Labrador Sea Water variability over the last 3000 years

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1. Introduction

Labrador Sea Water (LSW) is a key component of the Atlantic Meridional Overturning Circulation (AMOC), contributing 30% of the total volume flux of the lower limb of the AMOC. LSW also plays an important role in the subpolar North Atlantic circulation as it (i) influences the properties of the overflows through entrainment and mixing, and (ii) regulates the subpolar gyre circulation.

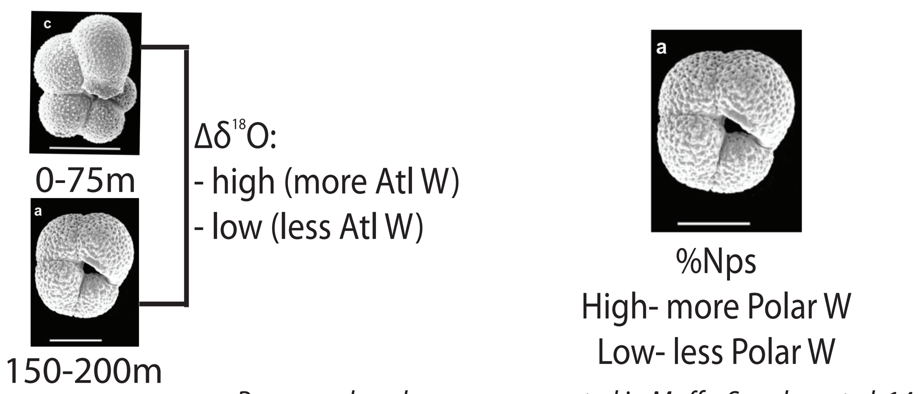
However, changes in LSW formation and its linkages to centennial North Atlantic climate variability is still poorly understood. Mainly due to the short time span of the instrumental records and because the intermediate nature of this watermass makes it difficult to find decadally resolved paleoceanographic archives.

We tackle this problem by comparing data from three sediment cores that indirectly tell us something about the strength of LSW convection such as: (1) freshwater stratification in the E Labrador Sea, (2) ISOW vigour changes in response to LSW and (3) SPG dynamics. We focus on the last 3000 years, a period that was punctuated by cold and warm events recorded in North Atlantic climate proxy archives.

2. Materials and Methods

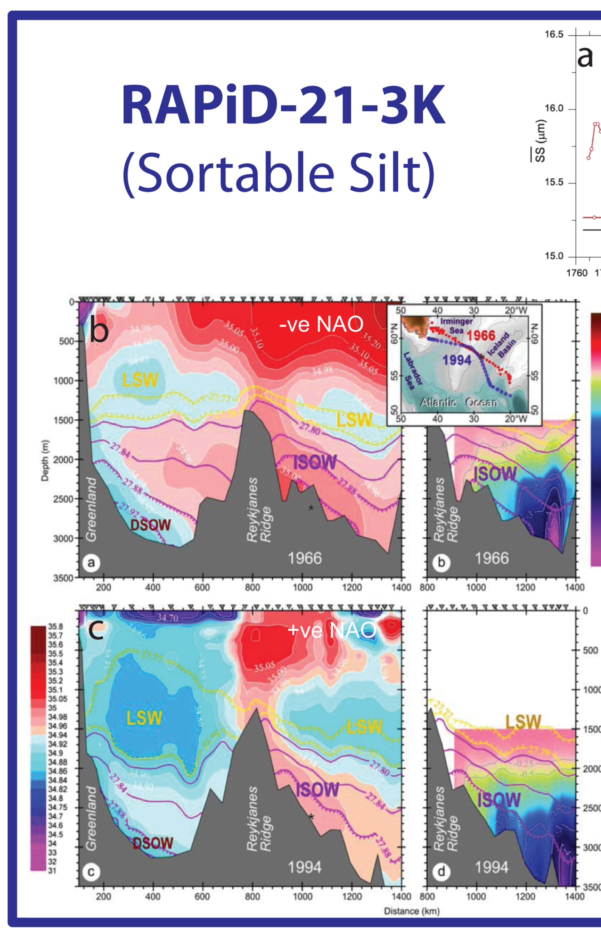
RAPiD-35COM (Polar vs Atlantic)

