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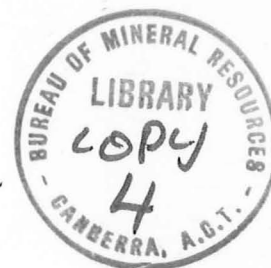


BUREAU OF MINERAL RESOURCES,
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NEW REVISED STRATIGRAPHIC NOMENCLATURE, NORTHEAST
CANNING BASIN, WESTERN AUSTRALIA.



by

A.N. YEATES[†], R.W.A. CROWE^{*}, R.R. TOWNER[†], LESLEY A.I. WYBORN[†]
and VIRGINIA L. PASSMORE[†]

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SUMMARY

It is proposed that the terms Hardman, Condren Sandstone, and Lightjack, previously defined as Members of the Liveringa Formation, be given Formation status and that the term 'Liveringa' be upgraded to Group status to include the Hardman Formation, Condren Sandstone, and Lightjack Formation.

New names proposed are:

- (1) Knobby Sandstone: Upper Devonian quartzose sandstone, previously recognized and informally named.
- (2) Lake Gregory Beds: Cainozoic mud, silt and sand in the Lake Gregory area.
- (3) Kirkby Range Member, Hicks Range Sandstone Member, and Cherrabun Member for three mappable units comprising the Hardman Formation in CROSSLAND 1:250 000 Sheet area.

It is also proposed that the term Wolf Gravel be discarded.

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REVISION OF THE LIVERINGA FORMATION

The Liveringa Formation in the Fitzroy Trough was subdivided into the Lightjack, the Middle and the Hardman Members by Guppy et al. (1958). The Members, however, were not differentiated on their maps. In the Gregory Sub-basin, the southeastern continuation of the Fitzroy Trough (Yeates et al., in prep.), the Liveringa Formation was subdivided into the Balgo, Condren Sandstone, and Hardman Members (Veevers & Wells, 1961; Casey & Wells, 1964). The Balgo Member was recognized as a lateral equivalent of the Lightjack Member, but, at the time, continuity of the units could not be demonstrated between the two widely separated type sections, and two separate names were retained. The term Balgo Member was subsequently discarded by Playford et al. (in press). The Condren Sandstone Member is equivalent to the Middle Member of Guppy et al. (1958). Casey & Wells (1964) recognized the Hardman Member in northwestern MOUNT BANNERMAN 1:250 000 Sheet area. Its only known stratigraphic equivalent to the southeast is probably the Godfrey Beds (Yeates et al., 1974), which was previously thought to be Lower Cretaceous (Casey & Wells, 1964).

