NON-CONCORDANT ^{14}C AGES OF CONTEMPORANEOUS PLANKTONIC FORAMINIFERA

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^{14}C dating of foraminifera is fundamental to constructing reliable age models for marine cores. Bioturbation within the sedimentary mixed layer, coupled with dissolution and changes in species diversity can cause significant offsets in ^{14}C ages even between contemporaneous planktonic species [1,2]. We use ^{14}C measurements from multiple species of planktonic forams and fragments from the Ontong-Java Plateau to test a steady state model of the mixed layer.

Bioturbation of the upper several cm of sediment at the seafloor produces an effectively homogenous mixed-layer (ML). This process continually mixes old and new sediments to produce an exponential distribution of particle ages within the ML (with a relatively high sedimentation rate of 5 cm/ka one may expect to find particles several thousands of years in age). All things being equal, two species of planktonic foraminifera picked from the mixed-layer should give identical mean ages. Dissolution within the ML results in fragmentation of foraminiferal tests. The effect of fragmentation will be to reduce the mean age of unbroken shells of any particular species since older shells will be broken and hence not picked for analysis. It follows that more vulnerable shells will give a younger age than more robust individuals (Fig. 1).

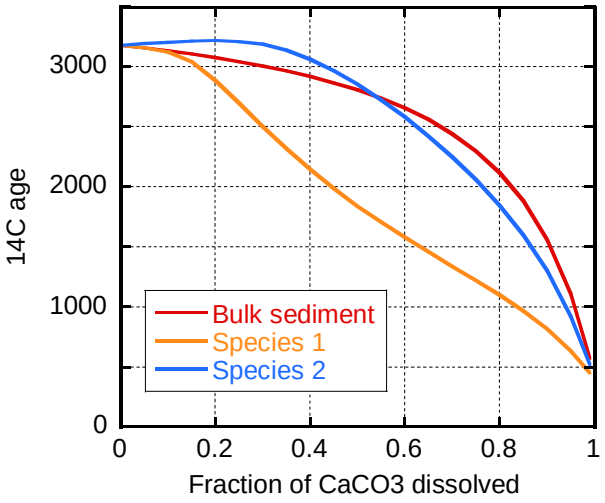

Fig. 1: Steady state model of the effects of dissolution and fragmentation within the sediment mixed layer. As dissolution increases the age of bulk, $CaCO_3$ decreases reflecting the continuous addition of new sediment. Ages of foraminifera are for unbroken tests. Hypothetical foraminifera species differ in 2 ways; species 1 dissolves at the same (proportional) rate as the bulk $CaCO_3$ and breaks up below a critical weight of 0.5x initial. Species 2 dissolves at 0.7x the bulk $CaCO_3$ rate with a critical weight of 0.3x initial *i.e.* species 2 is more robust than species 1.

Core-top samples from the Ontong-Java Plateau (OJP) in the western Equatorial Pacific have been analysed for ^{14}C on several species of planktonic foraminifera and fragments when identifiable (Fig. 2). The range of ages for various components is significant (> 2000 yr) but not random; differences between species appear systematic. Fragments are typically >1000 years older than whole shells for a single species, in line with model predictions. However, more robust species, such as *P. obliquiloculata* give younger ages than more fragile species such as *G. ruber*. Further, the age of bulk coarse fraction $CaCO_3$ increases with increasing water depth and degree of dissolution. These results suggest that the sediments are not at steady state and that changes in abundance have probably occurred through time. We are currently analysing foraminiferal assemblages in these samples and further samples from downcore in order to investigate any changes that have occurred.

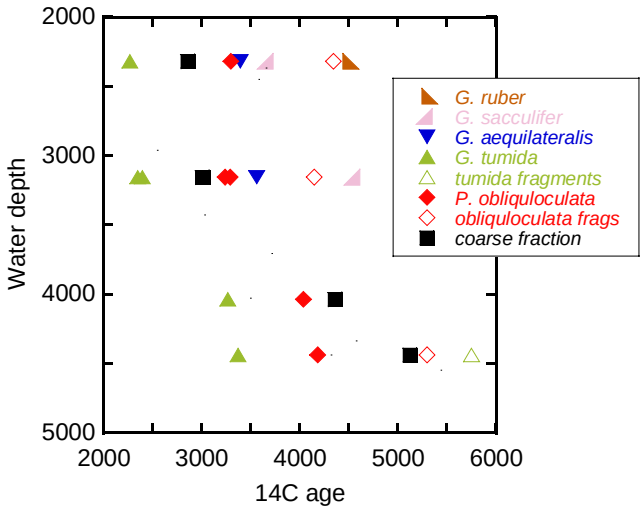

Fig. 2: ^{14}C age results from core-top sediments from the OJP (4 samples in total).

CONCLUSIONS

Core-top sediments from the OJP show the effects of dissolution and fragmentation on ^{14}C ages although the system is not in steady state. An important conclusion from these results is that in order to place confidence in, for example, benthic-planktic age differences for paleo-ventilation reconstructions, it is preferable to measure multiple planktonic species. This should highlight potential problems due to dissolution and fragmentation.

REFERENCES

[1] W. Broecker et al., Nucl. Instr. and Meth. **B5**, 331 (1984).

[2] W. Broecker et al., Paleoceanography **14**, 431 (1999).