(1) Δδ¹⁸O : Thermal Stratification (2)%Nps (Polar waters)



Proxy work on box-core presented in Moffa-Sanchez et al. 14

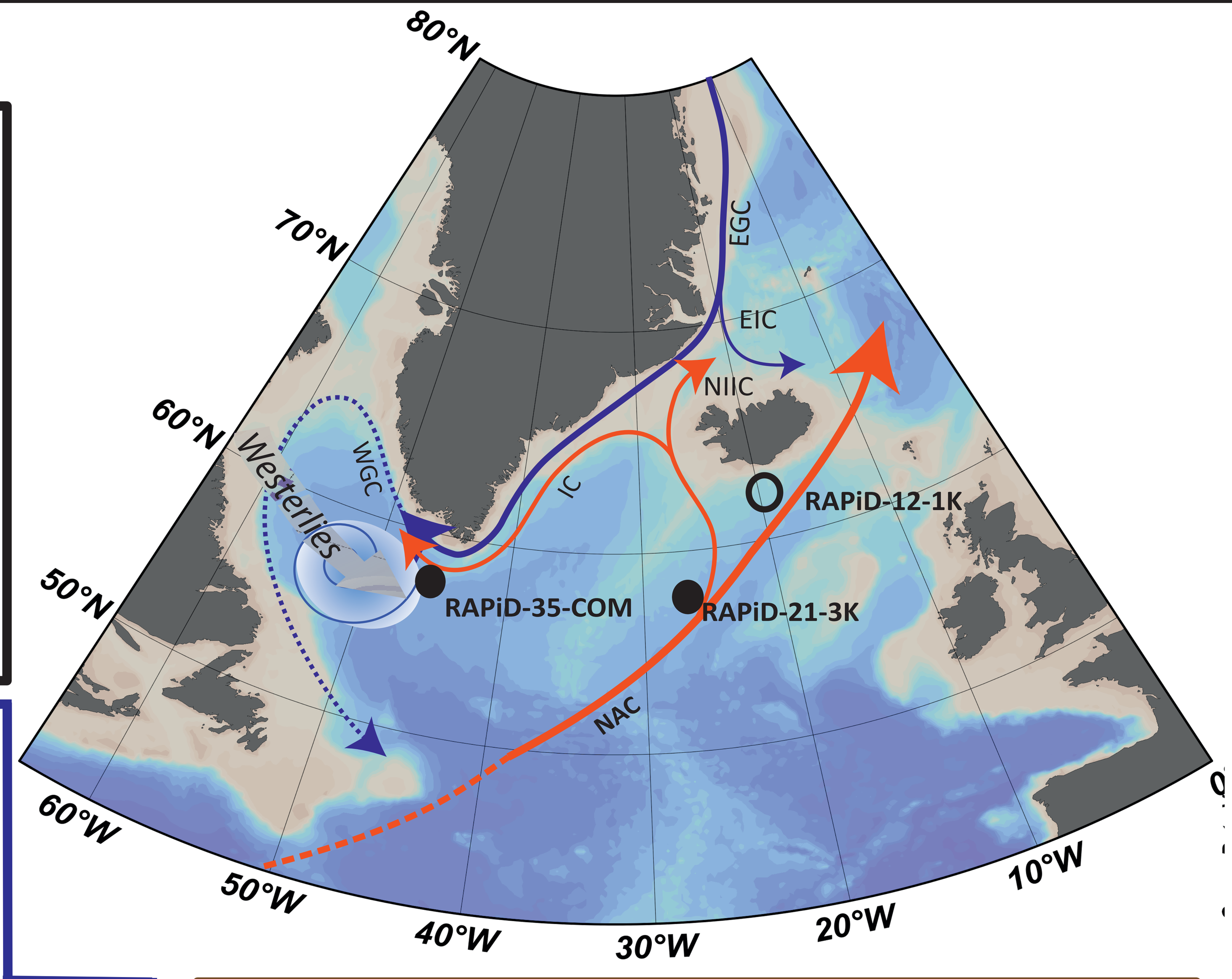
RAPiD-21-3K (Sortable Silt)



