Groundwater Quality in Southwestern Pennsylvania with Unconventional Shale Gas Extraction and Legacy Coal Mining

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The Appalachian Basin is historically known for energy resource extraction that has included conventional gas and oil drilling and coal mining. The dramatic increase in unconventional shale gas extraction (USGE) in the region over the past decade has presented new challenges to water resources. A significant portion of the population, especially in rural Pennsylvania, continues to rely on a private well as their sole source of drinking water. In an effort to determine what effect, if any, USGE is having on groundwater quality, we have collected over 1,000 samples of surface and private well water (e.g., groundwater) over the past six years and analyzed them for anions (e.g., bromide, chloride, fluoride, nitrate, nitrite, phosphate, sulfate), cations (e.g., metals), and light hydrocarbons (e.g., methane, ethane, butane, propane). Mass ratio analyses (e.g., Cl/Br, Mg/Li, SO_4/Cl, Ca/Mg, Ca/Sr) were then used to determine water quality and the potential contributions of produced water from conventional and unconventional oil and gas wells and mine drainage. The analysis included data generated from our own samples (e.g., surface and ground water, produced water from conventional and unconventional gas and oil wells, mine drainage) as well as data from the USGS and the PA DEP and other published sources. While there was evidence for brine contributions in some cases, our results indicated that most contaminants in Southwestern PA private water wells near active USGE (e.g., Butler and Washington counties) are most similar to mine drainage.