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UV laser ablation continuous flow mass spectrometry for in-situ oxygen isotopic ratio analysis of minerals in meteorites

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Meteorites provide direct information about the process of the formation of the solar system. In order to reveal the formation process of the primitive solar system, it is extremely important to analyze O-isotopic ratios of meteorites. Almost all meteorites are aggregation of microscopic silicate minerals, therefore the method of high-precision analysis of O-isotopic ratios of silicates must be established. In this study, we aim the development of the high-precision analytical method by the combination of the UV laser ablation of microscopic silicates in pure fluorine gas and the continuous flow mass spectrometry.

In this study, an ArF excimer laser (193 nm) is used for ablation of surfaces of samples and the spatial resolution is ~50 micron. A conventional triple-collector mass spectrometry is used for detection of signals, so the analytical precision of oxygen isotopic ratios are expected within 0.5 permil. The spatial resolution of this analytical method is close to that of SIMS, and the precision is close to conventional stable isotope mass spectrometry. Moreover, it is possible to carry out in-situ analysis of O-isotopic ratios.

O-isotopic ratios of each mineral in a single sample and the isotopic fluctuation within a single mineral can be analyzed using this method. Moreover, we expect to obtain clues to the origin of 16O-rich chondrules, the contribution of CAIs to chondrule precursors, and the relationship between chondrules and CAIs using this analytical method. The UV laser ablation continuous flow mass spectrometry will greatly contribute to the planetary material science.