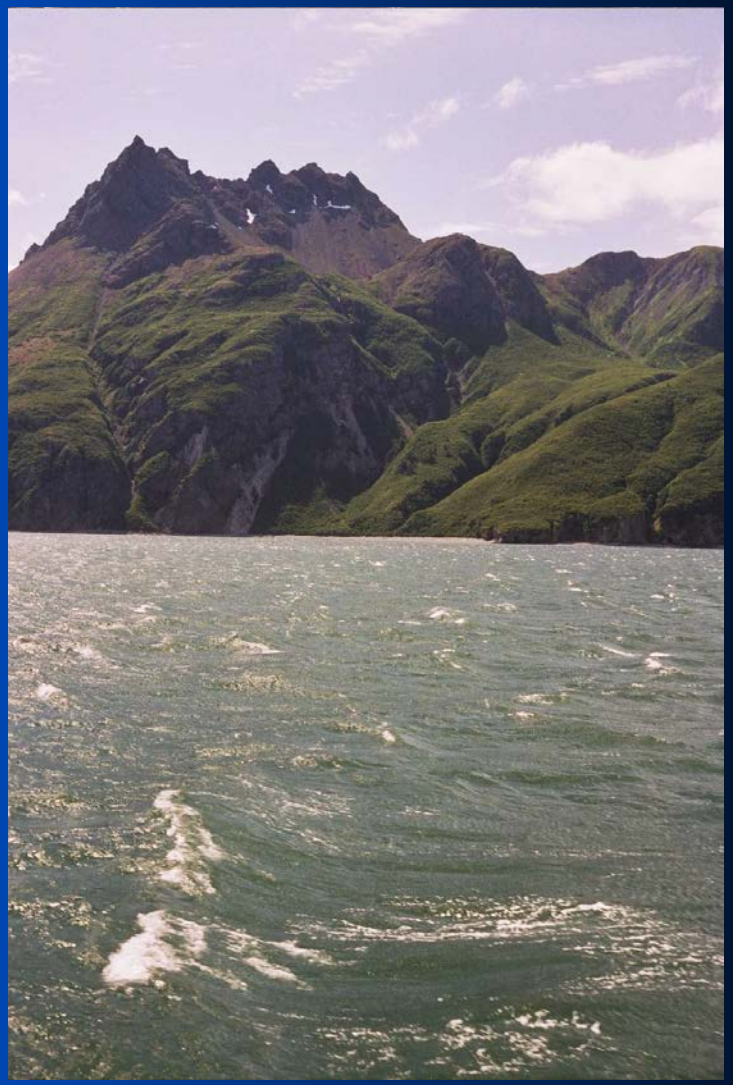
Iniskin – Iliamna Estuary Oceanography and Water Quality

Investigators:

J. P. Houghton and A. L. Stutes

Pentec Environmental/
Hart Crowser

February 2, 2012



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Study Goals

- Describe existing conditions
  - Oceanography
  - Water Quality
- Develop baseline for long-term monitoring
  - Water Quality
  - Sediment Chemistry
  - Tissue Chemistry

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Study Objectives

- Describe physical oceanography of Iniskin – Iliamna Estuary (IIE) and driving factors, based on existing information
- Compile field data on water quality in support of fishery investigations

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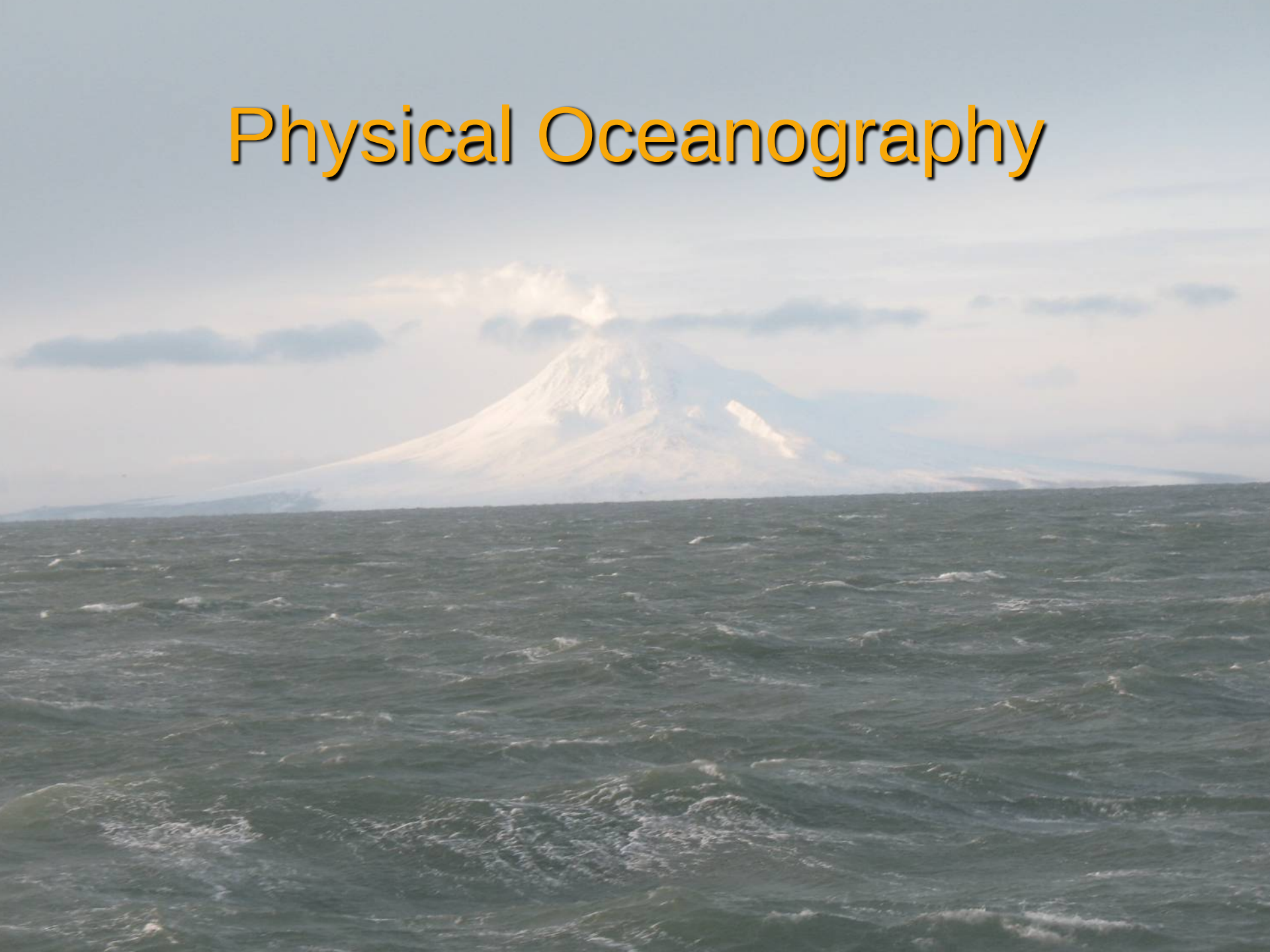
Physical Oceanography



Cook Inlet

Iniskin/Iliamna

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Basin Morphology

	Length (km)	Width (km)	Depth (m) Typ	Max
Cook Inlet	370	70 to 90	60	200
Iliamna Bay	8, 12*	2 to 3	4	12
Iniskin Bay	17	4	2	24

* Cottonwood Bay, 8 km; Iliamna Bay, 12 km

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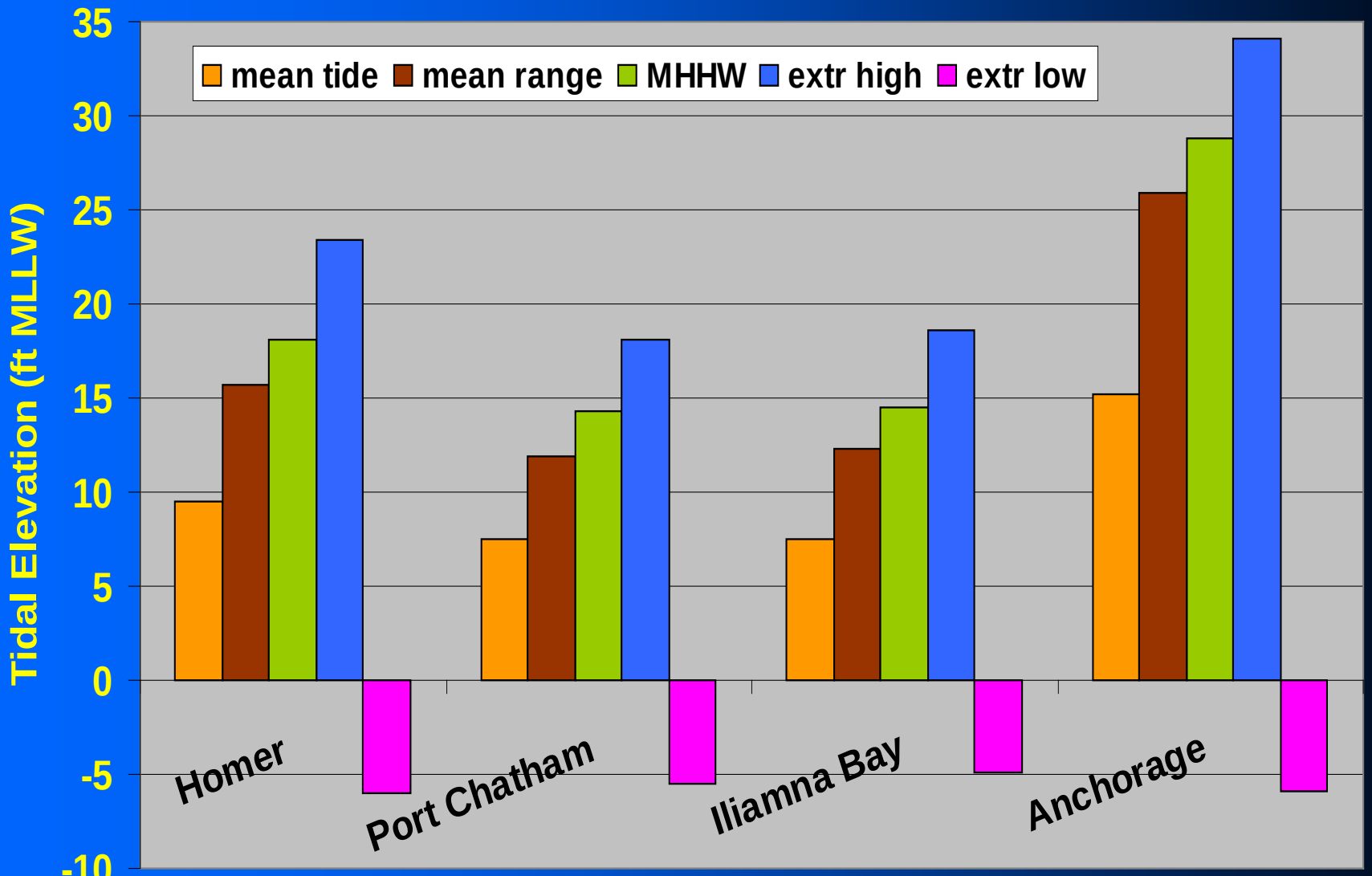
Cook Inlet Tides



