Evaluation of the acid-leaching technique for high-precision Pb–Pb dating of meteorite pyroxenes

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Precise and accurate chronological information on meteorites is essential to decode the early evolution of our solar system. The U–Pb system offers high-precision chronometer because of having two decay chains. For early solar system chronology, the U–Pb chronometer has been applied to meteorite pyroxenes and U-enriched accessory minerals such as zircon and apatite. Because pyroxenes contain U and radiogenic Pb with significantly lower abundances as compared to the accessory minerals, high-precision pyroxene Pb–Pb dating requires efficent removal of non-radiogenic Pb before isotopic analysis and this has been achieved by sequential leaching in acids such as HNO_3, HCl, HF and HBr [e.g., 1–3]. Yet, it is not well understood how non-radiogenic Pb components are removed during the acid-leaching: what materials and elements are eluted in each leaching step. In addition, it has been recently indicated that certain methods of acid-leaching can cause measurable isotope Pb fractionation, which leads to inaccurate Pb–Pb dating [4]. For establishing a robust acid-leaching method, it is essential to understand what is going on during each acid-leaching step.

In this study, we have investigated the change of pyroxene texture during several acid-leaching with HNO_3, HCl, HF and HBr using secondary electron imaging. We found that there is little difference in pyroxenes texture between before and after acid-leaching when applying 0.5–6M HNO_3, 6M HCl, 9M HBr. By contrast, pyroxenes are partially and heterogeneously dissolved when using 1M HF at 110 ˚C. These observations suggest that non-radiogenic Pb components are removed from the surface of or cracks within pyroxenes during the acid-leaching with HNO_3, HCl, and HBr, whereas the treatment with 1M HF causes elution of Pb from pyroxenes themselves. In the presentation, we will report the results of chemical analysis of acid-leachates and discuss what materials are eluted during each acid-leaching step.

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