONIAN

Carribuddy Formation (Sc)

The Carribuddy Formation is inferred to be present in the Cornish Sheet area from seismic evidence (AAR, 1974). At the type section, the unit consists of sandstone, siltstone, shale, dolomite, and evaporites (Koop, 1966).

EARLY DEVONIAN

Tandalgoo Red Beds (Dt)

The Tandalgoo Red Beds are also inferred to be present in the Sheet area on seismic evidence. They are composed of red and brown sandstone, siltstone, and shale, with minor limestone and evaporites (Koop, 1966).

DEVONIAN TO CARBONIFEROUS (DC)

On seismic and regional geological evidence, up to 10 000 m of subsurface section is thought to be equivalent to Late Devonian to Early Carboniferous sequences in neighbouring Sheet areas and is shown on the section as Undivided Devonian to Carboniferous.

An un-named carbonate sequence of late Middle Devonian to Early Carboniferous age is present in Crossland No. 3 well (WAPET, 1971b) to the west of the area. Devonian clastic rocks were encountered in WAPET Lake Betty No. 1 well to the north of the Sheet area and have been referred to the Poulton and Luluigui Formations (WAPET, 1972a).

EARLY CARBONIFEROUS

Laurel Formation (Cl)

The Laurel Formation (Thomas, 1957; Druce & Radke, 1977) probably occurs in the Gregory Sub-basin in the Cornish Sheet area as it was intersected in Lake Betty No. 1 well to the north (WAPET, 1972a).

Anderson Formation (Ca)

The Anderson Formation (McWhae et al., 1958), which in the Fitzroy Trough consists mainly of terrigenous clastic deposits, probably overlies the Laurel Formation in the Gregory Sub-basin as it was intersected in Aquitaine Point Moody No. 1 well (AAP, 1966) to the southeast of the Sheet area.

LATE CARBONIFEROUS TO EARLY PERMIAN

Grant Formation (Pg)

The Grant Formation (Guppy et al., 1952) has been mapped in the Sheet area for the first time, the thickest and most representative section being at Fisher Bluff in the central south. The unit is composed of sandstone, siltstone, and minor conglomerate. The sand grains are moderately to poorly sorted and angular to subrounded. Southwest of Point Massie the unit has large-scale trough cross-bedding, but near Fisher Bluff it consists of bioturbated sandy siltstone with planar cross-bedding. Fossil wood fragments and trace fossils are present throughout the unit, and tillite occurs in the Stansmore Sheet area.

TABLE 1. STRATIGRAPHY OF THE CORNISH SHEET AREA

Age	*Formation*	*Thickness (m)*	*Lithology*	*Fossils*	*Remarks*
PLEISTOCENE TO HOLOCENE	Alluvium Qa	10±	Clay, silt, sand, gravel, black soil, and recent reworked laterite		In creeks and clay pans
	Evaporites Qe	0.5±	Gypsum, rock salt, and alluvium		In Gregory Salt Lake area and other large salt pans
	Sand dunes and plains Qz	0-25	Aeolian sand		Seif dunes and plains
	Mixed aeolian alluvial deposits Qs	0-10	Mixed sand, silt, and clay		Normally depressions
CAINOZOIC	Ferricrete Czf	0-10	Extensively ferruginized and silicified rock		Caps low exposures in W
	Laterite Czl	0-15	Pisolitic and massive laterite		Common capping to argillaceous rocks
	Calcrete Czk	0-10	Calcrete, chalcedony		Includes kankar, caliche, and travertine; good aquifer
	Lake Gregory Beds Czg	0-100	Sand, silt, and clay, minor conglomerate, calcrete, and gypsum	Fish bones and gastropods	In depression around Gregory Salt Lake
MESOZOIC	Mesozoic Undivided M	?	Coarse sandstone and conglomerate, poorly sorted, cross-bedded		
MIDDLE TRIASSIC	Culvida Sandstone TRc	200+	Coarse to fine-grained sandstone, conglomerate, and siltstone	Plant macrofossils and palynomorphs	Confined to area around Culvida Soak. Similar to Millyit Sandstone
EARLY TO MIDDLE TRIASSIC	Erskine Sandstone TRe	120±	Medium and fine-grained sandstone and siltstone	Plant macrofossils and palynomorphs	
LOCAL DISCONFORMITY					
EARLY TRIASSIC	Blina Shale TRb	150±	Siltstone, shale, and minor fine-grained sandstone	*Isaura,* plants, trace fossils, Scythian to Anisian palynomorphs	Very poorly exposed
	DISCONFORMITY				
	Millyit Sandstone TRm	90±	Fine and medium-grained sandstone, coarser towards base, minor conglomerate, siltstone	Plant macrofossils, Early Triassic palynomorphs	

TABLE 1. STRATIGRAPHY OF THE CORNISH SHEET AREA.—*continued.*

Age	*Formation*	*Thickness (m)*	*Lithology*	*Fossils*	*Remarks*
LATE PERMIAN	Godfrey Beds Pf	50-150	Fine and medium-grained sandstone and minor siltstone	*Rhizocorallium, Diplocraterion,* and plant macrofossils	Thins to E; may correlate with Hardman Formation
	?DISCONFORMITY				
	Liveringa Group: Condren Sandstone Pr	50±	Fine and medium-grained sandstone and siltstone	Trace fossils, plants, and palynomorphs	Coarser-grained in SE; thins to NW
EARLY TO LATE PERMIAN	Liveringa Group: Lightjack Formation Pj	100+	Siltsone, shale, and sandstone	Marine Artinskian to Kungurian macrofossils	
EARLY PERMIAN	Noonkanbah Formation Pn	?300	Siltstone, shale, and minor sandstone; calcareous in parts	Marine Artinskian macrofossils	Poorly exposed, commonly ferruginized
	Poole Sandstone Pp	?300	Fine-grained sandstone, siltstone, minor coarse-grained sandstone	Elsewhere contains plants, marine macrofossils, and early to late Artinskian palynomorphs	Similar to Noonkanbah Formation in W. Crops out as rounded hills as in E. Southesk Tablelands
	DISCONFORMITY				
LATE CARBONIFEROUS TO EARLY PERMIAN	Grant Formation Pg	?2000	Fine to coarse-grained sandstone, siltstone, minor conglomerate	Trace fossils, wood fragments, and palynomorphs	Very good aquifer. Oldest rock exposed
	UNCONFORMITY				

