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E I N L A D U N G

zum

V E R A - S E M I N A R

von

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Chemistry and accelerator mass spectrometry – A life happily ever after?

Accelerator mass spectrometry (AMS) is the most sensitive analytical method to measure long-lived radionuclides. The detection limits are generally several orders of magnitude better, i.e. as low as 10^{-16} (radionuclide/stable nuclide), than any other mass spectrometry or decay counting method. AMS needs smaller sample sizes and measurements are finished within a few minutes to hours.

However, it is often forgotten that research projects applying AMS start with taking appropriate samples, followed by labour- and cost-intensive sample preparation. The goal can easily be described as "making the big samples (up to several kg's) to fit in an AMS target holder (< 10 mg)". This includes getting rid of the matrix and the troublesome isobars. By technical improvements of AMS leading to lower detection limits or better mass-and-element discrimination, sample masses can be reduced to gram-quantities instead of kg's allowing easier, faster, and cheaper chemistry. Recent AMS developments also address very efficiently isobar elimination.

Nevertheless, some samples can contain different sources of the radionuclide-of-interest such as ^{10}Be produced in the Earth's atmosphere polluting the ^{10}Be of interest produced in-situ in quartz. Hence, in this case chemistry is inevitable for cleaning the samples from the contamination. Another "mission" of chemistry might be the reduction of corresponding stable nuclides, e.g. ^{35,37}Cl, ^{27}Al, ^{nat}Fe by preceding cleaning or by gentle leaching to enhance the radionuclide/stable nuclide ratio or to minimize interfering nuclear reactions such as thermal-neutron capture on ^{35}Cl. When applying isotope-dilution AMS to simultaneously determine the ^{nat}Cl content of a sample, which is an absolute requirement for surface exposure dating of Ca- or K-rich minerals, chemical sample preparation is also mandatory.

As the majority of research projects involving AMS is of true interdisciplinary character, knowledge of sample preparation is usually passed-on to (young) non-chemists. These are trained learning-by-doing to perform the chemical preparation of their own samples. Therefore, the development of "routine" AMS sample preparation needs to have a strong focus on safety and easy-to-be-trained aspects with the least opportunity for failure.

In conclusion, although new AMS technical developments for isobar suppression like the laser-negative interaction system at VERA promise to reduce elaborate chemistry in some cases, we should keep in mind that chemical knowledge will always be needed for a lot of interdisciplinary research projects.

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