

Rate kinetics of synchrotron radiation-induced radiolysis of Fe²⁺ and Fe³⁺ ions in aqueous solutions to 500 °C

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Ionizing radiation causes radiolysis of water producing species such as H, OH[•], H⁺, OH⁻ and hydrated electrons, e_{aq}⁻. These transient species induce reactions that modify the chemical properties of aqueous fluids. To date, there is insufficient experimental data on aqueous systems under extreme radiation and temperature conditions to theoretically model and control water chemistry to limit corrosion of supercritical-water-cooled reactors. In order to better understand how the transient radiolysis species react with the Fe²⁺ ion, *in situ* Fe *K*-edge energy-dispersive XAS measurements (to 1.0 s resolution per spectrum) were made on 0.4 and 0.8M Fe (II)Cl₂ aqueous solutions to 500 °C using the hydrothermal diamond anvil cell at beam line ID24 at the European Synchrotron Research Facility (ESRF). Up to 100 time-resolved XAS spectra were acquired from the solutions at temperatures ranging from 300 to 500 °C and photon energies ranging approximately from 7.07 to 7.29 keV, at an incident flux of ~1 x 10¹³ photons/s. The Fe *K*-edge energy (E₀) was determined by fitting Lorentzian peak-curves to the derivative of each spectrum. The time-resolved E₀ data can be fit most accurately using second-order exponential decay curves. Our results show that the radiolytic reactions lead to oxidation of the Fe²⁺ ion at 300 °C whereas radiolysis results in reduction of the Fe³⁺ ion at temperatures between 400–500 °C. These trends are highly consistent making reliable determinations of reaction kinetics possible. The results from this study may be used to predict the kinetics of reactions that might occur in irradiated fluids that are in contact with steel components of the primary cooling loop of a supercritical-water-cooled nuclear reactor, and to help devise more reliable methods of making x-ray spectroscopic measurements of iron and other metallic species in hydrothermal fluids.

Application of irregular soil geochemistry survey side of gully to prospect in the Puqing antimony - gold exploration area deposit, Guizhou, China

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Exploration area located in the northwest of Dachang antimony-gold ore field which a well-known large-scale mineral deposit in china, attitude of stratum 8~10°, subtropical landscape area in the region. Traditional geochemical prospecting methods are not suitable for this area.

Successfully tested the method on the basis of sampling media, depth and concentration, with applying 1:25, 000 irregular soil geochemistry survey side of gully to mine searching. Upper part of illuvial horizon soil of side of fine gully for sampling layer, rough machining 20~40 mesh fraction of samples. Combination of long-profile method and frequency of statistical method to determine thresholds of Au, Sb and As to determine are 7ppb, 10ppm, and 30ppm respectively. some valuable abnormal areas have been found. Combined with the ore-controlling factors including strata and lithologic character, comprehensive consideration of the main ore element anomalies and ore-forming elements association, 4 key targets are selected. Ore-prospecting results significantly through surface work confirmed.

This prospecting method has strong operational and adaptability in subtropical landscape areas of Guizhou province. Prospecting target can be found quickly, economical and effectively for prospecting inclining metal mine near surface. Weak anomalies of ore-forming elements and its association, such as 10~20ppm of Sb, 30~60 ppm of As and 0.5~0.8 of As-Sb-Hg-Au association (based on STATISTICA software), are very important to geological prospecting exploration for the periphery of old antimony deposit.

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