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Geochemical and Microbiological Aspects of Two Terrestrial Methane Seeps, Oklahoma USA

We report on geochemical and microbiological studies of two terrestrial methane seeps in Oklahoma. Recent 1:24,000 scale geologic mapping in the Potato Hills, Ouachita Mountains in southeastern Oklahoma, has located an active methane seep along the southern exposure of the Potato Hills Thrust. The Potato Hills represent a window through a folded thrust duplex, and are currently a target of extensive gas exploration. The gas is likely escaping along fractures in the hanging wall of the thrust and is found conspicuously bubbling through a nearby creek. A second locality is found at Zedletone Mountain near the frontal faults of the Wichita Mountains in SW Oklahoma. The spring is brackish, discharges at approximately 19 L/min year round and is chemically anomalous with respect to surrounding surface waters in that it is supersaturated with respect to barite, fluorite, and carbonate minerals. A slightly radioactive barite-calcite precipitate is actively forming in direct spatial association with biomass. Methane bubbles continuously at the spring source. Active populations of methanotrophic and sulfur-oxidizing microbes have been studied via microcosm and in situ methods. Inverse chemical modeling and isotopic constraints in both scenarios suggest methane and deeper fluid migrating to the surface via faults, and mixing with shallow meteoric water. These springs offer insight into the operative biogeochemistry at modern and paleo methane seeps in terrestrial environments.