A Combined Approach In Determining Late Quaternary Fluctuations In Deep Water Masses Derived From Neodymium Isotopes, Faunal Variations And $\delta^{13}C$ In Foraminifera Along The Western Continental Slope Of South Africa

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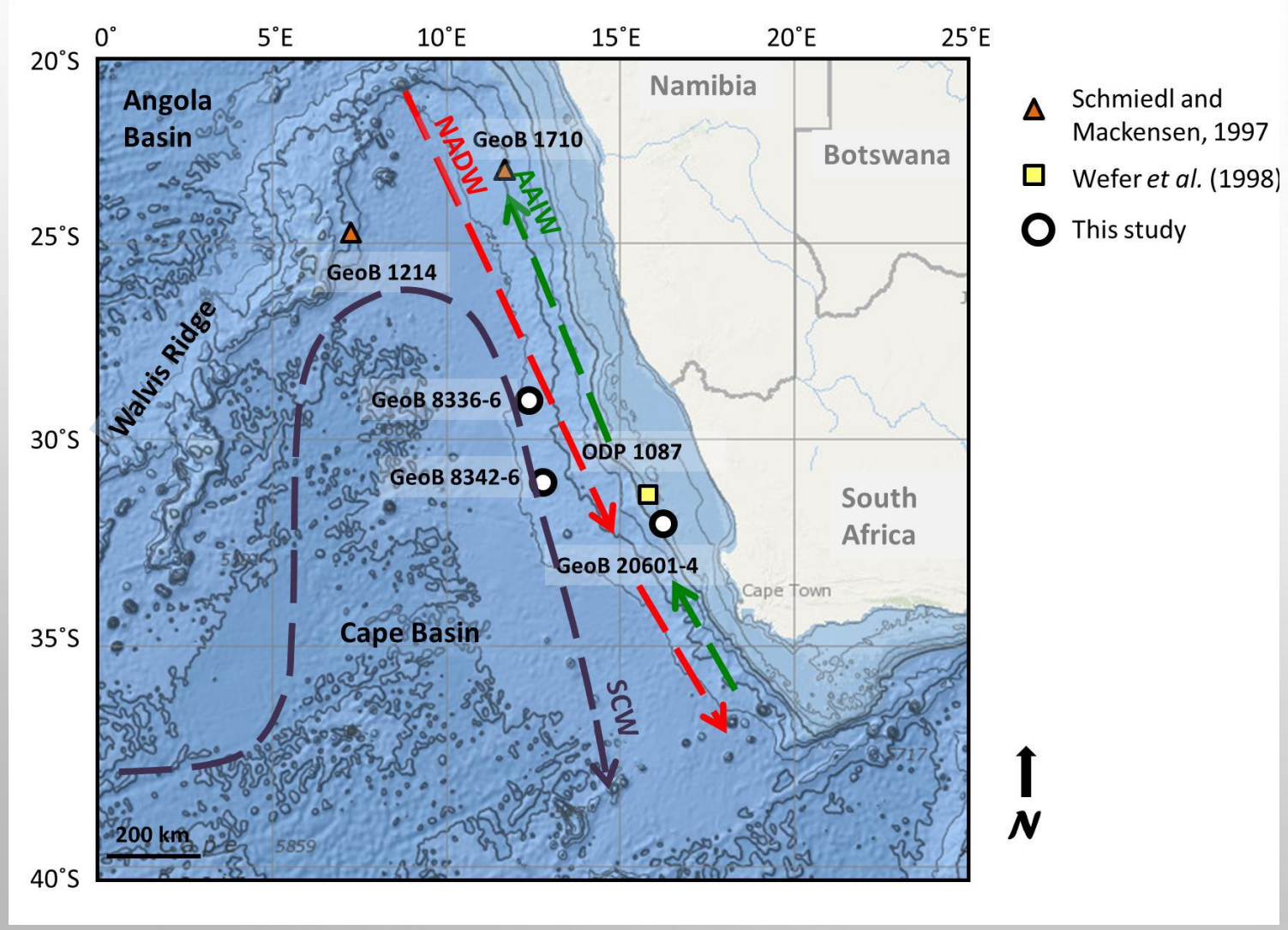
BACKGROUND

- Deep water masses are important in driving atmosphere-ocean systems
- What is the impact of deep water masses on the climate? (long-term question)
- What is driving these changes in deep water mass variations over time?
- Are these changes glacial-interglacial induced? Or is there longer-term influences on these changes in the water masses?
- Foraminiferal faunal analyses have been used to determine deep water mass conditions; $\delta^{13}C$ have been used; neodymium isotopes are increasingly being utilised over the past decade
- Do all of these methods provide the same result?
- A case study from the western continental margin of South Africa

STUDY AREA



- Location of cores along the western margin of southern Africa which have been studied for deep water masses in the late Quaternary. The flow paths of the deep water masses are indicated by the arrowed dashed lines (purple = SCW = Southern Component Water; red = NADW = North Atlantic Deep Water; green = AAIW = Antarctic Intermediate Water).

