

Performance of Pb Multi Ion Counting array in Triton Plus TIMS

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In analysis of picogram quantities of Pb using a single ion counting multiplier, as commonly used in U-Pb dating, precision is limited by the number of Pb atoms of each isotope registered by the multiplier during an analysis. Using an array of ion counters offers substantial increase in the total counts for each isotope and hence potentially better precision.

Here we report performance of an array of five ion counting multipliers: three regular SEMs and two compact discrete-dynode multipliers (CDDs), spaced for simultaneous measurement of Pb isotopes (**Table 1**, below), which is the configuration of the ANU Triton Plus.

Step	L5 (Plus block)				L4	Dispersion quadrupole (Volts)
	IC4 CDD	IC3 SEM	IC2 SEM	IC1 SEM	IC5 CDD	
1	205	206	207	208	(209)	-2
2	204	205	206	207	208	0
3	(203)	204	205	206	207	+7
4	202	(203)	204	205	206	+9
5	201	202	(203)	204	205	+16

Cross-calibration by sequential measurements of a single stable ion beam, followed by data acquisition in static mode, relies on the stability of relative yields of the multipliers. In our system, the ratios of multiplier yields drift by 0.05-0.1% per hour (after initial 2-hour settling). This method is thus applicable only to measurements requiring 0.05-0.1% uncertainty, and is impractical if higher precision is required.

An alternative way of using the multiplier array is to treat each channel as an individual detector, and pool the measured isotopic ratios. This approach does not depend on the multiplier yield stability, and can potentially produce precise and accurate results. However, it requires changing the dispersion quadrupole settings between the mass steps (Table 1) to keep the peaks aligned, and to circumvent the effects of imperfect peak flats that are common for CDDs. Our tests have shown that setting the dispersion quadrupole to $\pm 10V$ changes the signal SEM yields by 0.1-0.3%, and to $\pm 20V$ by up to 1.2%. No similar effect is observed for Faraday cups.

Our tests indicate that the Pb Multi Ion Counting array in its present form is adequate for measurements at 0.05-0.1% level of precision and accuracy. Achieving a precision level of 0.01-0.02% as required by modern U-Pb geochronology would require either radical improvement in the multiplier yield stability, or a more thorough understanding of the interplay between the zoom optics and the multipliers.

Vulnerability and resilience of soil organic matter to environmental change

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Soil organic carbon is one of the largest carbon pools on Earth. Huge amounts of soil C were lost, when soil was converted to cropland in the 18th and 19th Century. However, there is evidence that since the 1950, there is again an increase in carbon storage in the terrestrial biota, with still unclear relations to the contents of soil organic matter (SOM). Yet, different mechanisms contribute to losses and re-accrual of SOM after disturbance.

We will present and discuss some recent knowledge, compiled with own research, on the differential response of SOM to changes in climate, land use and soil attributes across different temporal and spatial scales. We surmise short-term heterotrophic respiration processes to provide a first indication on the vulnerability of soils to environmental change, with different sensitivity of SOM stocks against, e.g., climate induced changes in soil temperature, water content and soil properties. In the medium-term, these processes are increasingly linked to changes in soil structure and material translocations, whereas in the long-term decoupling processes to other element cycles and between surface soil and subsoil appear to contribute to an impaired resilience of soils and their organic matter to environmental change. The degree at which these processes re-couple to climate, management and socio-economy turn future projections into a challenging task. The examples will focus on agricultural systems from temperate and subtropical climates.