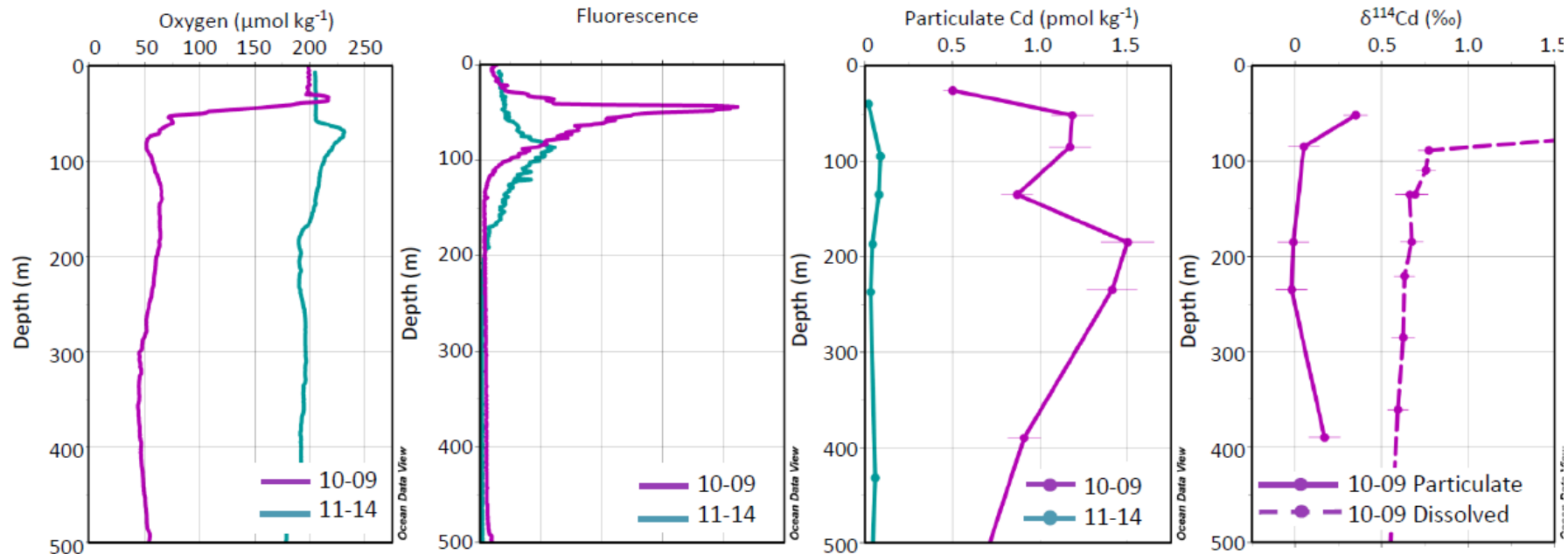


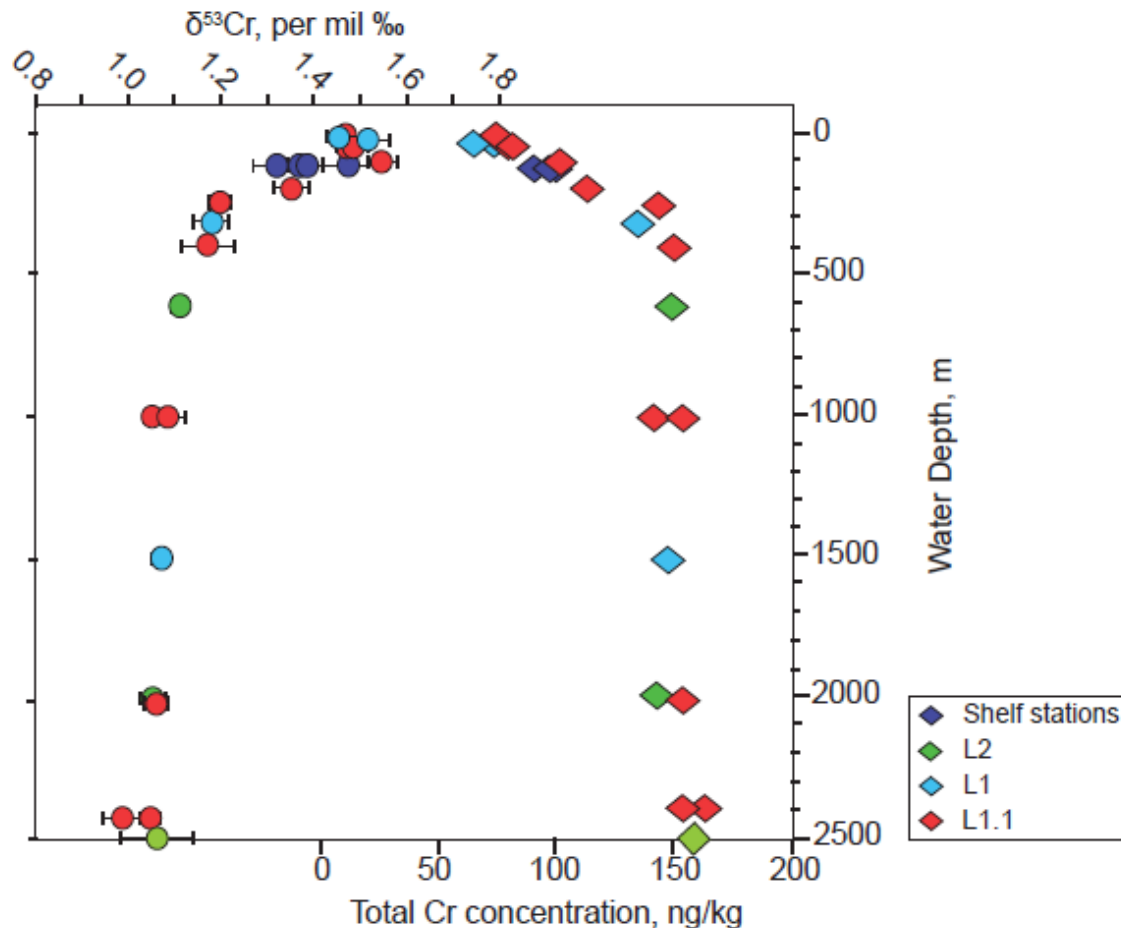
# Highlights (Cullen)