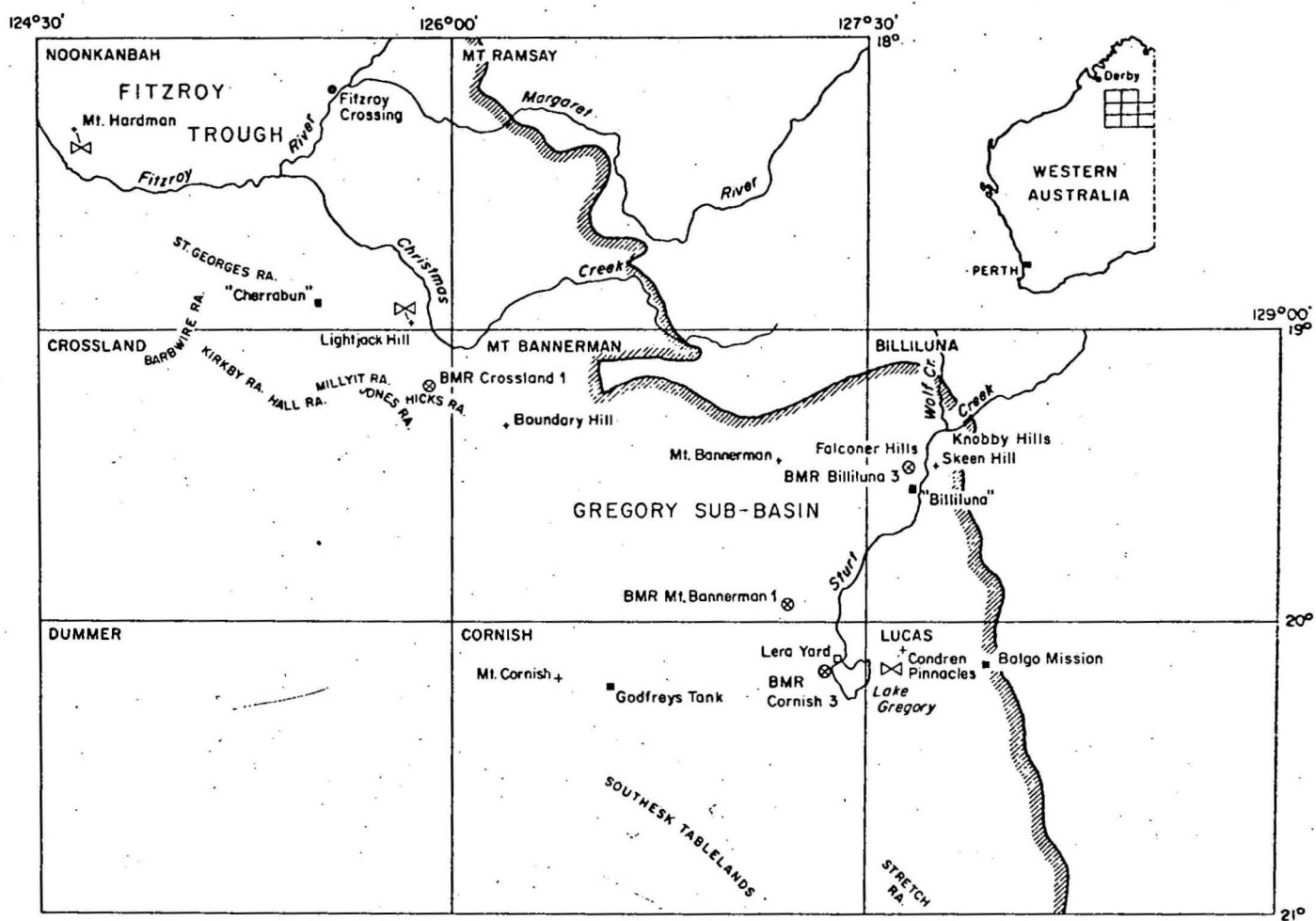
The type sections of the Hardman Formation, Condren Sandstone, and Lightjack Formation remain those described for these units when originally assigned Member status. The type sections (locations shown in Fig. 1) are at Mount Hardman (NOONKANBAH), Condren Pinnacles (LUCAS), and at Lightjack Hill (NOONKANBAH), and none of them is complete.

PROPOSED NAME: KNOBBY SANDSTONE

DERIVATION OF NAME: Knobby Hills: latitude $19^{\circ}23'S$, longitude $127^{\circ}43'E$, in BILLILUNA 1:250 000 Sheet area, Western Australia.

DISTRIBUTION: Crops out in an area of 40 km radius around Knobby Hills.

LITHOLOGY: Medium to coarse, cross-bedded quartzose sandstone containing abundant intraformational claystone clasts; quartz granule conglomerate, thin beds of quartz pebble conglomerate, and rare siltstone.



⊠ Type section locality

⊗ Stratigraphic hole

/// Approximate margin of Canning Basin

LUCAS 1:250000 Sheet area

0 50 100 KM

Fig.1 Locality map

Record 1974/183

KJ W/A 277

TYPE SECTION LOCALITY: Latitude 19°24'24"S, longitude 127°45'44"E, about 2 km east of Sturt Creek and 7 km north of Skeen Hill.

THICKNESS: At the type section (Appendix 1), 13 m; at Falconer Hills, 14.4 m is exposed. A shallow stratigraphic drill hole, BMR Billiluna No. 3, penetrated 170 m at Falconer Hills. The maximum thickness is estimated to be 350 m.

AGE: Late Devonian, based on fish fossils.