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Currents Near IIE

	Flood			Ebb		
	mean	max	dir^{o}	mean	max	dir^{o}
Chinitna Pt (SE)	1.3	2.4	021	-1.3	-2.5	209
Iniskin Bay	0.9	1.2	358	-1.2	-2.5	179
Augustine Is (NW)	0.6	1.2	060	-1.0	-1.9	229

Current speed in kts

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General Circulation in Lower Cook Inlet

- Rips develop with current shears, collect debris
- Mid-channel Rip: well developed, major feature north of Iniskin Bay (Anchor Point)
- Mid-channel Rip: weakly developed in south, follows ~10-m contour in Kamishak Bay (south)
- East and West Rips less well developed in north

(Dave Burbank 1977)

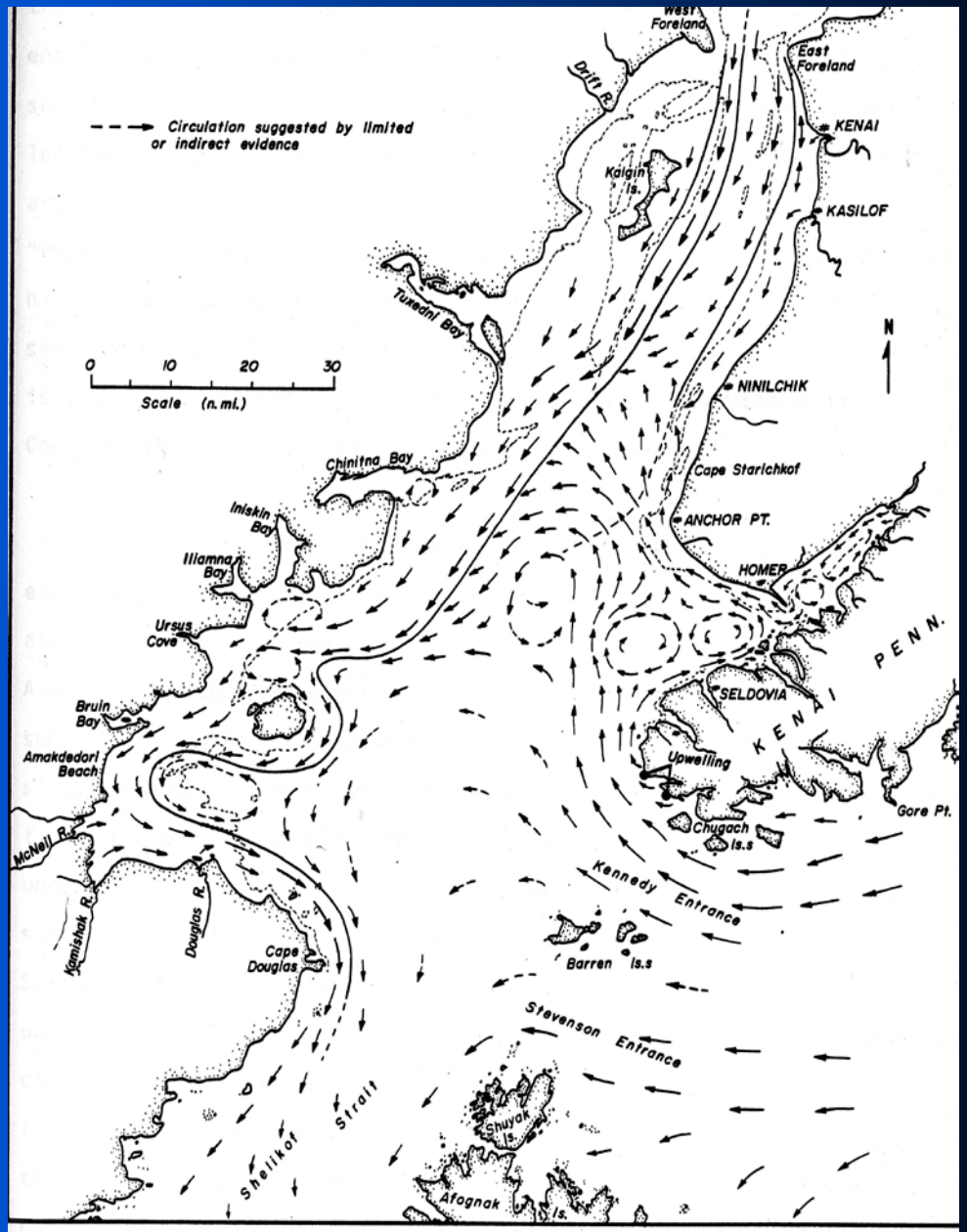

Figure 97. Net surface circulation in Lower Cook Inlet, based primarily on data collected during the spring and summer seasons.

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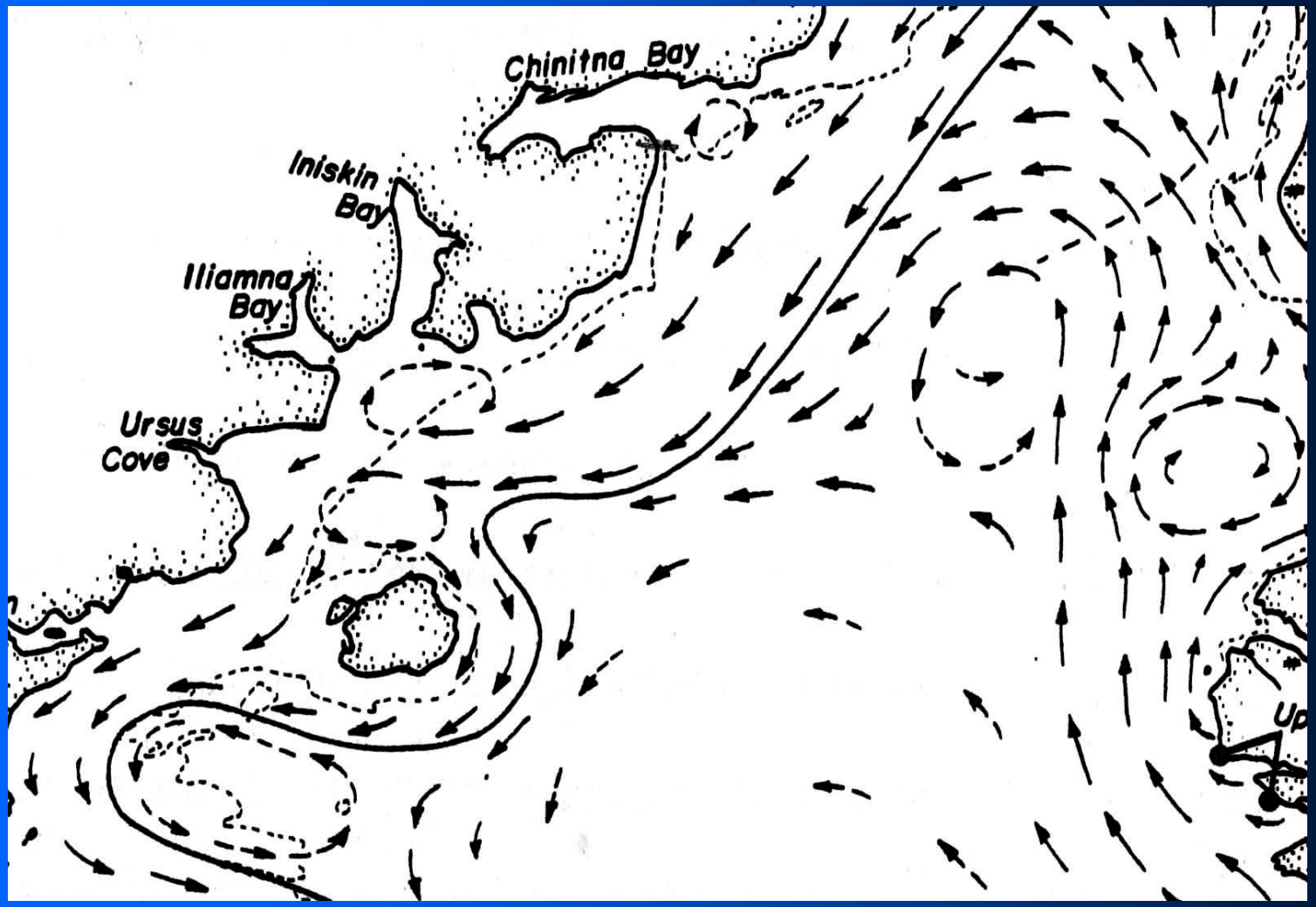
Detail of IIE (From Burbank 1977)



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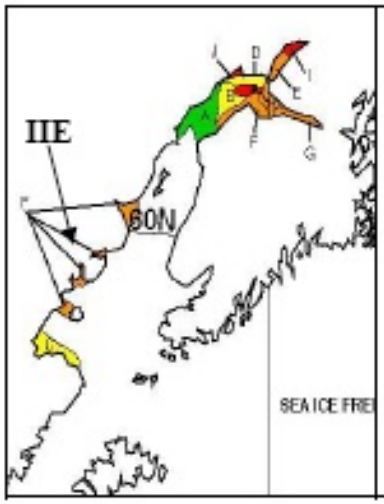
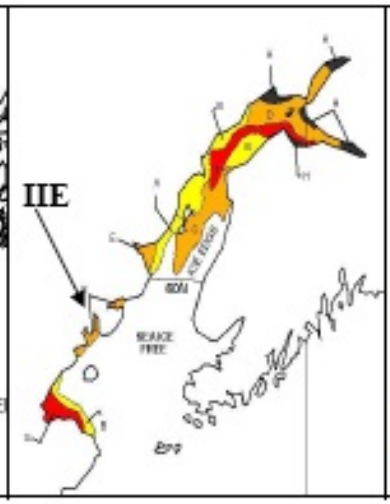
Ice

Cook Inlet Ice Conditions

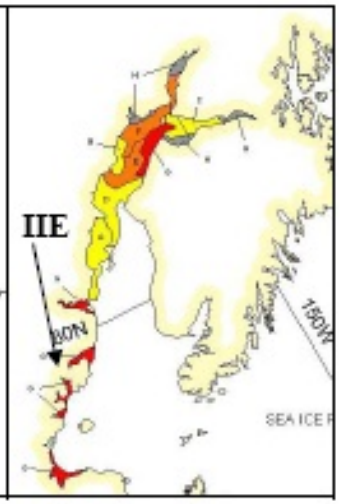
(Max. extent of ice pack – Source: NIC 2009)



