Ms Jamie Shamrock was born in Pennsylvania; she has earned already a B.A. in anthropology and a B.Sc. in geology. Ms. Shamrock is now going for her Master's degree at the University of Nebraska-Lincoln.

"Late Cretaceous biostratigraphy and adaptive radiation of the calcareous nannofossil genus *Eiffellithus*"

The study of calcareous nannofossils has great value in paleoecology, paleoceanography, and biostratigraphy as stratigraphic markers in petroleum exploration. The calcareous nannofossil genus *Eiffellithus*, a heterococcolith having an elliptical rim and central-area cross bars (Figure 1), contains numerous index fossils, as species display readily identifiable morphological characteristics. Since its first appearance in the late Albian, this genus rapidly evolved into one of the most abundant and ubiquitous components of nannofossil assemblages in the Late Cretaceous. *Eiffellithus* is one of the most dissolution resistant taxa and, as such, is one of the few easily recognizable species in poorly preserved assemblages (Hill, 1975; Thierstein, 1980). In addition, the rapid rate of evolution allows for greater precision in biostratigraphic correlation.

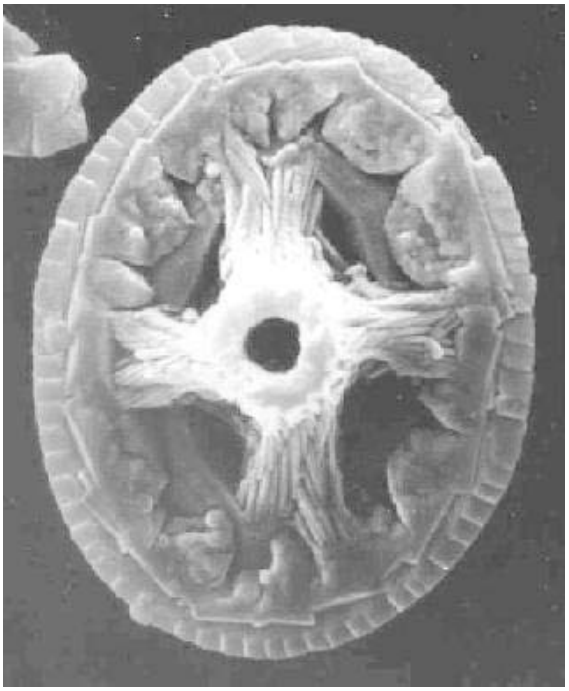

Figure 1: *Eiffellithus eximius*, from the Demopolis Chalk of Campanian age. Magnification 7200x, Scanning electron microscope. Perch-Nielsen, 1968.

The first attempt to map the genus *Eiffellithus* was by Perch-Nielsen in 1979, who recognized nine forms; five formal and four informal: this indicates the wealth of morphological diversity in the genera complex. Little follow-up work was completed until Watkins and Bergen (2003) documented the early evolutionary history of the genus *Eiffellithus* through the late Albian. No detailed study currently exists for this genus through the remainder of the Cretaceous, an interval which, with the presence of such geologically and climatically significant events such as Oceanic Anoxic Event (**OAE**) 2 (latest Cenomanian), the Cretaceous thermal maximum (Turonian), **OAE** 3 (Coniacian-Santonian boundary), and the late Campanian-Maastrichtian global cooling, provides the opportunity to address multiple research goals.

Research

Using core samples from Ocean Drilling Program (**ODP**) and Deep Sea Drilling Project (DSDP) sites in the Gulf of Mexico, the Western Atlantic, and the Indian Ocean, I propose to document the adaptive radiation of the genus *Eiffellithus* and correlate these changes with ocean-wide changes from the Cenomanian through the Maastrichtian, a period of approximately 35 my. This research will address three significant objectives: (1) To increase the biostratigraphic resolution of the Late Cretaceous by documenting the evolution of this abundant and preferentially preserved index fossil; (2) to resolve taxonomic ambiguities of this genus by documenting its development through the Late Cretaceous; and (3) the evolutionary history of the Eiffellithids will be examined in light of the paleoclimatic and tectonic history of the late Cretaceous. Samples will be taken from DSDP Leg 10, Site 95; from the Campeche escarpment in the Gulf of Mexico (Figure 2); and from ODP Leg 122, Sites 762, and 763 from Exmouth Plateau in the

Indian Ocean (Figure 3), as these cores contain well-preserved calcareous oozes and chalks representing relatively thick, continuous deposits. Regional signals will be minimized by sampling cores in distant oceanographic basins.

