Title: **Fast, but not furious – development & analytical advantages of the Cobalt ultrafast ablation cell**

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As far back as 1985, Alan Gray, one of the founding fathers of ICP-mass spectrometry, discussed the implementation of LA as a sample introduction system for ICP-MS, permitting elemental and isotopic analysis of solid samples. While direct bulk analysis of solid samples proves an efficient approach for indigestible samples, the approach has other key advantages: sample run time and material consumption are reduced, and spatially resolved information is acquired. The latter opens up the way to spot analysis, depth profiling analysis and mapping/imaging approaches in which the distribution of the analyte element(s) over the sample matrix is documented. After an initial phase of "creating elemental distribution images", LA-ICP-MS users became increasingly critical of the performance characteristics and academics and companies started R&D projects (i) to improve the spatial resolution, while (ii) keeping the sensitivity sufficiently high for detection/quantification at trace levels, (iii) to enhance the sample throughput, (iv) to avoid any type of skew between the actual element distribution and the corresponding LA-ICP-MS image and (v) to elegantly deal with the multivariate data obtained.

Over the past 5 years, efforts at the UGent-A&MS research group were focused on the challenges outlined above and they were met by a combination of (i) development of an ultrafast ablation cell, (ii) proper selection of the instrumental parameters based on fundamental insights and (iii) in-house developed imaging software.

Using computer fluid dynamics (CFD), an ultrafast ablation cell geometry was developed, ensuring very rapid washout as a result of its design and avoidance of any turbulence in the carrier gas stream. This led to the development of a prototype ablation cell, which, in cooperation with Teledyne Photon Machines was refined into a commercial-grade ablation cell with this novel geometry. This ablation cell, named the Cobalt cell, which will be discussed for the first time during this talk. The aerosol formed upon impact of an ArF*excimer-based 193 nm UV laser pulse on NIST SRM 612 material is evacuated from the cell in 3 ms (FW0.1M). Most ablation cells described up to now lack stage reproducibility on the scale of the smallest laser beam diameters due to backlash and hysteresis. Software has been developed by several companies to compensate for this lack in accuracy of the stages. In our design however, more advanced motion technology is employed to resolve this problem using hardware. The ablation cell design also employs a system which allows for a consistent sampling environment and aerosol transfer path at any ablation site. The transfer tubing is designed in such a way that gravitational settling and surface deposition on the tubing walls is eliminated. The first elemental images acquired by this new system will be presented in detail. The sample selection comprises a collection of zircons and HeLa cells (a cancer-derived immortal human cell-line abundantly used in scientific research). All images presented in this talk are based on data processing using an in-house developed imaging library. This new data processing library will be presented into more detail in a separate lecture.

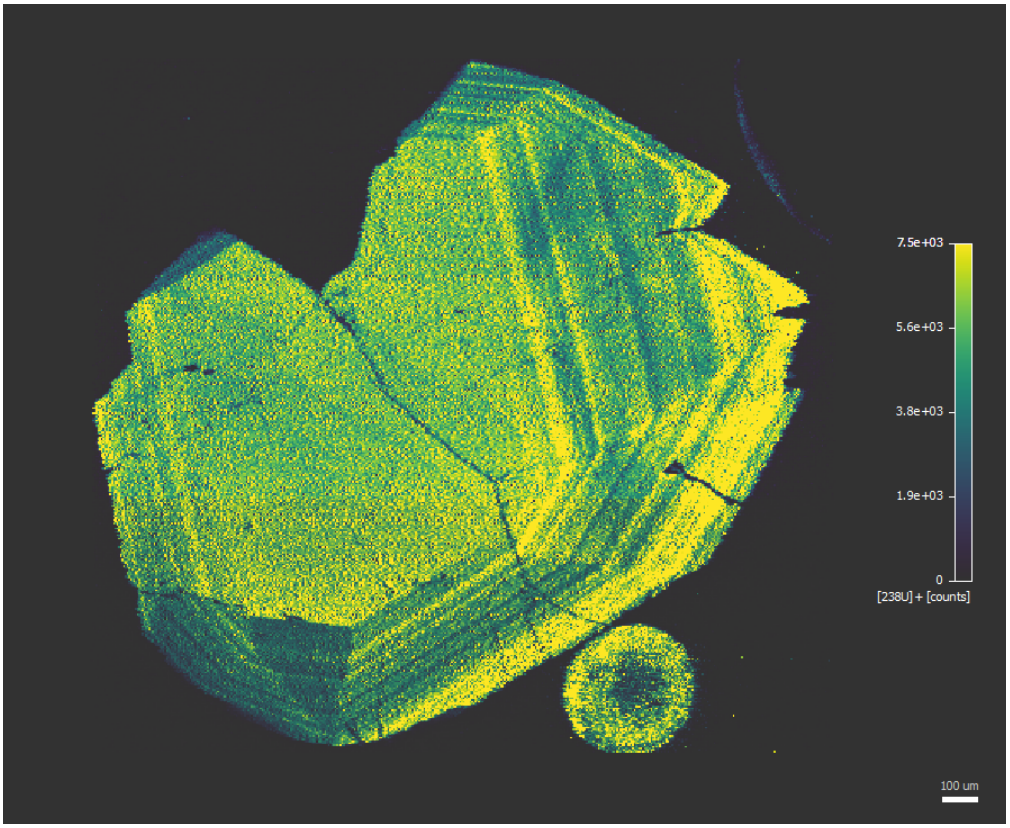

Figure 1 This is the first image ever created with the novel ablation system. Distribution of ^{238}U in a zircon cross-section. A 3 µm spot was used to acquire images at up to 150 pixels/s (translation speed of 450 µm/s).