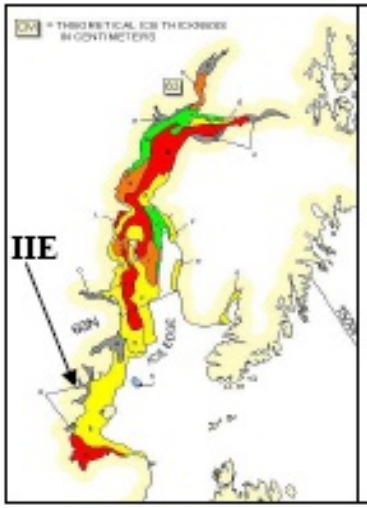
January 19, 2001



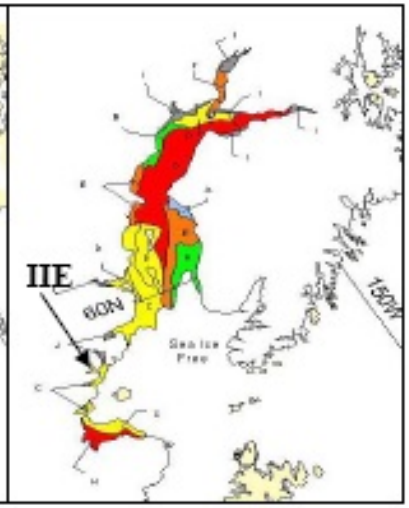
February 22, 2002



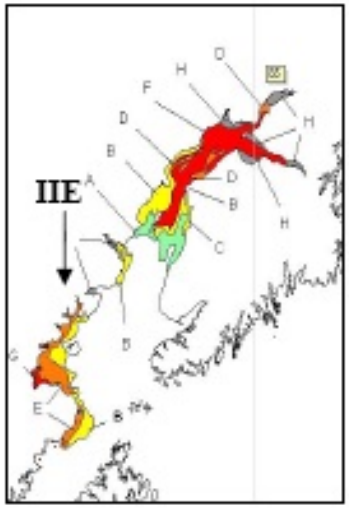
January 24, 2003



February 6, 2004



February 7, 2005



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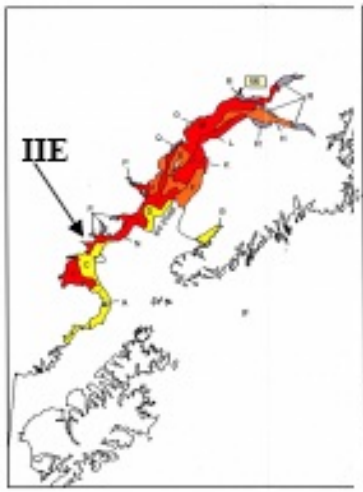
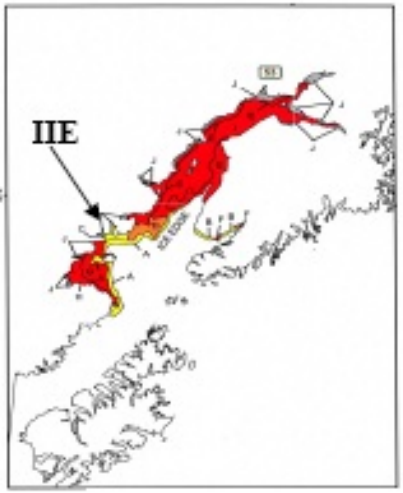


January 19, 2007

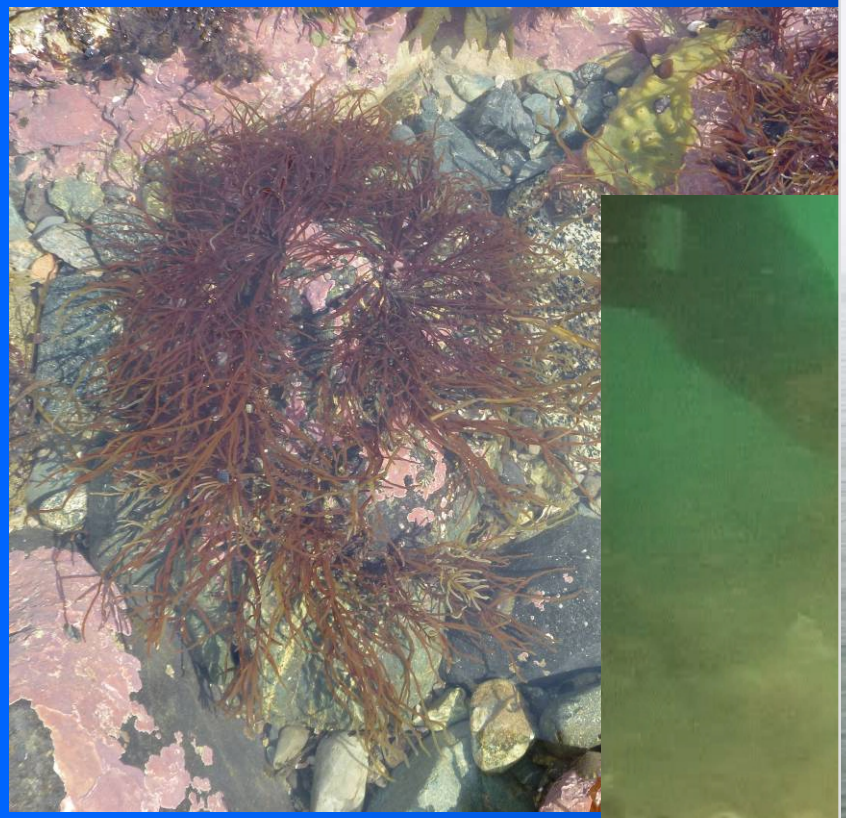


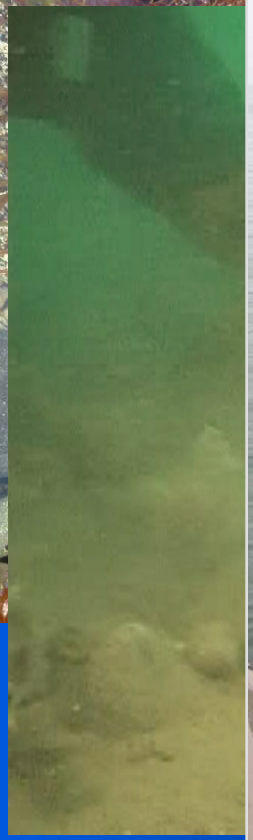
February 4, 2008

FIGURE 34-5a, Maximum Extent of Ice Pack in Cook Inlet, 2001-2008

Notes: Not to scale.
Source: NIC, 2009.
IIE: Iniskin/Iliamna Estuary

Water Quality





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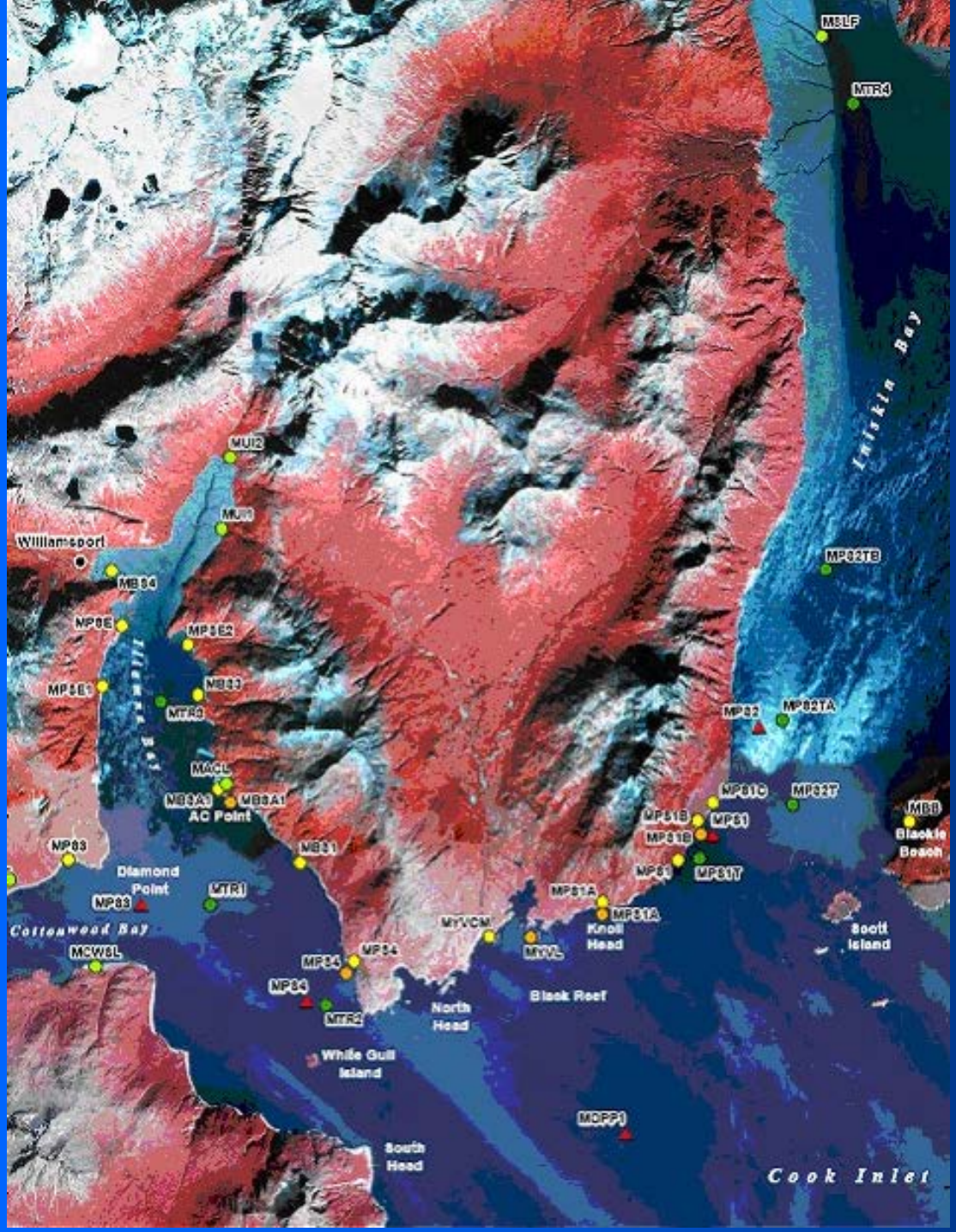

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Figure 34-4
Water Quality Station Locations, Marine Waters, Cook Inlet, 2004-2008

File: RDI_Pen_Seine_Trawl_Fig34-4_111013P_1of1_D66.mxd	Date: July 6, 2011
Version: 6	Author: RDI - LS

