Révész, K.M., Breen, K.J., Baldassare, A.J., Burruss, R.C., and Gorody, A.W., 2013, Geological and geochemical steps in evaluating compositional and isotope data to identify the origin of combustible gases in groundwater, *in* 10th Applied Isotope Geochemistry Conference (Abstract), Budapest, Hungary.

Abstract

The US has compensated for the decline of conventional natural gas production by accelerating wide spread production from unconventional gas fields. Innovative research is required to understand gas migration to water wells and evaluate the risks to groundwater resources. Our case study illustrates how to evaluate compositional and stable isotope data of both methane and ethane to identify the origin of natural gas dissolved in water supply wells. The investigation, located near Tioga Junction, Tioga County, north-central Pennsylvania, USA, was conducted by the U.S. Geological Survey in cooperation with the Pennsylvania Department of Environmental Protection (PADEP).

First, we identified and analyzed plausible natural gas sources that could potentially contaminate water wells at Tioga Junction to include the following: (1) deep native gas in the Oriskany Sandstone (thermogenic), (2) shallow native gas in Devonian shale bedrock (thermogenic), (3) microbial gas from organic debris (drift gas) in unconsolidated sediments and (4) non-native gas from a gas-storage field (thermogenic). Although gases from the Oriskany Sandstone and the gas-storage field were similar in chemical composition, where methane (CH4) and ethane (C2H6) are predominant, the gases had different stable carbon and hydrogen isotopic compositions.

Second, we investigated the hydrologic and geologic setting where contaminated water wells were located. Groundwater for rural-domestic supply and other uses near Tioga Junction is derived from two aquifer systems in and adjacent to the Tioga River valley. An unconsolidated aquifer of outwash sand and gravel of Quaternary age underlies the main river valley and extends into the valleys of tributaries. Outwash-aquifer wells are seldom deeper than 30 m. The river-valley sediments and uplands adjacent to the valley are underlain by a fractured-bedrock aquifer in sandstones and shales of Devonian age, primarily the Lock Haven Formation. Most bedrock-aquifer wells produce water from the Lock Haven Formation at depths of 76 m or less in upland and valley settings. Water wells with high dissolved methane concentrations occurred in clusters along the flank of an anticline and near a gas-storage field along the anticline axis.

Third, 35 out of 91 sampled water wells had measurable dissolved natural gas concentrations which we extracted and analyzed. Results showed that the □ 13C and □2 H values of methane in water samples from 14 wells reflected a microbial origin, while the composition of the other 21 wells was thermogenic (Figure 1). The C and H stable isotope ratios of methane and ethane in thermogenic gases from water wells either matched or were intermediate between samples of non-native storage-field gas from injection wells and gas samples from storage-field observation wells indicating, that the thermogenic gas in water wells is coming from the Tioga Gas-Storage Field.