U-Pb Dating of Detrital Zircons by Laser Ablation ICPMS for Sedimentary Provenance Studies

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Age dating of detrital zircon has proven to be a useful tool for stratigraphic correlations, identification of sediment sources and transport and depositional histories. Laser ablation ICPMS and ion probe (SIMS) have been successfully used to resolve the provenance of sediments in a variety of geological settings worldwide. Comparison of results from dating the same samples of detrital zircons by SIMS and LA-ICPMS (Košler et al. 2002) has demonstrated that both techniques are equally accurate and suitable for U-Pb dating of zircon for provenance studies. The advantages of SIMS are slightly more precise ages, less damage to samples and better spatial resolution. LA-ICPMS is the more cost-effective technique with the potential to analyse 3–5 times as many samples in a given time compared to SIMS.

Elemental fractionation of Pb and U has always been an important source of error in U-Pb dating of zircon by LA-ICPMS. There is, however, a variety of sampling techniques that suppress this fractionation, and several correction methods that can be used, resulting in accuracy and precision of age data that are sufficient for sedimentary provenance studies. They include external calibration by matrix-matched standards, use of special cell design, short ablation time (large laser pit diameter/depth ratio), laser beam rastering and mathematical methods of correction for elemental fractionation.

The laser ablation ICPMS method of age dating has been successfully applied to study the provenance of Cretaceous to Paleocene sandstones from the Norwegian Sea (Fonneland 2002). It can be demonstrated that material derived from east Greenland contains both Archean (3800–2500 Ma) and early Proterozoic rocks (ca 2000 Ma) while sediments derived from the Norwegian landmass are significantly younger (1600–1000 Ma). The changes in detrital zircon age spectra interpreted as a result of progressive change of sedimentary sources has been documented from several places in the Norwegian Sea, where it can be correlated with elevation of the Baltic margin in Coniacian to Maastrichtian times.

References