- Janssen et al. (2014, PNAS) coupled data of dCd, pCd & Cd isotopes and other suspended marine particles in the NE Pacific
- In O<sub>2</sub>-deficient waters, Cd is removed by coprecipitation with sulfide. Also, concurrent decoupling of zinc (Zn) and copper (Cu) from corresponding macronutrients
- These results suggest that the marine Cd cycle (but also Zn and Cu ones) may be highly sensitive to the extent of global oceanic oxygen depletion.



# Highlights (Holmden)

- Seawater with high  $\delta^{53}\text{Cr}$  and low Cr concentrations in the Pacific source water reflects reduction of Cr(VI) on organic particulates in the productive waters of the Chukchi Shelf, where isotopically light Cr(III) has been stripped from seawater and sequestered in shelf sediment before entering the Arctic Ocean.



# Canada GEOTRACES 2013-2014

K. Orians, M. Maldonado (Al, Ti, Fe, Cu, Mn), R. Francois (biogenic Si, POC, TIC): International particle intercalibration program, lead by P. Lam

Line P cruises, September 2013 & 2014 (K. Orians, J. Cullen, R. Francois, M. Maldonado, A. Ross)

GEOTRACES\_CCAR: Biogeochemical and tracer study of a rapidly changing Arctic Ocean. 2 cruises in the Arctic in 2015. Organized meetings:

