

Preliminary conodont studies of Barnicarndy 1 stratigraphic well, Canning Basin

by

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<i>F number</i>	–	<i>UWI</i>	W006030	<i>Zone (GDA94)</i>	51
<i>GSWA number</i>	231409–231418, 231423–231436	<i>Total depth (m)</i>	2680	<i>Easting</i>	373860
<i>WAROX site number</i>	SKMCAN190001	<i>DLAT</i>	–21.478167	<i>Northing</i>	7624440
<i>Photo numbers</i>	–	<i>DLONG</i>	121.782432		

Materials and methods

As part of the program of microfossil sampling and analyses devised for Barnicarndy 1 (previously Waukarlycarly 1) drillcore, an initial set of 10 carbonate samples was collected from the upper part of the Nambeet Formation in early 2020. However, in light of unsuccessful attempts to determine an age constraint on the lower part of this interval, an additional seven samples were selected from the lower, more siliciclastic part of the Nambeet and underlying Yapukarninjarra Formations in late 2020. These samples were not part of the original scope of paleontology studies for the stratigraphic well due to the lithology being unsuitable for acid processing. A final set of seven samples from the Barnicarndy Formation was collected in late 2020 and early 2021, targeting potential fish microfossils. Although this third sample set was collected primarily for fish microfossils rather than conodonts, all three sample sets were picked for microfossils to maximize the potential for biostratigraphic data. Depths of all three sample sets were widely spaced to provide good coverage of the core (Table 1).

Samples were digested at Macquarie University's acid preparation laboratory. Carbonate lithologies were targeted for sampling wherever possible, although these are not abundant in some parts of stratigraphy. Disaggregation of samples required the application of both acetic and formic acids for the majority of samples from the Nambeet and Yapukarninjarra Formations (sample sets 1 and 2), with the further breakdown of siliciclastic samples from the Barnicarndy Formation (sample set 3) facilitated with sodium bicarbonate. Mineral separation of digested material using sodium polytungstate was undertaken on the acid residues, with the heavy fraction subsequently handpicked for microfossils.

In addition to acid-prepared microfossils, several conodont elements were identified on core surfaces during on-site core logging. As all of the elements identified on core surfaces were simple cones unsuitable for biostratigraphic application, they are not discussed further within this report.

Results

A summary of results is provided in Table 1.

The first set of samples (GSWA 231409–231418) all yielded abundant conodonts permitting biostratigraphic analysis. Of these samples, the shallowest (GSWA 231409) yielded one incomplete element tentatively identified as *Jumudontus gananda*, suggesting assignment to the biozone of the same name; this zone indicates a late Floian – early Dapingian age. Given that the identification of the *Jumudontus gananda* Biozone is reliant on the identification of one partial conodont element, caution is advised in the application of this interpretation. The next five samples, GSWA 231410 to 231414, yielded conodont elements identified as *Bergstroemognathus extensus* and *Oepikodus communis*, together considered indicative of the *Oepikodus communis* Biozone and indicating a middle Floian age. GSWA 231415 yielded conodonts, although they could not easily be assigned to any particular biozone and additional work is therefore required. GSWA 231416 and 231418 are likely from the upper Tremadocian to lower Floian *Paroistodus proteus* Biozone based on their assemblages, which includes *Paroistodus proteus*. GSWA 231417 yielded only one unidentifiable coniform element, although as this sample is between two other samples assigned confidently to the *P. proteus* Biozone, it can be considered as belonging to the same biozone.

A preliminary laboratory report on the second set of samples, GSWA 231423–231429, indicates that none of the samples have yielded age-diagnostic microfossils, although a single simple cone element was recovered from sample GSWA 231426, and rounded partial elements were reported from samples GSWA 231423 and 231424. As a result, there is presently no detailed conodont biostratigraphy for the section below 2248 m.

A preliminary laboratory report on the third set of samples, GSWA 231430–231436, similarly indicates that none of the samples have yielded age-diagnostic microfossils. All samples have been reported barren with the exception of GSWA 231433, which yielded yet-to-be-identified tubular structures that are unlikely biostratigraphically relevant.

