

Single shot laser ablation-multiple collection-ICP-mass spectrometry for U-Pb age

HATTORI, Kentaro^{1*} ; SAKATA, Shuhei¹ ; HIRATA, Takafumi¹

¹Division of Earth and Planetary Sciences, Graduate School of Science, Kyoto University

Combination of laser ablation sample introduction technique and ICP-mass spectrometry (LA-ICPMS) has been widely used for element and isotopic analyses for solid samples¹⁾. One of the great advantages of LA-ICPMS is high quantitative capability achieved by the "post ionization" configuration. With the post ionization, ionization and atomization of the analytes in the plasma source will be independently carried out, and therefore, the optimization of the operational conditions for both the sampling and ionization can be made. This suggests that the hard ionization can be carried out even under the "soft" laser sampling. One of the major source of the analytical error is an elemental fractionation during the laser ablation (down-hole fractionation)²⁾. In fact, the measured Pb/U ratio can change with time when the larger ablation was made with ablation spots of higher aspect ratios³⁾. To overcome this, we have tried to measure U-Pb ages from the ablation spots of smaller aspect ratio (i.e., shallower pit).

The shallower ablation pit could be obtained when a smaller number of laser shots were adopted. To achieve this, a multiple collector-ICPMS was adopted to the U-Pb age determinations. With the multiple collector system, precision in the isotope ratio measurements can be improved even from the transient signals produced by the smaller number of laser shots. Hence, six isotopes were monitored by the six independent multipliers ; ²⁰²Hg (IC), ²⁰⁴Pb (IC), ²⁰⁶Pb (IC), ²⁰⁷Pb (IC), ²⁰⁸Pb (IC), ²³²Th (F) and ²³⁵U or ²³⁸U (IC).

Three natural zircons (OD-3⁴⁾, Plesovice⁵⁾ and GJ-1⁶⁾) were employed to evaluate the reliability of the resulting U-Pb ages. Nancy 91500⁷⁾ zircon was used as a calibration standard for the Pb/U ratio measurements. The glass standard (NIST SRM 610) was used for the calibration in the ²⁰⁷Pb/²⁰⁶Pb isotope ratio measurements. Laser ablation system used in this study was a New Wave Research femto laser ablation system (Fremont, CA 94538, USA), and the ICPMS instrument used in this study was a Nu Instruments (Wrexham, UK) Nu Plasma II multi-collector ICPMS. For comparison, U-Pb ages were also measured by the single collector-ICPMS instrument (Nu Instruments AttoM). In our presentation, we will demonstrate the high analytical capability of the MC-ICPMS technique from the single shot laser sampling.

References

- 1) J.Koch and D.Guenther, *Applied Spectroscopy*, 65(5), 155A-162A (2011).
- 2) S.Eggins, L.Kinsley and J. Shelly, *Applied Surface Science*, 127-129, 278-286 (1998).
- 3) I.Horn, R.L Rudnick and W. F. McDonough, *Chemical Geology*, 164, 281-301 (2000).
- 4) H.Iwano et al., *Island Arc*, 22.3, 382-394, (2013).
- 5) J.Sláma et al., *Chemical Geology*, 249, 1-35 (2008).
- 6) S.E.Jackson et al., *Chemical Geology*, 211, 47-69 (2004).
- 7) M.Wiedenbeck et al., *Geostandard Newsletter*, 19, 1-23 (1995).

Keywords: LA-MC-ICPMS, U-Pb age, zircon, single shot, elemental fractionation, aspect ratio