Petrogenesis of the Guposhan granitic complex, south China

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Most Mesozoic granitic complex from south China consists of predominant intrusions and late-stage, supplementary intrusions (volumetrically much smaller than the former). Traditionally, supplementary intrusions were considered to be residual melts through fractionation of the predominant intrusions. We choose to study a typical granite complex, the Guposhan pluton, and propose a different model for its origin. The predominant intrusions of the Guposhan complex are the Wanggao biotite monzogranite/ syenogranite, the Lisong hornblende biotite monzogranite and the Xinlu biotite monzogranite. They are intruded by the late-stage, supplementary Baishuidai syenogranite. One sample from the supplementary granite is chosen for zircon La-ICP-MS U-Pb dating, and yields a concordant age of 155.3±1.5Ma, which is significantly younger than the predominant granites (162 Ma) of the Guposhan complex. In the plots of SiO_2 versus other major oxides and trace elements, the data points of the predominant and supplementary granites show different evolutionary trends, and compositional gaps are visible between the two phases, especially in the plots of Fe_2O_3 、P_2O_5、TiO_2、Sr、Ba versus SiO_2. Trace element modeling using Rb-Ba and Sr-Ba co-variations suggests that the supplementary phase is unlikely to be the derivative from the predominant granites via fractionation. So we conclude that the supplementary granite formed through a new partial melting event related to an extensional regime. The supplementary granite is a typical A-type granite, having high SiO_2, alkaline, HFSE contents as well as high Ga/Al and Fe/Mg ratios, and is extremely depleted in Ba, Sr, P, and Ti. The predominant phases of the Guposhan complex probably have formed through a process of magma mixing between dominantly crustal melts and minor mantle-derived magmas, as is suggested by the presence of micro mafic enclaves, and by the significantly varied Nd isotopic compositions, with εNd(t)=-6.0 to -3.7 (predominant intrusions) and -5.6 to -3.4 (supplementary intrusions). The trace elements and Nd isotopic data suggest that the basement rocks (major source rocks for the Guposhan complex) should be dominated by paleoproterozoic orthometamorphic rocks. We suggest that the flat subduction of the Pacific slab and subsequent break-off and rollback have triggered the extension of the lithosphere in the mid- to late Jurassic. Asthenospheric upwelling and basaltic underplating played an important role in causing the partial melting of the basement rocks in South China.

Oxidative Dissolution of Uraninite in the Presence of Manganese Oxide

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Manganese is present at appreciable concentrations at several U-contaminated sites, and coupling of the biogeochemical cycles of U and Mn may affect the fate and transport of uranium. The long-term stability of U(IV) species produced in the subsurface during *in situ* bioremediation can potentially be limited by reoxidation to more mobile U(VI) species. Manganese oxide (MnO_2), which can be produced biologically even at low dissolved oxygen concentration, can act as a powerful oxidant that accelerates the oxidative dissolution of UO_2. Laboratory studies have been performed to investigate the physical and chemical factors controlling the interaction between UO_2 and MnO_2.

Because both MnO_2 and UO_2 are insoluble at environmentally relevant conditions, the degree to which physical contact was necessary for UO_2 oxidation was unknown. A well-mixed multi-chamber reactor with a permeable membrane was used to eliminate direct contact of the two minerals while still allowing transport of aqueous species. The oxidation of UO_2 was not significantly enhanced if MnO_2 was physically separated. Complete mixing of MnO_2 with UO_2 lead to a much greater extent and rate of U oxidation. It suggests that effective redox reactions between UO_2 and MnO_2 may require physical contact or close proximity. We hypothesize that dispersion and colloid migration of U(IV) species, and the spatial dynamics of biological Mn oxidation are critical factors in assessing the impact of coupled U-Mn biogeochemical processes on U stability in the subsurface.

Continuous stirred-tank reactors (CSTR) were used to quantitatively examine the rates of MnO_2-mediated UO_2 dissolution and the effects of chemical factors (mixing ratio and carbonate concentration). MnO_2 dramatically promoted the UO_2 dissolution at steady states, but the degree of promotion leveled off when the MnO_2:UO_2 ratio exceeded a certain value. UO_2 oxidation by MnO_2 was faster at higher carbonate concentrations. Substantial amounts of U(VI) were retained on MnO_2 surfaces through adsorption. The amounts of U(VI) adsorbed on MnO_2 were inversely related to UO_2 dissolution rates, suggesting that the U(VI) product could passivate MnO_2 surfaces. The release of Mn into the effluent was less than that of U, indicating that the fate of Mn and the changes of its oxidation states were more complex than previously anticipated. Based on the fundamental understandings of grain-to-grain contact, electron transfer, and surface speciation, a conceptual model was proposed to predict the oxidation rate of UO_2 by MnO_2. The model is applicable to broader water chemistry conditions and may be relevant to other redox processes involving two poorly soluble minerals.