$^{40}Ar/^{39}Ar$ dating of Quaternary volcanic ashes by multi-collection noble gas mass spectrometry: protocols, precision and inter-calibration

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The recent availability of commercial high-resolution, multi-collector, noble gas mass spectrometers equipped with ion-counting electron multipliers provides new opportunities for improved precision in $^{40}Ar/^{39}Ar$ dating. This is particularly true for single crystal dating of Quaternary aged samples where potassium-bearing phenocrysts may contain relatively small amounts of radiogenic ^{40}Ar. In 2005, the Quaternary Dating Laboratory, Roskilde University, installed a Nu-Instruments multi-collector Noblesse noble gas mass spectrometer, which is configured with a Faraday detector and three ion-counting electron multipliers. The instrument has the capability to measure several isotopes simultaneously and to change measurement configurations instantaneously by the use of QUAD lenses (zoom optics). The Noblesse offers several advantages over previous generation instruments and is particularly suited for single crystal $^{40}Ar/^{39}Ar$ dating of Quaternary samples because of: (i) improved source sensitivity; (ii) ion-counting electron multipliers, which have low signal to noise ratios enabling precise measurement of very small ^{36}Ar signals - resulting in accurate correction for atmospheric-derived ^{40}Ar; (iii) higher mass resolution allows hydrocarbon interferences to be pseudo resolved for the different argon isotopes; and (iv) multi-collection, allowing more data to be gathered in a fixed time in comparison with single-collector peak-switching measurements. We evaluate (i) protocols for detector inter-calibration and instrument mass fractionation using argon from a calibrated air pipette; (ii) precision and long-term data reproducibility; and (iii) results from inter-calibration experiments of $^{40}Ar/^{39}Ar$ ages on Quaternary volcanic ashes with the U-Pb, astronomical and historical chronometers.

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