METHODS

$\delta^{18}O_{(C.\ wuellerstorfi)}$

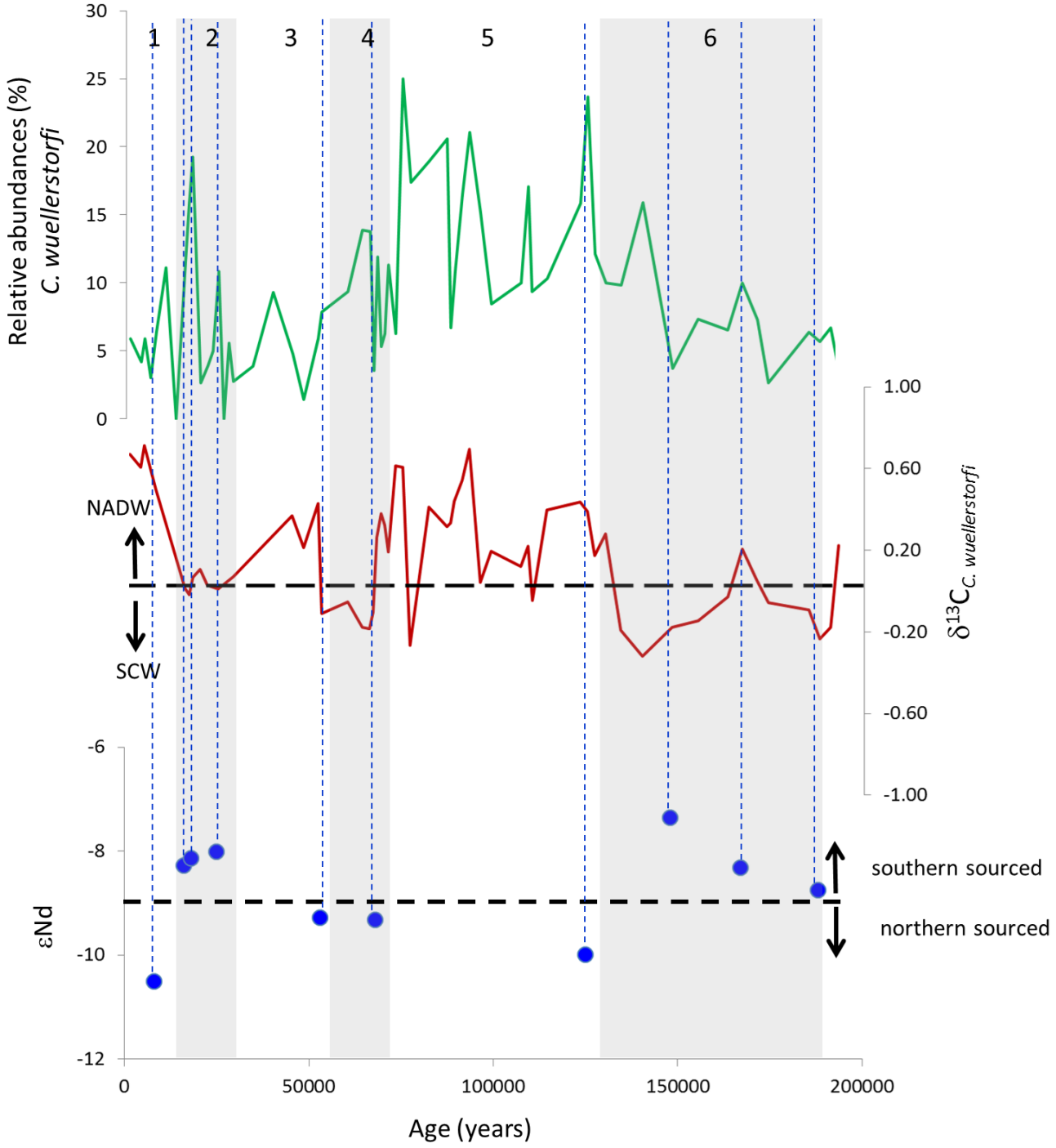
$\delta^{18}O_{(G.(Gc.)\ inflata)}$

-age control

$\delta^{13}C$

Faunal species counts

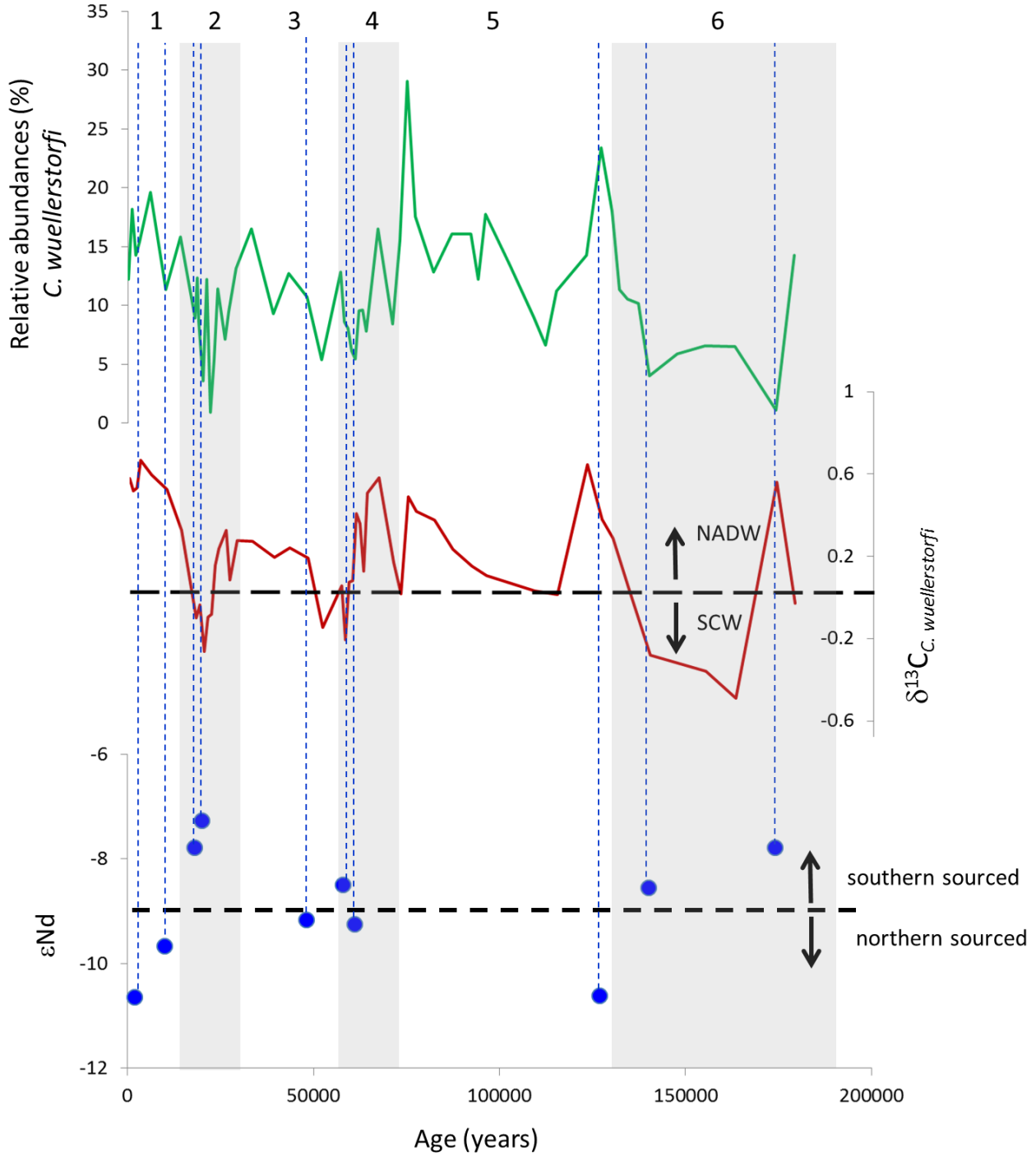
Neodymium isotopes (εNd)



RESULTS

GeoB 8342-6

- Relative abundances of *C. wuellerstorfi* highest during MIS 5 and at glacial terminations (GT II and I)
- $\delta^{13}C$ higher during interglacials
- εNd higher during peak glacials (MIS 6 and MIS 2)