TABLE 1. STRATIGRAPHY OF THE CORNISH SHEET AREA.—*continued.*

Age	*Formation*	*Thickness (m)*	*Lithology*	*Fossils*	*Remarks*
EARLY CARBONIFEROUS	Anderson Formation Ca	?1000	Sandstone, shale		Probably present in Gregory Sub-basin
	Laurel Formation Cl	?1000	Sandstone, siltstone, shale, limestone		Probably present in Gregory Sub-basin
DEVONIAN TO CARBONIFEROUS	DC	10 000±	Sandstone, siltstone, shale, limestone dolomite		Correlatives of other Devonian-Carboniferous formations elsewhere in basin
EARLY DEVONIAN	Tandalgoo Red Beds Dt	?1000	Sandstone, siltstone, shale; minor limestone, evaporites		Probably absent on Betty Terrace
?LATE ORDOVICIAN TO EARLY DEVONIAN	Carribuddy Formation Sc	?6000	Sandstone, siltstone, shale, dolomite, anhydrite, halite		
	DISCONFORMITY				
ORDOVICIAN	O	?4000	Sandstone, siltstone, shale, dolomite, limestone		Probably includes previously unrecognized units
	UNCONFORMITY				
PRECAMBRIAN	p$\mathcal{E}$		Igneous, metamorphic, and sedimentary rocks		

Seismic evidence (WAPET, 1970, 1971a, 1972c; AAR, 1974) suggests that the Grant Formation unconformably overlies Carboniferous sediments over most of the Sheet area, and it may overlie Devonian units on the Betty Terrace. Surface evidence indicates that it probably disconformably underlies Poole Sandstone.

No age-diagnostic fossils have been found in the Sheet area, but palynological evidence from petroleum exploration wells indicates a Late Carboniferous to Early Permian age for for the Grant Formation (WAPET, 1973).

PERMIAN

Poole Sandstone (Pp)

The Poole Sandstone (Guppy et al., 1952) is also recognized in the Sheet area for the first time. It consists of medium and thinly bedded and laminated fine-grained sandstone, siltstone, and minor coarse-grained sandstone. The bedding is laterally continuous and contains small-scale (ripple) cross-bedding. The formation is 312 m thick in Point Moody No. 1 well southeast of the area (AAP, 1966) and its lower boundary with the Grant Formation is either conformable or disconformable. The boundary with the overlying Noonkanbah Formation appears to be conformable and in places gradational. Where uncertainty as to the distinction between the Poole Sandstone and Noonkanbah Formation was encountered, outcrops have been assigned the symbol Pp-Pn Undivided.

Noonkanbah Formation (Pn)

The Noonkanbah Formation (Guppy et al., 1952) contains lenses of coarse-grained sandstone and granule conglomerate, some with fragmentary marine fossils. Outcrops resemble those of the Blina Shale, which was previously mapped as Noonkanbah Formation around Lady Edith Lagoon (Wells, 1962).

The Noonkanbah Formation thickens into the Gregory Sub-basin and lies conformably between the Poole Sandstone and the Lightjack Formation.

Liveringa Group

The Liveringa Group (Guppy et al., 1958; Yeates et al., 1975b) consists of the Lightjack and Hardman Formations separated by the Condren Sandstone.

The youngest unit, the Hardman Formation, has not been identified in the Cornish Sheet area but the Godfrey Beds may be a partial equivalent of it as they occupy a similar stratigraphic position, although their precise age and lateral relations are unknown.

Lightjack Formation (Pj)

On the First Edition geological map (Wells, 1962) the Lightjack Formation was called the 'Balgo Member' but following the usage of Playford et al. (1975) this name has been dropped. Many changes have been made to the mapped distribution of the unit as it appeared on the previous map.

The Lightiack Formation characteristically contains lenses of coarse to very coarse-grained sandstone which is poorly sorted and contains many angular grains. The unit also contains many clay-pellet conglomerate lenses, locally with marine fossils, particularly near the base.

Small-scale cross-bedding is common, and ripple marks are commonly preserved on bedding planes. Bioturbation is also common and the unit contains many trace fossils.

In the western part of the Sheet area the Lightiack Formation contains a middle sandstone member which consists of medium-bedded, cross-bedded, medium to fine-grained well-sorted sandstone. Individual grains are well rounded. This sandstone unit correlates with the 'plant-bearing' member that Guppy et al. (1958) described from the middle of the Lightjack Formation in the Fitzroy Trough. In the Cornish Sheet area this sandstone member is well exposed between Mount Romilly and Mount Fothringham.

A section of the Lightjack Formation near Mount Stewart is 88 m thick, but the unit thickens to the southeast as thicker sections have been measured in the Stansmore Sheet area. To the northwest the formation appears to maintain a fairly constant thickness.

The lower boundary of the Lightjack Formation with the Noonkanbah Formation is thought to be conformable, though the intraformational conglomerates near this contact may indicate slight local disconformities. Where there is insufficient exposure to confidently distinguish the Noonkanbah and Lightjack Formations, they have been mapped Undivided. To the east, in the Lucas Sheet area, the Lightjack Formation overlaps the Noonkanbah Formation near Balgo Mission (Crowe & Muhling, 1978). The unit conformably underlies the Condren Sandstone.

Condren Sandstone (Pr)

The Condren Sandstone is lithologically similar to the Godfrey Beds, and part of the area shown as Godfrey Beds on the First Edition map (Wells, 1962) is now mapped as Condren Sandstone.

The unit contains abundant ripple marks and large-scale trough cross-bedding. In the western part of the Sheet area current directions show a bi-modal distribution and the bedding is mainly thin and continuous, whereas in the Roberts Range in the southeast it is thicker and discontinuous. The formation rests conformably on the Lightjack Formation and the upper contact with the Godfrey Beds, well exposed near Godfreys Tank, is conformable or slightly disconformable.

Plant fossils in the Condren Sandstone in adjacent Sheet areas to the north and east indicate a Permian age for the unit (White, 1957; White & Yeates, 1976), and Yeates et al. (1975a) suggest it is Kazanian.

Godfrey Beds (Pf)

The Godfrey Beds were originally thought to be Cretaceous (Elliott, Casey, & Wells in McWhae et al., 1958; Veevers & Wells, 1961), but the 1973 mapping revealed Permo-Triassic plant fossils and that the Godfrey Beds were shown to underlie the Early Triassic Millyit Sandstone.

