COMMONWEALTH OF AUSTRALIA.

DEPARTMENT OF NATIONAL DEVELOPMENT.

BUREAU OF MINERAL RESOURCES GEOLOGY AND GEOPHYSICS.

RECORDS.

1961/88

EXPLANATORY NOTES ON THE BILLILUNA GEOLOGICAL SHEET

Compiled by

A.T. Wells

RECORDS 1961/88

EXPLANATORY NOTES ON THE BILLILUNA GEOLOGICAL SHEET

Compiled by

A.T. Wells

EXPLANATORY NOTES ON THE BILLILUNA GEOLOGICAL SHEET

Compiled by

A. T. Wells.

Records No. 1961/88.

INTRODUCTION

The Billiluna Sheet area lies between latitudes 19°00' and 20°00' South and longitudes 127°30' and 129°00' East. The eastern edge of the Sheet is the boundary between the Northern Territory and Western Australia; the northern edge is about 50 miles due south of Halls Creek. Access to the area is by way of a road from Halls Creek to either Sturt Creek Station or Billiluna Station; Billiluna is 114 miles by road from Halls Creek. The north-eastern portion of the Sheet is crossed by the Tanami track, which connects Halls Creek with Alice Springs through Tanami; it is used only occasionally.

Cattle are raised on the alluvial plains bordering Sturt Creek; the remainder of the area is barren sand-plain uninhabited by white people. Cattle are periodically driven along the Canning Stock Route from Billiluna Station to Carnegie Station in the south. The area has a low rainfall, but water-holes are plentiful along Sturt Creek and good water can be obtained from wells and bores sunk on the two cattle stations. Other sources of water include pools, rock holes, and springs, particularly in or near low ranges of hills. Several of the larger water holes in the Gardiner Range hold many thousands of gallons and probably dry up only during the severest droughts.

History of Investigations

A.C. Gregory was probably the first to enter the area: in 1856 he followed Sturt Creek southwards and discovered the salt lake into which the creek drains, and which now bears his name. In 1896, D.W. Carnegie crossed the area during his journey from the Western Australian goldfields to Halls Creek

and back (Carnegie, 1898). Between 1898 and 1900, A.A. Davidson led a prospecting expedition for the Central Australian Exploration Syndicate Ltd, and investigated areas of Precambrian rocks in the southern part of the Gardiner Range (Davidson, 1905).

A practicable stock route between Wiluna and Halls Creek was discovered by A.W. Canning in 1906-7. In 1908, H.W.B. Talbot accompanied Canning when the stock route was opened, and later (Talbot, 1910) published an account of the geology and water supplies. Kidson (1914) recorded magnetic observations along the Stock Route.

M. Terry covered parts of the area during his exploring and prospecting expeditions, and in his 1928 expedition (Terry, 1932) prospected the Gardiner Range at Larranganni Bluff.

Maddox (1941) made a geological reconnaissance for Caltex (Aust.) Development Pty Ltd in the north-eastern part of the Fitzroy Basin, including traverses east and south-east of Billiluna and Sturt Creek Stations. Reeves (1949) carried out extensive aerial and ground geological reconnaissance in the Fitzroy and Canning Basins for the Vacuum Oil Company. Much of his report on the north-eastern area is based on work by Kraus (1941), Maddox (1941), and Findlay (1942).

Matheson and Guppy (1949) did a reconnaissance survey of the Mt. Ramsay four-mile Sheet and made a traverse to the Wolf Creek Meteorite Crater (Guppy and Matheson, 1951).

Traves (1955) carried out a regional survey of the adjacent Ord-Victoria region to the north and the Precambrian Halls Creek Metamorphics which he mapped and studied were also identified on the Billiluna Sheet area. The area was photographed by the R.A.A.F. in 1953 from 25,000 feet, giving vertical

coverage at a scale of approximately 1:50,000. Semi-controlled 4-mile and 1-mile photo-mosaics supplied by the National Mapping Division were used for the geological compilation.

In 1955 a geological party from the Bureau of Mineral Resources entered the desert area using 4-wheel-drive vehicles. Casey & Wells (1956) described the travelling methods and conditions encountered during the investigation. A surveyor from the Lands and Surveys Department, Perth, accompanied the party and took astrofixes. Geologists from West Australian Petroleum Pty Ltd accompanied the Bureau party on several traverses and took gravity observations in the western part of the area (Garrett, 1956). In 1956 the Geophysical Section of the Bureau took gravity readings between Halls Creek and Godfreys Tank. In the same year a survey party from the Department of the Interior took several astrofixes and levels between these two points. The astrofix results shown in Table 1 were supplied by the Department of the Interior, Canberra, (prefix KBS) and the State Lands and Surveys Department, Perth (prefix N).

