Evaluation of Amino Acid Racemization Variability in Quaternary Corals

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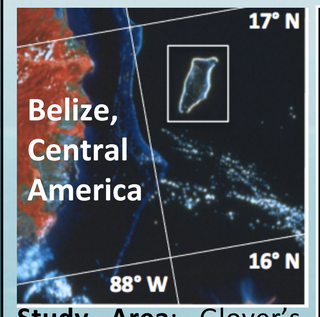
Objectives

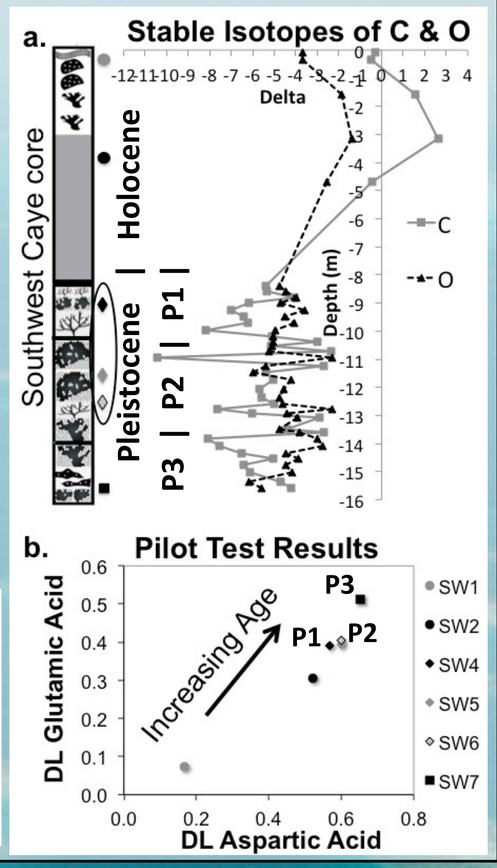


Study Area: Glover's Reef (white square) is located seaward of the Belize Barrier Reef approximately 45 km offshore. Water temperatures range from 27 to 29°C.

Initial Data

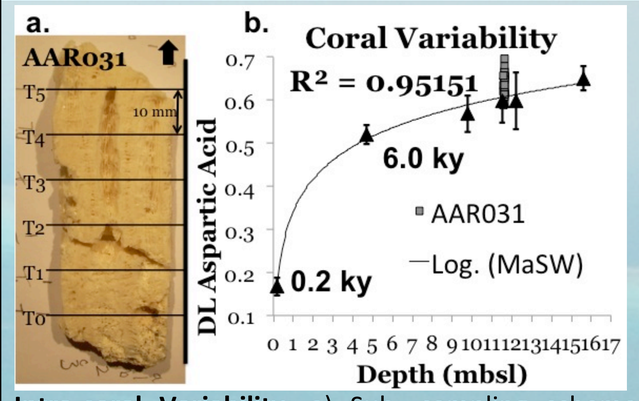
a) Stable isotope excursions of carbon and oxygen suggest two exposure horizons within the Pleistocene.

b) The extent of AAR in aspartic and glutamic acid increases monotonically down the core. A cluster of amino acid D/L values (diamonds) spans an exposure horizon, suggesting that the two youngest Pleistocene sequences are similar in age, possibly sub-stages of MIS 5e.



- **Determine what causes the variations of amino acid racemization (AAR) in Quaternary corals**
- **Develop best practices for using AAR to provide age control in reef deposits in which little material is suitable for U-series or ^{14}C techniques**
- **Determine if cores from Glover's Reef record sub orbital sea-level cycles**

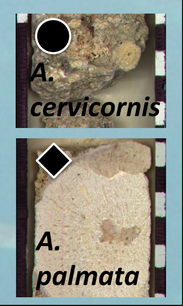
Approach



Intra-coral Variability: a) Sub- sampling scheme for AAR031 (Pleistocene *Montastraea cavernosa)* differentiates between corallites and coenosteum along time-equivalent transects.