The bedding is mainly thin, laterally continuous, and the Beds contain small and large-scale cross-bedding. Current directions, measured from trough cross-sets in the Godfreys Tank area are similar to those in the underlying Condren Sandstone which was probably deposited in a similar environment.

A sequence of medium to coarse-grained, poorly-sorted sandstone, in places conglomeratic, at the base of the Godfrey Beds in the Godfreys Tank area is interpreted as a basal part of the Godfrey Beds and probably indicates that the contact with the underlying Condren Sandstone there is disconformable. To the east, in the Lucas Sheet area, the contact is unconformable, and the Godfrey Beds overlap older Permian units (Crowe & Muhling, 1978).

No complete section of the Godfrey Beds is exposed in the Cornish Sheet area, but at least 90 m is exposed at Crown Head. It thins to the east as it is only about 25 m thick in the northwestern part of the Lucas Sheet area.

The Godfrey Beds are characterized by abundant *Rhizocorallium* and *Diplocraterion* trace fossils. The only macrofossil recorded from the unit is the plant *Lycopodiopsis pedroanus* which indicates a Permian or Triassic age (White & Yeates, 1976).

Numerous outcrops assigned the symbol P could belong to any of the described Permian formations. These outcrops are too weathered or too small to confidently assign a formation name.

TRIASSIC

Four Triassic units are recognized in place of the previous two.

Millyit Sandstone (TRm)

Rocks are mapped as Millyit Sandstone in the Cornish Sheet area as they are lithologically similar, and have similar plant fossils and the same stratigraphic position as the unit in the Crossland Sheet area where it was originally defined (Elliott, *in* McWhae et al., 1958).

The Millyit Sandstone consists of trough cross-bedded, poorly or thinly bedded, medium and fine-grained sandstone with a clay matrix. A stratigraphic borehole in the Lucas Sheet area to the east (BMR Lucas No. 13) penetrated 90 m of the unit and showed that in this area the lower part is coarser-grained than the upper part. Yeates et al. (1975a) have proposed a reference section for the formation near Chilpada Chara at 20°07′30″S, 126°53′55″E.

The lower boundary of the Millyit Sandstone was not seen in the Cornish Sheet area, but to the west the unit appears to rest conformably on the Godfrey Beds (Crowe & Muhling, in press). The boundary with the overlying Blina Shale is a disconformity in the Minnie Range.

Plant macrofossils found in the Millyit Sandstone indicate a Permian or Triassic age (White & Yeates, 1976). Palynomorphs from the unit in BMR Lucas No. 13 indicate that it is Early Triassic.

Blina Shale (TRb)

The Blina Shale (Brunnschweiler, 1954) is mapped over large areas in the Bishop Range/Lady Edith Lagoon area in the central east and in the Minnie Range in the central north, where Permian rocks were previously mapped (Wells, 1962).

It consists of well-bedded siltstone and shale with minor very fine-grained sandstone. It is extensively bioturbated; small-scale cross-bedding is common and wave-formed ripple marks are present in the Minnie Range.

The thickness of the Blina Shale in the Cornish Sheet area is unknown. In the Lucas Sheet area 130 m was measured at the Stretch Range, but there is evidence that it probably thins towards the basin margin (Crowe & Muhling, 1978) and it may therefore be thicker in the Cornish Sheet area.

The Blina Shale rests disconformably on the Millyit Sandstone in the Minnie Range; its upper boundary is thought to be mainly conformable but is locally disconformable with the overlying Erskine Sandstone.

Fossils in the Blina Shale in the Cornish Sheet area include the conchostracan *Isaura,* and numerous plants. The microflora of the unit indicates a Scythian to Anisian age (R. Paten, pers. comm.).

Erskine Sandstone (TRe)

The Erskine Sandstone (Brunnschweiler, 1954) consists mainly of cross-bedded and parallel-bedded, medium and fine-grained sandstone, but siltstone is increasingly common towards the top. The similarity in lithology between this unit and the overlying Culvida Sandstone has made it difficult to differentiate the two units in outcrop south of Culvida Soak. However, they can be differentiated in the subsurface, e.g. BMR Cornish No. 2 borehole.

No complete section of the Erskine Sandstone has been measured, but it is probably about 120 m thick. It rests conformably and locally disconformably on the Blina Shale, and the upper boundary is thought to be gradational with the overlying Culvida Sandstone.

Plant fossils and palynomorphs from the Erskine Sandstone indicate an Early Triassic age (White & Yeates, 1976).

Culvida Sandstone (TRc)

The Culvida Sandstone was originally thought to both overlie and underlie the Blina Shale (Casey & Wells, 1964) but it is now considered to overlie the Erskine Sandstone, and to have no contact with the Blina Shale. The type section is near Culvida Soak at 20°13′S, 126°55′E.

At Culvida Soak the coarser-grained units, which are cross-bedded, wedge out into parallel-bedded siltstone and fine-grained sandstone. In the subsurface in BMR Cornish No. 2, the Culvida Sandstone contains red siltstone and fine-grained sandstone 75 m thick.

The top of the Culvida Sandstone is everywhere eroded, but 207 m of the unit was intersected in BMR Cornish No. 2. The underlying Erskine Sandstone is thought to pass gradationally upwards into the Culvida Sandstone.

Plant fossils collected from the Culvida Sandstone have been assigned a Middle Triassic age (White, *in* Veevers & Wells, 1961; White & Yeates, 1976).

Outcrops assigned the symbol TR are too small or too weathered to be assigned confidently to any of the described Triassic formations.

UNDIVIDED MESOZOIC (M)

At two places a ferruginized conglomeratic sandstone unconformably overlies Permian units. The sandstone contains a wide range of pebble types, is poorly sorted, and has high-angle cross-bedding. It is unlike any of the Triassic formations, and is mapped as Undivided Mesozoic.

CAINOZOIC

Lake Gregory Beds (Czg)

The Lake Gregory Beds are defined by Yeates et al. (1975b) and the type section is in BMR Cornish No. 3 corehole at 20°11′S, 127°24′E. The best exposures occur along the eastern side of the Bulbi Plain and at Gilwah Waterhole in the northeast.

The Lake Gregory Beds consist of interbedded green and brown thin-bedded silt and clay and red and white sand, cross-bedded in places. It contains rare gravel, the pebbles consisting of laterite pisoliths, particularly at the base of the unit.

