

LA ICP-MS imaging of zircons by sector field, high sensitivity mass spectrometry coupled to fast-washout laser ablation

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Two-dimensional imaging of solid natural materials has become an increasingly desired tool in the last years for a wide range of geoscience applications. This has been made possible by the continuous development of laser systems (equipped with low-dispersion cell and fast-washout sample transport system) coupled to increasingly sensitive sequential mass spectrometers (quadrupole and sector field instruments) with short dwell time and mass switching time.

Continuous-scan imaging, where the laser is fired at a high repetition rate and the sample is scanned underneath the pulsed laser beam poses some challenges, such as the need for: synchronization between laser system and mass spectrometer to ensure exact correspondence between the MS time-resolved measurements and the physical location of the sampled surface; online (laser and MS) software packages capable to handle large amounts of data; post-data acquisition software to convert the acquired data into images.

In this study we coupled a Teledyne Photon Machines™ Iridia™ laser ablation system designed for high speed imaging to a high sensitivity Thermo Scientific™ Element XR™ HR-ICP-MS to collect elemental and isotopic images of zircon samples. The high sensitivity of the Element XR in this study was further enhanced by the Jet Interface (including a high capacity interface pump and specially designed Jet sample cone and X skimmer cone). The Iridia laser system is a 500 Hz, 193 nm water-cooled excimer laser equipped with the fast-washout Cobalt cell and the ARIS device (Aerosol Rapid Introduction System) ensuring minimal transfer volume and fast washout of less than 20 ms.

We report the method development and optimization of the coupling between the laser system and the sector field mass spectrometer used to collect isotopic images of unknown zircons. Zircon reference materials were used as external calibration standard and to validate the sample results. REE and U-Pb maps, generated using the HDIP software package (v. 1.6, Teledyne Photon Machines, MT, United States) revealed well resolved concentric oscillatory zoning.

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