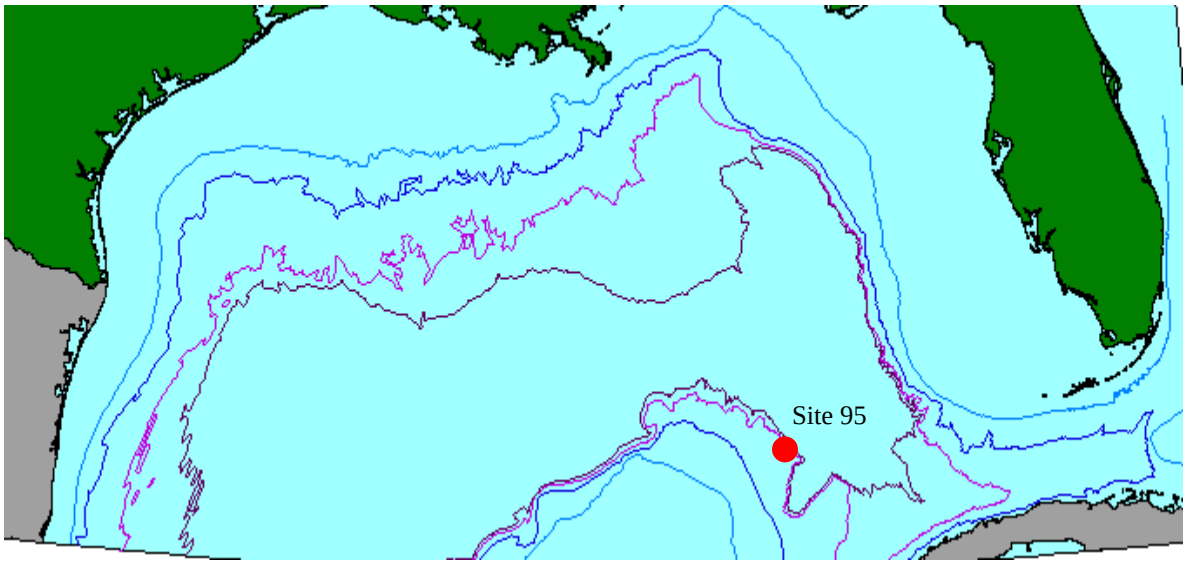

Figure 2: Site Location map for DSDP Leg 10, Site 95 in the Gulf of Mexico

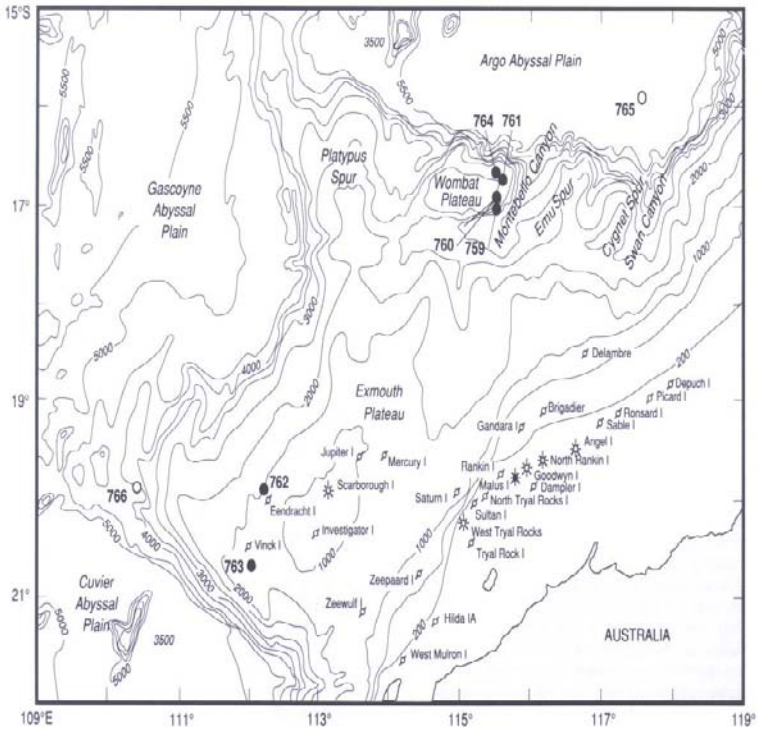

Figure 3: Site location map for ODP Leg 122, Site 762, and 763, Exmouth Plateau.

