

**Petrography and Micropore Systems of Mudrocks, Concretions, Nodules, and Ash from Devonian Shales in Highland and Bath Counties, Virginia**

Haynes, John T.<sup>1</sup>; Rose, Timothy R.<sup>2</sup>; Goggin, Keith E.<sup>3</sup>; Whitmeyer, Steven J.<sup>1</sup>; Walker, Seldon M.<sup>1</sup> (1) Geology & Environmental Science, James Madison University, Harrisonburg, VA. (2) Mineral Sciences, Smithsonian Institution, Washington, DC. (3) Sedimentology Group, Weatherford Laboratories, Houston, TX.

Ongoing field mapping and petrographic analyses (SEM, electron microprobe, cathodoluminescope, XRD, and thin sections) of Devonian rocks in the Williamsville 7½' quadrangle in southern Highland and northern Bath Counties, Virginia, has revealed that moderate to extensive microfracture porosity occurs in the phyllosilicates and associated calcareous nodules and concretions throughout the sequence of Devonian black mudrocks. Specifically, these are the Marcellus Shale, the Millboro Shale, the Beaver Dam member of the Needmore Shale, and associated concretions, septarian nodules (Purcell member of the Marcellus), and volcanic ash (Tioga K-bentonite). The black shales are typically fissile where weathered, they are carbonaceous and potassic (illitic), and they contain minor to trace amounts of iron oxides and sulfides, quartz, micas, and plant matter. Microfracture porosity developed as phyllosilicates were squeezed and deformed by differential compaction (e.g., around quartz grains), or were displaced by the growth of authigenic mineral phases (e.g., iron oxides, or pyrite framboids). We have also identified numerous submicron micromoldic or microintraparticle pores that are spherical to cylindrical.

Euhedral barite (as isopachous bladed crystals), euhedral pyrite (as cubes and framboids), and subhedral calcite are present in varying amounts in many calcareous nodules, including some septarian nodules, and associated tabular beds with abundant barite. Microfracture porosity of variable shape exists around most of these authigenic phases. In addition, there is some microintercrystalline porosity also present in several nodules that have an especially dense accumulation of barite crystals.

The Tioga K-bentonite is an altered tephra that now consists primarily of illitic mixed-layer illite/smectite with lesser phenocrysts of quartz and altered mica, and trace amounts of zircon and apatite. Its presence at, or just above, the base of the Marcellus seems to have contributed to development of more extensive fracturing and deformation in several exposures in our study area.

The variable nature of the microporosity has significant implications for the pore systems of these black shales on a more regional scale, particularly in light of the realized and future potential for natural gas production from these units in the Appalachian basin subsurface north and west of the study area.