Legend

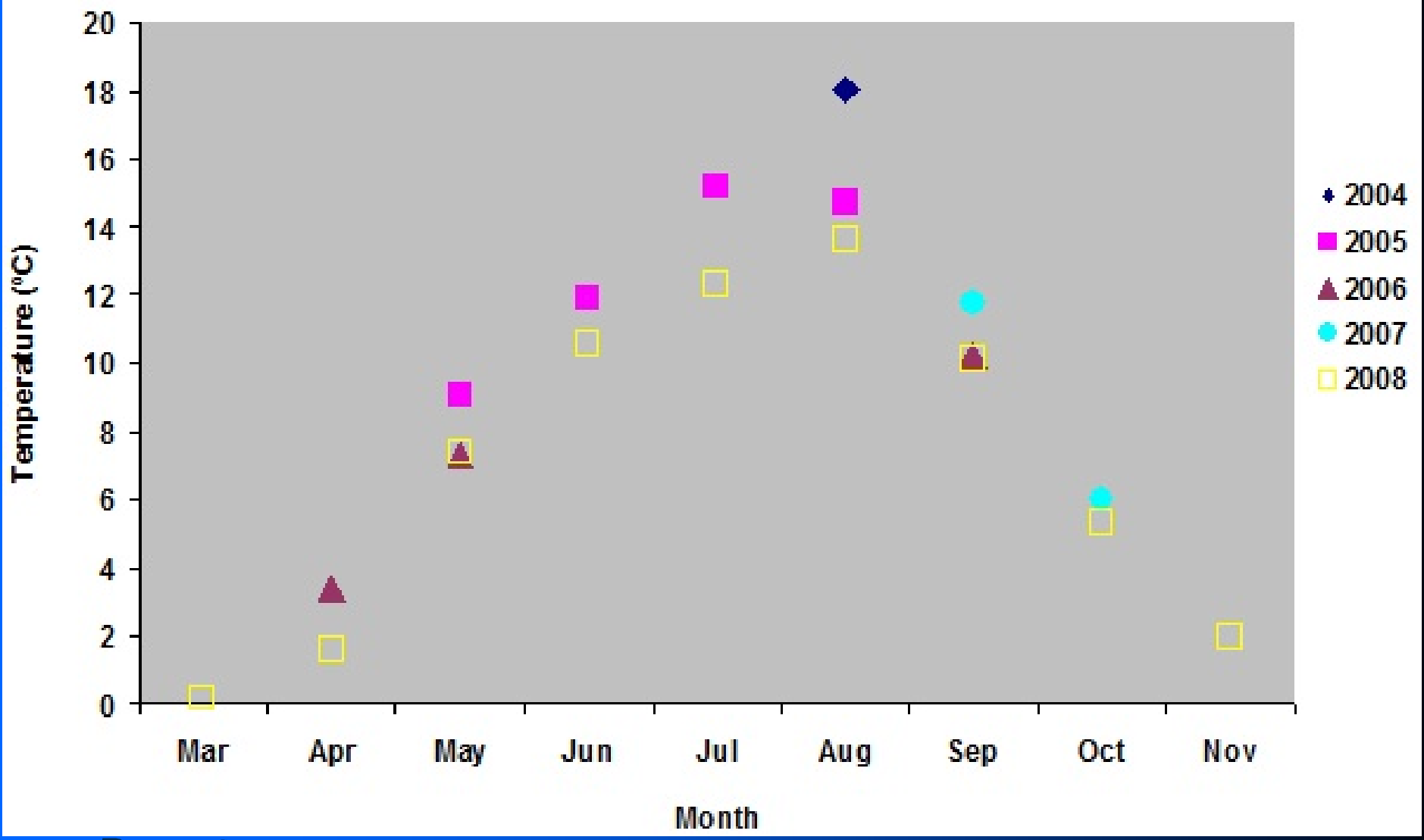
Sampling Locations

- 120-ft Beach Seine
- 30-ft Beach Seine
- Gill/Trammel Net
- Trawl
- Water Chemistry
- MTS4 — Station Identification Label Example
- Existing Community

Miles: 0 0.5 1 1.5 2
Kilometers: 0 0.5 1 1.5 2 2.5
Scale 1:55,000
Alaska State Plane Zone 5 (units feet)
1983 North American Datum

Station Locations

Mean Temperature by Month



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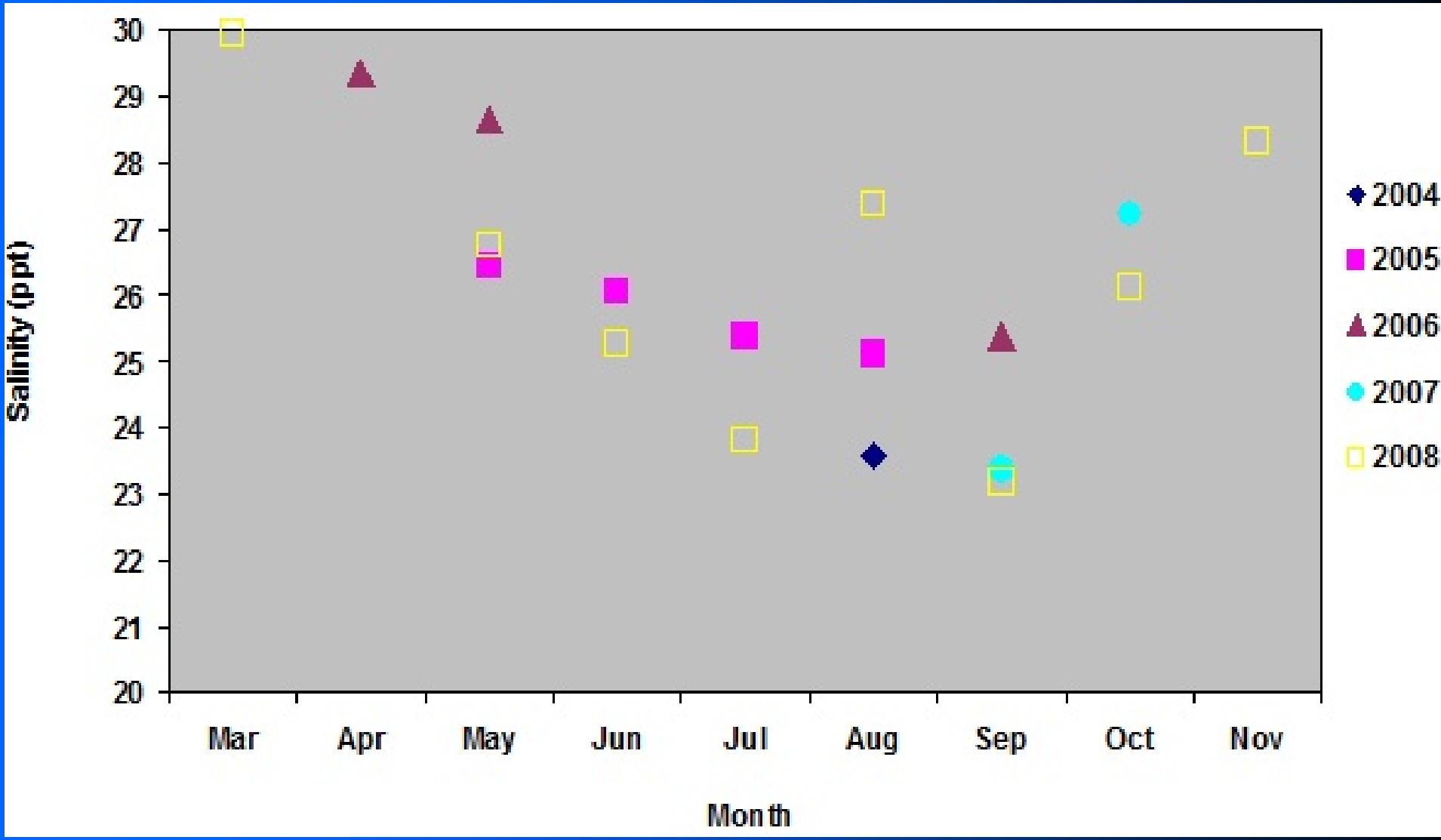
Mean Salinity by Month