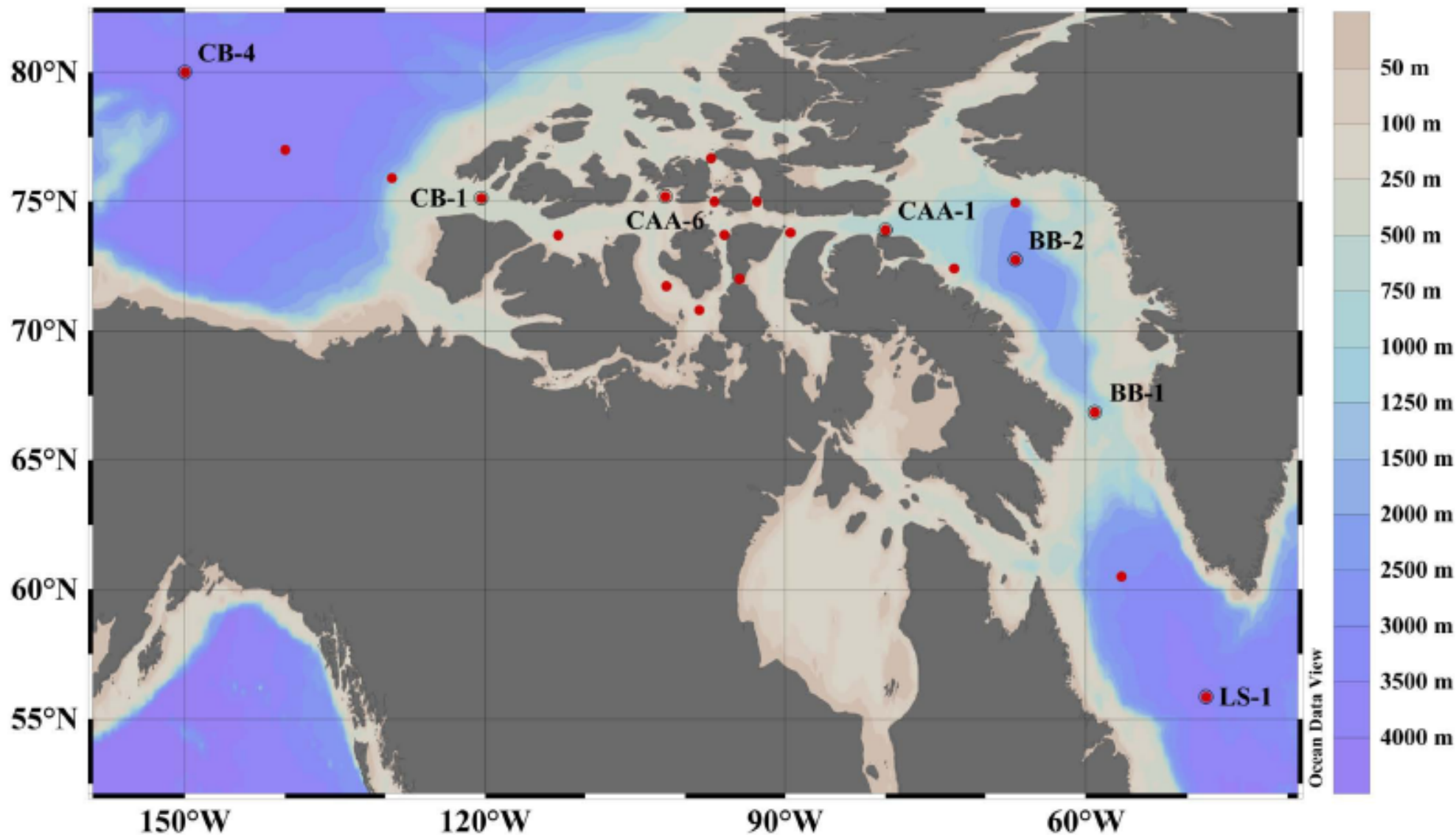
1. GEOTRACES Canada Modeling Meeting at UBC (April 25, 2014): P. Myers, X. Hu (U. of Alberta), N. Steiner, T. Sou (Fisheries and Oceans Canada, Victoria), S. Allen & D. Latornell (UBC, Vancouver)
2. Cruise planning UBC-DFO (IOS?DFO, Sidney, BC) on May 22, 2014
3. Cruise planning: October, 2014 (Quebec) to organize cruise with ArcticNet

Arranged a cross over station with the French program GEOVIDE in the Labrador Sea (55.842°N/48.093°W)