Methods

For stratigraphic correlation between sites I will construct an age model based on an age-depth plot for accumulation rates. I will prepare approximately 200 smear slides per site using the random settling technique for calcareous nannoplankton put

forward by Geisen, *et al.* (1999), a procedure which is known for consistent, reproducible results. Slides will be viewed on a Zeiss Photoscope III microscope and sample counts will be determined by methods presented in Chang (1967). I will construct a synopticon, a photographic traverse through slides over time, to provide a visual record of morphological changes through time. Biometric measurements will be taken on all *Eiffellithids* and analyzed using univarite statistical analysis. As shown by Watkins and Bergen (2003) individual species within the genus *Eiffellithus* can be resolved by discrete morphological characteristics such as size (length/width), obliquity, bar morphology (simple, bifurcate, trifurcate), and the bar angle to the major axis of the ellipse. Using the newly revised Eiffellithus complex I will make biostratigraphic correlations between site localities and compare these correlations to current zonation schemes. In addition, I will provide systematic paleontology for any newly resolved species.

Slides for DSDP Site 95 and ODP Sites 762 and 763 will be complete by March 2006. Initial results will be presented at the International Nannofossil Association annual meeting in September 2006, with manuscript preparation completed by May of 2007. Total duration of investigation will be approximately 16 months.

Chang, Y.M., 1967, Accuracy of fossil percentage estimation, *Journal of Paleontology*, 41, 500-502.

Erbacher, J., Huber, B.T., Norris, R.D., and Merkly, M, 2001. Increased thermohaline stratification as a possible cause for and oceanic anoxic event in the Cretaceous period. Nature, 409, 325-327.

Geisen, M., Bollman, J, Herrle, J.O., Mutterlose, J, and Young, J.R., 1999. Calibration of the random settling technique for calculation of absolute abundances of calcareous nannoplankton. Micropalaeontology, 45, 437-442.

Hill, M.E., III, 1975. Selective dissolution of mid-Cretaceous (Cenomanian) calcareous nannofossils, Micropaleontology, 21, 227-235.

Haq, B.U., von Rad, U., O'Connell, S., et al. 1990. *Proc ODP, Init. Repts.*, 122: College Station, TX (Ocean Drilling Program).

Perch-Nielsen, K., 1979. Calcareous nannofossils from the Cretaceous between the North Sea and the Mediterranean. *In:* Wiedmann, J. *ed*., Aspekte der Kreide Europas International Union of Geological Science, Series A, 223-272.

Poulsen, C.J., Gendaszek, A.S, and Jacob, R.L., 2003. Did the rifting of the Atlantic Ocean cause the Cretaceous thermal maximum? Geology, 31, 115-118.

Thierstein, H.R., 1980. Selective dissolution of Late Cretaceous and earliest Tertiary calcareous nannofossils; experimental evidence. Cretaceous Research, 1, 165-176.

Watkins, D.K. and Bergen, J.A., 2003. Late Albian adaptive radiation in the calcareous nannofossil genus *Eiffellithus*. *Micropaleontology*, 49, 231-252.

Wilson, P.A. and Norris R.D., 2001. Warm tropical ocean surface and global anoxia during the Mid-Cretaceous period. Nature, 412, 425-428.

Worzel, J.L., Bryant, W., et al., 1973. Initial Reports of the Deep Sea Drilling Project, Volume X, Washington (U.S. Government Printing Office.

www-odp.tamu.edu/.../ 198_SR/102/102_f1.htm

http://pubs.usgs.gov/of/of00-019/htmldocs/images/browse/bathyc.gif

http://www-odp.tamu.edu/publications/198_IR/198TOC.HTM