Correlation of carbonate sequences is bedevilled by heterogeneous facies that reflect a diversity of depositional, faunal, and isotopic settings. This diversity presents some challenges for detailed correlation, even at a regional scale. The Canning Basin of Western Australia presents world-class exposures of a carbonate-dominated shelf from Devonian times, where a highly irregular coastline created a variety of depositional environments: carbonate platforms and reefs, slope deposits, and hemipelagic basins, along with deposition around atoll-like blocks that were detached from the main coastline. Magnetostratigraphic correlation is based on the globally synchronous record of geomagnetic reversals, and can provide a temporal reference frame.

In this contribution, we present the results of four magnetostratigraphic profiles from four different environments along the Lennard Shelf covering Givetian to end-Fammenian (Middle to end-Devonian) times. Paleomagnetic results were obtained from thermal demagnetization of individual, oriented samples taken at the meter scale over approximately 2500 meters of composite section. Magnetite and hematite are inferred to be the principal magnetic carriers, and primary remanences are recovered from
roughly 25% of all samples. A relatively high reversal rate is observed in all sections, consistent with previously obtained results from the Canning Basin (Hurley and Van der Voo, Geology, 1990). Comparison of the primary magnetic polarity record from these different environments will allow cross-checks on the correlation between different environments, as well as providing a template for assessing other potential correlation schemes, including biostratigraphy, isotope chemostratigraphy, and magnetic susceptibility. The compiled results from this study will constitute the first systematic contribution to the construction of a Global Polarity Timescale for Middle to Late Devonian times.

Reference Cited

Magnetostratigraphy of Frasnian-Fammenian (Devonian) Carbonates of the Canning Basin, Western Australia: Evaluating the Potential for Regional and Global Correlations

Eric Tohver¹, T.E. Playton², S. Pisarevsky¹, Maodu Yan², J. Hansma¹, B. Roelofs³, Kate Trinajstic³, J. Kirschvink⁴, P. Haines⁵, R. Hocking⁵, Paul Montgomery²

¹ – University of Western Australia, 2 – Chevron, 3 – Curtin University, 4 – Caltech, 5 – Geological Survey of Western Australia

Funding from the Australian Research Council and Chevron
Outline

1. Canning Basin Overview – Correlation challenges across heterogeneous reef / platform / slope / basin environments
2. Multi-pronged correlation – workflow and comparison of different techniques
3. Quick introduction to magnetostratigraphy
4. Two worked examples –
   a. Windjana sites
   b. South Oscar slope versus Horse Springs Basin
5. Overview of correlation

Summary and Conclusions
C as ey F al ls
Hill s
Ho ", .

spring

O m

F
... nl an

R

noVE

-
SUMMARY: **Biostratigraphy** are best for large scale correlation, but less useful at finer scales, i.e., <10-100s meters of stratigraphic thickness.

SUMMARY: **Magnetostratigraphy** are excellent for mesoscale correlation, but absence of GPTS is problematic without biostratigraphy. Low recovery in weakly magnetized carbonates can lead to gaps in polarity assignment.

SUMMARY: **Isotope stratigraphy** can function for global correlations as well as environmental reconstructions. Local variations can be common, and the effects of post-diagenetic processes must be eliminated.
Unfortunately, the Global Polarity Timescale is patchy to nonexistent for this interval.
Thermal Demagnetization (12-15 steps)

Rock Magnetism

Mag [Am²/kg] - Field [mT]

Mag [Am²/kg] - Temp [°C]
Upper Frasnian platform to slope – Windjana Gorge
25% recovery of ~500 samples from 220 m of composite section

~20 reversals over 5-10 Ma interval

2-4 reversals/Ma
$y = 4.07x + 109.7$

$r^2 = 0.99$
Fammenian

Frasnian

Conodont zones 5-10

Conodont zone 13
Conclusions

1. Primary paleomagnetic remanences were recovered from ~25% of ~5000 samples taken from 7 separate sections of the Canning Basin of Western Australia.

2. Magnetostratigraphic results were integrated with biostratigraphy (conodonts) to provide a global reference frame.

3. The integrated chronostratigraphy provides a robust correlation scheme across different depositional environments, allowing the identification of heterogeneities in accumulation rates.

4. This study provides the first report of the Global Polarity Timescale of magnetic reversals for the Middle Devonian.
Mag-strat results from the Givetian (late middle Devonian)

370 m of composite section
~15 reversals in ~5 Ma
~3 reversals / Ma
Geopetals indicate tectonic tilt <10 degrees
Strong magnetizations, random directions, remagnetizations

WNB12A, W, UP

WNB109, W, UP

WNB223A

WNA89A

WNA108A

WNA134A

Strong magnetizations, random directions, remagnetizations
DEVONIAN REEF COMPLEXES
OF THE CANNING BASIN, WESTERN AUSTRALIA

Geological Survey of Western Australia
Bulletin 145

Phillip E Playford, Roger M Hocking and Anthony E Cockbain