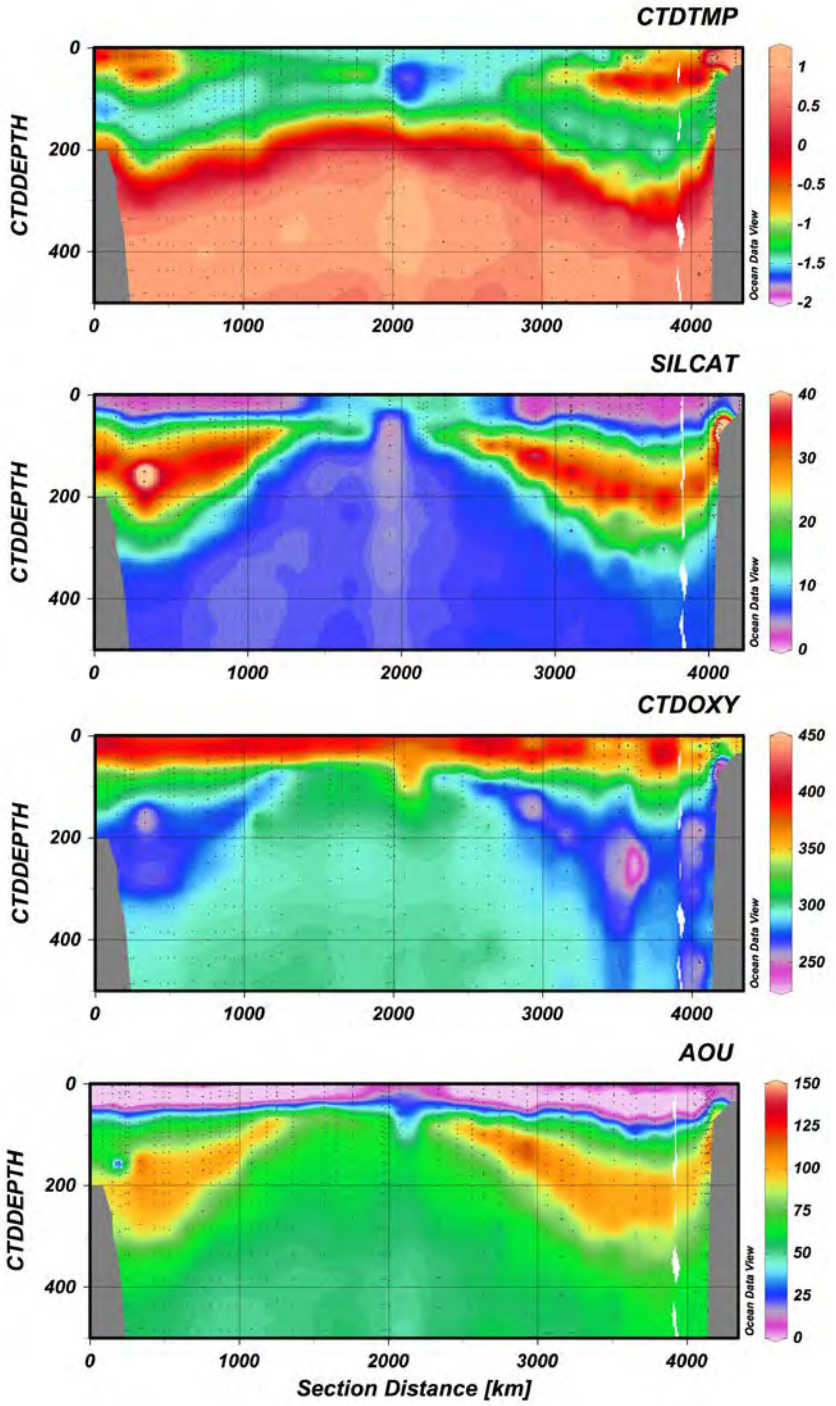
Properties of the western Arctic Halocline

Linking shelf processes to TEI distributions



Warmer Pacific Summer Water over cold Pacific Winter Water (sal 33.1)

Nutrient maxima in PWW ➔ Remineralized nutrient plume

Lower $[O_2]$ in PWW (high DIC)

High Apparent Oxygen Utilization (AOU)

Granger cont.

Granger cont.