Table I - Astrofix results for the Billiluna Sheet

Station	Latitude	Longitude	East	North
N1	18°59'36.0"	127°41'19.5"	594495	2617397
N2	19°32'26.8"	127°36'17.7"	584225	2551197
N3	19°59'54.7"	127°34'20.4"	579969	2495801
N4	19°02'37.9"	128°17'04.5"	663063	2610502
N5	19°29'38.5"	128°25' 51.7"	679170	2555743
N6	19°57'37.6"	128°14'05.3"	655883	2499552
N20	19°02'11.4"	128°59'19.1"	744200	2610175
N19	19°33'26.8"	128°56'26.1"	737590	2547141
KBS5	19°40'30.4"	127°41'06.9"	593288	2534847
KBS4	19°40'30.4"	127°35'15.5"	582090	2534949

PHYSIOGRAPHY

The Sheet contains elements of both marginal dissected highlands and desert sand-plains. Paterson (1954) has used the term Sturt Plateau Region for the elevated area mainly to the north of this Sheet. Between this large plateau and the semi-desert proper lies a marginal sand-plain with isolated ranges and hills. These insular hills are mostly rounded and generally rise less than 500 feet above the surrounding plain. The altitude of the sand plain rises from 1000 feet near Billiluna Homestead to about 1200 feet near the marginal ranges to the north and north-east. Mount Brophy, the highest peak in the Gardiner Range, is about 1800 feet high.

Seif dunes and wind-blown sand cover large areas, particularly in the south-west of the area. They are up to 50 miles long and average fifty feet in height, with some as high as 100 feet. The dunes have migrated westward, but their movement is now somewhat restricted by the sparse growth of spinifex, small shrubs, and herbaceous plants which partly covers them. The crests of some dunes are devoid of vegetation. Dunes are absent in the areas between the isolated marginal ranges.

Drainage is internal: most large streams - Sturt Creek is far the largest - flow into Gregory Salt Lake; small ones drain off the hills on to the sand plain and disappear in a proliferation of distributaries. Alluvial fans mark the debouchment of the small streams on to the plain, and some have accumulated narrow piedmont deposits.

The gradient of Sturt Creek from Astrofix N4 to its junction with Wolf Creek is little more than one foot per mile, and wide flood plains and an indistinct channel mark its upper reaches. Below the junction the grade increases, though only slightly, and between Stretch Lagoon and Gregory Salt Lake is about two feet per mile. The stream here runs in a well defin[illegible] channel.

A possible old course of Sturt Creek east and south of Denison Range, a south-west to Stretch Lagoon, is marked by discontinuous patches of travertine and alluvium, and claypans: headwater erosion by a stream that originally rose near the present Sturt Creek Homestead probably captured the old creek just north of the Sheet area, and Slatey and Lewis Creeks, which are not dissipated in the plain, would have been tributaries of the old creek.

Wolf Creek Meteorite Crater

A prominent topographical feature in the north-west of the area is the Wolf Creek Meteorite Crater. The Crater is 65 miles south of Halls Creek and was first observed from the air in 1947. It was described by Guppy and Matheson (1951). The depth of the crater is 160 feet below the rim and 70 feet below the general level of the surrounding land surface. The outer slope is generally 10° to 15° and the inner slope from 30° to 40°. The diameter of the rim is 2800 feet, and that of the flat inner floor is 1400 feet; both rim and floor are circular. The total width of the crater, which is the fourth largest in the world, is 2,800 feet. Its circular shape and well developed radial symmetry suggest that the crater is of the explosion type.

STRATIGRAPHY AND PALAEONTOLOGY

Proterozoic rocks occupy most of the Billiluna Sheet; they form the margin and basement to the Planerozoic sediments of the Canning Basin, and were the source of many of them. The sediments are nearly all arenaceous and fossils are confined to occasional thin beds.*

* Numbers with the prefix B, on the map, refer to localities of specimens now housed in the Bureau of Mineral Resources Museum, Canberra.

PRECAMBRIAN

The Precambrian rocks are divided into 'Lower Proterozoic' - Halls Creek Metamorphics (Traves, 1955) and Lewis Granite - and, overlying these unconformably, 'Upper Proterozoic' - Kearney Beds, Gardiner Beds, and Phillipson Beds. The threefold division of the Upper Proterozoic rocks is necessary because of the wide variation in their metamorphism and structure, which renders it impossible to correlate the widely separated outcrops. The Upper Proterozoic rocks are nearly all orthoquartzites; some are friable and porous, others silicified and very hard. Dips range from nearly horizontal to about 70° and in some areas the beds are tightly folded. The three divisions may prove to be coeval.

(?)LOWER PROTEROZOIC

Halls Creek Metamorphics (Traves, 1955)

The Halls Creek Metamorphics crop out at the bases of breakaways in the Gardiner Range, where they are unconformably overlain by Gardiner Beds. They underlie a large area between Larranganni Bluff and the southern edge of the Sheet, and are cut by large quartz reefs, up to 18 miles long and 1000 feet wide. At the base of Larranganni Bluff the rocks are folded shale, slate, and greywacke, with dips ranging from 50° to vertical; in some places they are cut by quartz veins containing hematite.

Lewis Granite (Casey & Wells, 1961)

The Lewis Granite intrudes the Halls Creek Metamorphics and is overlain by Phillipson Beds. It crops out at Tent Hill and in an arcuate line of small exposures to the south-west.