RESULTS

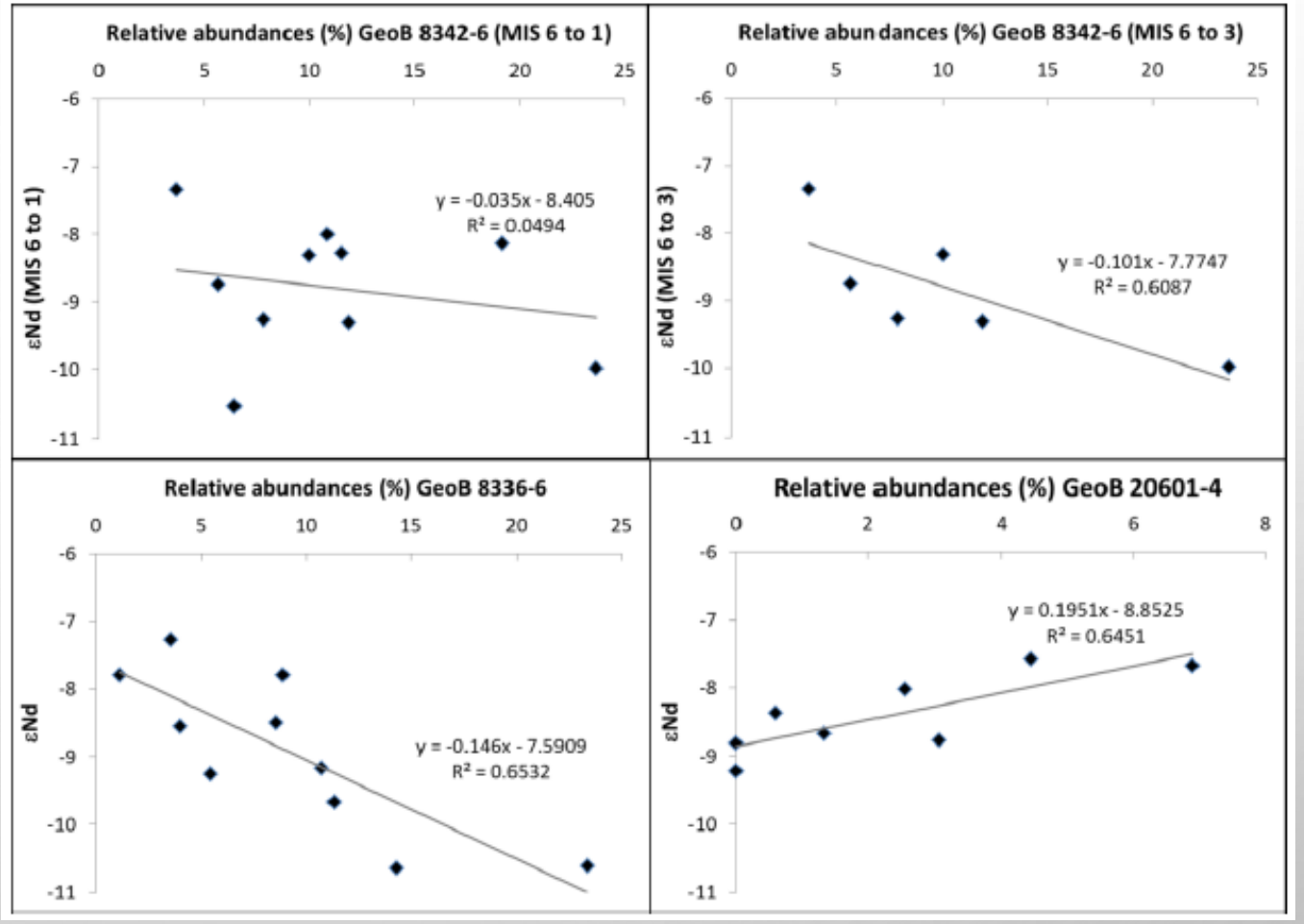
GeoB 8342-6

- Relative abundances of C. *wuellerstorfi* highest during MIS 5 and at glacial terminations
- $\delta^{13}C$ higher during interglacials
- εNd higher during peak glacials

