The Formation of Granite-Type Uranium Deposits in South China: Insights from Hydrodynamic and Chemical Modelling

Zenghua Li[1], Teng Deng[1], Deru Xu[1]
[1]East China University Of Technology, Nanchang, China

A large number of granite-hosted hydrothermal uranium deposits formed in South China between the Cretaceous and Paleogene periods. These deposits are primarily controlled by fracture zones within the granites and show a spatial association with nearby red bed rift basins and contemporaneous mafic dykes. However, it remains unclear how such deposits are formed under a consistent hydrodynamic framework. Two-dimensional simulations of fluid flow, coupled with rock deformation and heat transfer, were carried out to investigate the mechanisms driving fluid movement related to uranium mineralization under different thermo-mechanical conditions. The modelling results reveal that extensional deformation greatly promotes the deep penetration of oxidizing fluids, and the presence of a deep magmatic heat source encourages the formation of convection cells within the granites despite their relatively low permeability. Modelling results also indicate that the pre-existing NE- and NNE-trending faults provided favorable mineralization space for the dilational zones developed during extensional tectonic movement. Mineralogical, isotopic and chemical modelling indicates that pyrite, hematite and uranium minerals can be co-precipitated from the same ore-forming fluid, and the driving factor of uranium mineralization is due to the increase in pH value caused by water-rock reaction, the decrease in oxygen fugacity. The extensive granite-hosted uranium mineralization in South China likely stems from multiple forms of fluid flow governed by coupled shallow and deep geological processes within an overall extensional tectonic setting.