We will have a cross over station with the US in Canada Basin

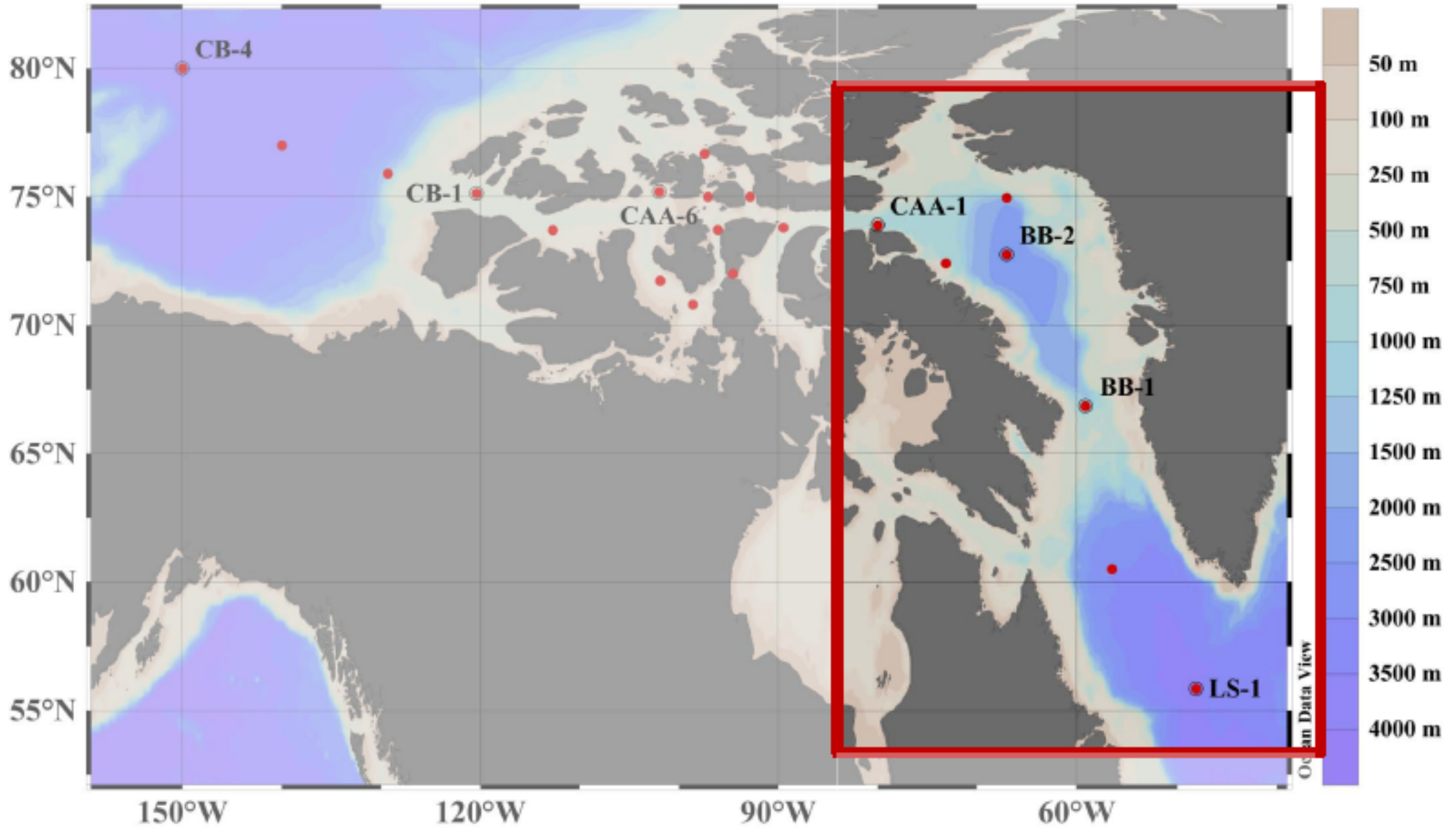


# Geotraces 2015 Stations (preliminary!)



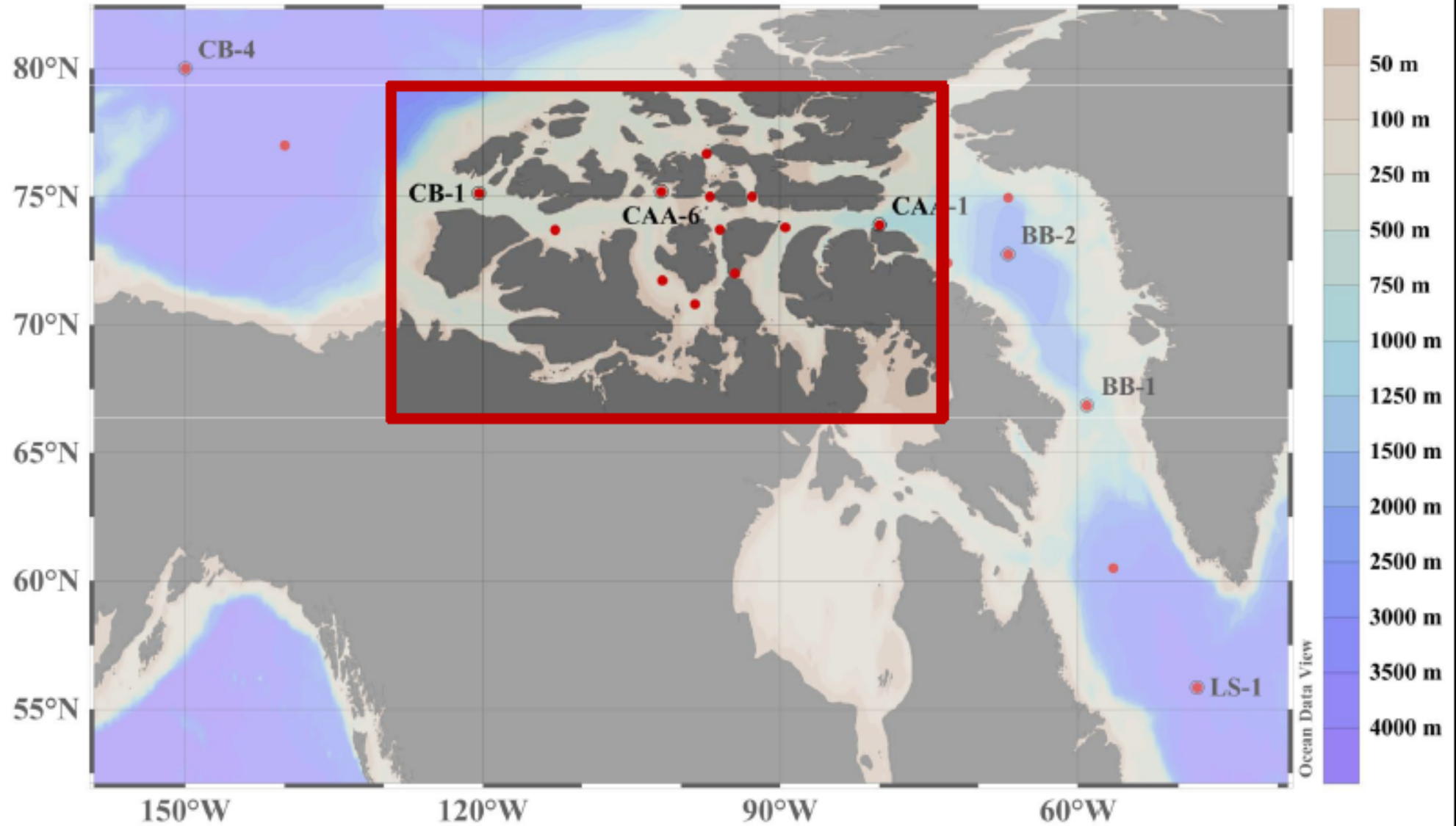
# Geotraces 2015 Stations (preliminary!)