The thickest section encountered was 99.7 m at the type section. The unit lies unconformably on Triassic and Permian sediments and interfingers laterally with other Cainozoic units.

Fish bones were found in a core sample and gastropods are present in coquinas in surface exposures, but none are age diagnostic. The unit is probably mostly Tertiary.

Calcrete (Czk)

Calcrete occurs widely throughout the Cornish Sheet area, particularly in the eastern half where it appears to overlie Blina Shale subcrop. Calcrete also caps exposures of the Lake Gregory Beds, and photo-patterns identified as calcrete occur in areas where the Noonkanbah Formation crops out.

The term calcrete is used according to Goudie (1972) and so it is not indicative of genesis and includes both pedogenic and lacustrine forms. Wells (1962) mapped the calcrete as travertine.

Laterite (Czl)

Pisolitic and massive laterite overlies the more argillaceous rock types of the Noonkanbah and Lightjack Formations and the Blina Shale, and thick laterite profiles are developed, e.g. at Point Massie. To the southwest of Point Massie the laterite has a well developed dendritic relict drainage pattern preserved on its surface.

Detrital secondary laterite occurs in some areas but is not differentiated from primary laterite on the map. The laterite is probably largely Tertiary.

Ferricrete (Czf)

Ferricrete caps exposures of Permian rocks on the western side of the Sheet area and is probably Tertiary, the same age as the laterite.

Sand (Qz)

Aeolian red and yellow sand underlies most of the Sheet area and forms longitudinal (seif) dunes and sand plains. Simple longitudinal dunes are the most common, though some chain types (terms of Crowe, 1975) also occur in the east central part of the Sheet area. Veevers & Wells (1961) and Crowe (1975) have described the sand dunes of the Great Sandy Desert.

Deposits of drainage depressions (Qs)

Colluvial and alluvial sand, silt, and clay mixed with aeolian deposits occur in depressions which merge with areas of alluvium. Some of the depressions may be remnants of a relict drainage system which formed before the sand dunes.

Alluvium (Qa)

Alluvial deposits include clay, sand, and gravel in drainage channels and in playa lakes. Older alluvium may occur in certain parts of the Sheet area as it does to the east (Crowe & Muhling, 1978).

Salt lake sediments (Qe)

Gypsiferous and saline sand, silt, and clay occur in salt lakes and salt pans. A thin salt crust develops on the surface of some of these sediments as at Gregory Salt Lake.

STRUCTURE

A structural interpretation of the Cornish Sheet area based on surface information is shown in Figure 2.

The main tectonic elements (from Yeates et al., 1975a) are described below and shown in the tectonic sketch map on the map Sheet.

Betty Terrace

The Betty Terrace is an area of downfaulted basement, intermediate in depth between the Billiluna Shelf to the northeast and the Gregory Sub-basin to the southwest. Geophysical surveys indicate that magnetic basement ranges from 9000 to 3000 m below sea level.

In the Lucas Sheet area to the east, Crowe & Muhling (1978) have suggested, from surface data, that within the Betty Terrace there is a small graben that may extend into the Cornish Sheet area in the region of Gregory Salt Lake.

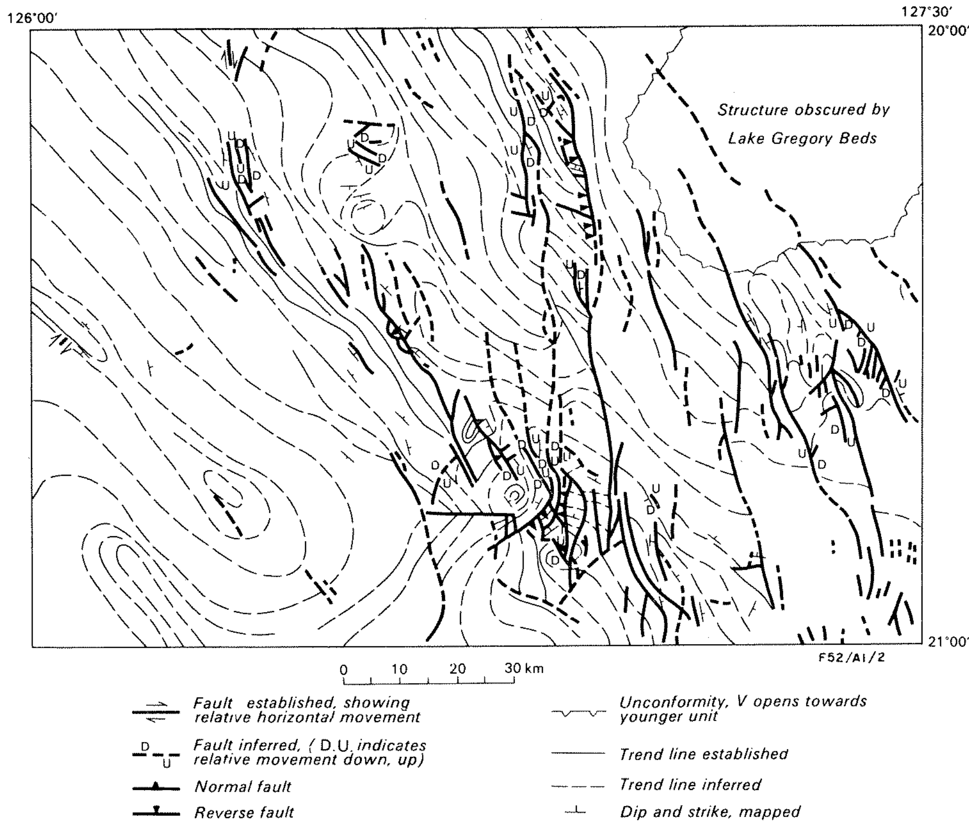

Fig. 2. Structure.

Gregory Sub-basin

The Gregory Sub-basin is an elongate, northwest-trending feature fault-bounded for most of its length. In the Sheet area, it is bounded to the northeast by the Stansmore Fault System and to the southwest by the Fenton Fault System.

Seismic evidence indicates that the Sub-basin reaches a depth of about 15 000 to 18 000 m on its northern side (AAR, 1974).

