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TOWARD AN ATLAS OF APPLIED APPALACHIAN BASIN SALINE FLUID HYDROGEOLOGY

William M. Goodman[1] and William M. Kappel[2]
[1]RESPEC, Rochester, New York, USA
[2]U.S. Geological Survey, Ithaca, New York, USA

Abstract

Definition and mapping of confined brine aquifer systems in the northern Appalachian Basin are incomplete-but-critical tasks in support of further successful development of the region's mineral and hydrocarbon resources. Improved mapping of the basin's brine aquifer systems is important for long-term survivability of subsurface dry salt mining operations and to energy companies interested in development of additional salt caverns for storage of natural gas and natural gas liquids derived from the Marcellus and Utica Shales. Further development of the Appalachian Basin's shale gas resources will require increased confidence in current disposal strategies for frac fluids and produced waters. Subsurface disposal in one or more confined brine aquifers continues to offer the potential to manage the current volumes of these types of saline fluids at depths below underground sources of drinking water (USDW) and connected surface waterbodies. The seismicity associated with deep subsurface injection at a Youngstown, Ohio, well has raised the level of community concern over the practice, so a more complete level of geologic characterization during the well permitting process is likely to be required in the future. An indirect benefit of increased characterization requirements may be quantification of brine aquifer permeabilities and identification of one or two zones that can receive large volumes of brine at high flow rates. Whereas the vast majority of frac water and produced water disposal wells function as designed, identification of brine aquifers in the Appalachian Basin that exhibit sufficient transmissivity for high rate disposal of large volumes of waste brine from cavern development has proved challenging.

Applied geoscientists working in the Appalachian Basin on saline fluid disposal problems and/or water risks to dry salt mine operations can benefit considerably from a readily available basin-scale compilation and analysis of brine reservoir and formation water data. Detailed studies already exist for specific parts of the basin, but a considerable amount of formation fluid pressure, major ion and isotope chemistry, and reservoir permeability data remain to be compiled and integrated into basin-scale maps and studies. These research products could lead to identification of highly transmissive, brine-bearing formations in the Appalachian Basin that can serve as disposal zones for waste brines from salt cavern leaching. The search for the high transmissivity disposal zones is likely to focus more attention on the poorly described "up-ramp" and basin-margin brine occurrences as opposed to the low-permeability, basin-center areas where the optimal salt deposits are preserved.

The hydrogeologic map and data compilation envisioned would be organized much like the West Virginia Geological Survey's 1996 *Atlas of Major Appalachian Gas Plays*. Such an "Atlas of Applied Appalachian Basin Saline Fluid Hydrogeology" would contain maps of basin-scale potentiometric surfaces and lateral trends in isotopic signatures, brine strength, major ion chemistry, and permeability for each prospective brine aquifer. An atlas of maps and data on brine-bearing formations generated cooperatively by scientists from industry, government, and academia would well serve the interested industries and host communities.

The Solution Mining Research Institute (SMRI) is an organization with members who may share interest in an Atlas of Applied Appalachian Basin Saline Fluid Hydrogeology. SMRI could serve as a sponsoring agency for an endeavor leading to generation of such a brine aquifer atlas for the Appalachian Basin.

The maps would cover the rock salt and brine-bearing regions of New York; Pennsylvania; West Virginia; Ohio; and southwestern Ontario, Canada.

Key words: brine disposal, disposal wells, geochemistry, Appalachian Basin, New York, Ohio, Ontario, Pennsylvania, solution mining, salt history