## Leg 3 - Labrador Sea (LS 1-2) and Baffin Bay (BB 1-4)



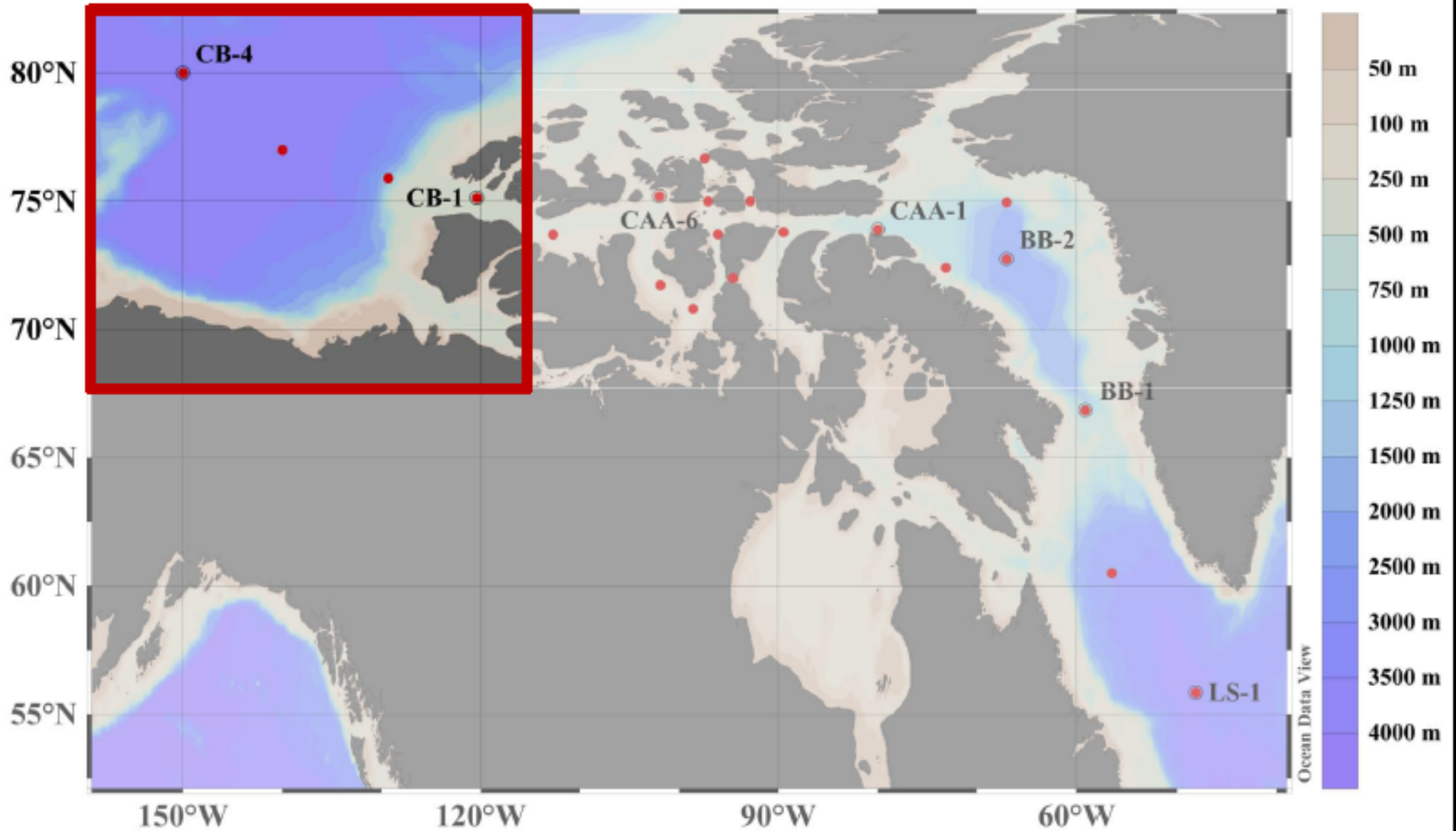
# Geotraces 2015 Stations *(preliminary!)*

