Fast Multi-Element LA-icpTOF Mapping of Gold Grains

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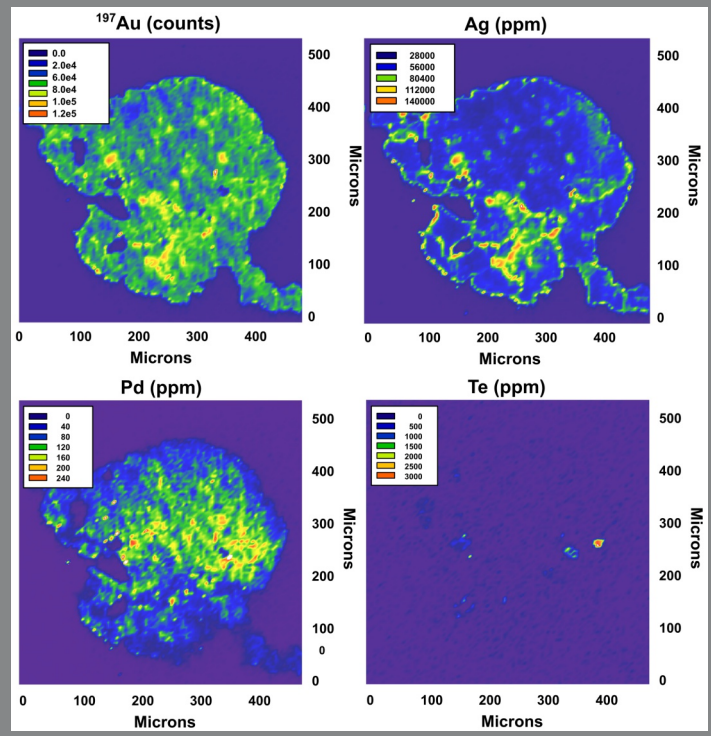
Gold deposits can form in a variety of geological settings and by different processes. The ability to differentiate and understand these is very important for the exploration model that is used to define the gold deposit. In many cases the first recognition of a gold deposit will come from placer gold grains in rivers that have been weathered from a hidden deposit. Trace element analysis has the potential to discriminate between deposit types.

The composition of gold samples is commonly measured with electron probe micro-analyzers (EPMA) which characterize Au, Ag and elements such as Cu, Hg and Pd if the concentrations are sufficiently high, but fail to detect other trace elements. Laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS) is a more sensitive method that can provide quantitative bulk analysis with detection limits in sub-ppm range. But, the standard single-spot LA-ICP-MS analysis does not capture high elemental heterogeneity within gold grains. Multi-element mapping with LA-ICP-MS can shed more light on the nature of the grain formation, but the method is very time consuming with standard LA-ICP-MS technology.

This work demonstrates high-speed multi-element mapping of detrital gold, enabled by combining the TOFWERK icpTOF and a recently developed fast laser ablation system. All isotopes present in a 500 µm gold grain (20 elements were detected above detection limits) were mapped with 5 µm resolution in less than 15 minutes, this corresponds to 11,000 multi-element spot analyses.

The combination of the icpTOF and fast laser ablation systems enables rapid mapping of all elements in gold grains, exposing elemental heterogeneities that are not captured with single-spot analysis.

icpTOF



Au intensity map and trace element concentrations maps of a detrital gold grain [sample originates from a placer deposit in British Columbia, Canada] acquired using the icpTOF and the Analyte G2 in combination with ARIS (Teledyne CETAC Technologies). An area of 550 µm x 500 µm was mapped at 5-µm resolution in 12 min, with all isotopes measured simultaneously for each 5-µm pixel. Ablation was performed at 20 Hz laser frequency, continuously scanning over lines at 100 µm/s, providing no interpixel overlap. Element sensitivities were determined with CRM silicate glass NIST610 and the concertation maps were generated using 100% normalization method. The maps show local enrichments of Ag, Pd and Te in the optically homogeneous gold grain.

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