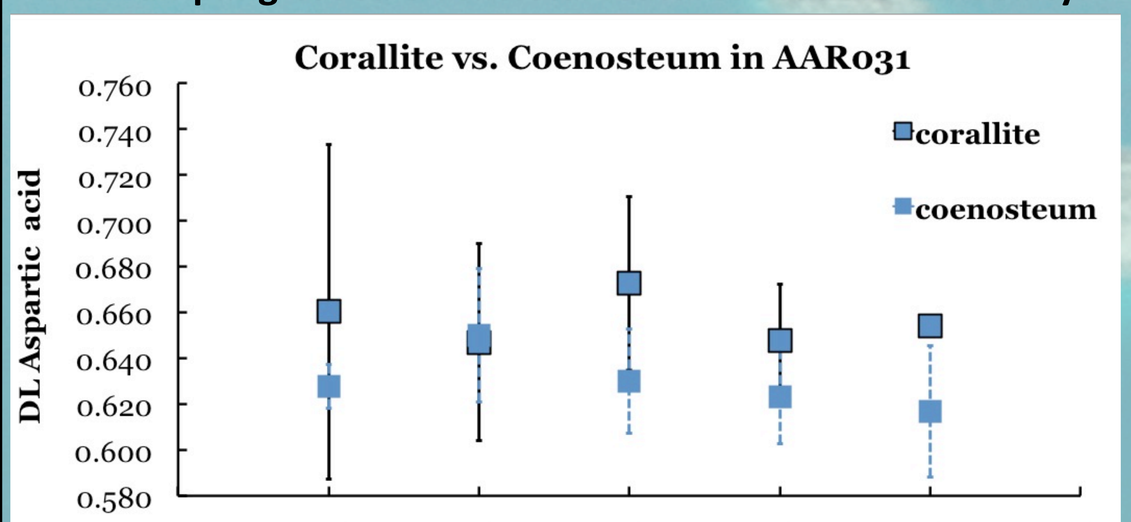
b) The correlation between DL aspartic acid and depth is very high, but the variability within the single sample AAR031 extends across the range of several Pleistocene samples.

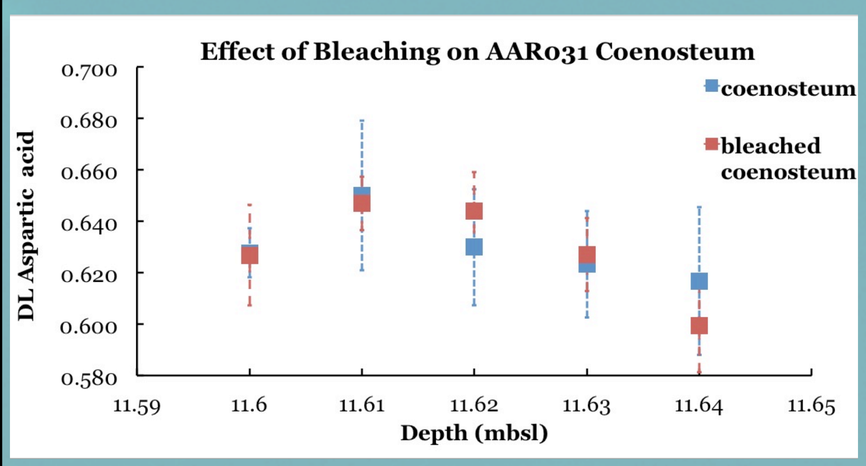
- **Corallite vs. coenosteum skeletal structure sub-sampling**
- **Bleaching vs. not bleaching prior to hydrolysis**
- **Compare correlations with depth for several coral species and eight different amino acids**



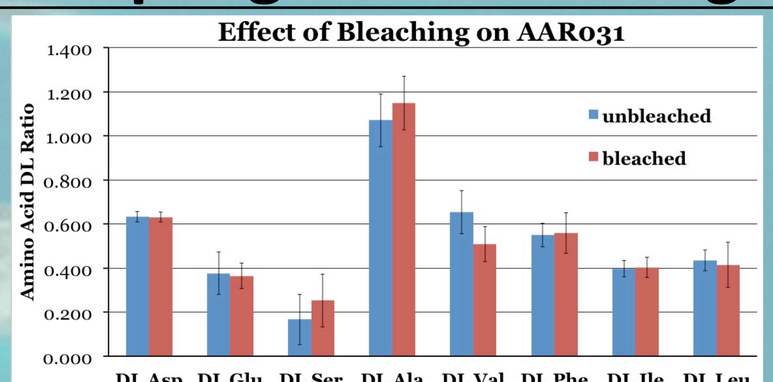
Results – Sub-sampling and Bleaching

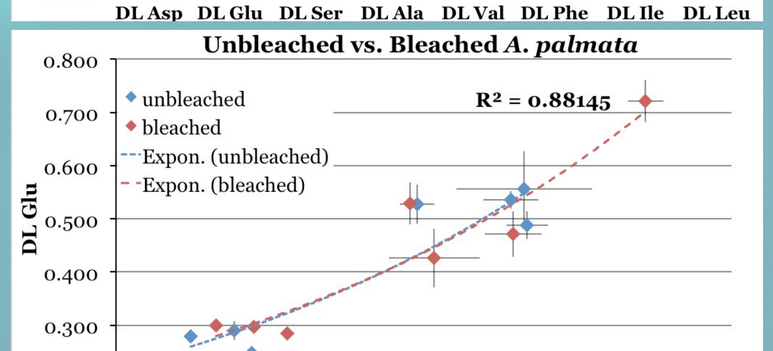
Sub-sampling based on skeletal features reduces variability.

