DeFord Lecture
Jennifer McIntosh, University of Arizona

Title: Evolution of earth's deep terrestrial water cycle over geologic timescales

Abstract: Over 97% of groundwater is sub-modern, poorly constrained beyond radiocarbon dating, and is weakly connected to the rest of the hydrological cycle. Million- to billion-year old groundwater and associated microbial life has been discovered at kilometers depth in the Earth's crust, deepening our perspective on the timescales and extent of the terrestrial water cycle and subsurface biosphere. Scarce insights into Earth's subsurface architecture, such as permeability distribution, fluid composition, and groundwater residence time, primarily come from spatially-disparate sampling locations, depths, and industries (e.g., water resources management; ore deposits; hydrocarbon production; anthropogenic waste isolation). Records of fluid-rock reactions indicate crustal permeability is dynamic over geologic timescales and paleofluid flow was likely episodic. This presentation focuses on our recent geochemical and hydrologic results of fluids in sedimentary basins (e.g., Paradox Basin of Colorado Plateau) and crystalline shield environments to provide insights into mechanisms and extent of meteoric water infiltration, retention, and flushing of fluids through the Earth's deep crust to Critical Zone. Application of novel age tracers help constrain 'intermediate age' (50 ka-1.4 Ma) groundwater that represent critical interfaces between the familiar near-surface hydrologic cycle and older, often 'hidden hydrogeosphere' at depth.