Kearney Beds (Casey & Wells, 1961)

The Kearney Beds crop out in low hills east of Wolf Creek and in a meridional belt 15 miles east of Billiluna Homestead. They are mostly silicified medium-grained sandstone and fine conglomerate, with current ripple marks, current-bedding, and weathered-out clay pellets. Dips range from 30° to vertical, and small faults and ramifying quartz veins are common. At B28, probable Upper Devonian or Lower Carboniferous sandstone overlies hard silicified sandstone of the Kearney Beds with an angular unconformity. No contacts with other Proterozoic rocks were observed. The thickness of the Kearney Beds is estimated at 2000 feet, but may be much greater.

Gardiner Beds (Casey & Wells, 1961)

The Gardiner Beds crop out in and around the Gardiner and Denison Ranges in the north-east of the Sheet area. The exposure at Larranganni Bluff is typical: hard silicified medium-grained sandstone with prominent joints and wave and current ripple marks, overlying alternating bands of shaly micaceous sandstone and chocolate-brown micaceous shale. At the base of the section a 40-foot conglomerate unconformably overlies the Halls Creek Metamorphics. At all outcrops the resistant silicified sandstone is prominent.

The thickest section measured in the Sheet area is 500 feet at Mount Brophy; but at Redcliff Pound, south of the Sheet, the Gardiner Beds are about 5000 feet thick.

Phillipson Beds (Casey & Wells, 1961)

The Phillipson Beds crop out at Tent Hill, where they form an arcuate line of hills stretching to the south-west. At Tent Hill the beds overlie the Lewis Granite and dip at 5° to the west. The section here consists of both hard and soft sandstone, with some pebbles; the sandstone is well jointed and

large-scale current-bedding, with sets up to 5 feet thick, is common. A basal conglomerate 10 feet thick contains pebbles of granite and quartzite. On the adjacent Lucas Sheet the relationship of the Phillipson Beds to the Lewis Granite is more obvious. The peneplaned flat surface of the granite on which the beds rest dips at 2-3° to the east and indicates a considerable period of erosion. A possible contact of the Phillipson Beds overlying the Gardiner Beds has been mapped in the Erica Range on the Stansmore Sheet.

ORDOVICIAN

Rocks of probable Ordovician age crop out at B3 on the Halls Creek-Billiluna road, 31 miles north of Billiluna Station, where a trilobite pygidium was found: it is referable to Dikelokephalina Brögger, of late Tremadocian age (J. Gilbert-Tomlinson, pers. comm.). The outcrop is small and consists of medium conglomerate, interbedded with ill-sorted sandstone with scattered pebbles and worm markings. The conglomerate contains boulders up to one foot across.

UPPER DEVONIAN-LOWER CARBONIFEROUS

Rocks of doubtful age crop out at and around Knobby Hills. They contain a specimen of Leptophloeum australe (McCoy) which may be of Upper Devonian or Lower Carboniferous age (White, 1957). The rocks are current-bedded medium to coarse-grained sandstone containing clay pellets, with some coarser bands in which are subrounded pebbles 1 inch across. The rock is friable when fresh. Foresets dip to the south-west at about 15°.

Wood and plant remains are common in the clean medium-grained quartz sandstone. At Skeen Hill, about 7 miles north-east of Billiluna Homestead, the basal clayey medium-grained sandstone also contains abundant wood fragments and clay pellets and is micaceous in places. The overlying few feet of sediments are current-bedded, better sorted, medium-grained, massive sandstone with no mica. At B28, ten miles east of Skeen Hill, the sediments dip at 9° to the south-west and overlie

steeply dipping Upper Proterozoic quartzite with an angular unconformity. This is the only locality at which the beds have been seen to be in contact with any other formation.

PERMIAN

Grant Formation

The Grant Formation (Guppy et al., 1958) was recognised on this Sheet, first in the Falconer Hills, about 4 miles north-north-west of Billiluna Homestead, and later at Mount Mueller. The formation is massive, and prominent jointing produces a characteristically rough terrain and forms distinctive geographical features.

White (1957) has recognised the following plant fossils

at B24: Vertebraria sp. cf. V.indica Royle, a Permian form;

at B25: Seed of Samaropsis type, which is common in the Permian. Noeggerathiopsis hislopi (Bunb.) a Permian plant;

at B29: Possibly portion of an impression of a leaf of Noeggerathiopsis. Possibly Permian;

at B?: Indeterminate stem impressions.

These rocks are believed to belong to the Grant Formation on the grounds of lithology - the sparkling quartz grains in the conglomerates give a characteristic texture - the presence of wood fragments, and the presence of the formation in a similar depositional environment, that is, overlapping older formations, in other parts of the margin of the basin.

Noonkanbah Formation

The Noonkanbah Formation (Guppy et al., 1958) crops out only in a small area south of Mount Mueller on the south-western corner of the Sheet, as rubble-covered plains with few solid outcrops of fossiliferous calcareous fine silty sandstone with red clay-pellets and some coquinite. The rocks were apparently laid down in fairly shallow water, little disturbed by currents.

