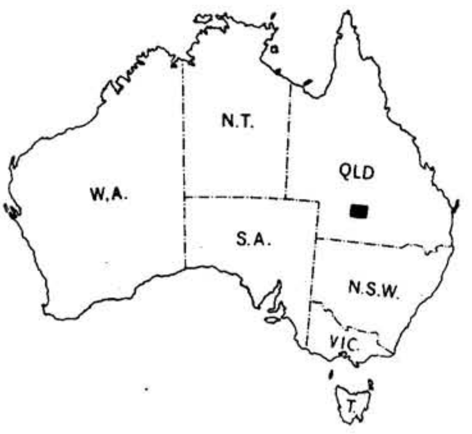
1:250,000 GEOLOGICAL SERIES—EXPLANATORY NOTES

QUILPIE

QUEENSLAND



SHEET SG/55-9 INTERNATIONAL INDEX

COMMONWEALTH OF AUSTRALIA

STATE OF QUEENSLAND

1:250,000 GEOLOGICAL SERIES—EXPLANATORY NOTES

Quilpie, Qld

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COMPILED BY B. R. SENIOR

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COMMONWEALTH OF AUSTRALIA

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Explanatory Notes on the Quilpie Geological Sheet

Compiled by B. R. Senior

The Quilpie Geological Sheet was mapped in 1968 as part of a joint project by the Bureau of Mineral Resources and Geological Survey of Queensland to investigate the Great Artesian Basin.

Air-photographs at a nominal scale of 1:50,000 taken by the RAAF in 1952 cover the area. Cadastral maps at 4 miles to 1 inch scale are available from the Queensland Department of Public Lands, Brisbane, and photo-mosaics at 4 miles to 1 inch scale and 1:250,000 planimetric maps from the Division of National Mapping, Canberra.

Access to the area from Brisbane is through Charleville, from where a graded and formed earth road, the Diamantina Developmental Road, continues west to Quilpie Township and thence as a bitumen road to Windorah. In 1968 a more direct route for this road, following that of the Great Western Railway, was being constructed. Numerous graded and formed dirt roads extend north and south from the existing Diamantina Developmental Road and a network of station tracks makes most of the area accessible to vehicles. Wet weather can disrupt road transport facilities.

The largest settlement is Quilpie township (pop. about 900); smaller areas such as Cooladdi and Cheepie occur at principal stopping points along the Great Western Railway. Numerous homesteads constitute the remainder of settlement in the area.

Previous Investigations

Whitehouse (1930, 1940, 1941, 1952) studied the principal features of the geology of Queensland, and later compiled a generalized account of the geology of the Great Artesian Basin (1954). Ogilvie (1954) described the hydrology of the basin in conjunction with Whitehouse's account of the geology. The progress of geological investigations of the whole basin up to 1960 is summarized by Hill & Denmead (1960).

Most subsurface exploration has been by Phillips Australian Oil Company in conjunction with Sunray DX Oil Company, using seismic surveys and drilling (Heikkila, 1966; Tanner, 1966, 1968). The geophysical surveys are listed in Table 1, and formation tops in exploration wells in Table 4. The latest summary of geophysical and geological work in the Adavale Basin is by Slanis & Netzel (1967).

Mapping by the Bureau of Mineral Resources in 1968 was reported by Senior et al. (1969). Maps, with explanatory notes, of sheets adjacent to Quilpie Sheet are: Adavale (Galloway, 1970), Eromanga (Ingram, in press), Toompine (Ingram, in press), and Charleville (Senior, in press).

TABLE 1. GEOPHYSICAL SURVEYS IN THE QUILPIE SHEET AREA

Year	*Abbreviated Title*	*Reference*
Seismic Surveys		
1959	Quilpie-Eromanga seismic survey	Bigg-Wither & Morton, 1962
1959	Grey Range seismic survey	Smart, 1962
1961	Jundah-Yaraka-Blackwater-Langlo seismic survey	Hier & Fjelstul, 1961
1959-60	Quilpie-Thargomindah-Charleville seismic survey	Hier & Spivey, 1962
1961	Seismic survey, Adavale area	Hier & Spivey, 1961
1962	Detailed seismic survey, Gumbardo area	Fjelstul & Beck, 1962
1963	Detailed survey, Quilberry Creek Prospect	Fjelstul & Beck, 1963
1966	Reconnaissance and detail seismic survey, Lake Dartmouth area	Tallis & Fjelstul, 1966
1966	Adavale Basin detail survey	Fjelstul & Rhodes, 1966
Gravity Surveys		
1960	Gravity traverse—Quilpie to Roma	Langron, 1962
1961	Gravity survey—Eromanga area	Smart, 1961
1964	Semi-detailed gravity survey—Adavale Basin	Darby, 1966
1964	Southern Queensland reconnaissance gravity survey	Lonsdale, 1965
1966	Dartmouth area gravity survey	Darby & Ingall, 1966
Aeromagnetic Survey		
1961	Aeromagnetic survey of Quilpie-Charleville-Thargomindah area	Rollins, Steenland, & Hier, 1961

PHYSIOGRAPHY

The Quilpie Sheet area is drained by the Bulloo and Paroo Rivers and the Winbin and Beechal Creeks. The Bulloo River rises north of the Sheet area and the others within it. Drainage reflects the regional tectonic grain, and the main channels are separated by meridional axes.

