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Log Interpretation of Sedimentary and Stratigraphic Controls on Sandstone Uranium Mineralization

Uranium mineralization in sandstone results from complex interactions among geologic, hydrologic, and chemical variables. Many of these interactions are poorly understood, but simple associations can be identified among these variables which, when evaluated in the proper context, are useful in uranium exploration.

Examination of roll-front uranium mineralization at the Highland Mine, Converse County, Wyoming reveals a close association between stratigraphic and sedimentary features (intrepreted from SP and resistivity logs) and both regional and local mineralization patterns. Measurements made across the fluvially derived Highland host rocks demonstrate that the most favorable strata for mineralization: 1) possess channel/interchannel sand/shale values of 0.8:1 to 1.7:1, 2) occupy transitional zones between higher permeability, updip sediments and lower permeability, downdip sediments, 3) have relatively thick (average =10m), laterally continuous sands, and 4) have low (average 1° to 3°) basinward dips. Channel sands contained within these strata are favored sites for uranium mineralization due to: 1) concentration of groundwater flow into them, 2) presence of numerous, small-scale barriers within them, and 3) greater exposure of these waters to uranium precipitants (principally organically derived reductants) contained therein. Mineralization is localized in relatively high-permeability portions of the channel sands,

Earth Science Bulletin, 1982

immediately updip from reduced permeability zones where the intrachannel shale percent (SP-defined) increases by a factor of 1.2X or more. The chemically mobile uranium minerals at Highland remain fixed in place only as long as the reductants are viable. Once the reductant is depleted, these minerals will migrate to a new site where both sedimentary and geochemical conditions are favorable for re-precipitation.