Measuring $^{36}$Ar without $^{35}$Cl interference

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Noble gas measurements are usually made in static mode, when the mass spectrometer sensitivity is inversely proportional to volume: this makes the building of very large instruments to obtain high mass resolution impracticable. A particularly challenging interference has hitherto been $^{35}$Cl, which differs in mass from $^{36}$Ar by 1 part in 3937. We have developed a method which makes improved use of the available MRP to remove interferences, and used it to obtain HCl-free $^{36}$Ar measurements on a multicollector instrument with MRP of only $\sim$6000 (MRP= mass resolving power = m/dm 5-95% on side of peak).

By arranging that the target mass position on a minor isotope (e.g. $^{36}$Ar), from which the interference must be removed, coincides with the $\sim$50% point on the side of a major isotope (e.g. $^{40}$Ar), it is possible both to set the mass accurately and to verify the mass position and stability during measurements. The peak top of $^{40}$Ar is measured in a separate mass step. Two small corrections are necessary. One compensates for the residual HCl tail at the $^{36}$Ar position. The other arises because the peak is not totally flat in the region of interest: $^{40}$Ar and $^{36}$Ar+HCl are measured on the peak top, whilst $^{36}$Ar is measured at the extreme edge, with slightly lower efficiency. The required correction parameters can be obtained from a series of air calibrations with different target/interference ratios. With samples containing $4 \times 10^{-15}$ to $3 \times 10^{-14}$ moles of $^{40}$Ar, $^{36}$Ar/$^{40}$Ar was measured, without HCl interference, to a 1σ precision of 0.5%, only slightly worse than counting statistics. This is potentially useful for $^{40}$Ar/$^{39}$Ar dating, where $^{36}$Ar is used to correct for trapped air, and may be particularly significant for smaller or younger samples.