Mean annual rainfall is 13 inches at Quilpie, increasing eastwards to 19 inches per annum at Charleville, 50 miles east of the Quilpie Sheet. The wettest period is between December and May. Potential evaporation exceeds 75 inches.

The physiography of the Quilpie Sheet area was described by Mabbutt (Appendix 5 *in* Senior et al., 1969), who divides the region into six landscape types (Fig. 1).

Alluviated watercourses occupy the lower ground (Fig. 1, unit 1). Alluvial belts have a complex of braided channels, a habit characteristic of most of western Queensland. The rivers and tributary watercourses flow intermittently; permanent waterholes are only present along the deeper channels of the Bulloo and Paroo Rivers. Channels within the alluvial belts are steep-sided and are separated by flats with clay soils which, when dry, form a micro-relief of polygons separated by shrinkage cracks.

Reworking of Tertiary and Quaternary sediments has resulted in extensive sandplains (unit 2). The sand surface is stabilized by a sparse to near-continuous vegetation cover, and there are no sand-dunes.

Plateaux and mesas (unit 4), between which is a 'hummocky' terrain of dissected structural benches, and low mounds (unit 3) occupy the divides between the main drainage lines. The margins of these landforms are steep-sided and strongly crenulate. Barren surfaces in unit 3 are vari-coloured owing to iron oxide impurities in the mainly white kaolinitic rocks.

The upper surfaces of the plateaux and flat-topped hills have distinctive hard cappings (unit 4). These cappings, referred to as 'weathered mantle' by Senior et al. (1969), consist of indurated reworked chemically altered Winton Formation. Large detached slump blocks litter the slopes of the steep escarpments. On the gently dipping backslopes of the weathered mantle the surface is a veneer of red sandy soil. These 'red earths' form plains, and a few corrugated surfaces along watercourses or where soil has been removed to expose the indurated parent materials.

Cuestas and small mesas with silcrete, or silcrete boulder and cobble, cappings (unit 5) are remnants of an original Tertiary land surface. They are intimately associated with unit 4—the weathered mantle—which underlies areas of disturbed or broken silcrete. Silcrete beds form distinct scarps, but the scarp faces are commonly mantled with silcrete cobbles and boulders. Silcrete has a strong columnar structure, with a polygonal pavement surface formed by the terminating columns.

Erosion by scarp retreat has resulted in abundant detritus forming pediment surfaces, and providing a surface litter to plains (unit 6). Most detritus is a gravel composed of fragments of the indurated cappings described above. Piles of silcrete gravel result in topographic inversion by protecting the underlying Winton Formation whilst erosion is proceeding around the periphery of the deposit. Gravel-covered mounds about 20 feet high have formed in this way.

STRATIGRAPHY

Tables 2 and 3 summarize the stratigraphy of the Quilpie Sheet area. Stratigraphic nomenclature for the Adavale Group is by Phillips Petroleum (1964) and Tanner (1968), with amendments by Galloway (1969); for the Jurassic by Exon (1966); and for the Cretaceous Rolling Downs Group by Vine et al. (1967).

Table 2. PALAEOZOIC STRATIGRAPHY

Age	*Rock Unit (Map Symbol)*	*Lithology*	*Thickness (feet)*	*Remarks and Environment*
Lower Permian	(Pl)	Sandstone, siltstone, conglomerate, minor coal	Up to 2000	Paludal
		UNCONFORMITY		
Upper Devonian to Lower Carboniferous	Buckabie Formation (D-Cb)	Red sandstone, siltstone, mudstone, vari-coloured in part	Up to 10,000	Continental and shallow marine
Middle Devonian (Adavale Group)	Etonvale Formation (Dme)	Siltstone, mudstone, sandstone, in part calcareous; dolomite	0-2000+	Shallow marine
	Boree Salt Member (Dmb)	Crystalline halite, minor anhydrite, minor shale interbeds	Variable due to local flowage	Isolated shallow marine basin (evaporite environment)
	Cooladdi Dolomite Member (Dmc)	Silty and argillaceous dolomite; minor limestone	Up to 250	Shallow marine
	Log Creek Formation (Dml)	Mudstone and siltstone, minor sandstone, labile and sublabile sandstone	0-5200+	Shallow marine, continental
	Bury Limestone Member (Dmu)	Limestone, dolomite, minor calcareous siltstone		Shallow marine
	Gumbardo Formation (Dmg)	Andesite and andesitic tuff in west; arkose and arkosic conglomerate in east	0-2400+	Continental Volcanic flows and pyroclastic deposits; derived fluviatile deposits
		UNCONFORMITY		
Lower Palaeozoic	(Pzl)	Metamorphics, volcanics, granite		