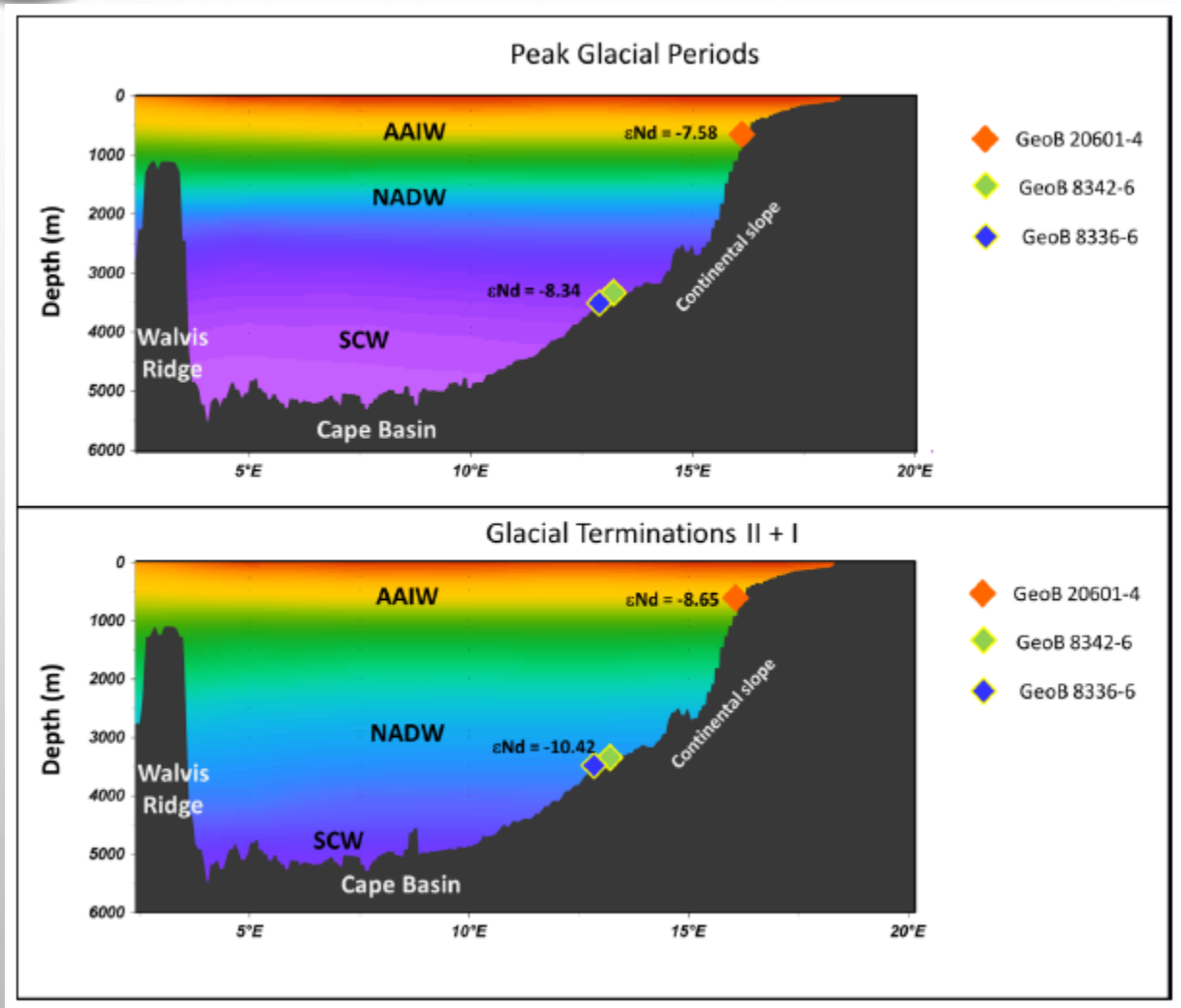
GeoB 8336-6

- Relative abundances of C. *wuellerstorfi* highest during interglacials
- $\delta^{13}C$ lowest during peak glacials; increasing during glacial terminations and into interglacials
- εNd higher during glacials, decreasing during interglacials
- Largest difference during transition from GT II and I into interglacials MIS 5 and MIS 1