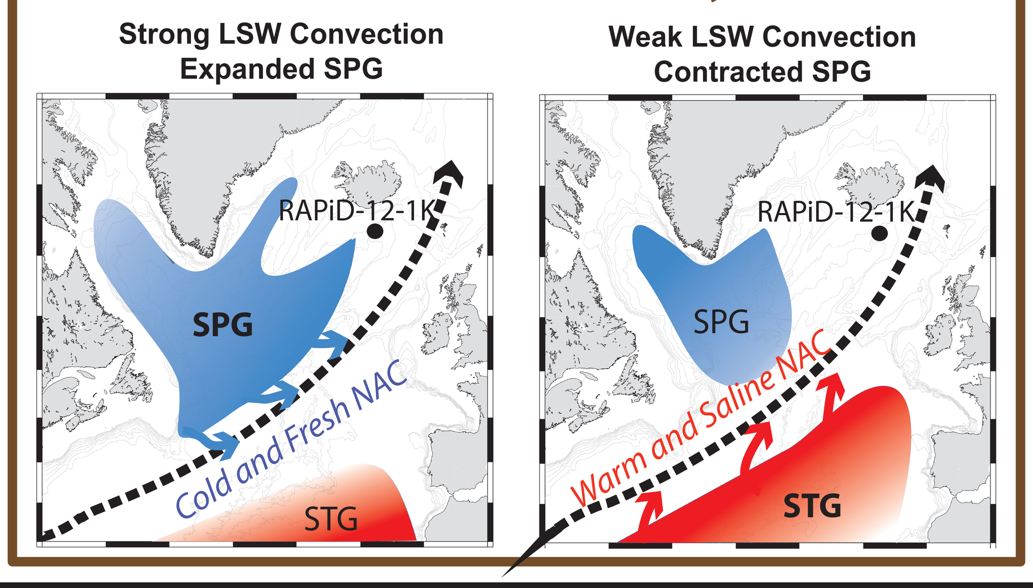
Previous $\overline{SS}$ work from this site indicates:
Last 230 years small $\overline{SS}$ (weak ISOW) during positive NAO index (Fig a).

Hydrographic observations:
Weak LSW convection faster ISOW (Fig b).
Strong LSW convection slow ISOW (Fig c).

Boessenkool et al. 07



RAPiD-12-1K (T&S-Thornalley et al.09)