TABLE 3. MESOZOIC AND CAINOZOIC STRATIGRAPHY

Age	Group	*Rock Unit (Map Symbol)*	*Lithology*	*Thickness (feet)*	*Remarks and Environment*
QUATERNARY		(Qa)	Alluvium; sand, silt, clay, soil, minor gravel	1 to 200	Fluviatile
		(Qs)	Quartzose sand	1 to 45	Aeolian
		(Qc)	Gravel, mostly silcrete	Superficial	Colluvial and alluvial
		Qr)	Sandy red earth, minor gravel, magnetic hematite nodules	1 to 45	Eluvial, and aeolian and colluvial
		QUATERNARY UNITS UNCONFORMABLE ON OLDER FORMATIONS			
TERTIARY		Glendower Formation (Tg)	Silcrete, quartzose sandstone, sandy conglomerate	1 to 30	Fluviatile
			UNCONFORMITY		
LOWER TO UPPER CRETACEOUS	Rolling Downs Group	Winton Formation (Kw)	Kaolinized, silicified, and ferruginized sediments. Labile sandstone, siltstone, mudstone, in part calcareous; minor coal	150 to 300 50 to 2250	Deeply weathered zone Fluviatile, lacustrine, and paludal
LOWER CRETACEOUS	Rolling Downs Group	Mackunda Formation (Klm)	Labile sandstone, siltstone, and mudstone, in part calcareous; coquinite	Up to 500 Mostly 200	Paralic
	Rolling Downs Group	Allaru Mudstone (Kla)	Mudstone, siltstone, in part calcareous; minor limestone	600 to 800	Shallow marine
	Rolling Downs Group	Toolebuc Limestone (Klo)	Calcareous shale	10 to 50	Marked peak on gamma-ray log, Shallow marine
	Rolling Downs Group	Wallumbilla Formation (Klu)	Mudstone, siltstone, labile sandstone, in part calcareous	700 to 1150	Shallow marine
UPPER JURASSIC TO LOWER CRETACEOUS		Hooray Sandstone (J-Kh)	Sublabile sandstone, quartzose, sandstone, conglomerate, minor siltstone	500 to 800	Fluviatile
UPPER JURASSIC	Injune Creek Group (Ji)	Westbourne Formation (Juw	Siltstone, mudstone, quartzose sandstone	200 to 375	Fluviatile
MIDDLE TO UPPER JURASSIC	Injune Creek Group (Ji)	Adori Sandstone (Ja	Labile sandstone, siltstone, mudstone	75 to 250 mostly 150	Fluviatile
MIDDLE JURASSIC	Injune Creek Group (Ji)	Birkhead Formation (Jmb)	Labile sandstone, siltstone, calcareous in part	200 to 350	Fluviatile
LOWER JURASSIC		Hutton Sandstone (Jlh)	Quartzose sandstone, minor siltstone and mudstone	About 500	Continental

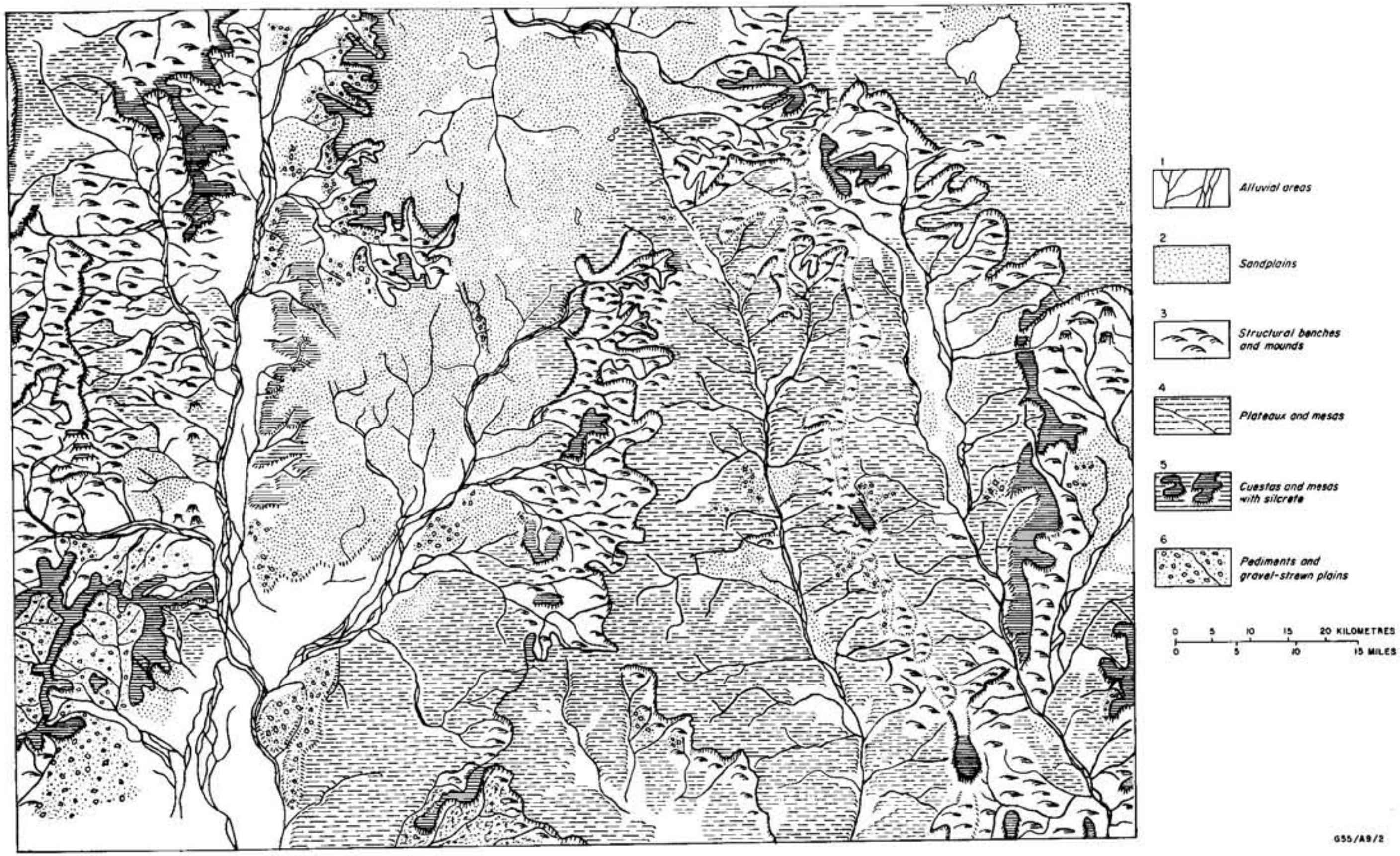

Fig. 1. Physiographic units of the Quilpie Sheet.