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Table 1. List of samples collected for microvertebrate (conodont and fish) processing from Barnicarndy 1, with interpreted biozonation for processed samples

Set no.	GSWA Sample no.	Depth (m)	Proposed analysis	Stratigraphy	Interpreted biozone
1	231409	1 354.85 – 1 355.70	conodonts	Nambeet Formation	<i>Jumudontus gananda</i>
1	231410	1 394.20 – 1 395.33	conodonts	Nambeet Formation	<i>Oepikodus communis</i>
1	231411	1 528.63 – 1 529.75	conodonts	Nambeet Formation	<i>Oepikodus communis</i>
1	231412	1 628.05 – 1 629.42	conodonts	Nambeet Formation	<i>Oepikodus communis</i>
1	231413	1 712.76 – 1 713.98	conodonts	Nambeet Formation	<i>Oepikodus communis</i>
1	231414	1 846.52 – 1 847.60	conodonts	Nambeet Formation	<i>Oepikodus communis</i>
1	231415	1 916.08 – 1 917.19	conodonts	Nambeet Formation	indeterminate
1	231416	2 047.02 – 2 048.13	conodonts	Nambeet Formation	<i>Paroistodus proteus</i>
1	231417	2 146.53 – 2 147.55	conodonts	Nambeet Formation	indeterminate
1	231418	2 246.06 – 2 247.17	conodonts	Nambeet Formation	<i>Paroistodus proteus</i>
2	231423	2 292.84 – 2 293.71	conodonts	Nambeet Formation	partial elements
2	231424	2 340.89 – 2 341.99	conodonts	Nambeet Formation	partial elements
2	231425	2 378.31 – 2 379.19	conodonts	Nambeet Formation	barren
2	231426	2 424.05 – 2 424.97	conodonts	Nambeet Formation	simple cone only
2	231427	2 468.46 – 2 469.67	conodonts	Yapukarninjarra Formation	barren
2	231428	2 551.76 – 2 553.15	conodonts	Yapukarninjarra Formation	barren
2	231429	2 583.38 – 2 584.39	conodonts	Yapukarninjarra Formation	barren
3	231430	1 327.43 – 1 327.92	conodonts, fish	Barnicarndy Formation	barren
3	231431	1 247.59 – 1 248.09	conodonts, fish	Barnicarndy Formation	barren
3	231432	1 166.83 – 1 167.29	conodonts, fish	Barnicarndy Formation	barren
3	231433	1 080.53 – 1 081.05	conodonts, fish	Barnicarndy Formation	barren; tubular structures
3	231434	1 018.57 – 1 019.09	conodonts, fish	Barnicarndy Formation	barren
3	231435	960.33 – 961.04	conodonts, fish	Barnicarndy Formation	barren
3	231436	871.70 – 872.19	conodonts, fish	Barnicarndy Formation	barren

The conodont assemblages recorded here are indicative of primarily intermediate shelf environments with the common presence of either *Oepikodus communis* or *Paroistodus proteus*, while the occurrence of *Jumudontus* and hyaline *Triangulodus* in some of the samples suggests fluctuations towards the proximal shelf. The inferred depositional settings from the conodont data are therefore consistent with the majority of macrofossils, which suggest water depths of below fair-weather and above storm-wave base (Martin et al., 2021). Conodont alteration index (CAI) values from this well are in the range of 1.5 to 2, consistent with values from elsewhere in the Canning Basin (Nicoll, 1993).

Conclusion

Results from this analysis include identification of the *Jumudontus gananda*, *Oepikodus communis* and *Paroistodus proteus* Biozones. This is consistent with an upper Tremadocian to late Floian – early Dapingian age range of sediments intersected within Barnicarndy 1 from depth ranges of 1354 m to 2247 m, and with assemblages described elsewhere in the Canning Basin from the Nambeet or lower Willara Formations (Normore et al., 2018).

The results presented here, although useful in providing biostratigraphic context for well stratigraphy, are considered preliminary as taxonomic studies are ongoing. Further work describing these assemblages in more detail, and integrating the data with other wells within the Canning Basin and more broadly worldwide, is planned. Further sampling will likely be required to clarify the extent of the biozones preserved within the section interpreted as the upper Nambeet Formation, and this sampling may also be incorporated into future research on this stratigraphic well.

References

- Martin, SK, Allen, HJ, Haines, PW and Phillips, C 2021, Preliminary paleontological summary of Barnicarndy 1 stratigraphic well, Canning Basin; Paleontology Report 2021/1: Geological Survey of Western Australia, 18p.
- Nicoll, RS 1993, Ordovician conodont distribution in selected petroleum exploration wells, Canning Basin, Western Australia; Record 1993/17: Australian Geological Survey Organisation, 136p.
- Normore, LS, Zhen, YY, Dent, LM, Crowley, JL, Percival, IG and Wingate, MTD 2018, Early Ordovician CA-IDTIMS U–Pb zircon dating and conodont biostratigraphy, Canning Basin, Western Australia: Australian Journal of Earth Sciences, v. 65, p. 61–73.

Recommended reference for this publication

Zhen, YY, Allen, HJ and Martin, SK 2021, Preliminary conodont studies of Barnicarndy 1 stratigraphic well, Canning Basin; Paleontology Report 2021/2: Geological Survey of Western Australia, 3p.

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