## Leg 3 - Canadian Arctic Archipelago (CAA 1-9)



# Geotraces 2015 Stations *(preliminary!)*

## Leg 4b - Canada Basin (CB 1-4)





# Stations details

<b>Leg 3 Baffin Bay/Labrador Sea</b>								
	Station	Cast Depth	Approx. Cast Depth	Target	Lat	Lon	Historical Station Overlap	Station Name
1	LS-1	Deep	3800 m	Cross-over French station	55.842	-48.093		
2	LS-2	Deep	~ 3000 m	North of Labrador Sea (near Davis Strait) to capture deep western boundary current (~3000m isobath)	60.5	-56.6		
3	BB-1	Shallow	~ 1000 m	Davis Strait - north of sill	66.857	-59.0614	APL Mooring	C3
4	BB-2	Deep	≈ 2500 m	center Baffin Bay	72.7510	-67.00	IOS 2006	B-01
5	BB-3	Shallow	< 1000 m	western Baffin Bay (capture wedge of CAA water)	72.408	-73.135	IOS 2006	BEW-09
6	BB-4	Shallow	< 1000 m	eastern Baffin Bay (capture wedge of WGC water)	74.9670	-67.00	IOS 2006	BNS-09
<b>Leg 3 Canadian Arctic Archipelago</b>								
	Station	Cast Depth	Approx. Cast Depth	Target	Lat	Lon	Historical Station Overlap	Station Name
1	CAA-1		750 m	mouth of Lancaster Sound	73.9	-80	almost CFL 2009	301
2	CAA-2		500 m	west of Lancaster Sound - into Prince Regent Inlet	73.8	-89.5	almost CFL 2009	302
3	CAA-3		< 200 m	Wellington Channel (east side Cornwallis Island flow)	75	-92.85		
	alternate	process study		Penny Strait - process study??	76.67	-97.43		
4	CAA-4		250 m	west of Summerset Island (Peel Sound)	73.713	-96.085	IOS 2006	PE3
5	CAA-5		< 200 m	center strait between Cornwallis Island and Bathurst Island (west side Cornwallis Island flow)	75	-97.1		
6	CAA-6		150 m	southern flow through strait between Byam Martin Isl. and Bathurst Island (north of CFL 309 into strait)	75.2	-102	CFL 2009	309
7	CAA-7		≈ 500 m	into Viscount-Melville Sound as far as possible (Western Parry Channel)	73.7	-112.7		
8	CAA-8		200 m	into southern arm (north of restriction)	71.7295	-101.8933	CFL 2009	310
9	CAA-9	if time....	< 200 m	if time, Victoria Strait or north of Queen Maud Gulf (something south on way to Kug)	70.8	-98.6		
	alternate	process study		Bellot Strait - process study??	72.006	-94.576	IOS 2004	cast5
<b>Leg 4b Canada Basin</b>								
	Station	Cast Depth	Approx. Cast Depth	Target	Lat	Lon	Historical Station Overlap	Station Name
1	CB-1	shallow	400 m	McClure Strait (as far in as possible)	75.1275	-120.3972	CFL 2009	2010
2	CB-2	deep	1200 m	1200m bathy line (capture boundary current)	75.899	-129.32755	JOIS	PP2/PP4
3	CB-3	deep	3800 m	140 W line deep station BGOS C	77	-140	JOIS	BGOS C
4	CB-4	deep	3800 m	cross over station	80	-150		

Canadian Arctic GEOTRACES\_CCAR  
Francois + 20 others + 6 DFO  
collaborators

**Biogeochemical & tracer study  
of a rapidly changing  
Arctic Ocean**

## 2 cruises planned, back to back summer/fall 2015:

aboard R.V. Amundsen, ~ 9 weeks, ~ starts  
late July)

