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Ultra-fast, high resolution 3D LA ICP-MS imaging of zircon

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Laser ablation-inductively coupled plasma-mass spectrometry (LA ICP-MS) has become a routine analytical technique for unidimensional (*i.e.*, single spot) or bidimensional (*i.e.*, continuous lateral scanning, one of the approaches most widely used in elemental mapping) elemental and isotopic anlysis. Due to the complexities of experiment setup and data reduction, in-depth three-dimensional LA ICP MS [1] has received less attention as 3D imaging requires the assembling of multiple image layers into a 3D volume representing the volumetric distribution of analytes, and generally takes an exorbitant amount of measurement time.We present new developments in ultra-rapid response laser ablation cell technology coupled to innovative state-of-the-art data reduction software. This enables the generation of high-resolution images assembled automatically and seamleasly to create 3D ditribution maps of elemental, isotopic and even geochronological information. The use of rapid-response technology enabled the acquisition of full pulse signals of less than 3ms (FW0.1M), which allowed the increase of the laser's repetition rate and scanning speed, in order to decrease scanning time without compromisig data quality. Furthermore, due to the increased mass flux in the setup, sensitivity is also increased, allowing for a higher lateral image resolution to be achieved.

The zircons used for this study are from the miaskitic alkaline suite of the Ditrău Massif in Romania, in which zircon occurs frequently throughout the magmatic, pegmatitic, and deuteric evolution stages of the intrusion. The sampled crystals appear associated with magnetite and subordinately biotite, occasionally forming schlieren in the leucocratic, coarse-grained nepheline syenite. Since there are oscillating interpretations as to the relative role of orthomagmatic and metasomatic processes in the formation of especially the coarse-grained nepheline syenitic internal zone of the massif, the isoptopic distribution maps allowed for additional discriminating criteria. As such, internal zoning consistent with magmatic crystallization was identified.

[1] Burger *et al.* (2015) Anal. Chem. **87**, 16, 8259-8267