Dickins (1958) has recognised "Chonetes" sp. (sulcate form) and Bellerophon sp. at B21, and "Chonetes" sp. (sulcate form) and "Heteropecten" sp. nov. at B22.

The presence of "Heteropecten" sp. nov. suggests that the outcrops lie in the top part of the Noonkanbah Formation. In places it is almost impossible to separate the Balgo Member of the Liveringa Formation from the Noonkanbah Formation in the field because of their similar lithology. Because of the poor exposures no clear-cut contacts between the two formations were seen in the field and reliable estimates of the thickness of the Noonkanbah Formation could not be made.

Liveringa Formation

The Liveringa Formation (Guppy et al., 1958) has been subdivided into three members in the north-eastern Canning Basin, but only the basal marine member, the Balgo Member, crops out on this Sheet.

The Balgo Member is correlated with the Lightjack Member (Guppy et al., 1958) of the Liveringa Formation, which has been defined and mapped in the Christmas Creek area. Outcrops of the member are restricted to small areas in the vicinity of Mount Mueller. The lithology is similar to that of the Noonkanbah Formation, except for the absence of calcareous or coquina beds. Where resistant sandstone members occur they are of medium-grained current-bedded sandstone with interbedded fine micaceous siltstone, and form steep-sided breakaways. A conglomerate near the top of the section at B14, about two miles west of Old Billiluna, contains rounded pebbles of quartz, quartzite and rarely granite and soft sandstone. The thickest section of the Balgo Member measured was 70 feet. The Member was probably laid down in a similar environment to the Noonkanbah Formation except perhaps for a minor shallowing of the water to account for a slight coarsening of the sediment. The contact with the underlying Noonkanbah Formation, although not seen in the field, is apparently conformable.

TERTIARY

Laterite and pisolitic Ironstone

Laterite is not widespread and there is no evidence to indicate that the laterite covered the whole of the area. At B24 near Mount Mueller the laterite capping of the sediments has been weathered and reconsolidated with sand grains and rock fragments: no laterite has formed on the Upper Proterozoic orthoquartzites.

At the north end of the Gardiner Range, 7 miles south-west of Mount Brophy Spring, dark brown vuggy ironstone about 15 feet thick overlies a medium-grained sandstone of the Gardiner Beds. The deposit is pisolitic and forms rather undulating hills on the valley floor; it may be a thick detrital laterite.

Lawford Beds (Casey & Wells, 1961)

The Lawford Beds are lacustrine deposits lithologically similar to the Oakover Beds (Maitland, 1904) as mapped in the south-west Canning Basin. Only one small outcrop is present, between the east and west branches of Wolf Creek.

TERTIARY OR QUATERNARY

Wolf Gravel

The Wolf Gravel (Casey and Wells, 1961) consists of alluvial gravel and some consolidated conglomerate of unknown thickness, on the banks of Wolf Creek. The age of the deposits is uncertain. Judging from its present distribution the Wolf Gravel is a stream deposit, probably from a larger, ancestral, Wolf Creek.

QUATERNARY

The larger travertine deposits are found principally near the largest streams or isolated in sand-plain areas where stream courses may have existed formerly. The travertine has formed at or near the surface by deposition from groundwater near

the margin of rivers, or by deposition from rivers or springs either near the rivers or in the sand plain. The travertine consists of massive white limestone which weathers to a dull grey colour and is associated with massive, or in some places laminated, chalcedony. Some of the chalcedony is brecciated and incorporated in the limestone.

Alluvial deposits are thin, and found only in the principal stream valleys, outwash plains and alluvial fans.

STRUCTURE

The Billiluna Sheet covers part of the north-east margin of the Canning Basin, where a thin veneer of basin sediments overlies Precambrian basement.

The Halls Creek Metamorphics are tightly folded: some of the parallel fold axes are only 200 yards apart, and flank dips range from 60° to vertical. The Upper Proterozoic Gardiner Beds lie on a fairly flat erosion-surface of the Halls Creek Metamorphics, the Phillipson Beds on Lewis Granite, and the Kearney Beds - the most deformed of the three - probably on Halls Creek Metamorphics.

Possible Ordovician rocks that crop out in the north-western corner of the Sheet area are little deformed, and dips are generally less than 10°. They represent a shallow-water facies distinct from that of the Ordovician Prices Creek Group farther north. An isolated group of outcrops of Devonian or Lower Carboniferous age at Knobbly Hill lies on Kearney Beds with an angular unconformity; the rocks are deformed into ill-defined folds with flank dips up to 10°.

Below the area of Ordovician outcrop, a depression has been charted during a gravity survey by the Geophysical Branch of the Bureau, which indicates a possible thickness of 10,000 feet of sedimentary rocks. This thickness may include the

Upper Proterozoic sediments: a similar 'low' is recorded below Upper Proterozoic outcrop north-west of Sturt Creek.

