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Sampling the Fox Hills-Lower Hell Creek Aquifer in Eastern Montana for Environmental Isotopes

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The use of environmental isotopes to improve our understanding of ground-water flow rates and recharge in regional ground-water flow systems is being evaluated as part of the ground-water characterization study that the Montana Bureau of Mines and Geology is conducting in eastern Montana. The isotopes being evaluated are carbon-14, carbon-13, tritium, deuterium and oxygen-18. Nine ground-water samples have been collected along two transects that follow flow paths in the Fox Hills-lower Hell Creek aquifer in eastern Montana. The sampling procedure for tritium, deuterium and oxygen-18 is straightforward and simply requires filling appropriately-sized sample bottles with representative water samples. However, sampling ground water for carbon-14 and carbon-13 requires special field treatment with precautions to avoid contamination from atmospheric CO_2. A practical method for direct precipitation of dissolved inorganic carbon from ground-water samples was devised following the procedure outlined by Dutton (1994). Ground-water samples were collected in 6-gallon (23-L) glass carboys and treated with ammonium hydroxide that was saturated with barium chloride. Inorganic carbon in the sample was precipitated as barium carbonate. At least 1 gram of carbon is required to perform the carbon-14 analysis. The alkalinity concentrations of the ground-water samples ranged from 500 to 1,255 mg/L as $CaCO_3$, indicating that there was ample carbon in the samples. After sufficient settling time the carboys were placed on a modified hand truck and inverted. The precipitate was collected in glass Mason jars which were attached to the carboy by means of a special transfer valve. Two relatively small jars of precipitate slurry were recovered from the 12 gallons (46 L) of sample collected at each well, and were then shipped to the laboratory. The method proved fast and efficient, easily allowing two people to sample 2 to 3 wells a day. Preliminary results from the isotopic analyses will be discussed if available at the time of the meeting.