Evaluation of short-lived radium concentration in the Chukchi Sea, Arctic Ocean

Lucia H. Vieira¹, Eric P. Achterberg¹, Michiel M. Rutgers van der Loeff², Jan Scholten³ and Joaquín Pampín¹

¹GEOMAR - Helmholtz Centre for Ocean Research Kiel, Germany. E-mail: lvieira@geomar.de
²AWI - Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research, Bremerhaven, Germany
³University of Kiel, Institute of Geosciences, Coastal and Continental Shelf Research Kiel, Germany

Introduction

The reduction in sea ice cover, lengthening of the ice melt season, and a general decrease in ice thickness result in an increase in light penetration in the Arctic Ocean and a dramatic increase in primary productivity (Arrigo et al., 2014). This leads to intense seasonal blooms of phytoplankton due to the favourable micro and macro-nutrient. The results here presented are part of research efforts in the eastern part of Chukchi Sea, with the objective is to trace Fe, a limiting nutrient for phytoplankton growth, by using Radium as an isotopic trace technique. These data present high concentrations of the short-lived Radium isotopes $^{223}$Ra and $^{224}$Ra in the study region.

Methods

During the SUBICE program, we sampled the Chukchi Sea continental shelf in the period 14 May - 20 June 2014 onboard the USCGC Healy. Fig 2 shows the location of the 45 sampling stations. Water samples (~ 200 L) were collected at approx. 10m depth by Niskin bottles or the ship’s underway seawater supply. The water was filtered through a column filled with MnO$_2$-impregnated acrylic fiber (~20 g). After partially drying, the Mn-fibers were counted on a Radium Delayed Coincidence Counter (RaDeCC).

Results

• Overall high concentration of the short-lived radium isotope $^{224}$Ra$_{ex}$ were observed (Fig. 5), contrasting with low activity of $^{223}$Ra (max. 0.13 dpm/100L) - both being weakly correlated.
• At most stations the water column was fully mixed, with temperatures close to the freezing point and low salinity (Fig 6).
• The high concentrations of $^{224}$Ra$_{ex}$ 200-300 km offshore (Fig. 4) contrast with the pattern described in Moore (2000), who showed a near-exponential decrease for both $^{224}$Ra$_{ex}$ and $^{223}$Ra with distance from the coast.
• The high $^{224}$Ra$_{ex}$ activity (e.g. 2.5 and 1.75 dpm/100 L at stations 143 and 175; 300km away from each other) cannot be attributed to the transport of radium enriched water between stations. Weingartner (2005) described a speed of 8 cm/s for the Bering Sea Shelf Water (Fig 1), whereas only a speed of 95cm/s could account for our data. Hence there was constant supply of $^{224}$Ra from sediments.

Conclusion

The enrichment of $^{224}$Ra$_{ex}$ in the shallow Chukchi Sea waters can be explained by the substantial and constant shelf sediment supply.

REFERENCES