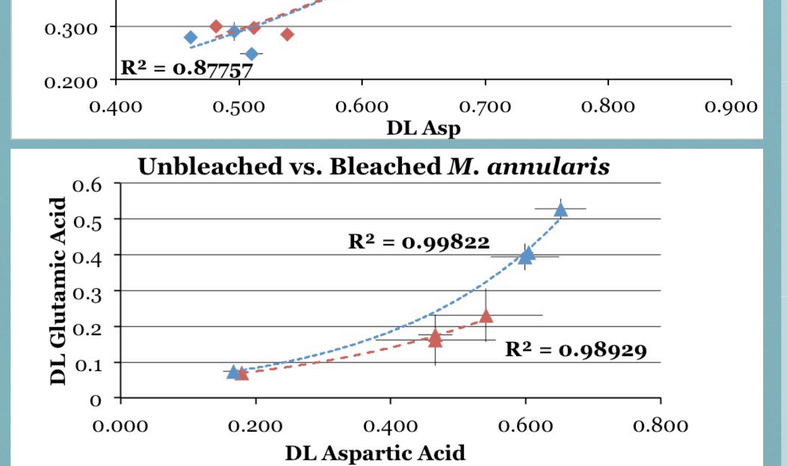




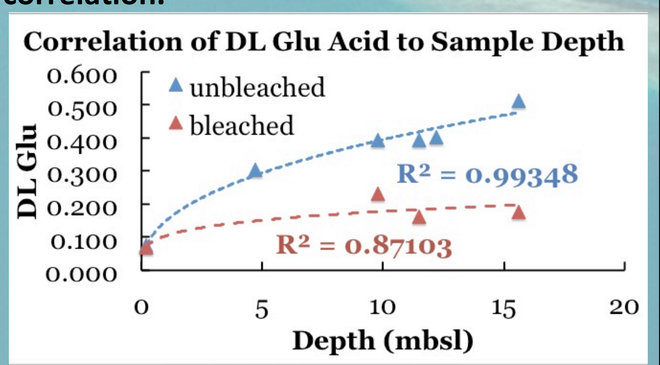
Bleaching does not significantly effect the DL ratio for all amino acids measured except valine. Its effect is minimal on the correlation between DL glutamic and DL aspartic acid for the coral species *Acropora palmata* and *M. annularis*.





