# The promise and potential pitfalls of acid leaching for Pb-Pb chronology

KENGO ITO[1] AND TSUYOSHI IIZUKA[1]

[1] Department of Earth and Planetary Science, University of Tokyo, Hongo 7-3-1, Bunkyo, Tokyo 113-0033, Japan

Precise and accurate chronological information on ancient materials (meteorites and Archean crust) is essential to decode the early evolution of our solar and Earth system. The U–Pb system offers a high-precision chronometer because of having two decay chains. Pyroxenes have been extensively applied for reliable meteorite Pb–Pb dating. Because of its low U concentrations (~ 10-100 ppb), reducing the level of non-radiogenic Pb in pyroxene sample is essential for precise determination of its Pb–Pb age. To remove contaminant Pb and phases enriched in initial Pb, acid leaching technique has been widely used. Although the results provide indicate the utility of acid leaching with $HNO_3$, HCl, HF and HBr [e.g., 1–3], the detailed mechanism of the radiogenic Pb separation remains elusive. In addition, it has been recently shown that certain methods of acid-leaching can cause measurable Pb isotope 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 dissolution process of non-radiogenic Pb from pyroxene fractions by combining SEM observation of acid-washed minerals and ICP-MS analysis of chemical leachates. The combined results reveal the resistance of minerals to acid treatments with $HNO_3$, HCl, and HF. We show that (i) washing with dilute acids can efficiently liberate contaminant terrestrial Pb adsorbed on the mineral surface; (ii) hot and more concentrated (~6 M) $HNO_3$ and HCl can separate pyroxenes from sulfides and anorthitic plagioclase that are highly enriched in initial non-radiogenic Pb; (iii) albitic plagioclase and pyroxenes show limited dissolution during the $HNO_3$ and HCl treatments, but are progressively leached by hot 1 M HF, making it difficult to separate them from each other; and (iv) within single pyroxene grains having exsolved lamellar textures, high-Ca lamellae are more efficiently leached by the HF treatment than low-Ca ones. We demonstrate that this heterogeneous and incomplete dissolution of pyroxene lamellae with dilute HF can result in inaccurate Pb-Pb age estimates. Currently, we are extending the application of the acid-leaching technique to Ti-bearing minerals such as sphene and ilmenite for high-precision Pb-Pb chronology.

[1] Amelin et al. (2002) *Science* 297, 1678–1683. [2] Bouvier et al. (2005) *Earth Planet. Sci. Lett.* 240, 221–233. [3] Connelly and Bizzarro (2009) *Chem. Geol.* 259, 143–151. [4] Amelin et al. (2010) *Earth Planet. Sci. Lett.* 300, 343–350.