The Permian sediments in the Mount Mueller area are little deformed, and generally dip gently to the south. They are cut by faults trending north-west, with displacements of only 100 feet or so. Surface geology suggests that the Permian succession thickens to the south-west, though gravity contours over neighbouring areas show a considerable range of thickness.

ECONOMIC GEOLOGY

No minerals of economic significance have yet been found within the Sheet area.

Petroleum Prospects

The sediments exposed are too thin and restricted to be considered in terms of possible petroleum accumulation; but the near-shore Ordovician and Devonian rocks suggest a thicker deposition farther south, in the centre of the Basin, and the lithology and fossil content of the Permian sediments also indicate the possibility of source rocks in the Basin.

Metals

Traces of gold were reported by Davidson (1905) from quartz veins in the Halls Creek Metamorphics near the Gardiner Range. However, the metamorphics show few signs of hydrothermal action. Areas to the south-west of Larranganni Bluff appear worthy of further prospecting, where quartz veins are numerous and granite intrudes the metamorphics. Some crystalline hematite is associated with the quartz veins.

In 1960, geologists from New Consolidated Goldfields investigated the Upper Proterozoic rocks in the Gardiner Range and Killi-Killi Hills. They reported some radioactivity in the basal conglomerate at Killi-Killi Hills.

Water Supply

Because large permanent pools of water occur in Sturt Creek, few wells or bores have been drilled for stock purposes. Rock holes and pools are common in creeks in the Gardiner Range. Wells at Billiluna Station encounter supplies of almost fresh water from sandstones of the Grant Formation. At Sturt Creek Station good supplies of water are obtained from the Upper Proterozoic Gardiner Beds. Wells generally strike good supplies of slightly alkaline water at depths of 20-80 feet in the Permian sediments.

BIBLIOGRAPHY

BREMNER, C. St. J., 1940 - Aerial geological reconnaissance of the Fitzroy Desert Basin, Western Australia. Unpubl. Rep. for Caltex (Aust.) Oil Development Pty Ltd.

CARNEGIE, D.W., 1898 - SPINIFEX AND SAND. London, Pearson.

CASEY, J.N., and WELLS, A.T., 1956 - Operational problems and conditions in the north-east Canning Basin. Bur. Min. Resour. Aust. Rec. 1956/93 (Unpubl.).

_____ 1961 - Regional geology of the north-east Canning Basin, Western Australia. Bur. Min. Resour. Aust. Rep. 49

DAVIDSON, A.A., 1905 - Journal of explorations in Central Australia, 1898 to 1900. S. Aust. parl. Pap. 27.

DICKINS, J.M., 1958 - Permian fossils from the Canning Basin, Western Australia. Bur. Min. Resour. Aust. Rec. 1958/7 (Unpubl.).

FINDLAY, W.A., 1942 - Geologic report, north-western Fitzroy Basin, Kimberley Division, Western Australia. Unpubl. Rep. for Caltex (Aust.) Oil Development Pty Ltd.

GARRETT, M.J., 1956 - Gravity traverses by Geological Party G.C. in the eastern portion of the Fitzroy-Canning Basin. Unpubl. Rep. for Wapet.

GREGORY, A.C., 1857 - Papers relating to an expedition recently undertaken for the purpose of exploring the northern portion of Australia. Brit. parl. Pap., London

GUPPY, D.J. and MATHESON, R.S., 1951 - Wolf Creek Meteorite Crater Western Australia. Smithson. Rep. for 1950 317-325.

GUPPY, D.J., LINDNER, A.W., RATTIGAN, J.H., and CASEY, J.N., 1958 - The Geology of the Fitzroy Basin, Western Australia. Bur. Min. Resour. Aust. Bull. 36.

KIDSON, E., 1914 - General magnetic survey of Australia and on an expedition over the Canning Stock Route Western Australia. Carneg. Inst. Dep. Terrest. Mag.

KRAUS, P.S., 1941 - Geologic and stratigraphic reconnaissance, north-west portion Caltex Concession 7-H, Kimberley Division, Western Australia. Unpubl. Rep. for Caltex (Aust.) Oil Development Pty Ltd.

MADDOX, W.H., 1941 - A geological reconnaissance of the north-eastern part of the Fitzroy Basin, Western Australia. Unpubl. Rep. for Caltex (Aust.) Oil Development Pty Ltd.

MAITLAND, A.G., 1904 - Preliminary report on the geological features and mineral resources of the Pilbara Gold-field. Bull. geol. Surv. W. Aust. 15

MATHESON, R.S. and GUPPY, D.J., 1949 - Geological reconnaissance in the Mount Ramsay Area, Kimberley Division, Western Australia. Bur. Min. Resour. Aust. Rec. 1949/31 (Unpubl.)

PATERSON, S.J., 1954 - General report of the survey of the Ord-Victoria Area; geomorphology. Sci. ind. Res. Org. Melb., Land Res. Ser. 4.

