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A Fluid Flow Model for Sediment Hosted Pb-Zn Ore Genesis in the McArthur Basin, Northern Australia

Numerical models permit comparison and testing of conceptual models for fluid migration and ore genesis. Simulations are presented here as part of a paleohydrologic study of the McArthur Basin, host to HYC ('Here's Your Chance') and other stratiform ore deposits that are thought to have formed near the seafloor in a hydrothermal 'sedimentary exhalative' (a.k.a. SEDEX) environment. For example, hydrogeologic simulations for the southern McArthur Basin have been constructed to characterize the plumbing system during syn-sedimentary mineralization in the Barney Creek Formation (1640 Ma). Our hydrogeologic profile extends about 150 km SW-NE across the Batten Trough near HYC and the stratigraphy is based on the interpretation of regional geophysics and geologic mapping. The flow system is assumed to be at steady-state, in a submarine environment, and fluid migration is driven only by density-driven free convection. Seawater recharges the basin subsurface across the entire Batten Trough, although at depth the pore fluids seep slowly (flow rates q< 0.1 cm/yr) across the McArthur Group, until they reach the oxidized Upper Tawallah Aquifer where metal concentrations increase and the brines are driven more quickly (q~ 10 cm/yr) toward the Emu Fault. The model predicts that about 250 m3/yr-m of fluid migrates through the basin annually, all of it rising up the Emu Fault at Darcy flow rates q~ 70 cm/yr. Structural focusing of fluid flow results in nearly isothermal temperatures of 120 oC in the upper 1 km of the Emu Fault. Other numerical experiments show that a high-permeability Tawallah Fault zone on the western side of the Batten Trough acts mainly as a conduit for sinking (recharge) fluids.