Geophysical Research Abstracts
Vol. 16, EGU2014-13889, 2014
EGU General Assembly 2014

Current problems and practices of laser ablation ICP-MS zircon geochronology

Jan Kosler (1,2)

(1) University of Bergen, Earth Sciences, Bergen, Norway (jan.kosler@geo.uib.no), (2) Czech Geological Survey, Prague, Czech Republic

The laser ablation ICP-MS (LA ICP-MS) dating technique is widely used for U-Th-Pb geochronology of accessory minerals. Zircon is the most commonly studied accessory phase in magmatic, metamorphic and sedimentary rocks because of its widespread abundance, resistance to abrasion and dissolution in natural environments, ability to quantitatively retain trace elements over geological time and low initial content of non-radiogenic Pb. Variable composition of zircon matrix, laser-induced elemental fractionation and instrumental discrimination of isotopes are the main obstacles to accurate and precise determination of Pb/U and Pb/Th isotopic ratios in zircon. Despite the potential errors in age determination due to these processes can be reduced by matrix-matched calibration and various data corrections, the uncertainty associated with the correction for laser-induced elemental fractionation typically dominates the age uncertainty budget.

Phase separation related to thermal effects of laser ablation and formation of non-stochiometric particles of variable size has been shown to be the primary cause of laser-induced elemental fractionation, that can be further enhanced by variable aerosol transport and processes in the plasma source of the mass spectrometer. The thermal effect of laser radiation on zircon typically results in breakdown of ZrSiO4 (+U,Th,Pb) to ZrO_2 (+U,Th) and SiO_2 (+Pb) and leads to efficient decoupling of the parent and daughter elements.

Radiation damage of zircon is potentially an important structural and compositional factor that can influence the ablation properties, including the Pb/U and Pb/Th elemental fractionation. However, data obtained so far are not indicative of a simple causal link between the radiation damage, the elemental fractionation and the age bias. Composition of ambient gas, including variable presence of oxygen during the ablation process is an additional factor that may alter the fractionation rate of the elements and result in biased U-Pb and Th-Pb zircon ages. Accordingly, monitoring the oxygen level during laser ablation may lead to improved accuracy of U-Th-Pb dating by LA ICP-MS.