noblesse



# Low Backgrounds with Noblesse

- New source materials and cleaning methods have enabled us to reduce the mass 36 background in Noblesse. This is desirable since $^{36}Ar$ is often used to indicate the amount of atmospheric contamination to a sample. In $^{40}Ar/^{39}Ar$ dating, this is a critical correction.
- We present data showing the $H^{35}Cl$ interference to mass 36 as low as $2x10^{-15}$ ccSTP. $H^{35}Cl$ could be measured both with the instrument pumping, and also in static mode with Ar present.
- For small samples, this low level of interference is similar to the uncertainty in the $^{36}Ar$ measurement; for larger samples it would be lost in the noise.

## Introduction

In $^{40}Ar/^{39}Ar$ dating, the background at mass 36 can be especially important, as the small $^{36}Ar$ peak is used for trapped air correction. The mass 36 peak is composite, composed of $^{36}Ar$, $H^{35}Cl$ ($m/\Delta m$=3937 relative to $^{36}Ar$) and $C_3$ ($m/\Delta m$=1108 relative to $^{36}Ar$).

In practice $C_3$ is easily resolved with Noblesse, so that any potential interference to $^{36}Ar$ derives from $H^{35}Cl$ only (Figure 1). Noblesse can resolve $H^{35}Cl$ from $^{36}Ar$ in high-resolving power mode, albeit with some loss of sensitivity. Alternatively, the instrument can be operated at higher sensitivity, when $H^{35}Cl$ is included in the $^{36}Ar$ measurement and a correction is necessary.

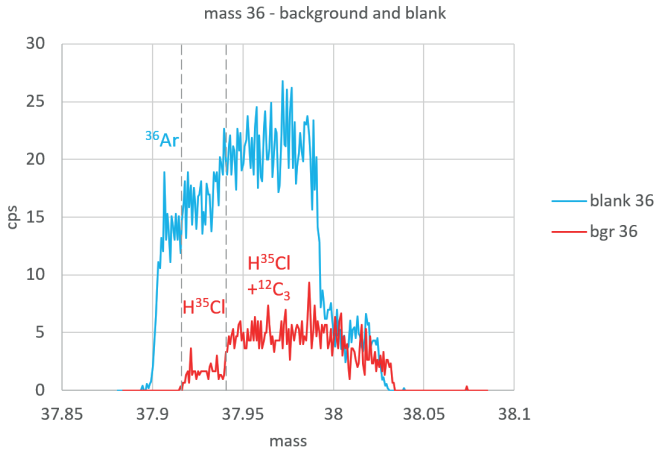


Figure 1: Mass 36 peak with and without Ar in the instrument (static and pumping, respectively). Scans made in high resolving power mode, with MRP ~6000 and sensitivity ~30000 atoms/cps, in order to observe the $H^{35}Cl$.

## Lower Backgrounds

Following developments in novel source materials and the introduction of new cleaning methods, Noblesse now exhibits extremely low mass 36 backgrounds. Over a period of 6 months, the filaments were deliberately exchanged frequently, and the instrument baked out after each change. In total six filaments were tried.

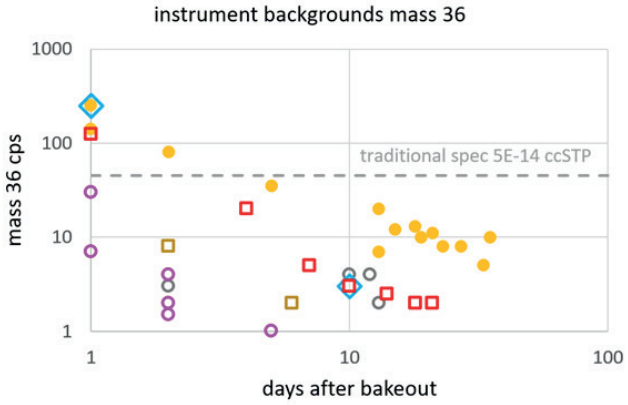


Figure 2: Observed mass 36 background ($H^{35}Cl$) after bakeout. Different symbols indicate different filaments and bakeouts. As expected, bakeout increases the background, which then decreases with time.

The amounts of $^{36}Ar$ and $H^{35}Cl$ were also measured (using the method described by Saxton, 2015), both for instrument background (pumping) and also with small amounts of Ar in the instrument.

The $H^{35}Cl$ remains measurable in the presence of a small amount of Ar, but the amount is similar to the uncertainty in the $^{36}Ar$ measurement (Figure 3). For larger amounts of $^{36}Ar$, the $H^{35}Cl$ will be lost in the measurement noise (i.e. 2 cps of $H^{35}Cl$ in comparison to the $^{36}Ar$ noise, which increases as √signal).

Given such low levels of $H^{35}Cl$, we expect that Ar measurements at lower resolving power (i.e. including $H^{35}Cl$ but applying a small correction) should be satisfactory for almost all samples. This would also offer the advantage of using Noblesse at higher sensitivity.

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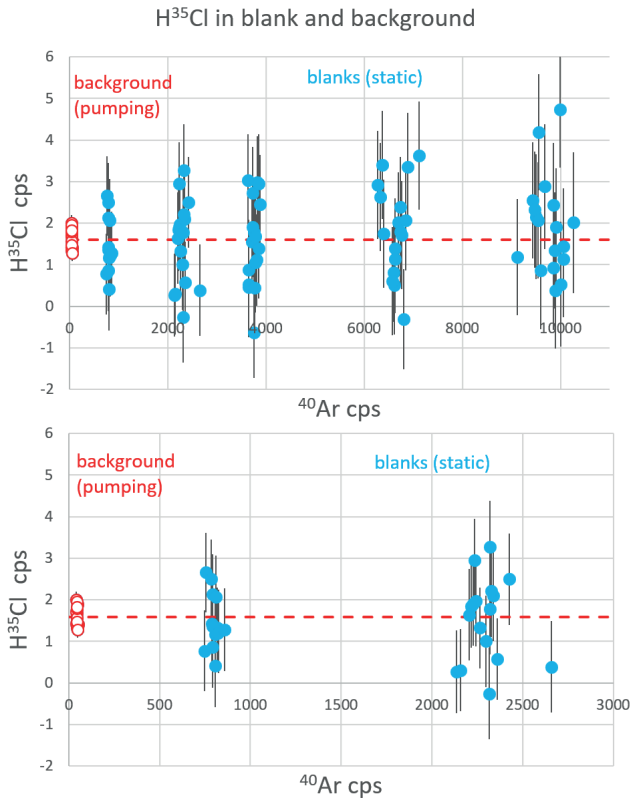


Figure 3: Amount of $H^{35}Cl$ observed with instrument pumping, and also in static mode. The $H^{35}Cl$ remains measurable in static mode, but the amount is similar to the measurement uncertainty: The dashed line indicates the average background value of 1.6 cps, which corresponds to 2 X $10^{-15}$ ccSTP (Ar equivalent). For larger samples, $H^{35}Cl$ would be lost in the noise.

## References

*J M Saxton, A method for measurement of $^{36}Ar$ without $H^{35}Cl$ interference. Chemical Geology, 409 (2015), 112-117.*