REEVES, F., 1949 - Geology and oil prospects of the Desert Basin, Western Australia. Unpubl. Rep. for Vacuum Oil. Co. Pty Ltd.,

TALBOT, H.W.B., 1910 - Geological observations between Wiluna and Halls Creek. Bull. geol. Surv. W.Aust. 39.

TERRY, M., 1927 - THROUGH A LAND OF PROMISE . London, Jenkins.

_____ 1932 - HIDDEN WEALTH AND HIDING PEOPLE. London & N.Y., Putnam

TRAVES, D.M., 1955 - The Geology of the Ord-Victoria Region, Northern Australia. Bur. Min. Resour. Aust. Bull. 27.

TRAVES, D.M., CASEY, J.N., and WELLS, A.T., 1956 - The geology of the south-western Canning Basin, Western Australia. Bur. Min. Resour. Aust. Rep. 29.

WHITE, Mary E., 1957 - Report on plant fossils from the north-east Canning Basin, Western Australia. Bur. Min. Resour. Aust. Rec. 1957/74 (Unpubl.).

* VEEVERS, J.J., and WELLS, A.T., 1961 - The geology of the Canning Basin, Western Australia. Bur.Min.Resour.Aust.Bull.60

TABLE 2 - STRATIGRAPHY OF THE BILLILUNA SHEET

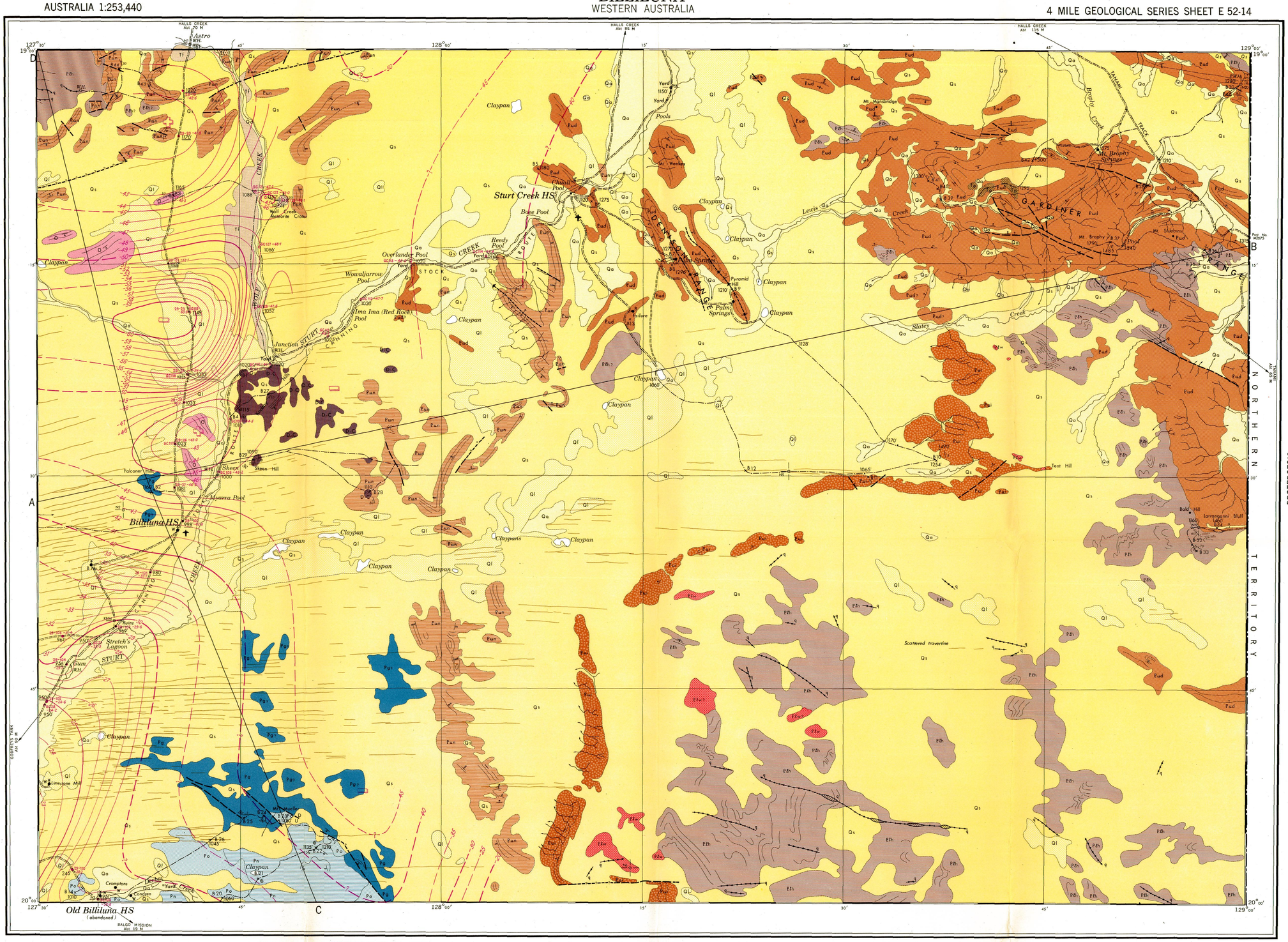
AGE	MAP SYMBOL	FORMATION	THICKNESS (feet)	LITHOLOGY	FOSSILS	ECONOMIC GEOLOGY	TIME EQUIVALENT
QUATERNARY	Qa	Alluvium	20±	Alluvium & black soil	-	Shallow water	
	Qs	Sand	0-120 +	Hematite-stained medium to fine-grained quartz sand.	-	" "	
	Ql	Travertine	10 +	Hard marl & limestone with varying amounts of chalcedony.	-	Limestone	
QUATERNARY or TERTIARY	Tf	Wolf Creek Gravel	20 +	Alluvial gravel & sand	-	Shallow water	
TERTIARY	Tl	Lawford Beds	100 ±	Lacustrine marl & limestone with capping of hard chalcedony.	-	Limestone	
	Tp	Pisolitic Ironstone	30 ±	Pisolitic ironstone & some laterite profiles.	-	Road metal	Pisolitic ironstone in other parts of the basin.
PERMIAN	Po	Balgo Member (Liveringa Fm.)	70 +	Micaceous, ferruginous sandstone, shale and quartz greywacke & conglomerate	Pelecypods with some brachiopods.	-	Lightjack Member of Fitzroy Basin.
