

High precision Os isotope ratio measurements on sub pg sample sizes using N-TIMS and multi ion counting detectors

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The ^{187}Re to ^{187}Os system gives information on the formation of planetary interiors because both elements have siderophile characters. For the Re-Os isotope systematics precise measurements of the $^{187}\text{Os}/^{188}\text{Os}$ isotope ratio are the major target. Analytical methods need to be sensitive and accurate because the abundances of Re and Os are very low in the ng/g range or even in the pg/g range and variations of the $^{187}\text{Os}/^{188}\text{Os}$ in silicate rocks are in the range of <1%. For negative thermal ionization mass spectrometry ionization efficiencies in the range of 10%-20% can be achieved, thus making TIMS the ideal analytical technology for high precision Os isotope ratio measurements of extremely small samples.

Because of the small sample sizes the use of ion counting detectors is the only possibility because the noise level of Faraday cup detectors is too high to achieve the necessary precision and accuracy on sub pg sample sizes. Today most instruments just use single collector peak jumping on the ion counting detector. In this study we evaluate the performance of an improved multi ion counting setup for Os isotope ratio measurements on ultra small samples. The attainable precision and accuracy will be discussed and a comparison to single collector peak jumping data will be given.

Geochemical monitoring of calcite precipitation during CO₂ injection into the Ogachi hot dry rock site

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Field experiments of CO₂ sequestration into the Ogachi hot dry rock site (HDR; the temperature is 200°C at 950m depth) have been performed for 3 years to investigate mineralization of a part of CO₂ as carbonates by interaction with rocks (Georeactor; Ca extraction from rocks and carbonate fixation). In 2008, two types of experiments were done; Test1 is that groundwater (EC=150 mS/m and 10m³ in volume) with tracer was injected into OGC-2 well to study the behavior of the fluid in the well. This result shows the fluid in the well can be replaced by reservoir fluid (EC=150 mS/m) within 5 days. Then, CO₂ dissolved groundwater (0.8 wt%CO₂) with tracer was injected (Test 2). These field experimental conditions were determined from the previous results at Ogachi, and laboratory experimental data on CO₂-water-rock interaction and their geochemical and reservoir simulations. Water samples are collected at the depth of 950m by a sampler (500ml in volume) and monitored for their chemical and isotopic compositions.

During the field experiments, dissolution or precipitation rates of calcite were determined by using a technique of "in situ analyses". Calcite crystals covered with Au film is hold in a crystal cell and set in a crystal sonde. The crystal sonde is then put into OGC-2 and water samples at the certain depth is introduced into the sonde. After 3 hour, the sonde is recovered and the calcite crystal is observed by a newly developed phase shift interferometer to analyze the dissolution or precipitation rates of calcite from the well fluids. The "in situ analyses" show that calcite precipitation was observed within 2 day after the injection. These data with the laboratory experiments and geochemical simulation results show a part of CO₂ injected above 150 degree C can be fixed as carbonate within a week and the saturation degree with respect to carbonate increases with decreasing CO₂ content.