FOSSILS: The lycopod Leptophloem australe (McCoy, 1874) and placoderm fishes, including undetermined arthrodires (Gilbert-Tomlinson, 1968, p. 210) Bothriolepis, Asterolepis, and crossopterygian remains (G.C. Young pers. comm.). The fish plates, though fragmentary, are widespread, but Leptophloem specimens are rarer.

RELATIONSHIPS: The Knobby Sandstone is unconformable on the Proterozoic Peterson Beds and is probably also unconformable on the Lower Ordovician Carranya Beds. The formation may conformably overlies rocks of possible Silurian-Devonian age in the subsurface. No upper contact is exposed. In the subsurface, the Knobby Sandstone is probably overlain by the Lower Permian Grant Formation in the Billiluna area, and possibly by Carboniferous rocks farther southwest away from the margin of the Canning Basin.

SYNONYMY OR MODIFICATION OF PREVIOUS NOMENCLATURE: Casey & Wells (1964) described the sandstone in the Knobby Hills area but did not formally name it. Late Devonian to Early Carboniferous age was assigned on plant fossil evidence.

Veevers et al. (1967) have referred to the 'Knobby Sandstone' informally.

PROPOSED NAME: LAKE GREGORY BEDS

DERIVATION OF NAME: Lake Gregory: latitude 20°12'S, longitude 127°30'E, in LUCAS and CORNISH 1:250 000 Sheet area, Western Australia.

DISTRIBUTION: Subcrops beneath aeolian sand in the terminal reaches of Sturt Creek. A few exposures occur along the margin of Lake Gregory.

LITHOLOGY: Green, brown, and red clay, silt, and fine sand, minor marl and calcrete and rare gravel.

TYPE SECTION LOCALITY: The type section is in BMR Cornish No. 3, a continuously cored hole located at 20°11'05"S, 127°24'15"E at Lera Yard, CORNISH.

THICKNESS: 99.1 m in BMR Cornish No. 3 (Appendix 1); 64.3 m in BMR Mount Bannerman No. 1.

AGE: Cainozoic, based on regional relationships.

FOSSILS: Indeterminate gastropods; possible plant root casts; indeterminate fish bones.

RELATIONSHIPS: Unconformable on Permian Formations; conformable beneath aeolian sand.

PROPOSED NEW MEMBERS OF THE HARDMAN FORMATION

1. Kirkby Range Member

DERIVATION OF NAME: Kirkby Range: latitude 19°07'S, longitude 125°13'E, in CROSSLAND 1:250 000 Sheet area.

DISTRIBUTION: The Member occurs in the Millyit Range and Kirkby Range in CROSSLAND.

LITHOLOGY: Argillaceous siltstone, argillaceous sandstone, minor shale, and calcareous sandstone.

TYPE SECTION LOCALITY: Latitude 19°09'39"S, longitude 125°34'24"E, 1.5 km west of Spring Creek on the northern scarp of the Millyit Range, CROSSLAND.

THICKNESS: At least 52 m at type section (Appendix 1), at least 22 m in the southern part of the Millyit Range, at least 75 m in Kirkby Range, and at least 70 m in BMR Crossland No. 1.

AGE: Late Permian, based on brachiopods, pelecypods, and a microfloral assemblage.

RELATIONSHIPS: A conformable and gradational contact with the underlying Condren Sandstone; apparent conformity with the overlying Hicks Range Sandstone Member (new name).

SYNONYMY OR MODIFICATION OF PREVIOUS NOMENCLATURE: The Member was previously recognized as part of the Hardman Formation.

2. Hicks Range Sandstone Member

DERIVATION OF NAME: Hicks Range: latitude 19°14'S, longitude 125°54'E, in CROSSLAND 1:250 000 Sheet area.

DISTRIBUTION: Crops out in a narrow belt extending from Barbwire Range to Hicks Range, CROSSLAND.

LITHOLOGY: Quartzose sandstone, fine to coarse, cross-bedded; minor quartz granule conglomerate.

TYPE SECTION LOCALITY: The type section is a scarp in the central part of Hicks Range at latitude 19°13'48"S, longitude 125°53'42"E.