	Pn	Noonkanbah Formation	200 ±	Sandstone, shale & quartz-greywacke, partly calcareous.	Abundant marine fossils, often as coquinites.	-	Dora Shale of S.W. Canning Basin.
	Pg	Grant Formation	200 ±	Medium to coarse sandstone sometimes poorly sorted with occasional rounded quartz pebbles.	Fossil wood & plants.	Water	Braeside Tillite & Paterson Formation of S.W. Canning Basin & Lyons Group of the Carnarvon Basin.
				ANGULAR UNCONFORMITY			
UPPER DEVONIAN or LOWER CARBONIFEROUS?	D-C	Undifferentiated	100 ±	Pebbly Sandstone	Leptophloeum australe	Water	Laurel Beds of Fitzroy Basin ?
				? - ? - ? - ? - ? - ?			
ORDOVICIAN?	O	Undifferentiated	250 ±	Interbedded medium-grained conglomerate & sandstone	Trilobite fragments.	Water	Prices Creek Group of Fitzroy Basin?
				? - ? - ? - ? - ? - ?			
?UPPER PROTEROZOIC	Bui	Phillipson Beds	200 +	Soft current-bedded sandstone, poorly sorted with dips up to 10°. Basal conglomerate.	-	-	Kimberley Plateau Succession & U. Prot. sequence of S.W. Canning Basin. (Traves, Casey & Wells, 1956). Nullagine "Series" of Pilbara area.
	Bud	Gardiner Beds	500 +	Hard, silicified, current bedded and ripple marked sandstone, strongly jointed. Folded with dips up to 15°. Some micaceous shale & fine sandstone. Basal conglomerate.	-	Water	
	Bun	Kearney Beds	2000+	Silicified flaggy & massive sandstone, & some conglomerate folded with dips up to 70°	-	-	
				ANGULAR UNCONFORMITY			
?LOWER PROTEROZOIC	Blw	Lewis Granite	-	Granite & muscovite granodiorite with pegmatite & quartz veins	-	-	Granite of Lamboo Complex & L. Prot. granite of S.W. Canning Basin
	Blh	Halls Creek Metamorphics	-	Folded quartz greywacke, slate, shale, laminated claystone, fine clay sandstone & some quartzite. Intruded by granite & cut by numerous quartz veins	-	Metamorphics worth prospecting for metallic deposits	Probably L. Prot. Metamorphics of the S.W. Canning Basin & Warrawoona "Series" of Pilbara area

