**MCMICKEN COLLEGE OF ARTS AND SCIENCES**
**Geology**

**SUMMER RESEARCH OPPORTUNITIES**
**FOR UNDERGRADUATE WOMEN**

**APLICATION DEADLINE: March 1, 2006**

*The Department of Geology is pleased to offer the following research project for the summer of 2006. Interested students are urged to contact the faculty member(s) directing the project that most interests them. By contacting the faculty member, you can discover more about the project, learn what your responsibilities will be and if possible, develop a timetable for the twelve-week research period.*

## SULFUR ISOTOPES AS A TOOL FOR RECONSTRUCTING DATES OF DISPOSITION: AN EXAMPLE FROM THE KOPE FORMATION OF SW OHIO

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Studies of recent sediments have shown that sulfur isotopic ratios, using the normalized ratios of $^{34}S$ to $^{32}S$, are sensitive indicators of the rates of bacterial sulfate reduction. The degree of microbial isotopic fractionation is inversely related to rates of sulfate reduction. The bacteria prefer the lighter $^{32}S$ isotope, but fail to discriminate effectively between $^{34}S$ and $^{32}S$ when growing at high rates. Rates of growth are determined by a number of environmental factors, including temperature and type of organic matter available. However, in marine systems, the rate of sedimentation is the most important forcing variable. At high sedimentation rates, consumption of organic matter by metazoans and by oxygen-utilizing bacteria is limited and more organic substrate is available to the sulfate reducers, who accordingly grow faster and therefore fractionate sulfur isotopes less. Conversely at slow sedimentation rates, the sulfate reducers receive a much lower amount of the organic substrate and produce large isotopic fractionations because of their low growth rates.
The degree of isotopic fractionation is expressed as the spread between the measured ratio and the reconstructed ratio for seawater sulfate at the time of deposition. That is

$$D^{34}S = ä^{34}S_{sulfate} - ä^{34}S_{pyrite}$$

Studies of modern sediments sampled by the Ocean Drilling Program gives the following relationship between sedimentation rate, ù, and degree of fractionation.

$$\text{Log } ù = -0.86 - 0.027D^{34}S$$

Preliminary studies of Kope samples have shown a wide range of $D^{34}S$ . Upper Ordovician seawater had a $ä^{34}S$ in sulfate of about 24 permil, which gives a range of $D^{34}S$ for the Kope of 10 to 40 permil. This range would correspond to sedimentation rates between 0.01 and 0.10 cm/yr. These values are reasonable for near-shore subtidal clastic deposition. Within the limits of this small dataset, there appears to be an inverse relationship between $D^{34}S$ and carbonate % values. That is, the low-carbonate mudstones were deposited at high rates of sedimentation,

whereas the high-carbonate mudstones are the slow, background accumulations.
For this project, we propose to test a short set of depositional cycles from the Kope. About 50 samples can be processed conveniently in a summer by an undergraduate. These results will then be compared to results from magnetic susceptibility measurements, being done at LSU, and paleontologic data, being gathered, if feasible, by a second WISE participant supervised by Dr. Brett.