Only the chemically altered Winton Formation and younger sediments crop out. Subsurface information is given by the oil exploration wells Phillips-Sunray Buckabie 1 and Dartmouth 1 in the Quilpie Sheet area and by Gumbardo 1 and Quilberry 1 in the adjacent Adavale and Charleville areas. Formation tops for these four wells are listed in Table 4.

Apart from geophysical evidence, subsurface information for the rest of the Sheet area is based on water bore drillers' logs. Gamma ray logs of nine of the deeper water bores are the basis for the correlation of the Jurassic to Cretaceous Eromanga Basin sequence on the map section.

Information on the nature of the basement is sparse. Only one of the two oil exploration wells drilled in the Sheet area, Phillips-Sunray Buckabie 1, reached basement—phyllite of possible Ordovician age. Similar rocks of assumed Ordovician age were penetrated in AOD Canaway 1 (Windorah Sheet), 5 miles from the northwest corner of the Sheet area. Phillips-Sunray Gumbardo 1 (Adavale Sheet, 2 miles north of Quilpie Sheet) encountered basalt dated by the potassium-argon method as Ordovician (Phillips-Sunray, 1963).

Sediments of the Devonian-Carboniferous Adavale Group (Phillips Petroleum, 1964) occur in Phillips-Sunray Buckabie 1 and Dartmouth 1, and in 17 other wells drilled in the more northerly parts of the Adavale Basin. The Adavale Basin is a large subsurface structure containing rocks of Middle Devonian to Lower Carboniferous age. The main part lies to the north of the Quilpie Sheet area, and it extends into the area as two troughs, the Quilpie and Cooladdi Troughs (Fig. 2). The results of geophysical work and drilling in the Adavale Basin are given by Heikkila (1966) and Tanner (1966, 1968).

Geophysical work indicates that Devonian sediments are present in the northern and northwestern parts of the Quilpie Sheet area; elsewhere sediments of the Eromanga Basin sequence rest on basement (Fig. 2). The Devonian sediments thicken considerably towards the axes of the Quilpie and Cooladdi Troughs, where up to 16,000 feet may be present.

The oldest stratified rocks of the Adavale Basin are included in the Middle Devonian Gumbardo Formation. This formation is predominantly volcanic in the type section (Gumbardo 1, Adavale Sheet) where it consists of andesitic tuffs and flows, and rests unconformably on Ordovician basalt. By extrapolation, similar deposits are likely to occur in the northwestern part of Quilpie Sheet. East and south from the centre of vulcanism, arkose and arkosic conglomerate predominate. Sediments of this type were found in Dartmouth 1 and are probably widespread in the deeper parts of the Quilpie and Cooladdi Troughs.

The name Log Creek Formation, defined and described by Galloway (1970), replaces the invalid 'Gilmore Formation' of Tanner (1968). The formation is informally divided into a lower shale member and an upper sandstone member throughout most of the basin (Slanis & Netzel, 1967; Tanner, 1968). The Bury Limestone Member is regarded as the eastern facies equivalent of the shale member. A sequence of 2276 feet of calcareous shale and limestone occurs between 5114 and 7390 feet in Dartmouth 1. Knuth (1967), by implication, correlates this sequence with the Bury Limestone Member.

The Log Creek Formation is mainly marine; the upper part grades to shallow marine and continental deposits (Tanner, 1968). Pelecypods, brachiopods, rare gastropods, and a few nautiloid fragments indicate a Devonian age (McKellar, 1966a), and pollen a Middle Devonian age (de Jersey, 1966). In Dartmouth 1, 5203 feet of the formation was drilled without reaching the base. This is the greatest thickness found to date in the Adavale Basin.

The Etonvale Formation consists of dolomitic shale and sandstone. At the base is a thin dolomite, the Cooladdi Dolomite Member, and its eastern evaporitic facies, the Boree Salt Member.

In Phillips-Sunray Quilberry 1 (Charleville Sheet), 204 feet of dolomitic limestone was drilled and attributed to the Cooladdi Dolomite Member (Cundill, Meyers & Associates, 1965). In the main part of the Adavale Basin this member is the source of a prominent seismic reflection known as the D3 horizon.

The Boree Salt Member has not been identified from any well in the Sheet area, but a dome 7 miles south of Dartmouth was interpreted by Tanner (1968) as a non-piercement salt dome due to flowage of Boree Salt. The member consists of halite, minor anhydrite, and other evaporites and has a maximum intersected thickness of 1816 feet (thickened by flowage) in Phillips-Sunray Bury 1 (Adavale Sheet).