Barbwire Terrace

The Barbwire Terrace is a narrow downfaulted block along the southwest flank of the Gregory Sub-basin. It is bounded to the northeast by the Fenton Fault System and to the southwest by the Dummer Range Fault System.

FAULTS, FOLDS, AND JOINTS

The major faults between the tectonic subdivisions show major normal displacement in the pre-Grant Formation sediments (AAR, 1974). Many faults identified on seismic profiles cannot be correlated with surface faults, and isochron maps (AAR, 1974) show that faults are commonly overlain by undisturbed Grant Formation. Thus major faulting took place before deposition of the Grant Formation.

Many of the faults seen on the surface show normal displacement, but one between Well No. 50 and Culvida Soak is a reverse fault. Other faults to the west of Culvida Soak show downthrow to the east, but the subsurface correlatives of these faults all show displacement down to the west (see cross-section). Thus there is evidence that some of the post-Middle Triassic faulting was of reverse type.

Farther to the northwest (in the Noonkanbah and Mount Anderson Sheet areas) Late Jurassic sediments transgress the Fenton Fault System without major displacement, so that the reverse movement is probably of Late Triassic to Middle Jurassic age.

Rattigan (1967) has explained the surface pattern of faults and folds, in the Fitzroy Trough (to the northwest), as an en-echelon pattern that can be attributed to right-lateral regional coupling between the Kimberley Block to the northeast and the 'Broome Swell' (Barbwire Terrace and Crossland Platform) to the southwest. As a somewhat similar pattern of faulting occurs in the Gregory Sub-basin these structures may have a similar origin. However, the east-trending anticlines in the Fitzroy Trough are absent in the Gregory Sub-basin.

Outside the Gregory Sub-basin, surface faulting is less intense, although seismic evidence indicates that faulting is more complex in the subsurface. The faults that are seen in the surface show little displacement and can be mainly correlated with subsurface faults.

Several lineaments are present in the area west and south of Gregory Salt Lake (see map and Fig. 2). These appear as dark lines of vegetation on the aerial photographs and as they are continuous with mapped faults they are interpreted as faults. They do not appear to displace the Lake Gregory Beds. Other lineaments in this area are linear ridges which are probably sedimentary features associated with the Lake Gregory Beds, but their exact nature is unknown.

Most rocks exposed in the Cornish Sheet area are flat-lying or gently dipping; some dip steeply near major faults.

In the Gregory Sub-basin and on the Betty Terrace, folding is uncommon and where present is attributed to faulting. One structural basin is present to the south of Godfreys Tank and another to the northwest of Fisher Bluff (Fig. 2). The former has low dips and is partly inferred, but the latter has dips up to 15° and is obvious on the aerial photographs. The origin of these basins is not known but is thought to be due to faulting.

On the Barbwire Terrace and Crossland Platform the rocks are gently folded (Fig. 2). Seismic evidence (WAPET, 1971a, 1972c, 1974) indicates that these folds developed simultaneously with deposition, as some of the units appear to thicken into synclines and thin over anticlines.

Joints are common in all the exposed Palaeozoic and Mesozoic units and are particularly well developed in exposures of Condren Sandstone around the Godfreys Tank area.

GEOLOGICAL HISTORY

Sedimentation started in the Ordovician, when marine sand and carbonate accumulated. The sea then regressed, probably in the Late Ordovician, and evaporitic conditions may have ensued (Carribuddy Formation) and may have persisted into the Early Devonian when the Tandalgoo Red Beds were laid down in a dominantly continental environment. In the Middle and Late Devonian the sea returned and carbonate was deposited. Sedimentation continued into the Carboniferous and sand, mud, and carbonate (Laurel Formation) were laid down in shallow seas. The sea then regressed and rivers deposited sand, mud, and pebbles (Anderson Formation).

During much of the Early Palaeozoic, differential subsidence was occurring contemporaneously with sedimentation as seismic records indicate that the subsurface units show thinning over structural highs and thickening into lows. Similar subsidence probably prevailed throughout the rest of the basin's history as surface data tend to show the same trends.

After Anderson Formation deposition, the area underwent a period of faulting, folding, and erosion during Middle to Late Carboniferous time before sedimentation recommenced (Grant Formation) in a marine and/or continental environment until Early Permian time. Periods of cooler climate may have resulted in tillite being deposited. Afterwards, shallow marine or lagoonal conditions prevailed (Poole Sandstone). Marine sedimentation then continued (Noonkanbah Formation) until Lightjack Formation time when the sea regressed and rivers deposited sand in the east (Condren Sandstone). In the west, shallow marine or lagoonal conditions probably continued until the end of the Permian (Condren Sandstone and Godfrey Beds).

During the Early Triassic, rivers probably deposited sand and silt (Millyit Sandstone). This was followed by deposition of the Blina Shale on mud flats under shallow marine or brackish-water conditions. The sea then retreated from the area and continental conditions prevailed with deposition by rivers and possibly in lakes (Erskine and Culvida Sandstones).

During the Late Triassic or Early Jurassic extensive faulting and folding occurred. Continental conditions probably have prevailed up to the present, but little record of any further Mesozoic deposits has been preserved.

During the Cainozoic, lacustrine deposition occurred in the Gregory Salt Lake area and laterite, ferricrete, and calcrete were formed. Since then the area has been subjected to an arid climate, resulting in aeolian landforms and deposition of aeolian sand and only minor amounts of sediment being deposited by water.

ECONOMIC GEOLOGY

Petroleum

The petroleum resources of the area have not been tested, but seismic surveys have revealed the broad subsurface structure, and units known to have potential elsewhere in the basin can be inferred in the Cornish Sheet area. Drew & Evans (1975) and Yeates et al. (1975a) have summarized the petroleum potential.

In the Gregory Sub-basin and its adjacent terraces, potential source rocks may be present in the Ordovician, as correlatives of the fossiliferous Prices Creek Group (Guppy et al., 1958) may extend into the Sheet area. However, seismic information indicates that these beds are probably too deep to warrant exploration (see cross-section). Correlatives of the Devonian carbonates encountered in WAPET Crossland Nos. 1 and 3 wells (WAPET, 1971b) have reservoir potential and if present could be prospective in suitable structures. The Carboniferous sequence may also have some potential in this area. The terraces flanking the Gregory Sub-basin are the most suitable sites for exploration, as they are structurally less complex, depths to reservoirs could be expected to be less than in the Gregory Sub-basin, and stratigraphic traps may also occur.

