

Development of *in situ* U-Pb analysis of uranium oxides using an ion microprobe

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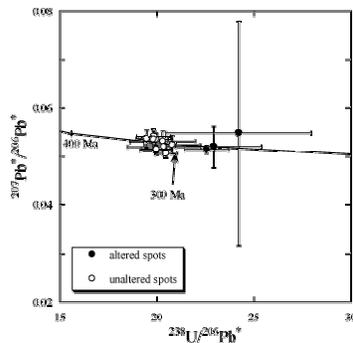
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The chronological study of uranium minerals provides practical information on the formation of uranium deposits as well as elemental transportation in association with the alteration of uranium minerals. Moreover, the timing of uranium mineralization from the Archean to the Paleoproterozoic period is a good indicator of atmospheric oxygen evolution, because uranium is only mobilized as a uranyl ion (UO₂²⁺) under oxidizing conditions (e.g., Holland, 1984). However there are some issues to estimate the ²⁰⁶Pb/²³⁸U age from SIMS analysis such as large variation of the ionization efficiency of secondary ions and standard material. In this study, we established a method for the *in situ* U-Pb isotopic analysis of uranium minerals in a similar manner to the conventional zircon analysis.

The Faraday mine uraninite from Bancroft, Canada was used as a standard material for the U-Pb calibration of three uranium minerals from Chardon, Ecarpière (the Armorica Massif, France) and Mistamisk (Labador, Canada). Quantitative analysis of major elements was carried out by EPMA. *In situ* U-Pb analyses of uranium minerals were performed by using a SHRIMP at Hiroshima Univ.

The calibrated SHRIMP ²⁰⁶Pb*/²³⁸U ratios of three uranium minerals from Chardon, Ecarpière and Mistamisk show a good correlation with Pb/U elemental ratios obtained from EPMA, which indicates the reliability of the SHRIMP calibration in this study. The SHRIMP ²⁰⁶Pb*/²³⁸U data of Ecarpière (285 Ma) and Mistamisk (1729 and 421 Ma) uraninite are consistent with previous chronological data obtained by TIMS. As shown in Figure, the selected SHRIMP data of the Chardon mine provide a ²⁰⁶Pb*/²³⁸U age of 313 Ma, which is older than the previously reported age of 264 Ma. Considering that the analytical spots were selected to avoid impure minerals and altered phases, which were probably formed by later processes, it is interpreted that the Chardon uraninite was crystallized by the remobilization of U during the cooling of the Mortagne granite (310-313 Ma).



Reference

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Calcite-water oxygen isotope fractionation at elevated temperatures: Experimental and theoretical study on the effect of pressure and dissolved NaCl

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We have conducted an experimental and theoretical study for investigating the effect of pressure and dissolved NaCl on oxygen isotope fractionation in the system calcite – water at elevated temperatures. First, our novel corresponding state principles approach for calculating the effect of pressure (density) on the reduced partition function ratio (RPF) of H₂¹⁸O (Polyakov *et al.*, 2007) shows that the RPF increases up to 1.0 ‰ with increasing pressure to 1 kb at 273-523°C. The RPF of CaCO₃ increases only slightly, thus the oxygen isotope fractionation of the system CaCO₃-water decreases up to 1.0 ‰ at 1 kb.

Our calculations of oxygen isotope fractionation factor between CaCO₃ and pure water are significantly (up to 2 ‰) lower than experimental values between CaCO₃ and calcite-saturated water at 300-750°C at 1 kb (this study) and 15 kb (Hu and Clayton, 2003). The cause of this discrepancy is due most likely to either errors in the calculation of ideal-gas RPF of H₂¹⁸O in the literature or the effect of dissolved CaCO₃ at elevated temperatures and pressures (Hu and Clayton, 2003). The effect of dissolved NaCl, ≤5m at 300-700°C and 1 kb (this study) and ≤37m at 300-750°C and 15 kb (Hu and Clayton, 2003), is found to be small (≤0.5 ‰).

It is very likely that pressure and dissolved CaCO₃ decrease and increase the calcite-water oxygen isotope fractionation at low and high pressures, respectively. In contrast, dissolved NaCl appears to have a small effect. However, the available data are still sketchy, and we have just begun to quantify the effects of these important variables for mineral-water isotope fractionation at elevated temperatures.

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References

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