Isobar contamination studies for Accelerator Mass Spectrometry (AMS)

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The study of rare long-lived atoms by mass spectrometry is made difficult by the presence of atomic isobars, which are often difficult to remove by chemistry alone. Using AMS the separation can often be undertaken either by exploiting anion instability, such as for ^{14}C, ^{26}Al, ^{129}I and others when the anion of the isobar is unstable, or sometimes by using the rate of energy loss differences at higher (MeV) energies. The latter approach is both difficult and costly for heavy isotopes. It is therefore necessary to identify and then eliminate as much as possible the sources of isobar contaminations in the first place. In addition to the usual target contaminations during sample preparation chemistry, we have identified an intrinsic type of ion source contamination due to ion implantations accompanying Cs^+ beam generation. These ions are used to generate the secondary anions for AMS. Studies of this contamination phenomenon are being carried out and will be discussed. From a particular Cs^+ sputter ion source we have so far identified the cations of K, Ca, Cr, V, Mn, Fe, Rb and Mo, as well as some of their oxides, at about the 10^{-6} level of Cs^+ flux. Some of the isotopes of these elements will interfere with the detection of such long-lived isotopes as ^{41}Ca, ^{53}Mn and ^{92}Nb, for example, as they will inevitably be implanted in the target. The origin of such beams, and those yet to be determined at lower levels such as W ions, will be discussed, as well as a solution of the isobar problems in these cases currently under study at IsoTrace Lab.

Stable isotopic tracers for variations in surface and deep water circulation in the North Atlantic since ~ 13 ka

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Stable isotopes from a well-dated Gardar Drift core, KN166-14 11JPC (eastern North Atlantic; 2707 m), show two distinct trends in Holocene circulation patterns. The Younger Dryas (YD) to early Holocene (~ 13 – 7 ka) is characterized by increasing Iceland Scotland Overflow Water (ISOW) strength and sea surface temperature (SST). The period from ~ 7 ka – present is characterized by decreasing ISOW and SST.

The benthic foraminiferal (*P. wuellerstorfi*) $\delta^{13}C$ record for the YD to early Holocene increases gradually, interpreted as a strengthening of ISOW, consistent with reported increases in ISOW flow [1, 2]. From ~ 7 ka – present, benthic $\delta^{13}C$ values decrease, indicating a weakening ISOW. Interestingly, decreasing ISOW strength at our site is coincident with relatively constant flow at Eirik Drift (western North Atlantic), which records combined ISOW and Denmark Straits Overflow Water (DSOW); this indicates that DSOW compensated for weakened ISOW.

Planktonic foraminiferal (*G. bulloides*) $\delta^{18}O$ records indicate that SST warmed from ~ 13 - 7 ka, consistent with observed GISP2 warming [4]. SST cooled from ~ 7 ka – present while no long-term cooling occurs in the GISP2 record [4]. Thus, Gardar SST may be linked to variability in the Gulf Stream, which contributes warm, salty water to the modern eastern North Atlantic

Finally, millenial- to centennial-scale shifts in benthic foraminiferal $\delta^{13}C$ values suggest that high frequency variations in ISOW flow are superimposed on the long term trends. The fluctuation timing is similar to a proximal sediment grain-size record that shows millenial-scale periodicity in ISOW strength [5]. Additional high-frequency climatic events, such as the 8.2 ka event, may also be observed in our record [3].

[1] Fagel *et al.* (2002) *Geochim. et Cosmochem. Acta* **66(14)**, 2569-2581. [2] Keigwin & Jones (1989) *Deep Sea Res.* **36**, 845-867. [3] Kleiven *et al.* (2008) *Science* **319** 60-64. [4] Alley (2000) *Quat. Sci. Rev.* **19** 213-226. [5] Bianchi & McCave (1999) *Nature* **397**, 515-517.