Continental to shallow marine sediments of the Devonian to Carboniferous Buckabie Formation consist of a monotonous sequence of varicoloured (primarily red) siltstone, sandstone, and mudstone. Minimum penetrated thickness is 121 feet in Phillips-Sunray Quilberry 1 (on the continuation of Quilberry Anticline in Charleville Sheet), and the maximum 2510 feet in Buckabie 1. The formation may be 10,000 feet thick in structurally low areas according to seismic interpretation (Tanner, 1968, p. 115). It is barren and is dated by its stratigraphic position—conformable above the Middle Devonian Etonvale Formation and unconformable below Lower Permian non-marine sediments (Tanner, 1968).

The only Lower Permian sediments in the Quilpie Sheet area comprise a 552-foot sandstone sequence in Dartmouth 1, which rests unconformably on the Etonvale Formation, and contains pollen of P1 age (Evans, 1966).

The distribution of Permian rocks is difficult to assess. They pinch out to the south of Dartmouth 1 and were not found in Quilberry 1 (Charleville Sheet). Probably the Permian thickens north and west of Dartmouth 1 and locally thickens in the Quilpie and Cooladdi Troughs.

Upper Permian and Triassic sediments occur in the northern part of the Adavale Basin (Adavale Sheet) but have yet to be proved in the Quilpie Sheet area. Possibly they are preserved near the axes of the Quilpie and Cooladdi Troughs.

Jurassic sediments were penetrated by the oil exploration wells and many of the deeper water bores. A complete sequence from the Hutton Sandstone to the Hooray Sandstone is present. The Hutton Sandstone rests unconformably on basement in the Cheepie Shelf area, and unconformably on Permian and older sediments over the Cooladdi and Quilpie Troughs. It is mainly a fluviatile sandstone sequence and has a uniform thickness of about 500 feet in the Quilpie Sheet area.

It is followed conformably by the Injune Creek Group, a relatively uniform sequence of sublabile sandstone and siltstone beds, with a marked sandy interval known as the Adori Sandstone. The group is conformably overlain by the Hooray Sandstone.

The Cretaceous Rolling Downs Group represents a major cycle of marine transgression and regression. The Wallumbilla Formation and Allaru Mudstone are mainly argillaceous, but the fauna is entirely shallow water (Vine & Day, 1965; Vine et al., 1967). The brackish-water sediments of the Mackunda Formation were succeeded conformably by the Lower to Upper Cretaceous Winton Formation, which was deposited in fluviatile, lacustrine, and paludal environments.

The sequence drilled in Quilberry 1 (Table 4) indicates that the Mackunda Formation, if present, should crop out in the axial zone of the Quilberry Anticline. Because of the chemical alteration of sediments the presence of this formation might have been overlooked. However, abundant fossil plant debris occurs in almost all outcrops in the Quilberry Anticline. Leaves of *Phyllopteris lanceolata* Walkom (White, 1969) suggest that the sediments are non-marine and belong to the Winton Formation.

Exposures of Winton sediments within the Sheet area consist of pale kaolinized rocks with some beds selectively ferruginized and silicified. The alterations occurred during a late Cretaceous or early Tertiary period of weathering which affected up to 300 feet of the rocks.

TABLE 4. FORMATION TOPS FROM OIL EXPLORATION WELLS IN AND NEAR THE QUILPIE SHEET AREA

	Buckabie 1 Grid. ref. 209745	*Gumbardo 1 Grid. ref. 256263*	*Dartmouth 1 Grid. ref. 328753*	*Quilberry 1 Grid. ref. 346719*
Datum K.B. in feet	738	930	1118	1063
Ground elevation (above sea level)	723	916	1104	1050
Winton Formation	0	0	0	0
Mackunda Formation	Not picked	790	Not picked	Not picked
Allaru Mudstone	1750	1300	935	75
Toolebuc Limestone	2342	1847	1420	680
Wallumbilla Formation	2354	1875	1460	730
Hooray Sandstone	3164	2792	2515	1700
Westbourne Formation	3800	3585	3180	2300
Adori Sandstone	4100	3715	3530	2575
Birkhead Formation	4200	3875	3755	2720
Hutton Sandstone	4410	4190	4030	2930
Lower Permian	Not present	Not present	4550	3380
Buckabie Formation	5216	4728	Not present	3500
Etonvale Formation	7726	7693	Not present	Not present
Boree Salt Member	Not present	Not present	Not present	Not present
Cooladdi Dolomite	Not present	9055	Not present	5410
Log Creek Formation	Not present	9144	—	5610
Bury Limestone	Not present	Not present	5114	Not present
Gumbardo Formation	Not present	10393	7390	7825
Basement	8810	12835	Not reached	Not reached
Total Depth	9070	12940	10010	10013

OIL EXPLORATION WELL	REFERENCE	YEAR DRILLED
Buckabie 1	Phillips-Sunray, 1962	1961
Gumbardo 1	Phillips-Sunray, 1963	1962
Dartmouth 1	Knuth, 1967	1966
Quilberry 1	Cundill, Meyers & Associates, 1965	1965

The Tertiary sediments rest unconformably on the Winton Formation. They are correlated with Whitehouse's (1940, 1954) Glendower Formation of the northern Eromanga Basin and are dominantly arenaceous, quartzose, and fluviatile, probably of early Tertiary age. Subsequent alteration by weathering during the Tertiary silicified the sandstone in part to silcrete.

Quaternary deposits are widespread in the Sheet area but are mainly thin. The thickest known Quaternary sequence is alluvium in the Bulloo Valley, which may be 200 feet thick in the Bulloo Syncline south of Quilpie township.