FIRST EDITION 1961

AUSTRALIA 1:253,440

BILLILUNA
WESTERN AUSTRALIA

4 MILE GEOLOGICAL SERIES SHEET E 52-14



Compiled and published by the Bureau of Mineral Resources, Geology and Geophysics, Department of National Development.

Transverse Mercator Projection.

INDEX TO ADJOINING SHEETS
Showing Magnetic Declination

MT. RAMSEY	GORDON DOWNS	BIRRINDUDU
MT. BANNERMAN	BILLILUNA	TANAMI
CORNISH	LUCAS	THE GRANITES

ANNUAL CHANGE 25' E

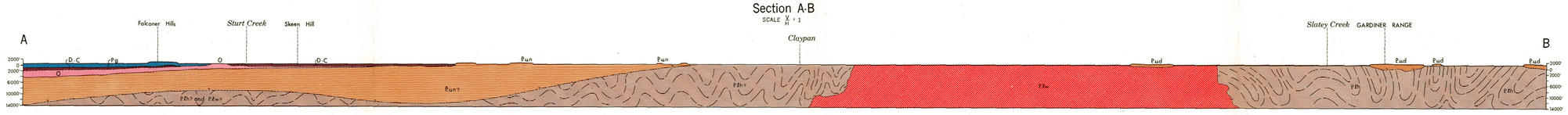
Scale
4 Miles to 1 Inch

GEOLOGICAL RELIABILITY DIAGRAM

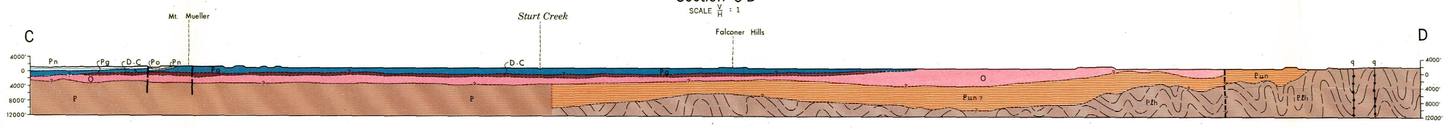
B Reconnaissance—traverses with air-photo interpretation
C Sketchy—air-photo interpretation

Geology by: J. N. Casey and A. T. Wells
Gravity data by: G. Neumann, S. Waterlander, J. R. van Son, J. van der Linden and West Australian Petroleum Pty. Ltd.
Compiled October 1959 by: J. N. Casey, A. T. Wells.
Drawn by: Adastra Airways Pty. Ltd.

Section A-B
SCALE V/H = 2



Section C-D
SCALE V/H = 1



Reference

CAINOZOIC

QUATERNARY
- Qa — Alluvium
- Qs — Sand
- Ql — Travertine, tufa

TERTIARY
- Wolf Gravel — Tf — Alluvial gravel and sand
- Lawford Beds — Tl — Lacustrine marl, chalcedony
- Tl — Laterite, pisolitic ironstone

PALAEOZOIC

PERMIAN
- Balgo Member—Liveringa Formation — Po — Sandstone, shale, quartz greywacke, marine fossils
- Noonkanbah Formation — Pn — Sandstone, fine quartz greywacke and shale, partly calcareous; marine fossils
- Grant Formation — Pg — Pebbly sandstone with wood remains; probably fluvioglacial

U. DEVONIAN ? — L. CARBONIFEROUS ? — D-C — Pebbly sandstone with plant fossils

ORDOVICIAN ? — O — Conglomerate, sandstone; trilobite remains

PROTEROZOIC

UPPER ?
- Unconformity
- Phillipson Beds — Pud — Current-bedded sandstone and basal conglomerate
- Gardiner Beds — Pud — Current-bedded ripple-marked silicified sandstone, shale, basal conglomerate
- Kearney Beds — Pun — Silicified sandstone

LOWER?
- Unconformity
- Lewis Granite — PEw — Granite and muscovite granodiorite
- Halls Creek Metamorphics — PEth — Quartz greywacke, shale, slate

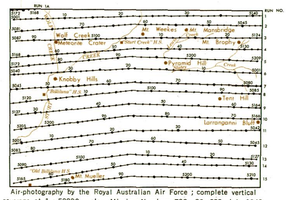
UNDIFFERENTIATED — P — Sandstone and shale

- Established geological boundary, position approximate
- Inferred boundary
- Established anticlinal crest (showing plunge), position approximate
- Established synclinal trough (showing plunge), position approximate
- Established fault, position approximate, relative movement indicated where known
- Inferred fault
- Inferred fault, concealed
- Measured strike and dip of strata
- Strike of vertical strata
- Dip < 15°
- Dip 15°-45°
- Dip > 45°
- Trend of bedding
  (air-photo interpretation)
- Quartz dyke
- Marine macrofossil locality
- Plant fossil locality
- × B 12 — Text reference to specimen locality
- Sand dunes
- 1100' — Height in feet, instrument levelled
- 1300' — Height in feet, barometric
  (datum: mean sea level, Derby)
- Windpump
- W — Well
- WH. — Waterhole
- P.WH. — Permanent waterhole
- Route of geological party's traverse
- Vehicle track
- Geological party's traverse along vehicle track
- State boundary
- Landing ground
- Astro station
- 29-102 — Bureau of Mineral Resources gravity station
- GC28 — West Australian Petroleum Pty. Ltd. gravity station
- -24-2 — Bouguer anomaly value in milligals
- Bouguer Anomaly contours (milligals)
- (only 5 milligal contours shown where extrapolated)
- Gravity Anomaly - relative high
- Gravity Anomaly - relative low

The Bouger Anomalies are based on Observed Pendulum Gravity Values at
Mundiwindi 978.7455 Port Hedland 978.6444 Anna Plains 978.6224
Derby 978.5188 Halls Creek 978.4607 gals.

An average rock density of 2·2 gm/cc has been adopted for the reduction of Bouguer Anomalies

AIR-PHOTOGRAPH FLIGHT DIAGRAM



Air-photography by the Royal Australian Air Force; complete vertical coverage at 1 : 50000 scale; Mission Numbers 790 - 93, 833, July 1949

BILLILUNA
SHEET E 52-14

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, W.A.

Printed by Mercury Press, Hobart

Complimentary