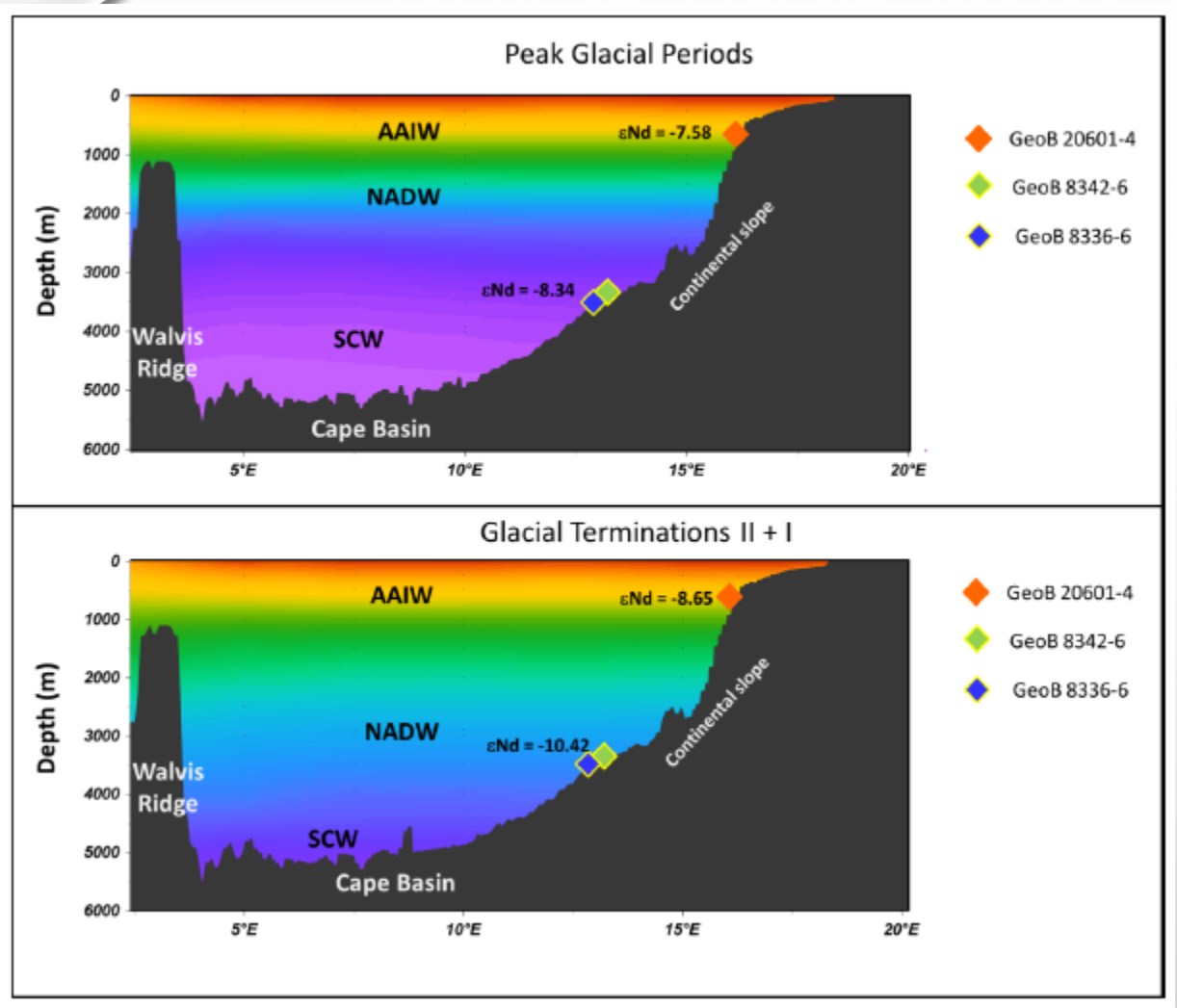
Correlation between εNd and C. *wuellerstorfi* abundances



WHAT DOES ALL THIS MEAN?

