The use of foraminifera to quantify reworked grains in coastal sediments using Amino Acid Racemization: Preliminary results

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Introduction
Coastal barrier landforms, located where either the coastline is subsiding or the uplift rate is slower than sea level rise, are often found to contain a substantial reworked component derived from older, antecedent features (Cooper 1994; Roy et al. 1994; Bateman et al. 2011; Ryan 2015). Quantiﬁcation of this reworked component is seldom attempted.

Here we present preliminary results of a study utilizing amino acid racemization (AAR) analysis of individual foraminifera as a means of quantitatively assessing the contribution of reworked sedimentary materials of earlier interglacial periods.

Methods
Individual *Elphidium* sp. and *Lamellodiscorbis* sp. foraminifera were plucked from the ≤500 µm fraction of 3 modern beach sediment samples (Figure 1) taken along the South Australian coast. Tests were preferentially selected for robustness, color, and level of preservation; characteristics which can serve as indicators of age.

Individual tests were analyzed separately using AAR and followed the sample preparation and analysis method established by Kaufman and Marly (1998), Hearty and Kaufman (2000), and Hearty et al. (2004). All analyses were conducted at the University of Wollongong, Australia using an Agilent 1100 series RP-HPLC.

Holocene foraminifera can be differentiated from reworked foraminifera because:

- Pyrolysis experiments of *Lamellodiscorbis dimidiatus* and *Elphidium crispum* show that Holocene tests should exhibit a lesser extent of valine racemization than of glutamic acid (Lachlan 2011). AAR results of modern shell and whole-rock have supported this conclusion (Ryan 2015).
- The average racemization extent of accepted individual Holocene tests should not exceed the whole-rock result, which represents an integrated average of all biomarkers in that sample.
- Older, reworked tests will plot as outliers to Holocene values.

Preliminary Conclusions
1. Analysis of modern foraminifera results shows that the extent of valine racemization is less than that of glutamic acid with very few exceptions to a D/L value of 0.200. Therefore, any accepted foraminifer result from a Holocene sedimentary unit with a valine D/L value greater than 0.200 can be regarded as reworked.
2. Individual foraminifera of Holocene-age can exhibit extents of racemization above and below the site whole-rock value but the calculated average does not exceed the whole-rock value.
3. Reworked foraminifera of late to middle Pleistocene age are distinguishable.
4. The quantity of reworked grains is variable along the length of the coastline with a relationship to sediment source.

Ongoing Research
- Pyrolysis experiments to establish racemization rates through time for inner-shelf foraminifer species *Lamellodiscorbis dimidiatus*, *Elphidium advenum*, *Elphidium crispum*, and lagoon foraminifer species *Ammonia becarri*.
- Additional single foraminifera analysis to establish representative modern AAR values for *L. dimidiatus*, *E. advenum*, *E. crispum*, *Cibicides corticus*, *Rosalina bradyi*, and *A. becarri*.
- Additional single foraminifera analysis to establish AAR representative values of MIS 5e for *L. dimidiatus*, *E. advenum*, and *E. crispum*.
- Additional analysis of foraminifera plucked ‘blindly’ from sediment samples to establish a representative population of contemporaneous and reworked foraminifera at individual field sites followed by quantitative analysis to determine percent contribution by antecedent landforms.
- AAR analysis of *A. becarri* tests plucked from modern lagoon shoreline sediments stained by Rose Bengal to assess the effects of the stain to AAR procedure and results.

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Literature Cited


