# Fluid Flow and Reactive Mass Transport Modeling of Ore Genesis in Sedimentary Basins: Example of Unconformity-Related Uranium Deposits

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To help understand the formation of unconformity-related uranium deposits, and in particular to address possible reducing mechanisms in the precipitation of uraninite, a highly conceptualized 2-D model is developed that fully couples fluid flow and heat transfer with reactive mass transport. A series of numerical scenarios are investigated using TOUGHREACT to examine the effect of graphite zone and Fe-rich chlorite as the reducing agents on the ore genesis. It is revealed that both the reducing mechanisms can lead to the precipitation of uraninite below the unconformity and away from the faulted zone. Formation of the deposit is likely in relation to the decrease of oxygen fugacity, generally resulting from the interaction of oxidized uranium-bearing fluids with the reductants, and the locale of deposit appears to be controlled by a dominant downwelling convective flow and the resultant temperature regime. Uraninites precipitate simultaneously with hematite in the areas experiencing the reduction of oxygen fugacity and having a temperature of 180-200°C and a pH of 2.5-4.5. Wide-spread alteration halos in the basement and around the deposit include hematite, chlorite and muscovite accompanied by minor amounts of pyrite and K-feldspar alteration. These numerical results have important geological and exploration implications.