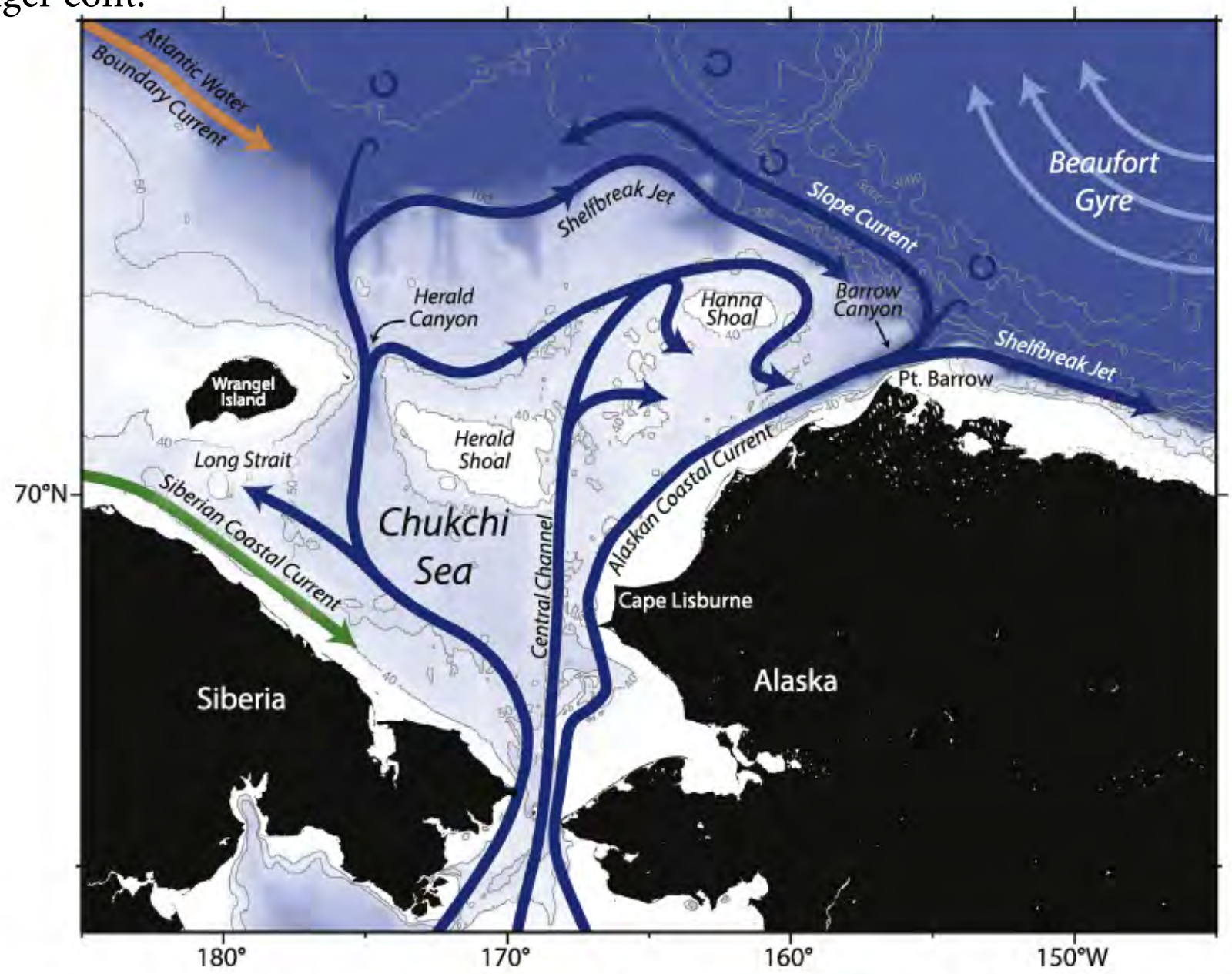


Fig. 1. Revised schematic of the circulation of the Chukchi Sea and western Beaufort Sea from Brugler et al. (2014), including an extended Chukchi shelfbreak jet and the newly-described Chukchi slope current based on the results of this study.

Nutrients entering the Arctic at Bering Strait are insufficient to explain the high concentrations in the halocline

Jones and Anderson (1986), Moore et al. (1983):

- Brine layer from ice formation entrains regenerated nutrients from sediment-water interface
  - PWW is not an advected brine layer, but a water mass

Lin et al. 2019:

- Brine-induced convection during ice formation releases regenerated nutrients from shelf sediments
  - But… steady-state problem, can't export more nutrients from the Chukchi shelf than you bring in from the Bering Sea

Granger cont.

Nutrients entering the Arctic at Bering Strait are insufficient to explain the high concentrations in the halocline