Sandy red earths are widespread and have formed in the upper part of a weathered mantle which forms an indurated capping to the altered Winton Formation. They represent further breakdown of the weathered mantle by soil-forming processes. Their thickness ranges from 2 feet on sloping surfaces to about 45 feet on plains. Slight soil creep gives a banded mulga scrub pattern, visible as a characteristic pattern on air-photographs.

STRUCTURE

Middle Devonian to ?Carboniferous sediments of the Adavale Group are confined to the Quilpie and Cooladdi Troughs, structural remnants of the Adavale Basin. These troughs contain up to 16,000 feet of pre-Mesozoic sediments, and have steep-sided or fault-bounded margins. Seismic contours of the Devonian D3 horizon combined with the structural geology are illustrated in Figure 2.

A regional unconformity separates the Adavale Group, and Lower Permian where present, from the Mesozoic Eromanga Basin sequence. In contrast to the strong folding and faulting in the Adavale Group, the Eromanga Basin sediments are almost flat-lying, disturbed in places by shallow folds which are essentially the result of drape-folding over deeper structures. Structural contours on the Hooray Sandstone are shown in Figure 3.

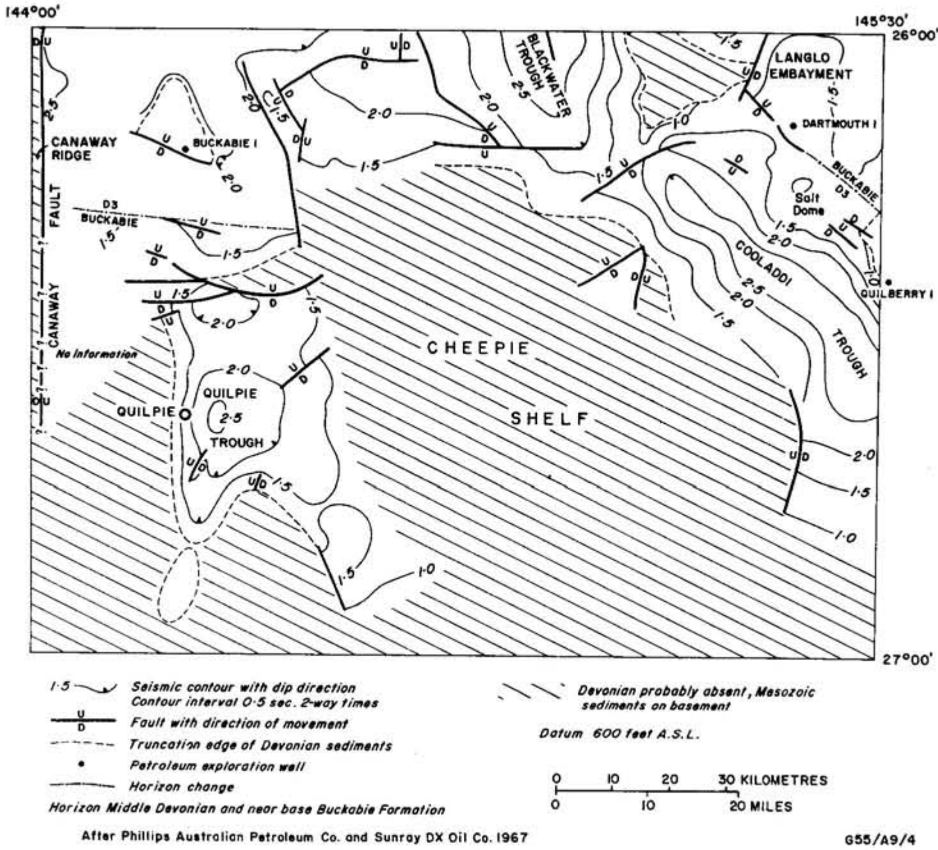

Fig. 2. Structural elements, with seismic contours of the Devonian D3 horizon.

Surface delineation of structure is hindered by paucity of outcrop, and consequent lack of measurable dips. The four surface anticlines appear to be symmetrical, with limbs dipping at less than 3°.

The presence of the Buckabie Anticline is deduced entirely from seismic interpretation. The Quilberry and Yalamurra Anticlines are delineated by

