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Comparison of Nb versus AgBr sample matrices for stable chlorine isotope analyses with AMS

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Chlorine isotope ratios measured in geologic samples are useful for quantifying surface exposure ages and erosion rates and can provide information relevant to planetary formation processes. Accurate and precise measurements of $^{35}Cl/^{37}Cl$ are important both to studies investigating subtle deviations in $\delta^{37}Cl$ and for those requiring analysis of radioactive ^{36}Cl. This is because ^{36}Cl concentrations are inferred from AMS analysis of $^{36}Cl/Cl$, where Cl is typically determined via isotope dilution of the natural Cl isotope ratio. In AMS systems, stable chlorine analyses are typically performed on AgCl embedded in an AgBr matrix. Partially, this is because AgBr is suitably free from isobaric ^{36}S for use in ^{36}Cl analysis, but also because Br and Cl can be co-precipitated as Ag(Br+Cl), effectively homogenizing sample Cl and simplifying sample preparation. Use of AgBr as a sample matrix does, however, come with downsides that include increased sensitivity to light and humidity, reactivity with metals, and enhanced memory effects in the ion source. Additionally, Cl contamination in Br carriers negatively impacts the ability to analyze Cl-poor materials with total sample Cl masses ≤10 µg. To mitigate these effects, we have developed an alternate method where stable Cl analyses are performed on AgCl embedded in a Nb matrix and coupled this with our recently developed accelerator mass spectrometry (AMS)-based analytical method. To effectively compare Nb and AgBr matrices, we processed and analyzed five silicate sample types with Cl contents ranging from ~5-500 ppm – quartz, feldspar, andesite, rhyolite, and basalt, the latter three of which are also USGS standards – from sample splitting and dissolution to AMS target preparation using both Nb and AgBr matrices. Sample preparation was identical for all replicates aside from the addition of either Br for the typically used AgBr matrix method, or Nb for the new Nb matrix method. The outcome of these experiments and the benefits of Nb as an alternative sample matrix for stable Cl analyses, particularly for microgram scale samples, will be discussed. Prepared by LLNL under Contract DE-AC52-07NA27344, this is LLNL-ABS-2003040.