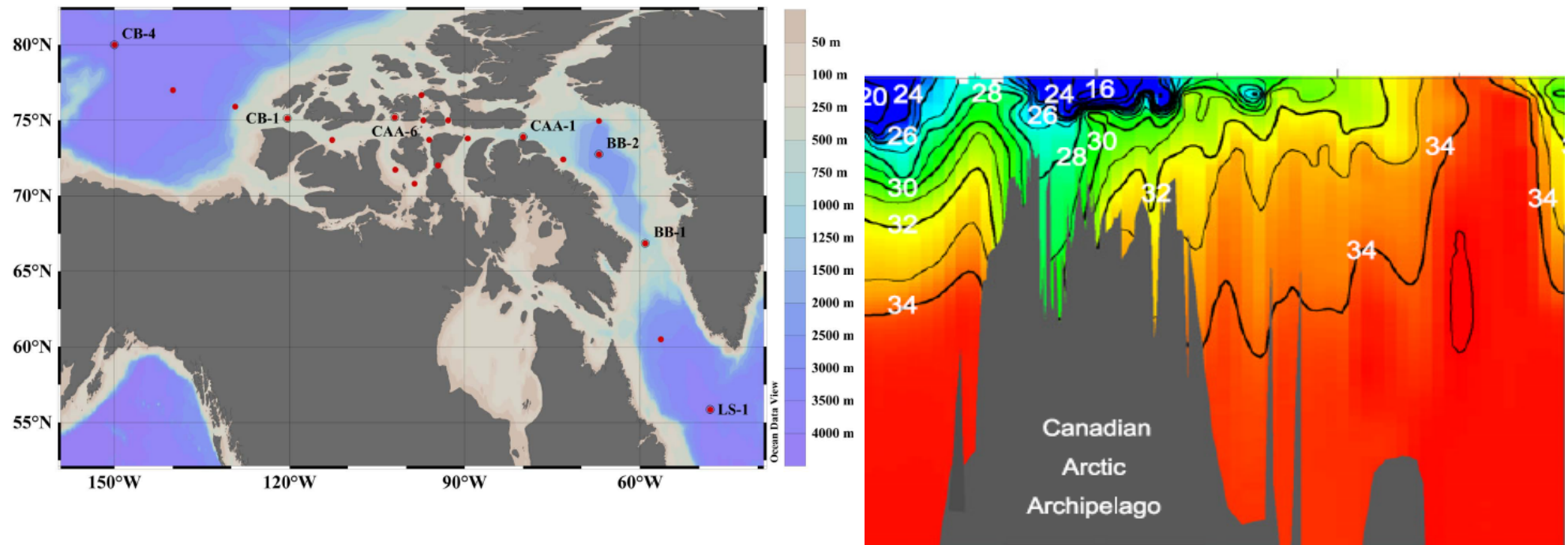
- Labrador Sea - CAA cruise (in collaboration w/  
Arctic Net Program): July 2<sup>nd</sup> to Aug 13<sup>th</sup>
- Canada Basin (in collaboration w/ DFO C30):  
Sept 8<sup>th</sup> to Sept 24<sup>th</sup>

## The multi-disciplinary CAA project augments the core GEOTRACES measurements by:

- (1) developing novel water & circulation tracers to monitor future circulation changes in the CAA,
- (2) assessing the effect of ocean acidification on metal speciation, bioavailability and toxicity
- (3) documenting the effect of TEs on primary and secondary production & trace gas emissions in the CAA, and
- (4) integrating physical, biological and chemical parameters into a numerical model (NEMO+PISCES, Bopp et al., 2005) to predict changes in circulation & productivity in the CAA, their consequences in the N. Atlantic, and globally

# TEIs measured at

- Leg 4B, Canada Basin: 2 deep, 1 to 1200m & 1 to 400m
- Leg 3 Baffin Bay/Labrador Sea: 3 shallow, & 3 deep
- Leg 3 CAA : 3 down to 500m, 6 down to 200m



## 5 THEMES

**Theme 1. Water mass structure and circulation**

**Theme 2. Essential and Toxic Elements**

**Theme 3. Nutrient distributions, biological production, carbon sequestration and climate-active gas fluxes**

**Theme 4. Biological and chemical consequences of ocean acidification**

**Theme 5. Synthesis and modeling (S. Allen, UBC; P. Myers, U. Alberta; N. Steiner, CCCMA)**

# THEME 1

## Water mass structure and circulation

### GEOTRACES core measurements in red

Hydrography (DFO, ArcticNet)

$^{230}\text{Th}$ ,  $^{231}\text{Pa}$  (R. Francois; UBC)

$^{129}\text{I}$  &  $^{137}\text{Cs}$  (J. N. Smith; BIO)