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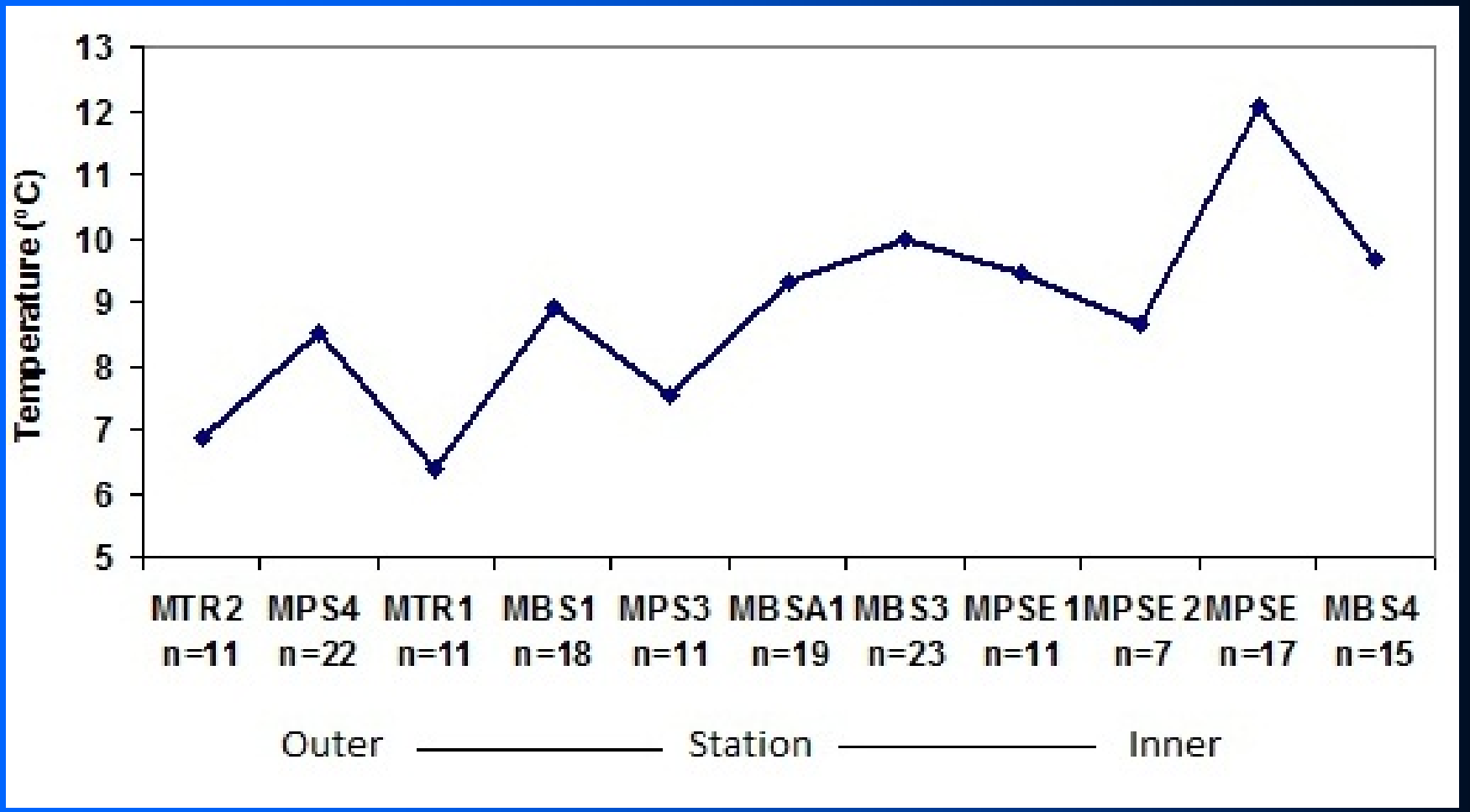
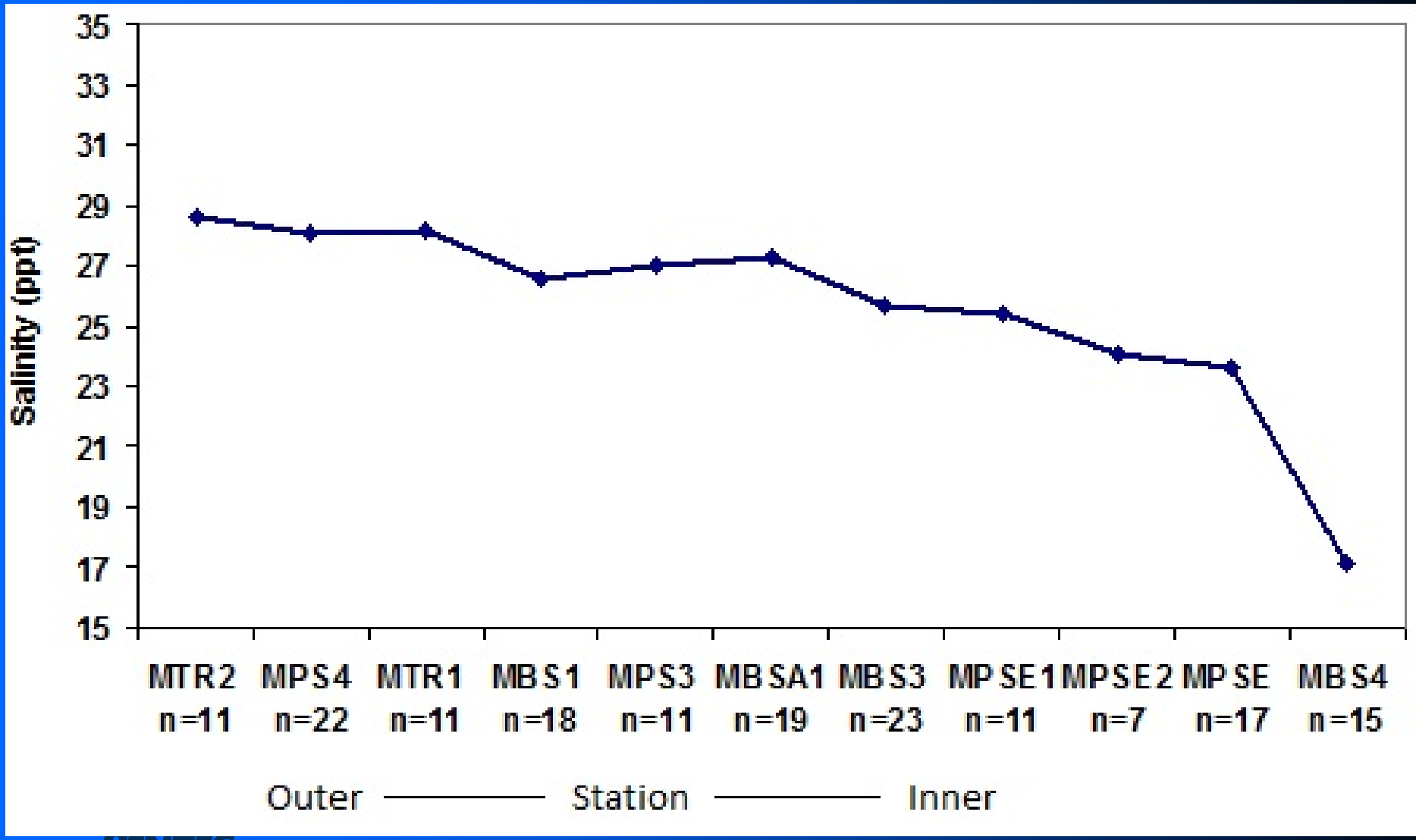
Reflects upper inlet water