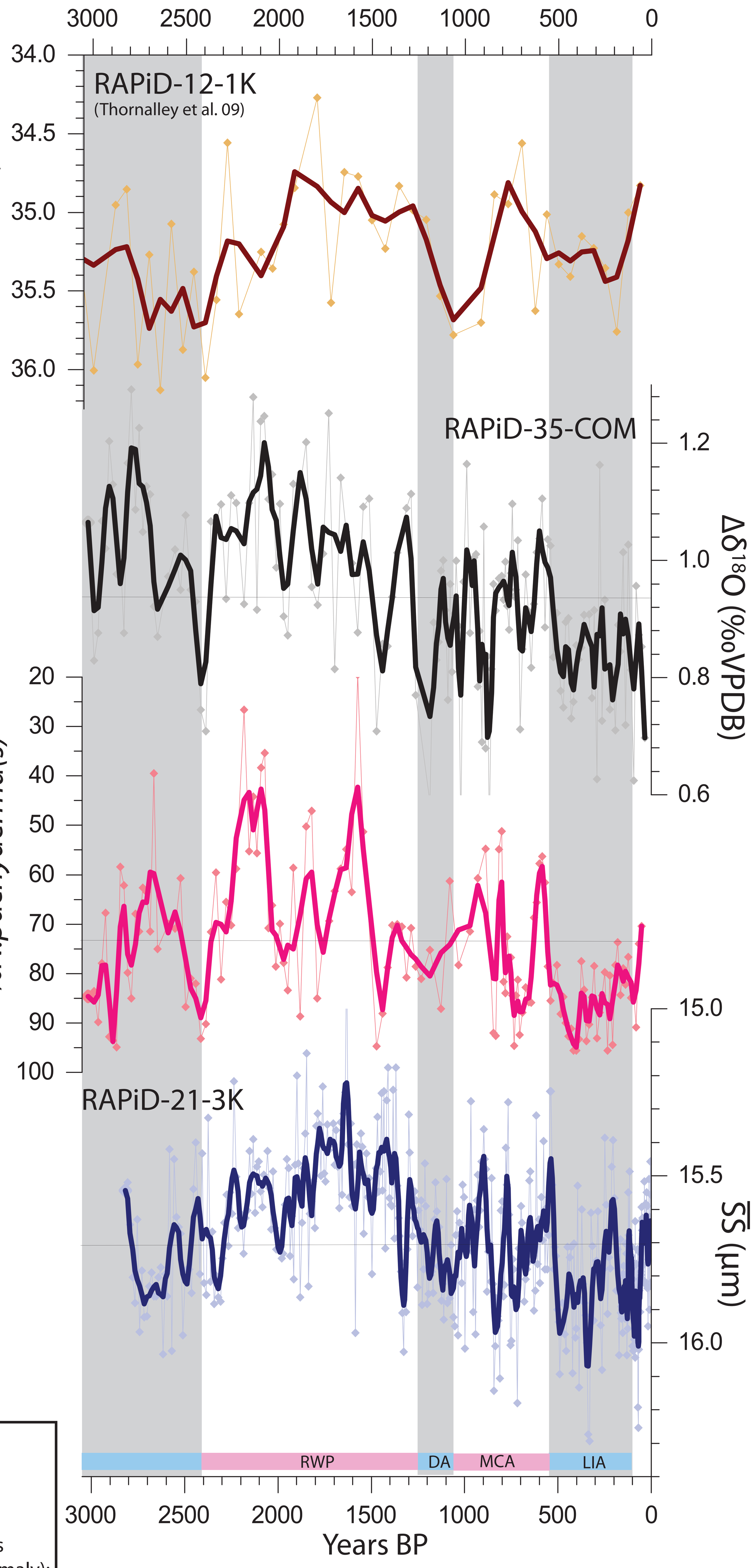
3. Results

More Saline NAC
Weak and contracted SPG

Decreased thermal stratification
Less Atlantic Waters SE Lab Sea

Increase Polar species
More polar waters reaching SE Lab Sea

Stronger ISOW
Reduced LSW in Iceland Basin



Glacier advances
Glacier retreats
After Denton and Karlen 1973
RWP (Roman Warm Period); DA (Dark Ages Cold Period); MCA (Medieval Climatic Anomaly); LIA (Little Ice Age)

4. Conclusions

Over the last 3000 years, during North Atlantic cold periods (e.g. LIA and DA) we find:
-Saltier conditions in the NAC--> contracted SPG indicative of weak LSW formation
-Increased in Polar versus Atlantic waters--> Freshwater stratification in the E Lab Sea, which would have inhibited winter convection.
-Increased ISOW strength --> reduced presence of LSW in the Iceland Basin

Conversely, during warm events (e.g. MCA, RWP) we find: Fresher NAC (expanded SPG), more Atlantic waters reaching SE Lab Sea and slower ISOW. All indicative of stronger LSW formation.

From this evidence, we conclude that LSW convection was likely weaker during these North Atlantic cold events. Since the overflows do not show any concomitant centennial variability (Moffa-Sanchezet al. 15), **we argue that LSW formation changes may have played an important role in slowing the AMOC and reducing its attendant northward heat transport to the higher latitudes contributing to these cold climatic events.**

5. References

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6. Acknowledgements

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