On the Crossland Platform there are two main prospective units. The first is the Ordovician which elsewhere contains potential source and cap rocks, although suitable reservoirs have not been located. The second major prospect is the Devonian sequence. Until recently, suitable reservoirs had not been located in the Devonian on the Crossland Platform, but Drew & Evans (1975) have pinpointed several possible reef structures from seismic data and these may extend into Cornish Sheet area. Should more detailed seismic work support the identification of reefal structures in the area, then the petroleum prospects would be upgraded.

Coal

Units below the Permian rocks are not considered prospective for coal as they occur at too great a depth in the area.

Thin coal seams have been recorded in the Grant Formation in the Gregory Sub-basin but its potential in the Cornish Sheet area is unknown (AAP, 1966; WAPET, 1972a). The Poole Sandstone is thought to be a shallow-water marine or lagoonal deposit so it may be prospective. However, root beds and fossil plant material were not seen in the area so it probably has little potential.

Both the Noonkanbah Formation and the lower part of the Lightjack Formation are interpreted as marine deposits and are unprospective, but the upper part of the Lightjack Formation and the rest of the Liveringa Group have some potential as they are thought to contain paralic facies. Coal is known to occur in this part of the sequence in the Fitzroy Trough to the northwest (Guppy et al., 1958).

The Triassic units have all been intersected in bores in or near the Sheet area and, as there has been no coal recorded in them, they are not considered prospective.

Groundwater

The groundwater potential of the Sheet area is poorly known, and any assessment depends on knowledge of the formations, where they have been tested, outside the area. Prospective aquifers include the Grant Formation, Poole Sandstone, and Condren Sandstone in the southeast of the Sheet area, and the Millyit and Culvida Sandstones. At shallower depths calcrete would be prospective. The Lake Gregory Beds would yield mainly saline water.

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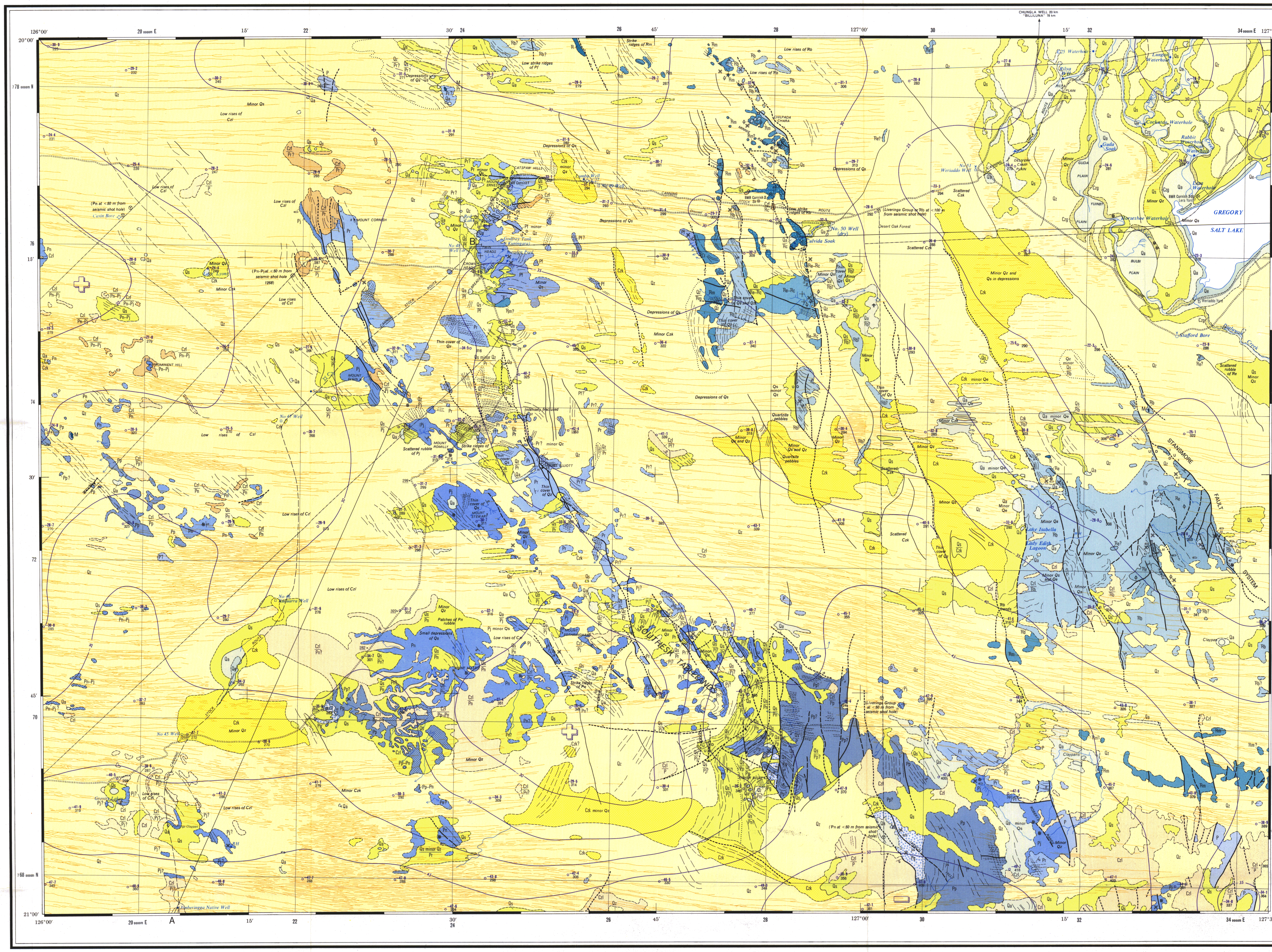
SHEET SF 52-1



Reference

- Geological boundary
- Syncline
- Fault (D, U indicates relative movement down, up)
- Normal fault, triangle indicates direction of dip
- Inclined fault
- Fault, showing relative horizontal movement

Where location of boundaries, folds and faults is approximate, line is broken; where inferred, queried; where concealed, boundaries and folds are dotted, faults are shown by short dashes

- Strike and dip of strata
- Strike and dip of strata, dip not measured
- Horizontal strata
- Dip < 5° (airphoto interpretation)
- Dip 5°—15° (airphoto interpretation)
- Trend line (airphoto interpretation)
- Joint pattern (airphoto interpretation)
- Lineament (airphoto interpretation)