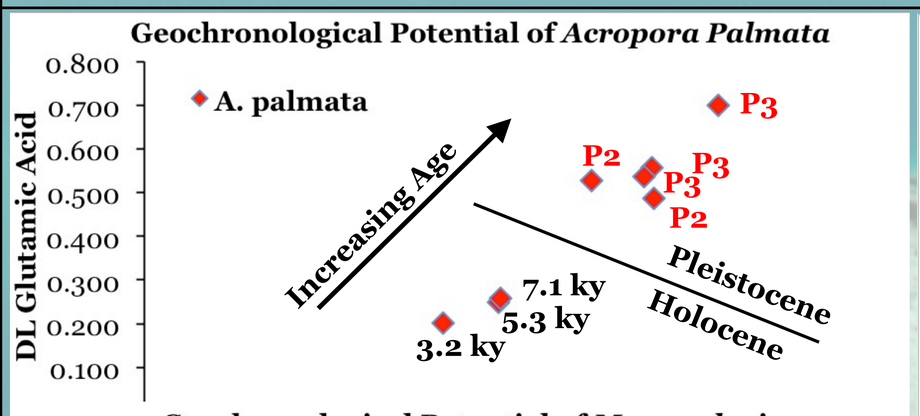


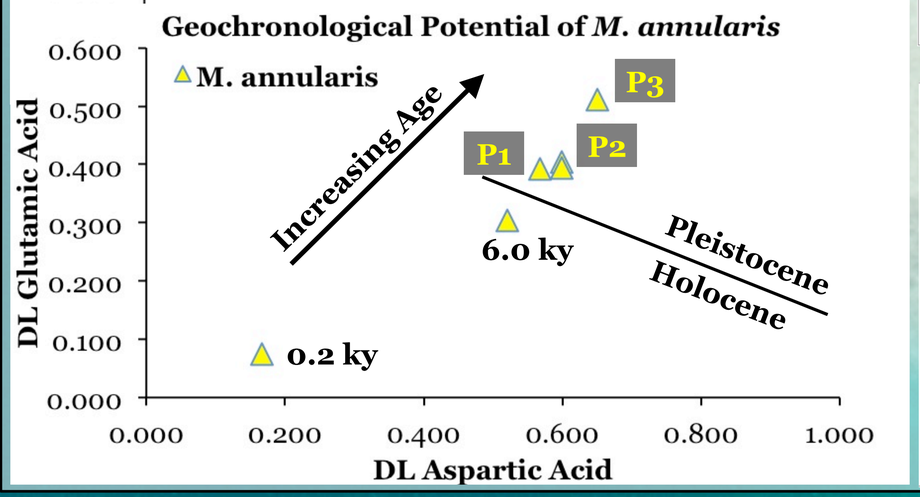
Correlations of amino acids to sample depth, bleaching usually results in a weaker correlation.

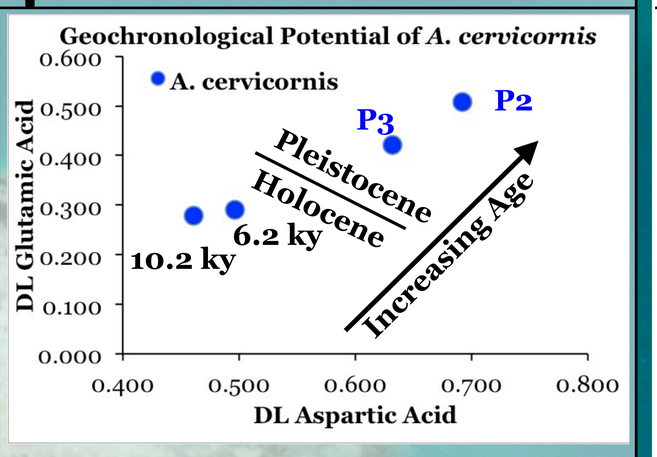


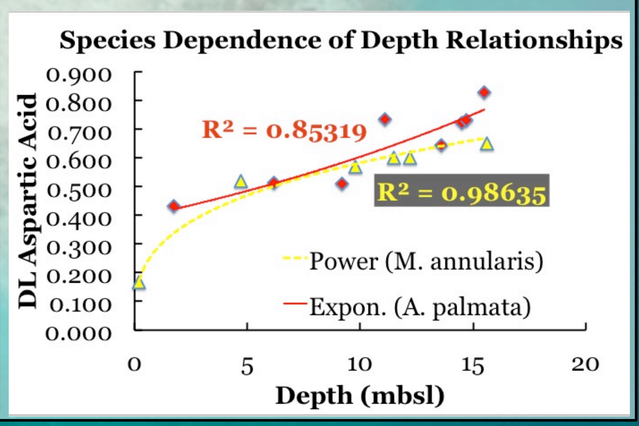
Amino Acid	Unbleached	Bleached
◆ *Acropora palmata* – Exponential Relationships ◆		
DL Aspartic Acid	0.6341	0.5486
DL Glutamic Acid	0.8200	0.6960
DL Serine	0.1863	0.1992
DL Alanine	0.5199	0.6627
DL Valine	0.7075	0.7951
DL Phenylalanine	0.2351	0.0429
DL Isoleucine	0.1356	0.1032
DL Leucine	0.2072	0.0002
▲ *Montastraea annularis* – Power Relationships ▲		
DL Aspartic Acid	0.9999	0.9530
DL Glutamic Acid	0.9964	0.8710
DL Serine	0.6229	0.9666
DL Alanine	0.9998	0.8977

Results – Inter-species









Major Conclusions

- **Sampling only coenosteum material reduces intra-sample variability of DL aspartic acid in *Montastraea cavernosa*.**
- **Bleaching of Pleistocene Caribbean corals may result in less intra-sample variability, but it weakens the correlation between amino acid DL ratios and depth.**
- **The relationship between amino acid DL ratios and depth is species dependent. *Acropora cervicornis* samples plot out of stratigraphic order.**
- **Caution should be used when interpreting AAR-based age models in corals from studies that do not consider the variability introduced by different species, sampling, and preparation methods.**

Acknowledgements

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