Mean Temperature in Iliamna Bay



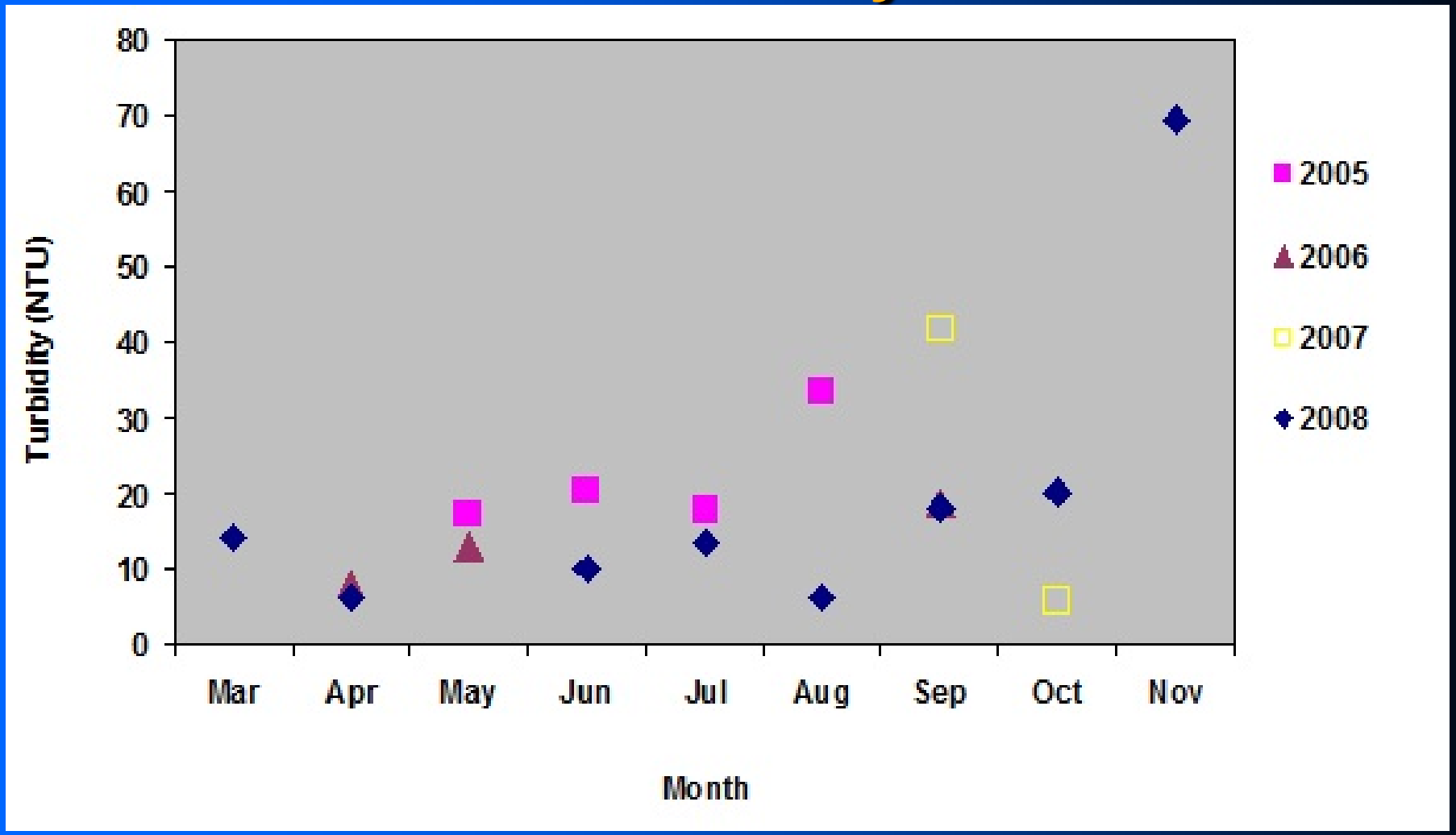
PENTEC ENVIRONMENTAL

Mean Salinity in Iliamna Bay



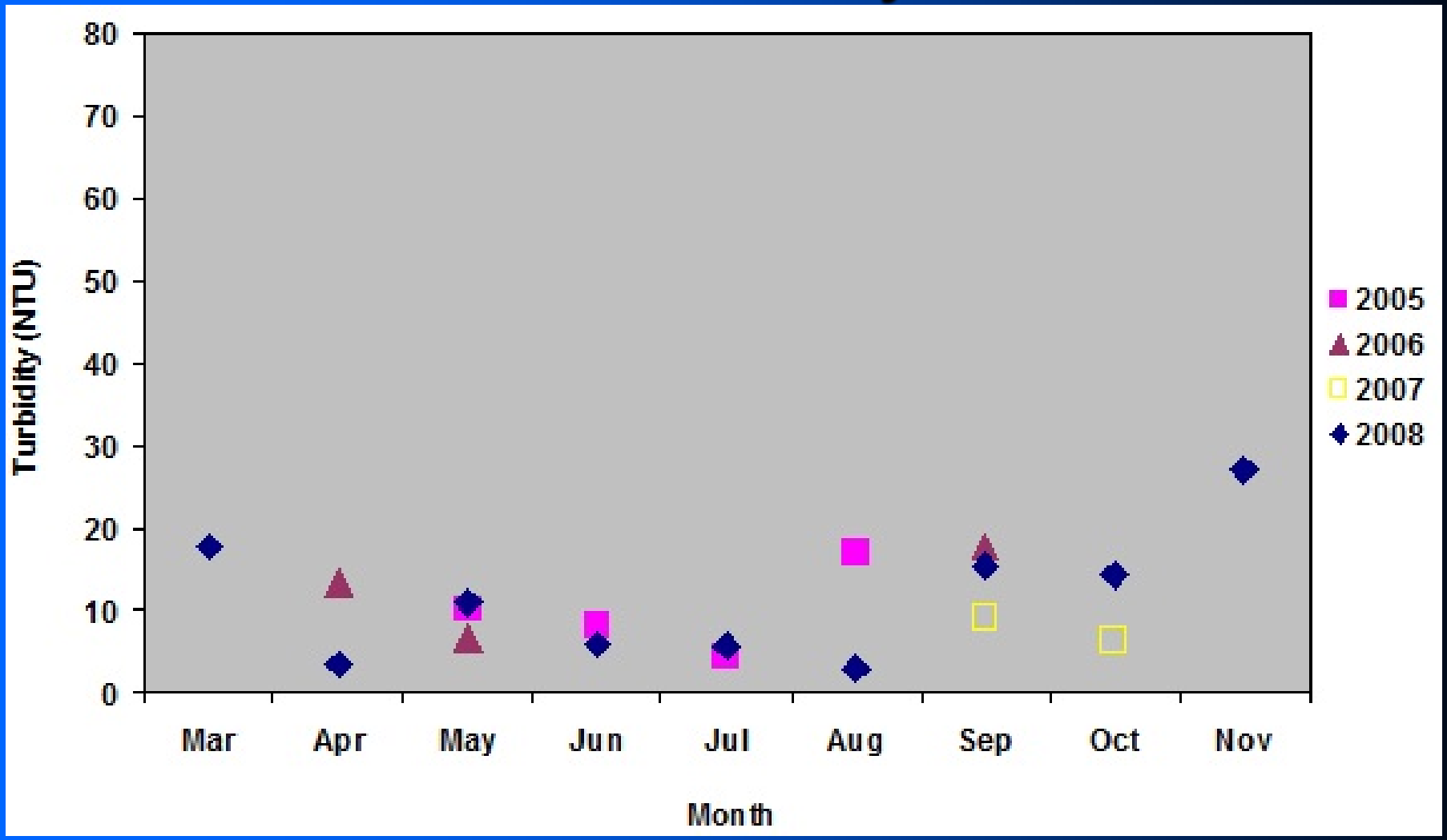
PENTEC ENVIRONMENTAL

Mean Turbidity by Month, Iliamna Bay



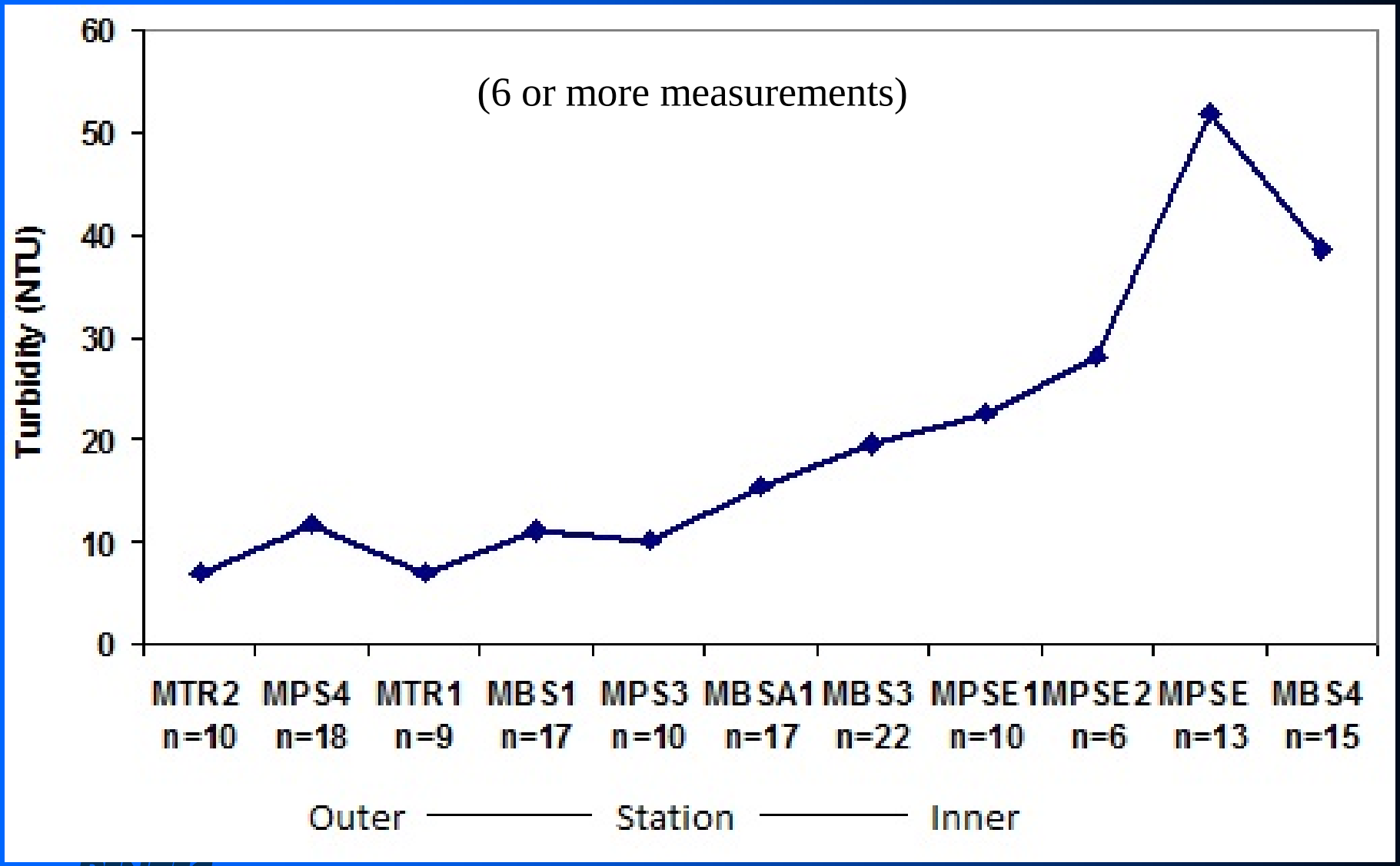
PENTEC ENVIRONMENTAL

