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The Application of Geographic Information Systems Technology to Geologic, Hydrogeologic, and Environmental Research

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Spatial data are of primary importance in nearly all aspects of geological and hydrogeological research. In undertaking such research, it is fundamental that observations and phenomena be located in a georeferenced coordinant system in order to understand and visualize the distribution of these data and to discern their relationships to other observations and phenomena. For this reason, geologic studies are particularly well suited to take advantage of computer-based geographic information system (GIS) technology, which combines the data input, storage, retrieval, analysis, and manipulation functions of a relational database with automated mapping and data visualization capability. GIS allows data to be analyzed and visualized in ways that would be too time consuming, too cost prohibitive, or nearly impossible to perform using other methods. Geological applications for GIS and related technology range from basic management of locational data (e.g., water or hydrocarbon well locations, sample localities, land holdings, etc.) and associated attribute information to detailed geologic mapping and complex analyses and modeling of hydrocarbon reservoirs, aquifer systems, or drainage basins.

We have implemented GIS with the primary near-term function of supporting and enhancing our geological and hydrogeological research programs. Current research applications include monitoring and modeling of nonpoint source pollutant loadings to aquifer systems and drainage basins, delineation of public water supply wellhead protection areas, hydrogeologic flow modeling, and environmental monitoring. Examples from these studies serve to illustrate the applicability and efficiency of the GIS approach to geologic research.

Recognition of Hardgrounds in Terrigenous Stratigraphic Sections: The Moseley Limestone (Middle Eocene, Southeast Texas)

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At Stone City Bluff in southeast Texas, the contact between the Stone City Formation and the Cook Mountain Formation lies at the top of the Moseley Limestone. The contact is significant because it has been interpreted both as a regional disconformity marked by lithoclasts and alternatively as a conformable surface marked by burrow-fill structures protruding through the top of the limestone. The true nature of this contact is important because it may yield insight into the recognition of breaks in sedimentation within sections consisting of terrigenous marine sediments. The former interpretation is correct. Lithoclasts are of two types: rounded clasts of "glauconite" arenite and irregularly shaped clasts of dark limestone, both of which are similar to rock types found within the Moseley Limestone. Both types of clasts were exposed as lithified objects on the seafloor because they have epibionts and endolithic traces preserved within them. The clasts originated by early diagenetic cementation in the form of concretions and lithified burrow fillings, which were then exposed by seafloor erosion. During a subsequent interval of nondeposition, encrusting and boring biota colonized the clast surfaces. The Moseley Limestone was pervasively cemented after final burial, with the clasts cemented to the upper surface. These relationships provide a more thorough understanding of the depositional history of the Moseley Limestone and criteria useful in recognizing sedimentation breaks in terrigenous strata.