

Spectral Analysis of the Fayetteville Shale and the Imo Formation, Northern Arkansas, Inferences Regarding Radionuclide Concentrations, TOC and Shale-Gas Sources

J. Puckette, D. Boardman, and Adetola Alase
Oklahoma State University, Stillwater, OK

Analysis of gamma-ray spectrometry data collected from the Mississippian Hindsville, Fayetteville, Pitkin and Imo formations in northern Arkansas provides insight into radionuclide accumulation and concentration of organic matter in natural gas-bearing rocks. More than 300 spectral gamma-ray measurements were integrated with lithologic data to examine relationships between sediment source, U and Th concentration and TOC. At Spring Hill, AR, the basal black-organic-rich unit of the Fayetteville transitions upward to gray shale, U and TOC concentrations decrease upward, total API gamma-ray decreases, and Th shows a slight increase. The upward-decreasing gamma-ray values are attributed to an increase in terrigenous sediments that diluted the U concentration. A positive correlation between U and TOC supports a marine source for organic carbon. The Marshall, AR outcrop contains two primary depositional cycles in the upper part of the Fayetteville Shale. The lower cycle consists of black shale overlain by gray shale with thin-bedded limestone and culminates in limestone. U and Th decrease upward across the cycle, as do API gamma-ray and TOC, a pattern generated as the siliciclastics are diluted by carbonate. The upper cycle at Marshall begins with black shale and is similar to the lower cycle in that U, Th, TOC and API gamma-ray decrease upward as carbonate content increases. This cycle is in transitional contact with the overlying Pitkin limestone. In the Imo, U, Th, TOC and gamma-ray decrease upward from the basal black shale to the sandstone. In the Fayetteville and Imo, API gamma-ray responds to U and Th and consequently may not be a reliable indicator of TOC concentration. However, U correlates positively with TOC across all units and is viewed as a reliable tool for estimating their gas-sourcing potential.