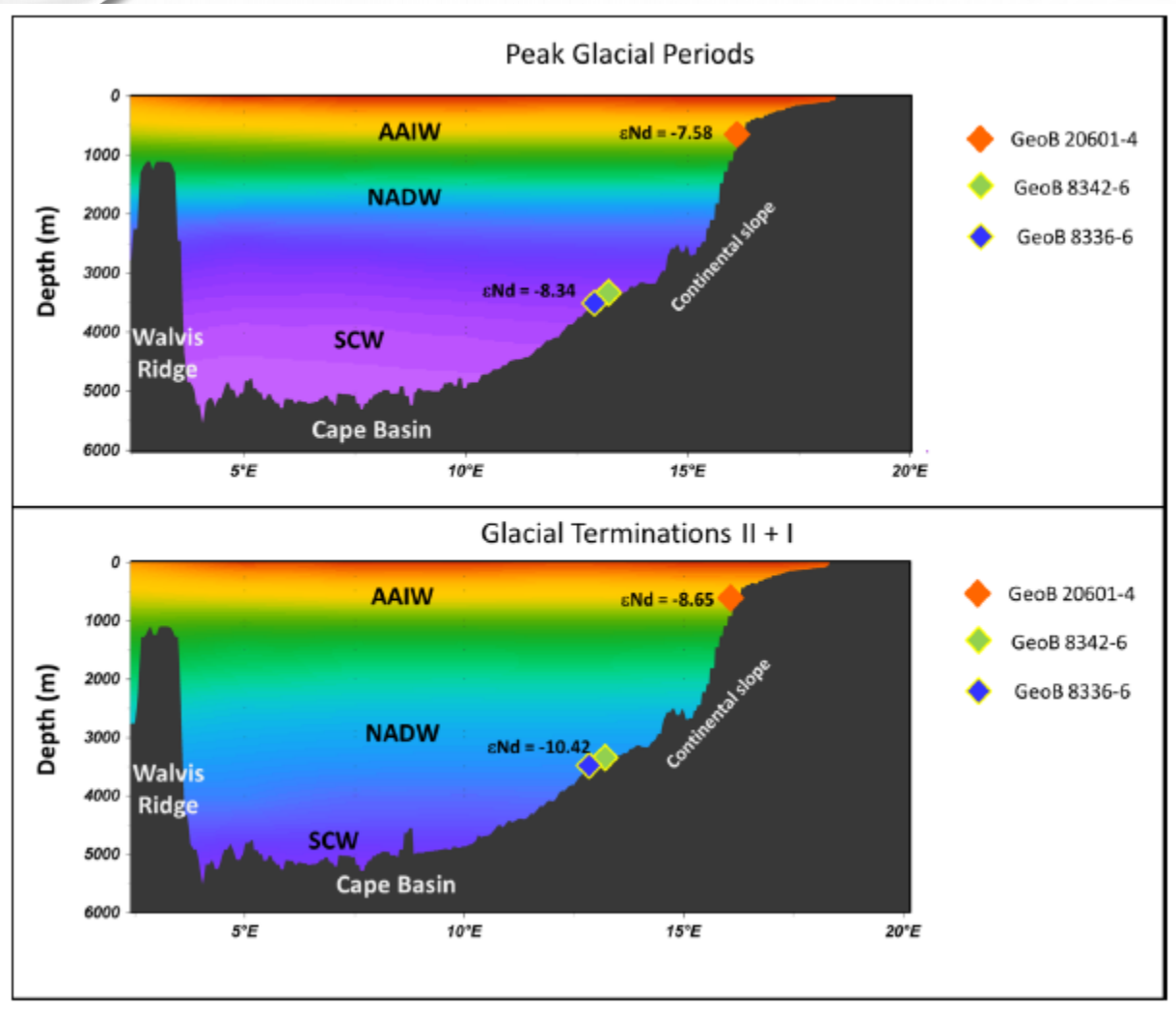


- *Cibicidoides wuellerstorfi* has been used to determine oxygenated environments in the past
- Decreased abundances of this species may indicate less oxygenated environments or oxygen-depleted water masses
- Higher abundances during interglacials and glacial terminations indicate higher oxygenated bottom waters during these periods
- NADW is a relatively high oxygenated water mass



WHAT DOES ALL THIS MEAN?