- Macrofossil locality
- Plant fossil locality
- Wood fossil locality
- Palynomorph locality
- Trace fossil locality
- Measured sections
- Stratigraphic hole

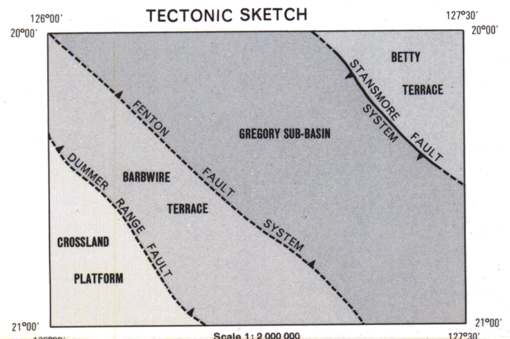
- Bore
- Abandoned bore
- Well
- Windpump
- Waterhole
- Rockhole

- Sand dunes
- Vehicle track
- Seismic traverse line
- Fence
- Landing ground
- Trigonometrical station
- •315 Elevation in metres, accurate
- •283 Elevation in metres, approximate

- Gravity station
- −45·5 Bouguer anomaly (milligals)
- −35 Isogal
- Gravity anomaly—relative high
- Gravity anomaly—relative low

Bouguer anomalies are based on the May 1968 observed gravity values at isogal gravity base stations in and near the area. For the calculation of Bouguer anomalies 2.67g/cm³ has been adopted as an average rock density

TECTONIC SKETCH

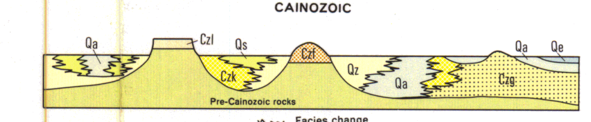


Reference

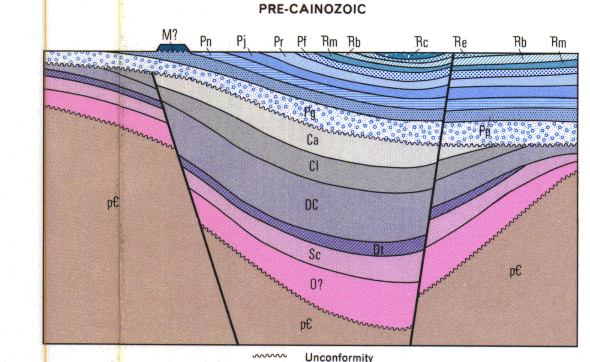
CAINOZOIC	QUATERNARY		Qa	Clay, silt, minor sand and gravel: alluvial and lacustrine
			Qe	Halite, gypsum, minor clay, silt and sand: evaporitic and alluvial
			Qs	Sand, silt and clay: alluvial and aeolian in depressions
			Qz	Sand: aeolian
			Czk	Calcrete, kankar, chalcedony: fluviolacustrine and pedogenic
			Czl	Laterite, pisolitic or massive: pedogenic
			Czf	Ferricrete: weathering product
		Lake Gregory Beds	Czg	Sand, silt, clay, minor gravel, calcrete, gypsum; red, brown and green: lacustrine
MESOZOIC			M	Coarse, poorly sorted sandstone and conglomerate; cross-bedded: fluvial
	TRIASSIC		Ʀ	Undivided sandstone
	MIDDLE TRIASSIC	Culvida Sandstone	Ʀc	Fine to coarse sandstone, conglomerate, red siltstone; cross-bedded, fossiliferous
			Ʀe–Ʀc	Undivided Ʀe or Ʀc
	EARLY? TO MIDDLE TRIASSIC	Erskine Sandstone	Ʀe	Fine to medium sandstone, parallel-bedded, cross-bedded; minor siltstone; plant fossils: fluvial
	EARLY TRIASSIC	Blina Shale	Ʀb	Siltstone, shale, very fine sandstone, bioturbated, fossiliferous: shallow marine to fresh water
		Millyit Sandstone	Ʀm	Fine to medium sandstone, thin-bedded, cross-bedded; minor conglomerate, siltstone: fluvial
PALAEOZOIC	PERMIAN		P	Undivided sandstone, siltstone, shale
	LATE PERMIAN	Godfrey Beds (Liveringa Group)	Pf	Fine and medium sandstone, minor siltstone, cross-bedded, ripple marked, burrowed: paralic
		Condren Sandstone (Liveringa Group)	Pr	Fine to medium sandstone, siltstone; cross-bedded, ripple-marked: probably fluvial in east, paralic in west
	EARLY TO LATE PERMIAN	Lightjack Formation (Liveringa Group)	Pj	Fine to coarse sandstone, siltstone, shale, cross-bedded, rarely fossiliferous: shallow marine
			Pn–Pj	Undivided Pn or Pj
	EARLY PERMIAN	Noonkanbah Formation	Pn	Siltstone, shale, fine to medium sandstone, calcareous, rarely fossiliferous: marine
			Pp–Pn	Undivided Pp or Pn
		Poole Sandstone	Pp	Fine sandstone, siltstone, minor coarse sandstone; ripple-marked, cross-bedded: shallow marine or paralic
	LATE CARBONIFEROUS TO EARLY PERMIAN	Grant Formation	Pg	Fine to very coarse sandstone, siltstone, minor conglomerate; cross-bedded; bioturbated: marine with probable tillite in subsurface
	EARLY CARBONIFEROUS	Anderson Formation	Ca	Sandstone, shale (section only)
		Laurel Formation	Cl	Sandstone, siltstone, shale, limestone (section only)
	DEVONIAN TO CARBONIFEROUS		DC	Sandstone, siltstone, shale, limestone, dolomite (section only)
	EARLY DEVONIAN	Tandalgoo Red Beds	Dt	Sandstone, siltstone, shale, minor limestone, evaporites (section only)
	LATE ORDOVICIAN? TO EARLY DEVONIAN	Carribuddy Formation	Sc	Sandstone, siltstone, shale, dolomite, anhydrite, halite (section only)
	ORDOVICIAN		O	Sandstone, siltstone, shale, dolomite, limestone (section only)
PRECAMBRIAN			p€	Undivided igneous, metamorphic and sedimentary rocks (section only)

