Evaporite Speleogenesis in the Castile Formation: Eddy County, NM and Culberson County, TX

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The Permian Castile Formation crops out over an area of ~1800 km² in the western Delaware Basin, where it hosts extensive karst development in laminated, massive, and nodular gypsum fabrics, as well as in selenite, gyspite and biogenic limestone. Karst development ranges widely, including: sinkholes (filled and open), hypergenic and hypogenic caves, brecciation and calcitization. Combined field studies and GIS analyses have identified >3500 surficial karst manifestations and suggest >10,000 are probable; however, less than 10% are open and large enough to be humanly entered for study.

Hypergenic karst is characterized by sinkholes and small caves that are laterally limited with rapid passage width decrease away from insurgences. Hypogenic karst is reflected in larger caves with complex morphologies (e.g. risers, half-tubes and cupolas) indicative of confined dissolution. More than 1000 individual calcitized masses (i.e. biogenic limestone produced as a byproduct of bacterial sulfate reduction in the presence of hydrocarbons) have been documented, which indicate cross-formational fluid migration. Native sulfur and selenite masses are commonly found associated with calcitized evaporites.

Intense karst development, biogenic limestone and selenite commonly occur in clusters, suggesting a speleogenetic correlation between these features. A proposed polygenetic model for speleogenetic evolution is being developed, which includes: 1) Calcitization associated with upward migration of fluids along fractures; 2) Confined evaporite dissolution associated with fluid migration through brine density convection originating from porous biogenic limestone; 3) Selenite precipitation through oxidation of secondary sulfur in the presence of hypergenic fluids; and 4) Epigenic overprinting resulting from surface denudation and cave breaching.

Biographical Sketch

Kevin Stafford was born in Houston, Texas and raised in Troy, Texas. After high school, he obtained a BS in Geology from the University of Texas at Austin and went to work as a field geophysicist with Western Geco (Schlumberger), where he worked widely abroad. After five years in the petroleum industry, he returned to school where he obtained a MS in Geology in December 2003 at Mississippi State University working on island karst within the Mariana Islands. He is currently a Ph.D. candidate in Geology at New Mexico Tech. His current research is focusing on speleogenesis within Permian evaporite rocks of the Delaware Basin, with a specific emphasis on hypogenic transverse speleogenesis, evaporite diagenesis, and karst evolution.