Monthly Mean Water Turbidity, Iniskin Bay



PENTEC ENVIRONMENTAL

Mean Turbidity in Iliamna Bay



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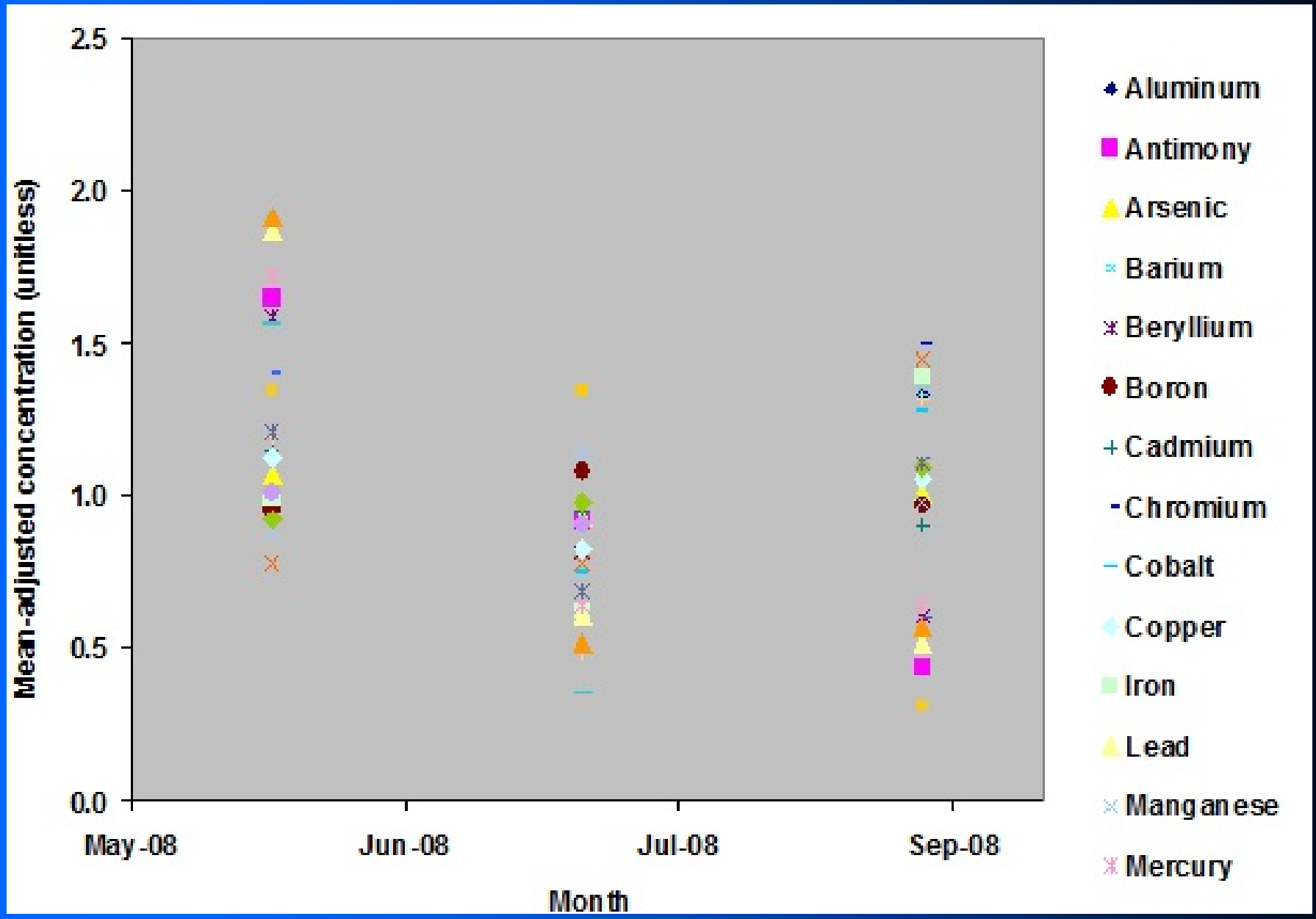
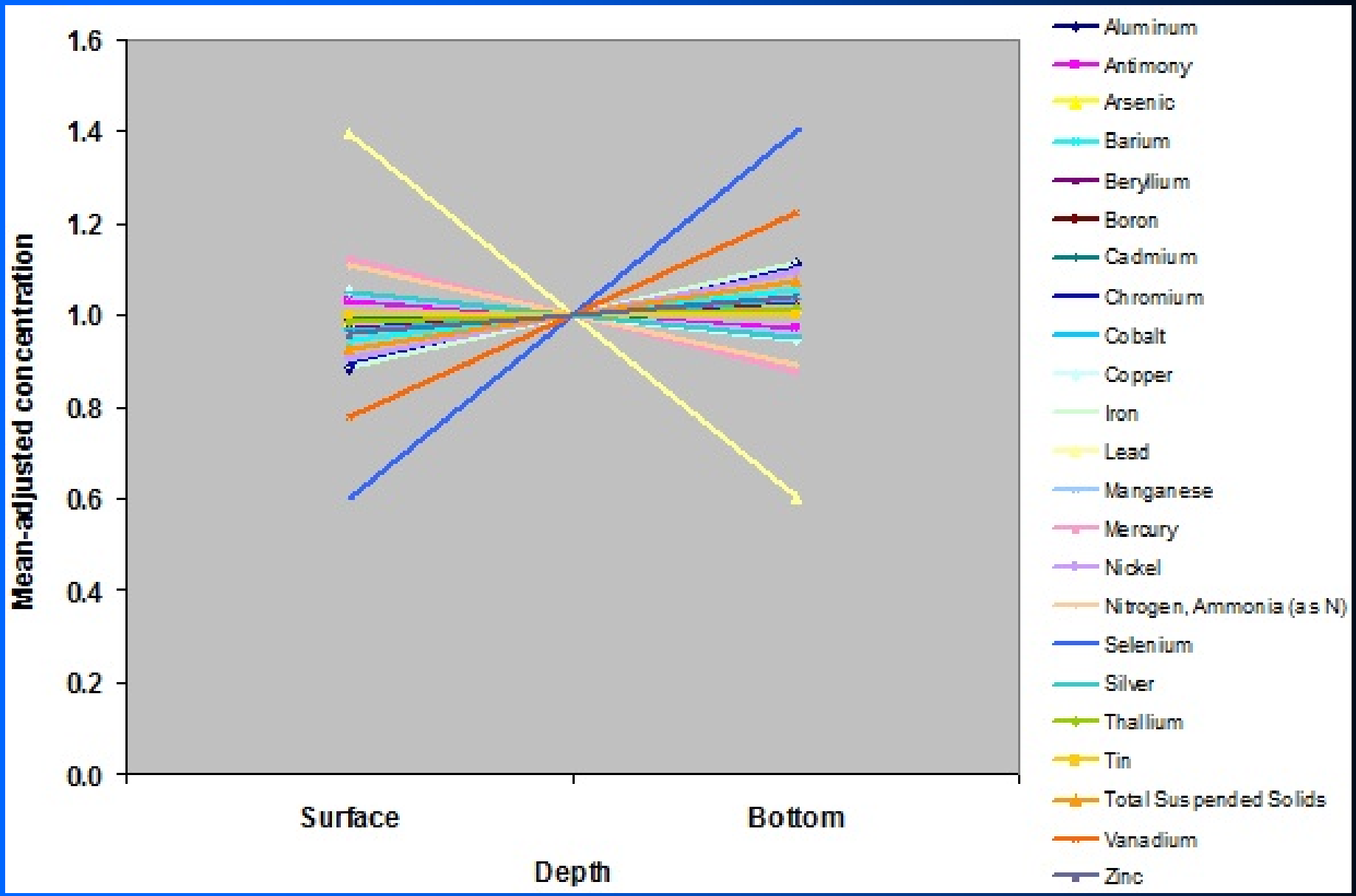
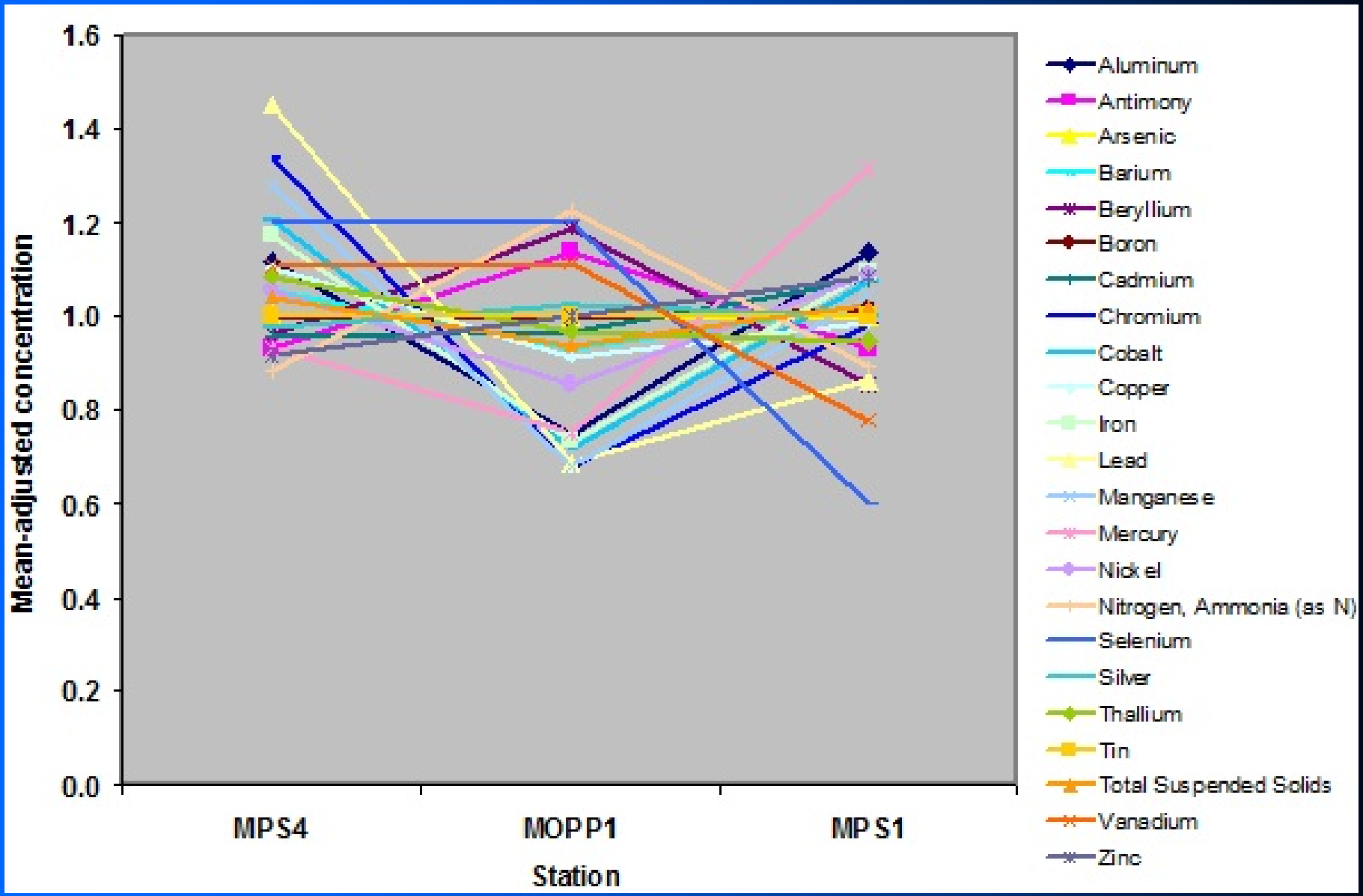
Water Chemistry - Season