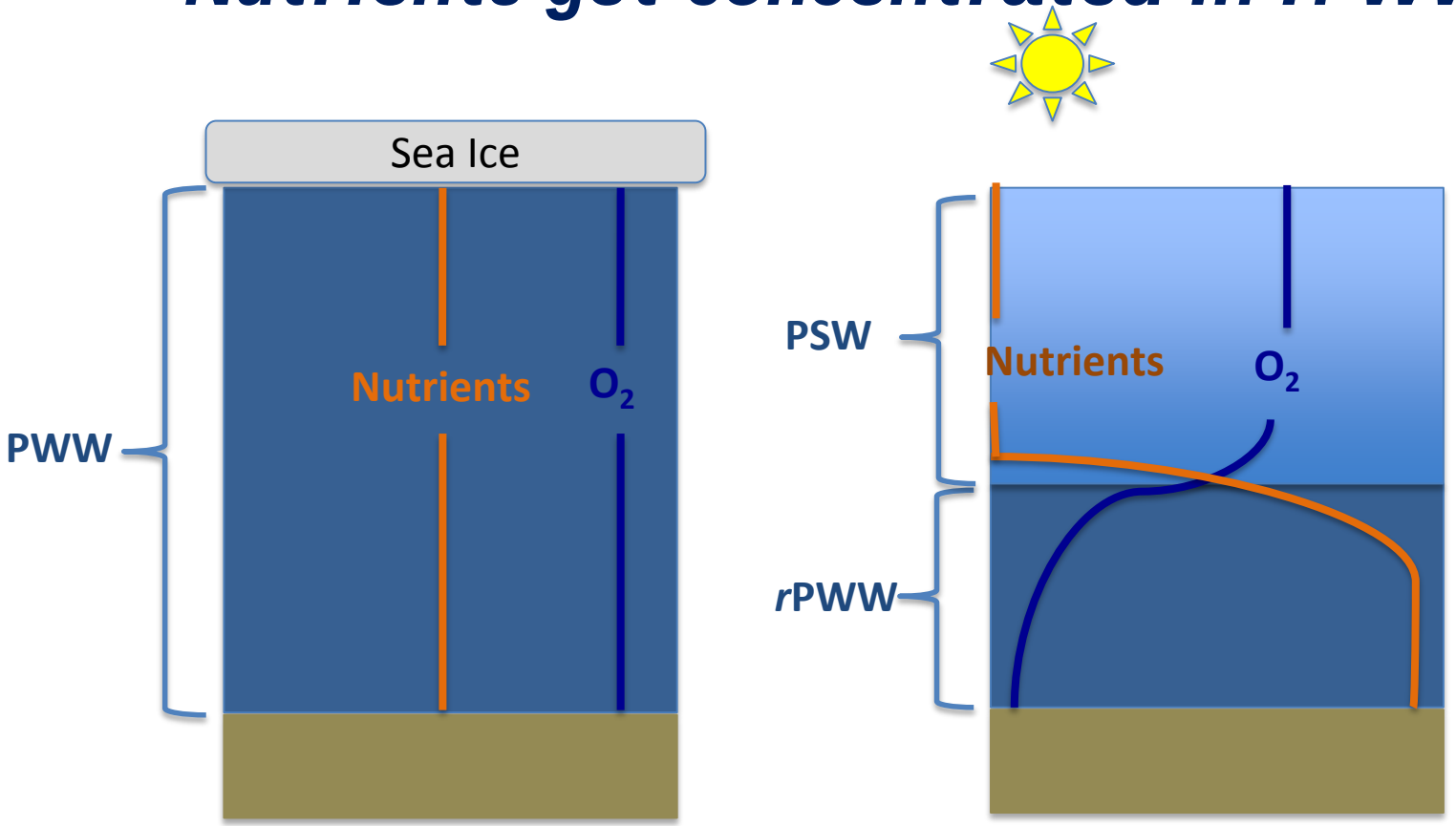
Cooper et al. 1997

"…the nutrient maximum of the upper halocline forms primarily from winter waters advected through Bering Strait."

- Advocate for a short residence time of PWW on the Chukchi shelf in winter of ≤ 4 months
  - But:
    - Residence time 6 months to 2 years, longer in winter (Woodgate et al. 2005)
    - Does not explain high AOU (low O_2) and high DIC
      - Water is ventilated at the shallow Bering Strait

PWW in Winter vs. Summer

Nutrients get concentrated in rPWW ?



Winter PWW:

- Equilibrium [O_2]
- low AOU
- *less* nutrients
- Equilibrium [DIC]

Summer *r*PWW:

- low dissolved [O_2]
- high AOU
- high nutrients
- High [DIC]

Granger

Sum of halocline PWW properties suggest:

- Nutrients are concentrated in *r*PWW due to remineralization during the growing season

- *r*PWW may ventilate the basin when water column is stratified (in warm season)

- Net off-shelf advection of PWW is recorded primarily in summer and autumn (Woodgate, 2005; Weingartner 1998; 2007; Pickart et al. 2005)

But…

- Silicic acid in the halocline can be higher than observed in rPWW on the Chukchi.

  Similar dynamic on the shallow East Siberian Shelf…?

Halocline TEIs
Questions of Interest

- Synopsis of distribution of TEIs in the western Arctic Upper Halocline
- How are shelf processes are implicated in their distribution(s)?
- What insights on halocline formation/ventilation are afforded by TEI distributions?
- Implications for a warming Arctic, in light of changing circulation and increased shelf production
  - Formation of PWW is predicated by sea ice formation