THICKNESS: 27.9 m at type section (Appendix 1); 14.8 m at Spring Creek in the Millyit Range, and at least 10 m in the Kirkby Range.

AGE: Late Permian, based on marine faunas above and below the Member.

RELATIONSHIPS: Rests with apparent conformity on the Kirkby Range Member and is conformable beneath the Cherrabun Member.

SYNONYMY OR MODIFICATION OF PREVIOUS NOMENCLATURE: The Member was previously recognized as part of the Hardman Formation.

3. Cherrabun Member

DERIVATION OF NAME: Cherrabun Homestead: latitude 18°54'42"S, longitude 125°31'24"E, in NOONKANBAH 1:250 000 Sheet area, Western Australia.

DISTRIBUTION: Millyit Range, Jones Range, and Hicks Range, CROSSLAND.

LITHOLOGY: Fine micaceous sandstone, fossiliferous sandstone, micaceous and ferruginous siltstone, and shale.

TYPE SECTION LOCALITY: At the source of a tributary of Spring Creek at latitude 19°11'00"S, longitude 125°33'06"E, in CROSSLAND.

THICKNESS: At least 22.2 m at type section (Appendix 1); at least 24.6 m in Hicks Range.

AGE: Late Permian based on brachiopods, pelecypods, and gastropods.

FOSSILS: Brachiopods, pelecypods, gastropods, trace fossils, and a microfloral assemblage.

RELATIONSHIPS: In CROSSLAND the Member is conformable on the Hicks Range Sandstone Member and is overlain with slight angular unconformity by the Lower Triassic Millyit Sandstone.

SYNONYMY OR MODIFICATION OF PREVIOUS NOMENCLATURE: The Member was previously included within the Hardman Formation.

VALIDITY OF THE TERM WOLF GRAVEL

The Wolf Gravel (Casey & Wells, 1964) was the name given to unconsolidated gravel, conglomerate, and sand of unknown thickness along the banks of Wolf Creek, BILLILUNA. We recommend the term be discarded as these deposits are indistinguishable from other alluvial deposits of both Wolf Creek and Sturt Creek.

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APPENDIX 1

DETAILS OF TYPE SECTIONS

Knobby Sandstone

| | |
|-------|---|
| Top | eroded |
| 0.5 m | Granule conglomerate, cross-bedded, silicified |
| 2.0 m | Quartzose sandstone, fine-grained, and interbedded siltstone; thin-bedded, ripple cross-laminated |
| 1.0 m | Sandstone, medium to coarse; clay pellets |
| 0.2 m | Quartz-pebble conglomerate containing clay pellets |
| 1.5 m | Quartzose sandstone, medium-grained, cross-bedded |
| 0.4 m | Quartzose sandstone, coarse-grained and cross-bedded, and granule conglomerate |
| 0.5 m | Quartzose sandstone, fine to medium, cross-bedded |
| 0.3 m | Quartzose sandstone, medium to coarse, cross-bedded |
| 0.2 m | Quartz-pebble conglomerate with clay pellets |
| 0.2 m | Quartz-granule conglomerate |
| 1.3 m | Sandstone, medium to coarse, cross-bedded; thin interbeds of granule conglomerate |
| 1.5 m | Quartzose sandstone, coarse to medium; high-angled, large-scale cross-beds; wood fragments |
| 0.3 m | Quartzose conglomerate, pebble, clay pellets; fish plates |
| 0.4 m | Quartzose sandstone, coarse-grained |
| 0.3 m | Sandstone, fine to medium, silicified |
| 0.2 m | Granule conglomerate; fish plates |
| 2.0 m | Quartzose sandstone, fine to medium, cross-bedded; silicified |
| Base | - not exposed |

