10e13 Ohm Faraday Multi-collection: Striving for Accuracy to Match Ultra-high Precision $^{40}Ar/^{39}Ar$ Measurements

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High-sensitivity, low-background, multi-collection noble gas mass spectrometers are increasingly populating the earth sciences community and are on the threshold of revolutionizing our understanding of geochronology systems. $^{40}Ar/^{39}Ar$ measurements on the ARGUS VI mass spectrometer routinely provide age precision of ~0.1‰ for typical Cenozoic sanidines, but also yield unprecedented precision across the full range of geochronology samples. The combination of quiet and responsive Faraday collection coupled with ion-counting measurements provides incredible dynamic range, accommodating the multitude of isotopic compositions encountered in $^{40}Ar/^{39}Ar$ geochronology. Recent installation of prototype 10T Ohm Faraday amplifiers provided by Thermo Scientific extend the useful range for Faraday detection by a factor of 2-3 compared to 1T Ohm amplification. The 10T Ohm amplifiers are used effectively for ion beams as small as ~10,000 cps before it becomes advantageous to make measurements in ion counting mode. Coupled with exceptionally low mass-spectrometer background values (i.e., mass 36 of 7E-21 moles) the ARGUS VI can measure previously unrecognized scatter related to experimental and geological processes. For instance, neutron flux variations across 2 mm irradiation pits are detectable and result in variable apparent ages that are solely artifacts of irradiation. Samples irradiated in a highly restricted geometry still have measurable age scatter that we suggest is related to geological complexities at the sub per mil level. This scatter currently challenges our ability to unambiguously evaluate the accuracy of ultra-high precision measurements because strong cases can be made for accepting the mean, the young, or the old population. Age spectrum measurements ubiquitously display complex patterns on single crystal sanidines of all ages, further contributing to the difficulty in formulating accurate geological interpretations. We are confident that conceptual models for accurate age assignment will be developed, but currently we lack the tools to fully utilize the power provided by ultra-high precision argon isotope measurements.