**Nd isotopes** (C. Holmden, U. Saskatchewan; R. Francois, UBC)

**Pb isotopes** (K. Orians; UBC & B. Bergquist, U. of T.)

**Cr isotopes** (C. Holmden, U. Saskatchewan)

$\delta^{18}\text{O}_{\text{H}_2\text{O}}$   $\delta^{13}\text{C}_{\text{DIC}}$  and Ba (A. Mucci, McGill; Thomas, Dalhousie)

ALK, (Mucci, McGill)

trace elements with strong Atlantic-Pacific gradients

(Cd, Ag)

cDOM (C. Geguen; U. Trent)

## THEME 2

### Essential and Toxic Elements

**Fe, Zn, Cu, Cd** (J. Cullen, Uvic)

Pb, Hg, MeHg in air, aerosols, ice, H<sub>2</sub>O (F. Wang; U. Manitoba)

**Cr** (C. Holmden, U. Saskatchewan)

**Al, Mn, Pb, Ga** (K. Orians, UBC)

**Pb isotopes** (K. Orians; UBC & B. Bergquist, U. of T.)

**Nd isotopes** (C. Holmden, U. Saskatchewan; R. Francois, UBC)

**Ra isotopes** (H. Thomas, Dalhousie U.)

Organic complexation (A. Ross, IOS/Uvic)

**Aerosols** (B. Bergquist, U. of T.)

Colloidal Fe (B. Bergquist, U. of T.)



## THEME 3

### Nutrient distributions, biological production, carbon sequestration and climate-active gas fluxes

- $p\text{CO}_2$ ,  $\text{CH}_4$ , DMS,  $\text{N}_2\text{O}$ ,  $\text{O}_2/\text{Ar}$  (Tortell, UBC; Thomas, Dal)
- triple O isotopes (R. Hamme, U. Vic.)
- DIC, ALK, pH,  **$\text{d}^{13}\text{C-DIC}$**  (A. Mucci, McGill)
- $^{234}\text{Th}$  (L. Miller; IOS; DFO)
- macronutrients & relevant stable isotopes  
( **$\text{d}^{15}\text{N-nitrate}$** , M. Kienast; Dalhousie U;  
Silicon isotopes, D. Varela; U. Vic)
- **Fe isotopes** (Bergquist; U. Toronto)
- phytoplankton pigments (Maldonado, UBC)
- $\text{N}_2/\text{Ar}/\text{Kr}/\text{Xe}$  (R. Hamme; U. Vic)

## THEME 4

# Biological and chemical consequences of ocean acidification

pH, ALK, DIC, trace elements and isotopes,  
Underway surface sampling & depth profiles  
Manipulation experiments

- Biota-trace element interactions (Maldonado, UBC):
  - Size-fractionated particles (Go-Flo & MacLane; ICPMS)
  - Rates of trace metal uptake ( $^{14}\text{C}$ ,  $^{55}\text{Fe}$ )
- Primary production (Tortell/Maldonado/Varela):
  - ( $^{13}\text{C}$ ,  $^{15}\text{N}$ ,  $\text{O}_2/\text{Ar}$ ), Si uptake, C:N:Si uptake ratios
- Phytoplankton biomass & sps composition (Maldonado, UBC):
  - Microscopy, HPLC pigments, flow cytometry
- Photosynthetic competence (Maldonado, UBC)
- Bacterial productivity (R.Rivkin, Memorial Univ.)

# BioGEO TRACES

- Proteomics, genomics (Maldonado, UBC; Rivkin, Memorial)
- Trace metals in size-fractionated particles (Maldonado, UBC)

- Dissolved trace metal concentrations: Fe, Al, Mn, Cu, Zn, Cd, Pb, THg (MeHg), Ag, Ba, Cr,
- Dissolved  $^{129}\text{I}$ ,  $^{230}\text{Th}$ ,  $^{231}\text{Pa}$ ,  $^{234}\text{Th}$  concentration
- Radiogenic Pb and Nd isotopes
- N stable isotopes in nitrate,  $\delta^{18}\text{O}$ , Si isotopes
- Carbon stable isotopes in DIC
- Marine particles (R. Francois, UBC)
- Aerosols (B. Bergquist; U. Toronto)
- Ra, Fe, and Cr isotopes
- $p\text{CO}_2$ ,  $\text{CH}_4$ , DMS,  $\text{N}_2\text{O}$ ,  $\text{O}_2/\text{Ar}$ , triple O isotopes, DIC, ALK, pH
- $\text{N}_2, \text{Ar}, \text{Kr}, \text{Xe}$ ,  $\text{N}_2/\text{Ar}$ , triple O isotopes