Coupling of elemental imaging and high resolution U-Pb chronology

TAKAFUMI HIRATA[1], SHUHEI SAKATA[1], KENTARO HATTORI[1] AND TOSHIHIRO SUZUKI[2]

[1]Dept. of Earth and Planet. Sci., Kyoto Univ. Japan. (hrt1@kueps.kyoto-u.ac.jp)
[2]Dept. of Earth and Planet. Sci., Tokyo Inst. Tech., Japan.

Rapid and unremitting developments in both the laser ablation technique and the multiple collector-ICP-mass spectrometry (MC-ICPMS) have revolutionized the precision of the isotopic ratio measurements [1]. With the multiple-ion counting system equipped in the MC-ICPMS, together with the new correction technique for the initial disequilibrium for the U-Th-Pb decay series, higher analytical precision and accuracy can be obtained from young zircons (e.g., <0.1Ma) [2]. Moreover, shorter analysis time achieved by the MC-ICPMS setup results in shallower ablation pit (<1μm). Major problem associated with the multiple-ion counting technique would be a non-linear time-dependent changes in the gain and the background (dark noise) of the collectors. This is one of the large sources of analytical error in the resulting U-Th-Pb ages. To minimise the systematical error in the U-Th-Pb age measurements, an ion counting system utilising a compact-type Daly collector was introduced [3]. Several unique features could be derived by the Daly collector, such as (a) smaller time-changes in gain and background level of the collector, (b) wider dynamic range covering 0 to >5 Mcps, and (c) clear difference in the pulse intensity against the noise intensities. With the Daly ion collector, better precision and accuracy in the U-Th-Pb isotope ratio measurements can be made.

Another important feature of the laser ablation-ICPMS technique is the analytical capability for sensitive elemental/isotopic mapping analysis, which could be widely used to evaluate the system closure for the decay series nuclides. Combination of the elemental imaging and the U-Th-Pb age determination can provide further precise and reliable age data from various minerals such as zircon, monazite or carbonates.

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