DIAGRAMMATIC RELATIONSHIP OF ROCK UNITS

CAINOZOIC

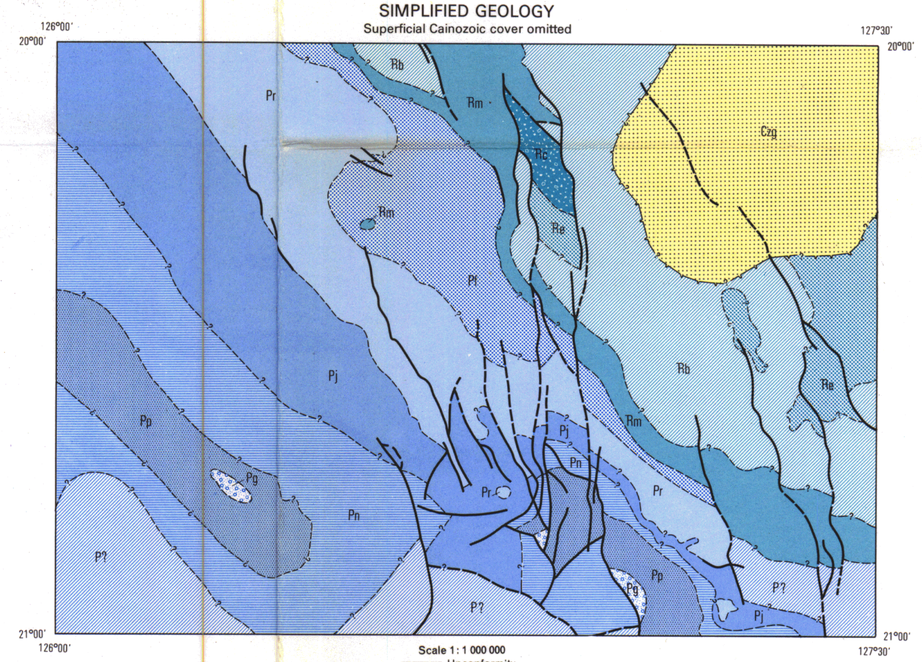


PRE-CAINOZOIC



SIMPLIFIED GEOLOGY

Superficial Cainozoic cover omitted



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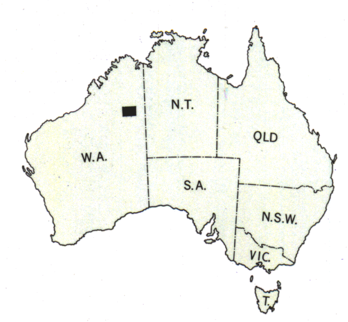


INDEX TO ADJOINING SHEETS

Showing magnetic declination 1975

MOUNT ANDERSON SE 51-11	NOONKANBAH SE 51-12	MOUNT RAMSAY SE 52-9	GORDON DOWNS SE 52-10	BIRRINDUDU SE 52-11
McLARTY HILLS SE 51-15	CROSSLAND SE 51-16	MOUNT BANNERMAN SE 52-13	BILLILUNA SE 52-14	TANAMI SE 52-15
JOANNA SPRING SF 51-3	DUMMER SF 51-4	CORNISH SF 52-1	LUCAS SF 52-2	THE GRANITES SF 52-3
SAHARA SF 51-7	PERCIVAL SF 51-8	HELENA SF 52-5	STANSMORE SF 52-6	HIGHLAND ROCKS SF 52-7
TABLETOP SF 51-11	URAL SF 51-12	WILSON SF 52-9	WEBB SF 52-10	LAKE MACKAY SF 52-11

Scale 1:250 000

5 0 5 10 15 20 25 KILOMETRES

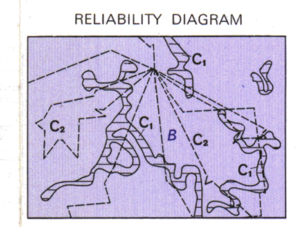
GREY NUMBERED LINES ARE 20 000 METRE INTERVALS OF THE AUSTRALIAN MAP GRID, ZONE 52
TRANSVERSE MERCATOR PROJECTION

Schematic Section

Thin Cainozoic cover omitted

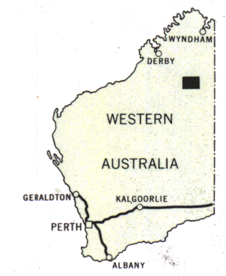
Scale: V/H = 1

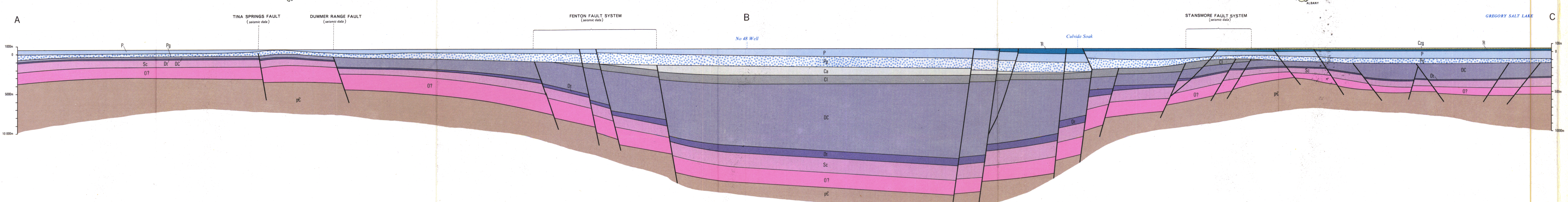
RELIABILITY DIAGRAM



- Geology C₁ General reconnaissance: many traverses and airphoto interpretation
- C₂ General reconnaissance: helicopter traverses, mainly airphoto interpretation
- Helicopter traverse
- Gravity B Reconnaissance

Geology 1955 by J. N. Casey, A. T. Wells, BMR
1973 by R. W. A. Crowe, GSWA; A. N. Yeates, A. T. Wells, R. R. Towner, P. A. Jell, L. A. I. Wyborn, BMR
Compiled 1974 by R. W. A. Crowe, GSWA; A. N. Yeates, D. G. Walton, BMR
Gravimetry by Geophysical Branch, BMR
Cartography by Geological Branch, BMR
Drawn by Mapping Systems Pty. Ltd.
Printed by Mercury-Walch, Hobart, Australia





SECOND EDITION 1978

CORNISH

SHEET SF 52–1

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