Letter of Intent
US GEOTRACES Arctic Section

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Analyses: (~10 full depth 36 sample profiles)

- Silicon isotopic composition of dissolved silicic acid
- Silicon isotopic composition of biogenic silica
- Silicon isotopic composition of ice algae.

Number of Berths Required: 0

Sampling can be done by Super Tech: Yes – ice sampling is a possible exception.

Nature and amount of sample required:

- 4L (shallow), 2L (deep) sea water samples from conventional CTD/rosette – filtered directly from Niskins through in-line Supor filter capsules. Collaborating with the team measuring N isotopes and the team measuring ^{230}Th and ^{231}Pa for sampling has worked well in the past.
- ¼ of a Supor filter from in situ pump samples
- Sea ice samples for ice algae – We assume others will be focused on ice collection. We will coordinate with that team. We will not need trace metal clean ice samples

Rationale:

Silicon isotopes arguably are among the most informative of the paleo-nutrient proxies. By combining indices of the relative depletion of surface silicic acid using diatom $\delta^{30}Si$ (De La Rocha *et al.*, 1997) with assessments of the silicic acid content of source waters fueling surface production using the $\delta^{30}Si$ of sponge spicules (Hendry *et al.*, 2010) estimates of absolute silica production rates can be reconstructed. The promise of obtaining absolute production rates from sedimentary records is unique to Si isotopes and is not currently possible for other nutrient proxies. Realizing this promise requires understanding of the processes controlling Si isotope distributions in the modern ocean to verify the assumptions underlying application of the $\delta^{30}Si$ for paleo reconstructions.

The first data on Si isotopes in the Arctic were collected as part of the Canadian GREOTRACES cruise to the Canadian Basin. That study showed the Arctic to be the heaviest of all ocean basins with respect to isotopes of Si in silicic acid (Varela, unpublished). Si isotope distribution was a strong function of water mass identity with Upper Halocline waters at ~200m depth being a maximum in $[Si(OH)_4]$ minimum in $\delta^{30}Si(OH)_4$ relative to Atlantic Water or Deep Canadian Basin Water. That study also observed a possible strong contribution of sea ice diatoms to near surface $\delta^{30}Si$ within biogenic silica consistent with the heavy isotopic signature of sea ice diatoms (Fripiat *et al.*, 2007). Knowing how well observations from the Canadian Basin extend to other parts of the Arctic is important for verifying models that infer a strong role of the Arctic in controlling Si isotope distributions observed on the US GEOTRACES north Atlantic section (Brzezinski & Jones, 2014). Those models assume that the heavy isotopic signature observed in the Canadian Basin is typical of the Arctic in general. The US GEOTRACES section offers an opportunity to test that assumption.

The proposed section samples the Bering Sea end member defining the waters entering the Arctic through the Bering Strait. Sampling in the highly productive Chuckchi Sea will define how these waters are modified before entering the deep basins. Extension of sampling to the north pole will allow an evaluation of whether the heavy nature of the Arctic is universal or confined to the Canadian Basin. These data will also inform how the silicic acid maximum that extends across much of the Arctic Ocean associated within the upper halocline influences Si isotope distributions across the Arctic.

References

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