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The utility of foraminifera for the relative dating of beach barriers and identification of reworked sediment using amino acid racemization

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The Pleistocene beach barriers of the Coorong Coastal Plain, South Australia, are comprised predominantly of carbonate bioclastic and quartzose sands. Due to long-term subsidence in the northern reaches of the coastal plain, the barriers coalesce and lose topographic expression in the landscape, hampering the identification and correlation of barriers of contemporaneous age in the region. The discernment and relation of the various barriers is vital to understanding the development of this landscape throughout the Quaternary. However, because of the subsidence, associated shell beds to all but the last interglacial barrier are subsurface and not accessible. Furthermore, the whole-rock amino acid racemization (AAR) method was found to be unsuitable due to the low carbonate content of the sediments and concerns for the leaching or contamination due to the comminuted nature of the shelly component of the sediments.

The high quartz content and lack of suitable mollusk shell material in the northern coastal plain prompted an investigation of the applicability of AAR in the analysis of single foraminifer tests. The skeletal tests of foraminifera, a common occurrence across all latitudes, are incorporated as individual grains into nearshore and terrestrial sediments through wave, tidal, and aeolian processes. The principle purpose of this investigation was to determine whether the relative age of beach barriers could be determined through the analysis of single tests and whether sediment contribution from antecedent barriers could be identified. Thermoluminescence (TL) samples, previously shown to be an effective complement to AAR, were analyzed to provide chronological constraint to the AAR results.

Foraminifera from numerous modern depositional environments were analyzed to assess natural variability in depositional setting and to establish aspartic and glutamic D/L values representative of modern/Holocene foraminifera; i.e. aminozone. Multiple genera were analyzed from the modern sediments to assess their suitability to AAR, which can vary due to genus-specific racemization kinetics. Tests of Lamellodiscorbis dimidiatus, common in the Pleistocene barriers, were analyzed from MIS 5 and MIS 7 sediments. Aminozones were identified in the MIS 5 and MIS 7 sediments allowing correlation of discordant barrier features and the identification of reworked foraminifera. A reworked contribution was identified in nearly every sediment sample, illustrating that foraminifer tests are surprisingly robust and can survive potentially multiple phases of deposition and reworking. The aspartic D/L values of foraminifer picked from the modern sediments reflect the early, fast rate of racemization, providing higher temporal resolution than Pleistocene tests. Radiocarbon calibration of the former would provide absolute ages. This work is preliminary and additional analyses will provide better constraint of aminozones and emphasize the usefulness of single test foraminifer amino acid racemization.