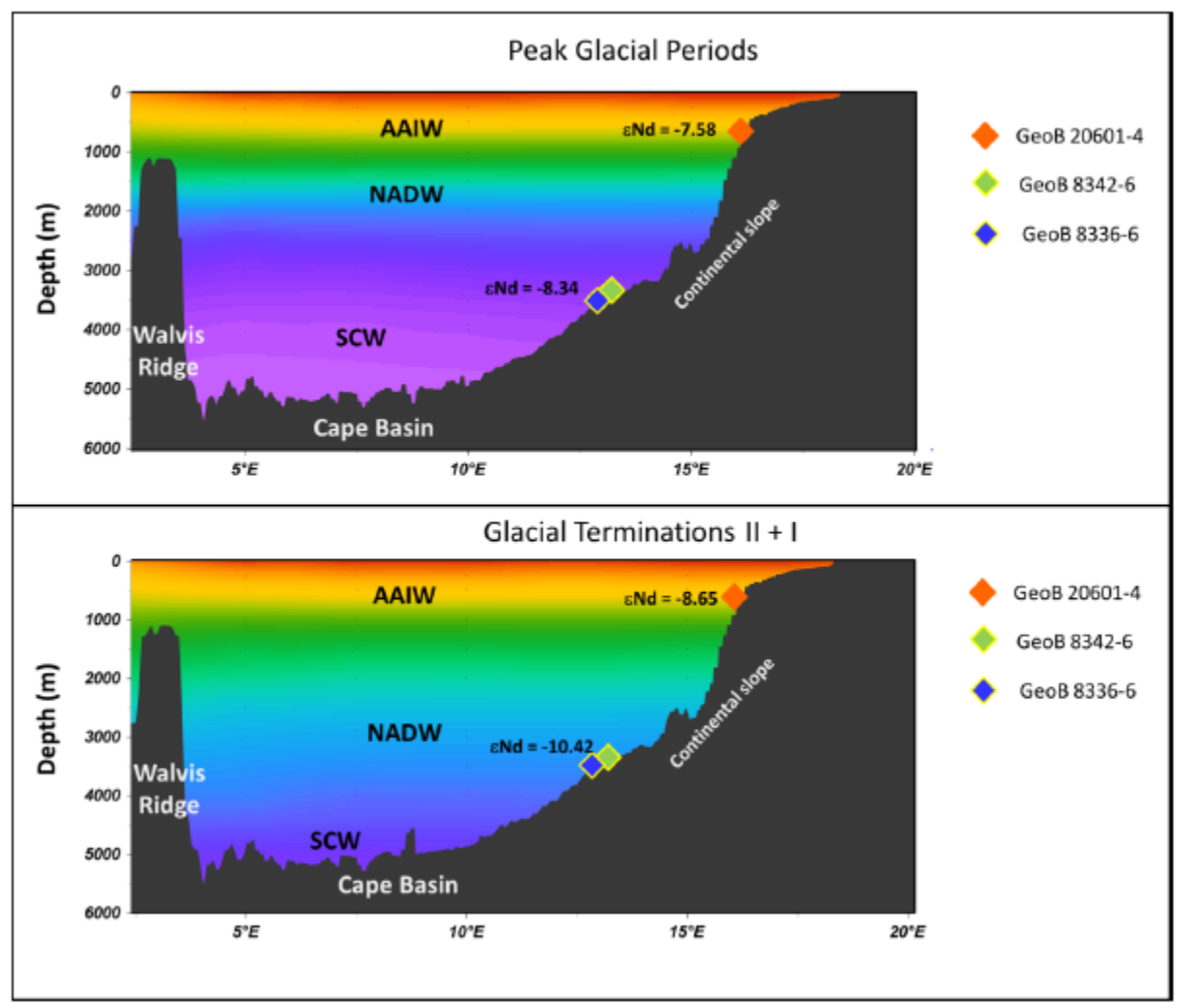
- $\delta^{13}C$ has been used in previous studies as indicator of bottom waters
- Higher $\delta^{13}C$ has been associated with NADW and lower $\delta^{13}C$ with southern sourced waters such as Antarctic Bottom Waters
- The higher $\delta^{13}C$ during interglacial periods indicate the presence of NADW during these periods



WHAT DOES ALL THIS MEAN?

- εNd extracted from mixed planktic species. There is relatively no intra-species variability in εNd. Planktic species also acquire bottom water signals upon settling and burial. Previous studies found similar εNd values between planktic and benthic species.
- Higher εNd values indicate southern sourced water masses
- Lower εNd values indicate northern sourced water masses
- The progressively decreasing εNd values from glacial periods to glacial terminations in this study and lower εNd values during the interglacials indicate that warming periods are favourable towards NADW penetration and strength in the southeast Atlantic.

WHAT DOES ALL THIS MEAN?



- When all methods are read in-line with each other, all of them indicate a stronger presence of NADW during glacial terminations (end of MIS 6 and MIS 2) and the interglacials following these terminations (MIS 5 and MIS 1).
- The neodymium isotope (εNd) method was the better method in determining how the NADW mass strengthens from glacial terminations to interglacials.
- Results for a shallower core (at 874 m) indicated Antarctic Intermediate Water values, but fluctuating within that range during glacial and interglacial periods.

CONCLUSIONS

- Faunal counts of reliable species such as C. *wuellerstorfi*, $\delta^{13}C$ and εNd are methods that provide indications of bottom water presence during specific time periods, but the reliability of these datasets are increased when used together.
- All methods in this study indicate a stronger presence of NADW during glacial terminations and interglacials.
- εNd values indicate that NADW penetration into the southeast Atlantic strengthens during glacial terminations II (end of MIS 6) and I (end of MIS 2) and the interglacials following (MIS 5 and MIS 1).
- Further work on this project is currently investigating water masses over a larger area from off-shore Central Africa to south of the study area.

ACKNOWLEDGEMENTS

- Staff and colleagues at the University of Cape Town and MARUM
- Funding provided by the National Research Foundation and the Bundesministerium für Bildung und Forschung

University of Cape Town • iYunivesithi yaseKapa • Universiteit van Kaapstad

marum
Zentrum für Marine Umweltwissenschaften

NRF National Research Foundation

Bundesministerium für Bildung und Forschung

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