# GEOLOGY AND GEOGRAPHY

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## ABSTRACTS

**Ground-water Modeling of Small Watersheds in the Coal-mining Region of Southwestern Indiana.** Richard F. Duwelius, U.S. Geological Survey, Water Resources Division, Indianapolis, Indiana 46254.——Ground-water flow in four small watersheds in southwestern Indiana was simulated using a modular finite-difference model as part of a coal hydrology study done by the U.S. Geological Survey. One reclaimed mine, one unreclaimed mine, and two unmined agricultural areas were modeled. Model layers were constructed to simulate flow in the entire sequence of rocks between hydraulically "tight" underclays beneath major coal seams.

The models confirm the low hydraulic conductivities of the unconsolidated glacial till and Pennsylvanian bedrock. Calibrated conductivity values, which are higher than field-measured values, indicate preferential flow in areas of higher transmissivity or along fractures and bedding planes not intersected by the test wells. Underclays separate flow systems in each watershed. Shallow flow systems discharge to smaller streams while flow in the deeper bedrock follows regional patterns and discharges to major surface drains, such as the Wabash and Eel Rivers. The models indicate that coal mining can triple recharge rates and horizontal and vertical conductivities, deepen flow paths, and alter surface drainage within small watersheds.

**Sulfur Isotope Ratios in Indiana Sulfide Minerals.** W.S. Gaddis and N.R. Shaffer, Indiana Geological Survey, Bloomington, Indiana 47405.——Sulfur isotope ratios were determined for more than 100 secondary Mississippi Valley-type sulfides collected from geodes, vugs, and joints in Mississippian, Devonian, and Silurian carbonate rocks throughout Indiana to understand the origin of the sulfur. One possible origin of the sulfides is that hydrothermal water containing sulfur with $\delta^{34}S$ of 0°/oo rose through faults such as the Mt. Carmel Fault, permeated carbonate formations, and deposited secondary sulfide minerals. If true, then sulfides in geodes and joints near the fault system should have sulfur ratios near 0°/oo, and values should change away from the fault as the hydrothermal water interacted with ground water with positive $\delta^{34}S$ values.

Sulfur isotope values range from +29.8 to −26.5°/oo (average −4.6°/oo) but do not show patterns associated with faults. Sulfur in pyrite (average +4.3°/oo) and in sphalerite from joint fills (average +6.9°/oo) tend to have more positive isotope ratios. From this evidence it seems unlikely that faults and fractures were pathways for hydrothermal sulfur-bearing fluids.

**Examination of a Popular Belief: Is There a Relationship Between Winter and Summer Temperatures?** WILLIAM A. GUSTIN, ISU Climatology Laboratory, Department of Geography/Geology, Indiana State University, Terre Haute, Indiana 47809.——In order to examine the widely-held notion that the weather of one season is a predictor of the next, monthly average temperature data were used to establish 30-year normal values for the Terre Haute 8S reporting station. The period of December through February was classified as being the 'winter' season, and that of June through August represented the 'summer' season. An attempt was made to ascertain the strength of the relationship between summer and winter temperatures, if any existed. First, the relationship of a preceding summer to the temperatures of the following winter were analyzed. Likewise, the relationship of the temperatures of a preceding winter season was analyzed in respect to its efect on a following summer season. These analyses were accomplished by calculating the monthly and seasonal derivations from the calculated 30-year normals. The deviations were used to determine 'r' values, which show the degree of correlation between an independent and a dependent variable. Initial tests of the data indicate a low degree of correlation, although some data subsets show some stronger elements of correlation.

**An Estimate of Indiana's Coal Reserves that Comply with Current Sulfur Dioxide Emission Standards.** WALTER A. HASENMUELLER, LOUIS V. MILLER AND JIMMY J. JOHNSON, Indiana Geological Survey, Bloomington, Indiana 47405.——Current clean-air standards limit emissions from coal-fired electric utilities to a maximum of 1.2 pounds of sulfur dioxide per million Btu heat input. We selected the 920 complete channel samples of Indiana coal seams with known reserves from the Indiana Geological Survey's Coal Analysis Data Base to compute the pounds of sulfur dioxide per million Btu for each of these samples. The computed values of pounds of sulfur dioxide per million Btu have a range of 34.0 pounds and a mean of 5.6 pounds; 4.2 percent of the computed values are at or below the 1.2-pound standard. We used recent reserve estimates to weight each computed value with the fraction of the total Indiana reserve that it represents. These weighted values were then used to construct a cumulative curve of pounds of sulfur dioxide per million Btu versus total coal reserves. The curve indicates that about 461 million tons, or 2.8 percent of Indiana's 17.5 billion tons of coal reserves, are at or below the 1.2-pound standard.