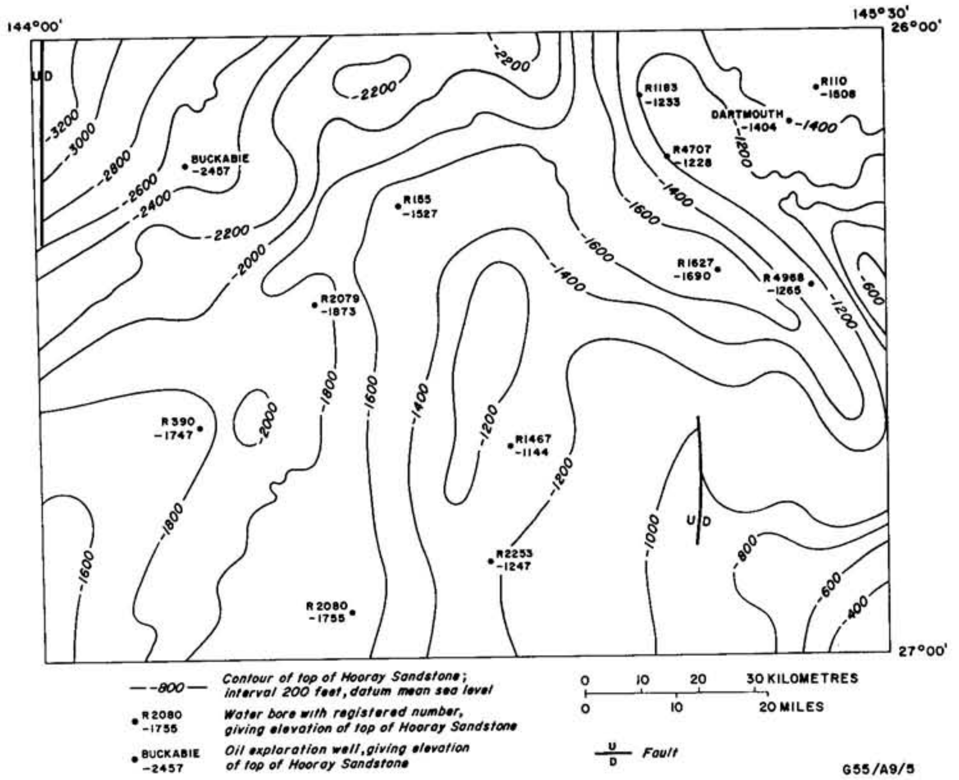

Fig. 3. Structural contours on the Hooray Sandstone.

seismic interpretation and are partly expressed in the topography. The Yalamurra Anticline has resulted from fault movements at depth. It has a surface expression as a north-trending fold, and is eroded, with a core zone measuring 11 by 1½ miles between its peripheral cuestas. Interpretation of seismic data indicates a 10,000-foot displacement on the pre-Mesozoic horizon (Hier & Spivey, 1962) lessening to 500 feet in the Hooray Sandstone reflector.

The Winbin and Tumblebur Anticlines have not been previously identified. They are in the Eromanga Basin sequence and are the combined result of growth during deposition by periodic vertical movements along old fault lines, and differential compaction.

The Canaway Ridge (Fig. 2) forms the divide between the Adavale Basin (Devonian-Carboniferous) to the east and the Cooper Basin (Permian-Triassic) and Warrabin Trough (Devonian) to the west. The Canaway Fault forms the eastern margin of the ridge, and is expressed at the surface by a line of west-facing scarps, and silcrete beds within the Glendower Formation tilted towards the east.

Synclinal axes are not evident at the surface. The Bulloo Syncline and the syncline west of the Quilberry Anticline were located from seismic data and wireline and lithological logs of water bores.

GEOLOGICAL HISTORY

The basement rocks were steeply folded and slightly metamorphosed in an orogeny probably in late Silurian to early Devonian time.

Sediments were then deposited on the western shelf of the Tasman Geosyncline during the Devonian (Tanner, 1968). In the Quilpie area vulcanicity in the Middle Devonian (Gumbardo Formation) was followed by more stable marine conditions (Log Creek Formation). The area was uplifted and eroded before being again inundated (Cooladdi Dolomite Member of Etonvale Formation). In the northeast, the Boree Salt Member was deposited in an evaporite basin. Shallow seas in the Middle Devonian (Etonvale Formation) regressed, leaving low-lying arid flood plains and saline lakes in late Devonian to early Carboniferous times (Buckabie Formation; Tanner, 1968).

Fold movements in late Carboniferous time downwarped the Devonian rocks in the Quilpie and Cooladdi Troughs, and caused erosion of the Devonian and basement rocks in intervening areas. Mobilization of the Boree Salt Member during this phase of tectonism produced salt domes and diapiric ridges (Tanner, 1968).

The Quilpie area was land throughout the Permian and Triassic. Deposition took place mainly in swamps during the Permian and in rivers and lakes during the Triassic. Epeirogenic movements after the Triassic affected the Permo-Triassic sediments, and the more uplifted areas were eroded.

Renewed uplift occurred along the Canaway Fault, and basins developed to the east and west of the Canaway Ridge. Lower Jurassic fluviatile and lacustrine sediments (Hutton Sandstone) were deposited in the basins. The Canaway Ridge was transgressed in the Middle to Upper Jurassic by fluviatile sediments of the Injune Creek Group.

A marine transgression in the Lower Cretaceous resulted in deposition of mud and silt and then sand (Wallumbilla Formation). Clear water conditions followed for a short while and thin calcareous silts grading to limestone to the north of Quilpie Sheet were laid down. These beds have an anomalous concentration of radioactive minerals which makes them readily identifiable on gamma ray logs.

Sedimentation continued in a shallow sea (Allaru Mudstone) and then in a paralic environment (Mackunda Formation). Subsequent Cretaceous deposits (Winton Formation) were deposited in lakes, swamps, and rivers.

At the end of the Cretaceous the area was peneplaned and the Winton Formation sediments deeply weathered. The weathered beds were slightly tilted and locally eroded before fluviatile Tertiary sands were laid down. Some of the sands were subsequently silicified and leached to form silcrete before epeirogenic movements slightly warped and buckled them.

Renewed uplift, related to block faulting along old lines such as the Canaway Ridge, occurred in late Tertiary time.

Alluvial deposits accumulated in the shallow downwarps during late Tertiary and Quaternary time.

ECONOMIC GEOLOGY

Groundwater

The Queensland Irrigation and Water Supply Commission has records of 153 bores drilled in the Quilpie Sheet area: 12 are flowing, 5 have ceased to flow owing to loss of pressure, 122 are subartesian bores or wells, and 14 are abandoned. About 10 other bores or wells are not registered. Abandonment was due to insufficient supply, excess salinity, bore collapse, or equipment failure; precise details are not available. Oil exploration wells Phillips-Sunray Buckabie 1 and Dartmouth 1 were completed as artesian water bores.

