Development of a K-Ar dating instrument for future in-situ dating on planetary surface

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"Crater chronology" is often used to estimate the timing of geologic events. Absolute age determination relies on the correlation between crater number density and age (chronology function). Determining the shape of the chronology function is important not only for determining an accurate age, but also for understanding the temporal variation of the impact flux to the Earth-Moon system. In-situ age measurements and/or sample-return mission(s) are crucial to resolving this problem. We have been developing an in-situ dating method using K-Ar system for future planetary landing missions on the Moon or Mars. The K-Ar dating method employs a radiometric decay of 40K into 40Ar with a 1.25 Gyr half-life. Our system measures the abundance of K and Ar at the same laser irradiation spot on a sample using two techniques: laser-induced breakdown spectroscopy (LIBS), and quadrupole mass spectrometer (QMS). Potassium and argon are extracted from a sample simultaneously by a laser ablation in which the sample is vaporized by a series of intense (> 1GW/cm2) laser pulses. Our in-situ K-Ar dating instrument enabled us to obtain the model ages of three previously measured samples with known K concentrations and ages: 2.1±0.3 Ga for a hornblende (K2O=1.12 wt%, 1.75 Ga), 1.8±0.2 Ga for a biotite (K2O=8.44 wt%, 1.79 Ga), and 2.0±0.3 Ga for a plagioclase (K2O=1.42 wt%, 1.77 Ga).

Yuichiro Cho is a doctoral student at The University of Tokyo, Japan. He completed his master's degree in the Department of Earth and Planetary Science at The University of Tokyo in 2011. His master thesis work involved building an in-situ K-Ar dating instrument with funding from the Japan Aerospace Exploration Agency (JAXA). He is interested in when impacts, volcanic eruptions, and other geologic events occurred on planetary surfaces. In the doctoral course, he has been refining the development of the in-situ dating instrument to attain more accurate age values and to achieve a more feasible engineering design. He has also analyzed remote-sensing data obtained by the Japanese lunar orbiter Kaguya, and found young lava flows on the Moon. His research is supported by the Research Fellowship for Young Scientists in Japan Society for the Promotion of Science (JSPS).