

Revisiting the Milk River Aquifer with novel tracers

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The Milk River aquifer in southern Alberta, Canada, was selected about 30 years ago for an IAEA coordinated international project that was aimed at evaluating all isotope techniques available at that time for dating old groundwater. Analyses were carried out for halides and other major and trace elements, stable isotopes (²H, ³He, ⁴He, ¹³C, ¹⁸O) and radioactive isotopes (²²²Rn, ⁸⁵Kr, ³⁷Ar, ³⁹Ar, ¹⁴C, ⁸¹Kr, ³⁶Cl, ¹²⁹I, ²³⁴U, ²³⁸U). The extensive tracer data brought valuable insights but also revealed limitations of the applied methods for dating groundwater having residence times from hundreds of years up to possibly a million years. Gradual increases in apparent age along two flow paths over relatively short distances was qualitatively confirmed by most methods. However, the effects of secondary processes prevented a definitive determination of the absolute time scale. The ongoing project reinvestigates the age structures of the Milk River Aquifer using ⁸¹Kr covering the broad area down gradient of the Milk River where low radiocarbon activities were reported in the previous studies. With a goal of accurately interpreting the multi-tracer data in the context of a dual porosity system, we will review existing data from the literatures and present the framework of geochemical and hydrologic models simulating the solute contribution to the groundwater flow from different geometries of low porosity zones. Preliminary ⁸¹Kr data may be presented if available. This work is supported by the NSF Hydrologic Sciences program, Award #2114036.