Geochemical Constraints on the Origin and Volume of Shale Gases in the Eastern Illinois Basin, Dariusz Strąpoć and Arndt Schimmelmann,, Indiana University, Department of Geological Sciences, Bloomington, IN 47405-1405; Maria Mastalerz and John Rupp, Indiana University, Indiana Geological Survey, Bloomington, IN 47405-2208

Gases from the New Albany Shale (Upper Devonian–Lower Mississippian) and Maquoketa Group shales (Ordovician) from Indiana were investigated compositionally and for carbon stable isotope ratios ($\delta^{13}C$ values). The shales were characterized by total organic carbon (TOC) and total nitrogen, $\delta^{13}C_{kerogen}$ and - $\delta^{15}N_{total\ nitrogen}$ values, and petrographic composition of organic matter. Surface area plus micropore and mesopore volumes were also determined and compared to desorbed and residual gas contents. The New Albany Shale was sampled across depth intervals of 410–425 m and 825–851 m in two locations, and TOC content ranges from <1 to 13 wt. percent. New Albany Shale samples range from immature (R_o = 0.55 percent) to mature (R_o = 0.8 percent). The Maquoketa shale contains ~1.3 to 1.6 wt. percent TOC at a depth of 1,305–1,322 m. The total gas content in shales ranges from 0.15 to 2.2 cm^3/g (5 to 70 scf/t) and is strongly correlated with the TOC content, indicating that the organic fraction is dominantly responsible for generation and storage of gas. There is a strong positive correlation between micropore volumes and TOC content, suggesting that micropore volume controls total gas content. There is no consistent relationship between mesopore volume, TOC content, and gas content. The New Albany has a uniform $\delta^{13}C_{TOC}$ value of –29.6‰ (st. dev. 0.3‰, n=37) and the Maquoketa –30.0‰ (st. dev. 0.1‰, n=29). $\delta^{15}N_{total\ nitrogen}$ values for the New Albany and Maquoketa are +1.0 (st. dev. 0.5‰, n=29) and +2.6 (st. dev. 0.2‰, n=29), respectively. Mean elemental $C_{organic}/N_{total}$ ratios in the New Albany and Maquoketa are ~26 and ~18, respectively; higher total nitrogen content in the Maquoketa shale's rock coincides with a higher N_2 content in its gas (average 13 percent versus 4 percent, both n=3). Chemical composition and $\delta^{13}C_{methane}$ values of gases indicate a thermogenic origin of hydrocarbon gases in both New Albany and Maquoketa shales at depth; hydrocarbon gases from a shallower New Albany site resulted from ~1:1 vol:vol mixing of thermogenic and microbial gases.