Lake Gregory Beds

| | |
|--------------|---|
| 0 - 3.1 m | Clay, pale green to grey, and sand, fine to medium |
| 3.1 - 4.3 m | Sand, red, medium to coarse |
| 4.3 - 9.4 m | Clay, grey, cream, green with authigenic gypsum, cross-laminated |
| 9.4 - 13.4 m | Sand, pale grey to white, fine to very fine with some clay matrix |

| | |
|---------------|---|
| 13.4 - 14.6 | Mud, grey, green, rare grains of quartz sand |
| 14.6 - 18.6 m | Sand, red, fine to medium; conglomeratic at top |
| 18.6 - 21.3 m | Mud, grey, green, red; thin beds of lateritic pisolites at top |
| 21.3 - 46.3 m | Sandy silt, red to brown; interbedded with silty clay |
| 29.0 m | thin bed of lateritic pisolites |
| 42.7 m | thin bed of sandstone, white, very fine-grained |
| 46.3 - 61.0 m | Silty clay, pale olive, brown; interbedded with sandy silt, pale green, brown |
| 52.3 | thin bed of conglomerate, clasts of ferruginized rock |
| 61.0 - 63.4 m | Sand, pale brown, very fine-grained, well-sorted |
| 63.4 - 94.5 m | Silty claystone, interbedded pale green and brown, mottled, poorly lithified clay; some clayey siltstone |
| 79.2 m | bed of lateritic pisolites |
| 94.5 - 97.2 m | Sand, light brown, very fine-grained; clay matrix |
| 97.2 - 99.1 m | Conglomerate, brown clasts up to medium pebble size; clasts mainly lateritic pisolites in clay matrix |
| 99.1 m - Base | Siltstone, multicoloured, interbedded with sandstone, very fine-grained; unconformably overlies Permian Sandstone |

NEW MEMBERS OF THE HARDMAN FORMATION

Cherrabun Member

| | |
|-------|--|
| Top | Millyit Sandstone, unconformably overlying: |
| 1.2 m | Siltstone, dark grey to black, laminated; microfossils |
| 9.7 m | Sandstone, fine-grained, friable, thin-bedded, low-angle cross-bedding, interference ripples; clay pellets abundant near base; thin lenses of granule conglomerate |
| 2.0 m | Siltstone, brown, micaceous, laminated |
| 1.0 m | Shale, grey, strongly weathered |
| 2.7 m | Sandstone, silty, very fine-grained, pale brown; abundant marine fossils and worm tubes |
| 0.6 m | Siltstone, laminated; fossiliferous |
| 5.0 m | Sandstone, micaceous, very fine-grained, silty, brown, thin bedded, poorly sorted |
| Base | conformable on Hicks Range Sandstone Member |

Hicks Range Sandstone Member

| | |
|--------|---|
| Top | eroded |
| 7.5 m | Quartzose sandstone, micaceous, fine to medium, a few clay pellets. |
| 1.5 m | Quartzose sandstone, medium-grained, micaceous, high-angle cross-bedding to 25°. |
| 18.9 m | Quartzose sandstone, micaceous, medium-grained, well sorted, massive, cross-bedded; at 3.5 m and 13 m above base, quartz granule conglomerate |
| Base | conformably on Kirkby Range Member |

Kirkby Range Member

| | |
|-------|--|
| Top | eroded |
| 6.6 m | Quartzose sandstone, micaceous, mottled, massive; abundant clay pellets |
| 8.6 m | Sandstone, mottled, fine-grained, bedding poorly developed; abundant vertical worm tubes |
| 8.6 m | Sandstone, micaceous and silty, grey, fine-grained, laminated to thinly bedded, appears massive where weathered; abundant fossils. Worm tube bed immediately above the fossil beds |
| 3.6 m | Quartzose sandstone, micaceous, fine-grained, thin-bedded, ripple cross-laminated; cross-bedded (15° at 260°) |
| 4.8 m | Sandstone, silty, fine-grained, yellow, laminated to thin-bedded |
| 3.4 m | Sandstone, silty and micaceous, yellow-brown, fine-grained, thin-bedded; cross-bedded (10° at 55°) |
| 6.5 m | Sandstone, micaceous and silty, grey, fine-grained, laminated, bedding poorly developed; ripple cross-laminated; strongly cross-bedded (20° at 110°) |
| 4.9 m | Scree of fine-grained micaceous sandstone |
| 5.0 m | Shale, laminated, platy; strongly weathered |
| Base | not exposed, but elsewhere conformable on Condren Sandstone |