QUANTITATIVE PALEOBATHYMETRY USING GEOCHEMISTRY AND SHAPE ANALYSIS OF BENTHIC FORAMINIFERA, OFFSHORE GULF OF MEXICO

Douglas F. Williams[1], Anthony C. Gary[1], and Nancy Healy-Williams[1]

ABSTRACT

Present methods of making paleodepth estimates using depth indicator species of benthic foraminifera are often limited. We present a new, more quantitative approach to paleobathymetry of Gulf Coast offshore sections using the geochemistry and shape of ubiquitous benthic foraminifera. The oxygen-18/oxygen-16 ratios and shape characteristics of benthic foraminifera vary systemically with water depth along the Gulf of Mexico margin. Temperature directly affects the proportion of ^{18}/o ration will be recorded in the benthic foraminifera. This relationship allows the ^{18}o difference between benthics living at different water depths to be predicted. Our morphometric analyses of benthic foraminifera using fourier series analysis have shown that many taxa exhibit shape changes which are also correlatable to known environmental variables along shelf-slope depths.

These variables provide independent measures for quantitatively estimating water depth in extant and extinct benthic taxa. It is possible to describe these geochemical and morphological changes with water depth by a series of regression lines. These regression lines can then be used to make paleobathymetric interpretations very accurately and quantitatively between wells. Practical applicaton of the model would involve morphometric analysis of a particular benthic foraminiferal species and characterization of the depth-dependent shape parameter using Fourier series analysis. Oxygen isotopic analysis would then be performed. Paleodepth estimates are then possible by inputing the shape parameter and isotope data to the regression equations based on the modern reference surface. Comparison of the estimated paleodepth with interpretations based on other more standard techniques would then take place prior to input into the appropriate depositon or basin models.

Quantitative estimates made in this new manner can provide important information for depositional and basin modelling in hydrocarbon exploration. The fact that the shape parameters and isotopic composition are predictable, independent, but corroborative, enables the paleontologist to make paleodepth estimates with increased accuracy and confidence. The end result should be better constraints on depositional models of important exploration areas of the Gulf Coast. This approach should also be useful in calibrating paleodepth inferences of extinct benthic foraminifera from Paleogene Gulf Coast sections.

[1]**Morphometrics Studies Group, Department of Geological Sciences, University of South Carolina, Columbia, SC 29208**