Groundwater is mainly used for stock. However, Quilpie town bore 390 provides inhabitants with domestic and industrial water. Some homesteads rely on bore water for domestic purposes.

The most utilized aquifers are those of the Winton Formation; they yield subartesian supplies of water of variable quality and quantity. They are used because the cost of drilling to deeper aquifer systems is prohibitive, and, in the interests of conservation, licences for artesian bores are seldom granted. In a small area on Greenmulla property, southeast of Quilpie township, artesian bores 11806, 12691, 13302, and 13926 flow from a Winton Formation aquifer. Depth of this aquifer ranges from 445 feet in the east to 752 feet in the west (a small flow recorded from 1475 feet while drilling Quilpie town bore 390 was probably from the same aquifer). These bores are situated in low-lying land on the Bulloo plains 200 feet below intake beds in sandstone outcrops in the hills to the east, the regional dip being 1° to 2° west. The water is suitable only for stock, and has a high conductivity of 7700 and 9350 micromhos/cm at 25°C (Table 5).

Flowing water of good quality and quantity is obtained from Hooray Sandstone aquifers. The present potentiometric surface of these aquifers is below the land surface in elevated areas, especially in the east and northeast of the Sheet area. For this reason bores 4968, 4707, 1182 and 3959, although originally artesian, have ceased to flow. The potentiometric surface

TABLE 5. BORES INITIALLY FLOWING OR STILL FLOWING

Q.I.W.S. Number	*Total depth in feet*	*Aquifer*	*Conductivity @ 25°C in micromhos/ cm*	*Initial flow in g.p.h.*	*Status*	*Grid. ref.*
110*	3666	Hooray Sandstone Adori Sandstone Birkhead Formation	—	23,558	C	333759
155*	2884	Hooray Sandstone	550	45,833	A	250736
390	2952	Hooray Sandstone	704	54,820	A	212694
1181	3560	Hooray Sandstone	—	?	A	329764
1182*	4857	Hooray Sandstone Adori Sandstone Birkhead Formation	1000	?	C	297758
1466	3010	Hutton Sandstone	—	?	Abd	313678
1467*	2676	Hooray Sandstone	935	Large flow	A	272689
1627*	3201	Hooray Sandstone	1149	33,330	A	313724
2079	3110	Hooray Sandstone	—	—	A	234717
2080	2918	Hooray Sandstone	682	49,600	A	241657
2253*	2748	Hooray Sandstone	—	42,800	A	269666
3959*	2570	Hooray Sandstone	—	45,833	C	346738
4707*	3516	Hooray Sandstone	—	—	C	303746
4968*	3500	Hooray Sandstone Hooray Sandstone Birkhead Sandstone	935	12,410	C	334719
11806	512	Winton Formation	—	—	A	239674
12691	472	Winton Formation	9350	—	A	227682
13302	569	Winton Formation	7700	600	A	224682
13926	752	Winton Formation	—	50	A	217684

A = Artesian Bore
C = Artesian Bore ceased to flow, with mechanical pump
Abd = Artesian Bore ceased to flow, and abandoned
* = Gamma ray logged bore

is above the land surface over the remainder of the Sheet area, where there are still some large flows.

The Hooray Sandstone aquifers are about 1600 feet deep in the eastern two thirds of the Sheet and 2500 and 4000 feet deep in the west. A summary of bores initially flowing or still flowing on Quilpie Sheet is given in Table 5.

Oil and Gas

Prospecting for oil and gas has so far been unsuccessful. The two deep exploration wells indicate that the Eromanga Basin sequence is waterlogged and that the underlying Adavale Basin sequence is relatively impermeable.

Twenty exploration and field development wells have been drilled in the whole Adavale Basin and major, but as yet noncommercial, gas has only been found at Gilmore (Adavale Sheet), where it occurs in sandstone beds of the Log Creek Formation.

In the Quilpie Sheet area only the Quilpie and Cooladdi Troughs have been drilled. These troughs contain up to 20,000 feet of sediments, of which about 16,000 feet are marine Devonian beds, likely source rocks for petroleum. The steep margins of the troughs are in part faulted and could provide hydrocarbon traps if suitable reservoir beds exist.

Little interest has been shown in the Eromanga Basin sequence. The sequence contains marine argillaceous deposits which are possible source beds for petroleum, and numerous porous and permeable sandstone beds, gently folded. But it has been indirectly explored by water-bore drillers and no traces of hydrocarbons have been noted within the Eromanga Basin sequence in the Quilpie Sheet area.

Opal

Abandoned shafts and shallow bulldozed trenches are present along a zone of chemically altered Winton Formation west of the Canaway Fault (Grid ref. 180760), 7 miles east of the well known Hayricks Opal mine (Cribb, 1948). No details of the quantity or quality of opal extracted are known.

Constructional Materials

Gravel and sand are available in sufficient quantities to supply local needs. Surface veneers of gravel are available almost everywhere in sufficient quantity to surface roads. Silcrete gravel quarries were worked close to and supplied gravel for the Diamantina Developmental Road west of Quilpie. Deposits of poorly consolidated quartz sandstone about 30 feet thick occur east of the Bulloo River near Glencoe homestead.

Silcrete cobbles and boulders of local origin are used to construct causeways across watercourses. All other constructional materials are imported.

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