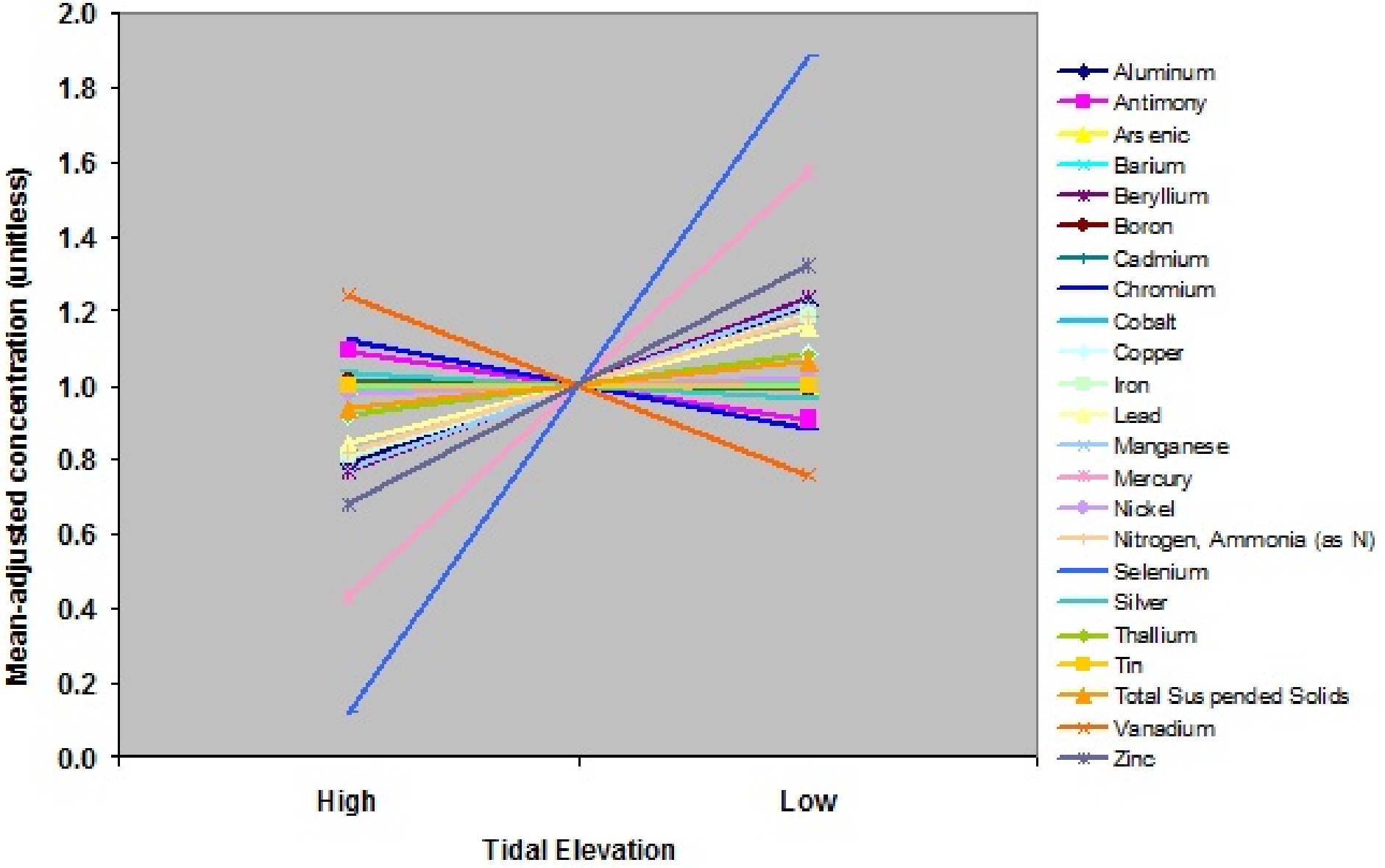
Water Chemistry - Depth



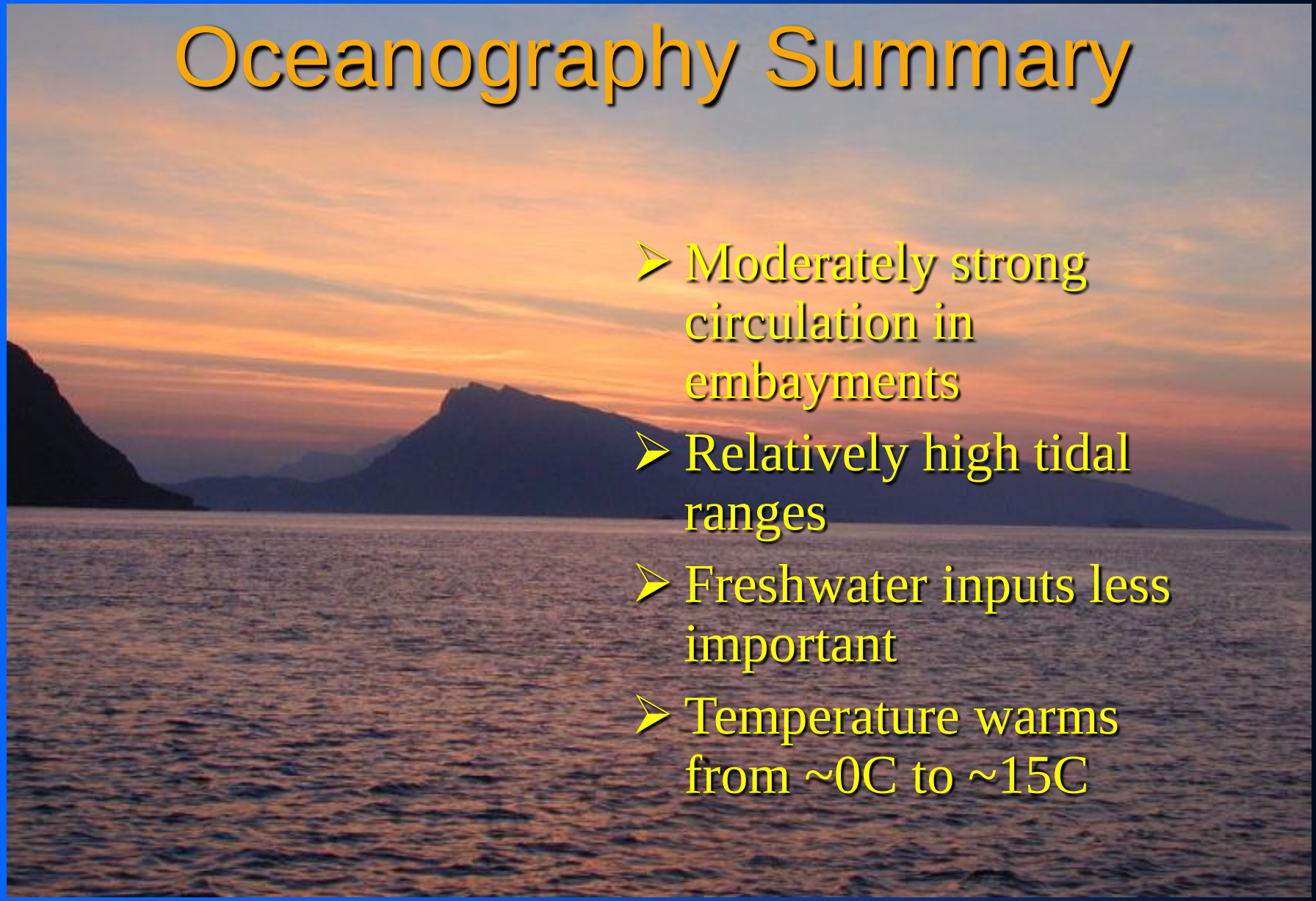
Water Chemistry – Station



Water Chemistry – Tide stage



Oceanography Summary



- Moderately strong circulation in embayments
- Relatively high tidal ranges
- Freshwater inputs less important
- Temperature warms from ~0C to ~15C

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Sediment Quality

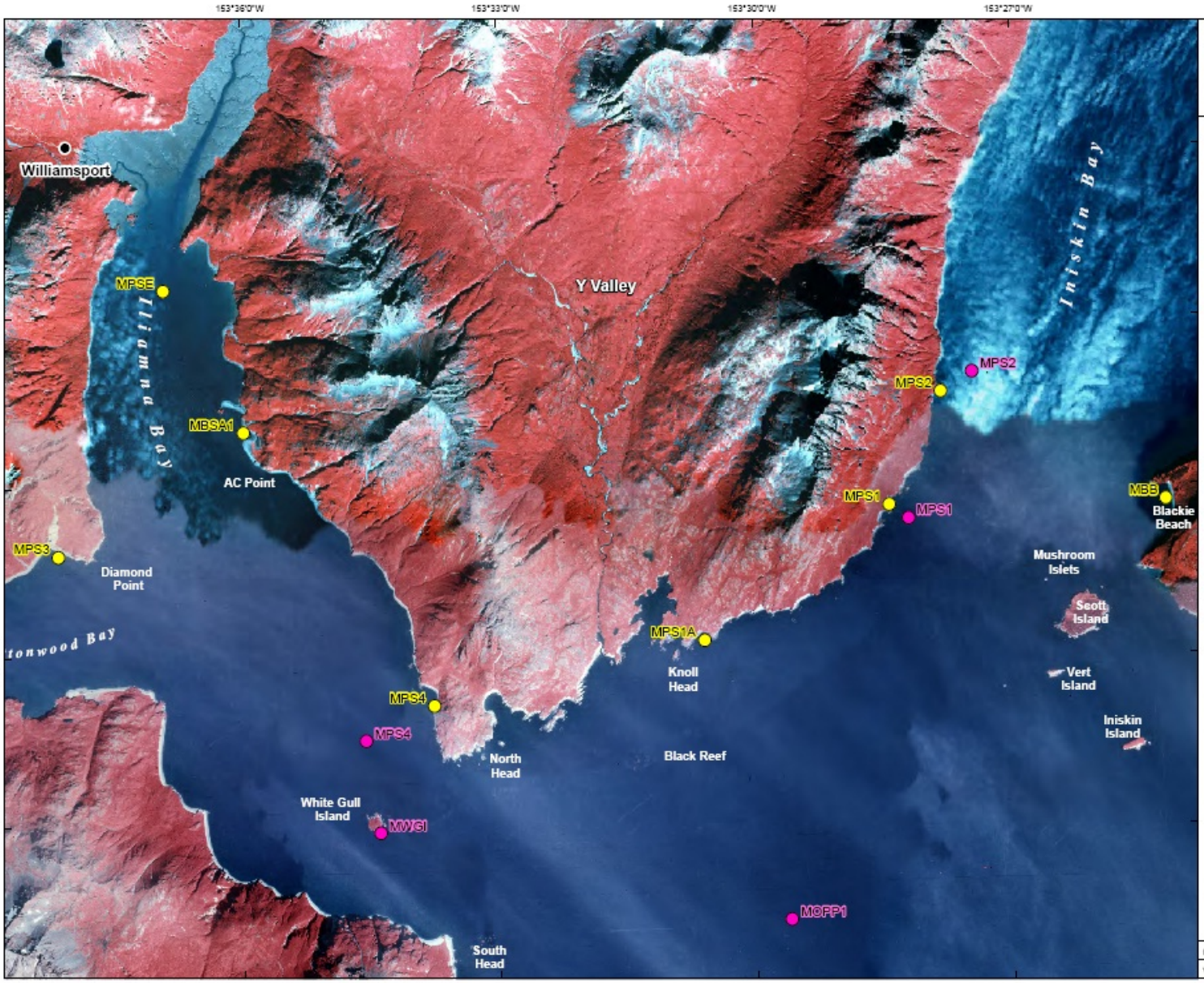

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Figure 35.4-2a
Trace Elements Study,
Sampling Stations for Marine Sediment,
2004-2008

Legend

- Intertidal Sediment Station
  - MPS2 Intertidal Station Identification Code Example
- Subtidal Sediment Station
  - MPS2 Subtidal Station Identification Code Example
- Existing Community

Note:
Sampling locations varied slightly for each sampling event; therefore, station locations depicted here are approximate.

Miles 0 0.5 1 1.5
Kilometers 0 0.5 1 1.5 2
Scale 1:41,323

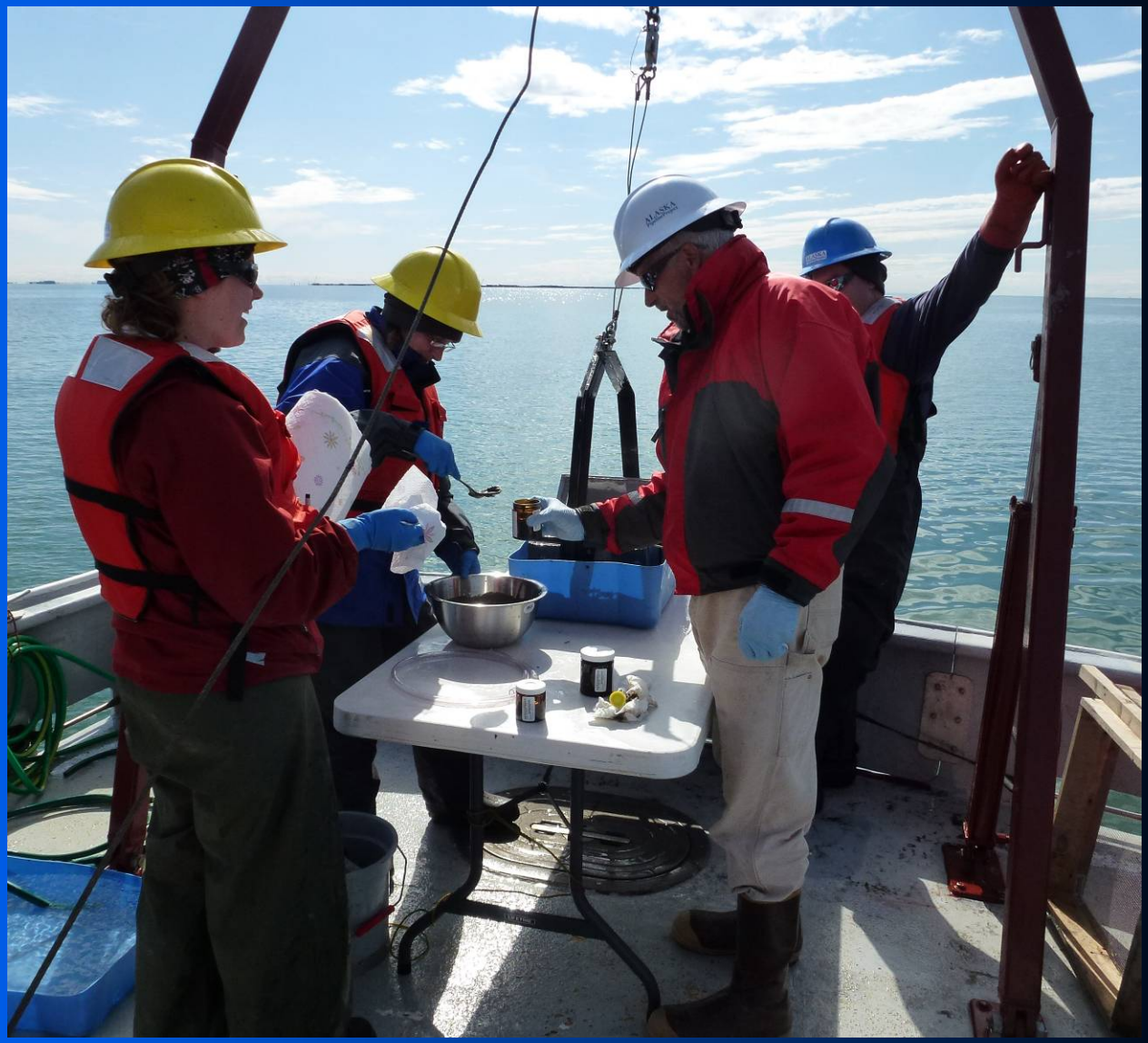
Alaska State Plane Zone 5 (units feet)
1983 North American Datum

File: RDI_Pen_Fig35-4-2a_11X17L_1of1_D01.mxd	Date: June 28, 2011
Version: 1	Author: RDI-LS

Sediment Quality

Methods

- 0.1-m^2 van Veen
- Sample top 4 cm
- Sample below 10 cm



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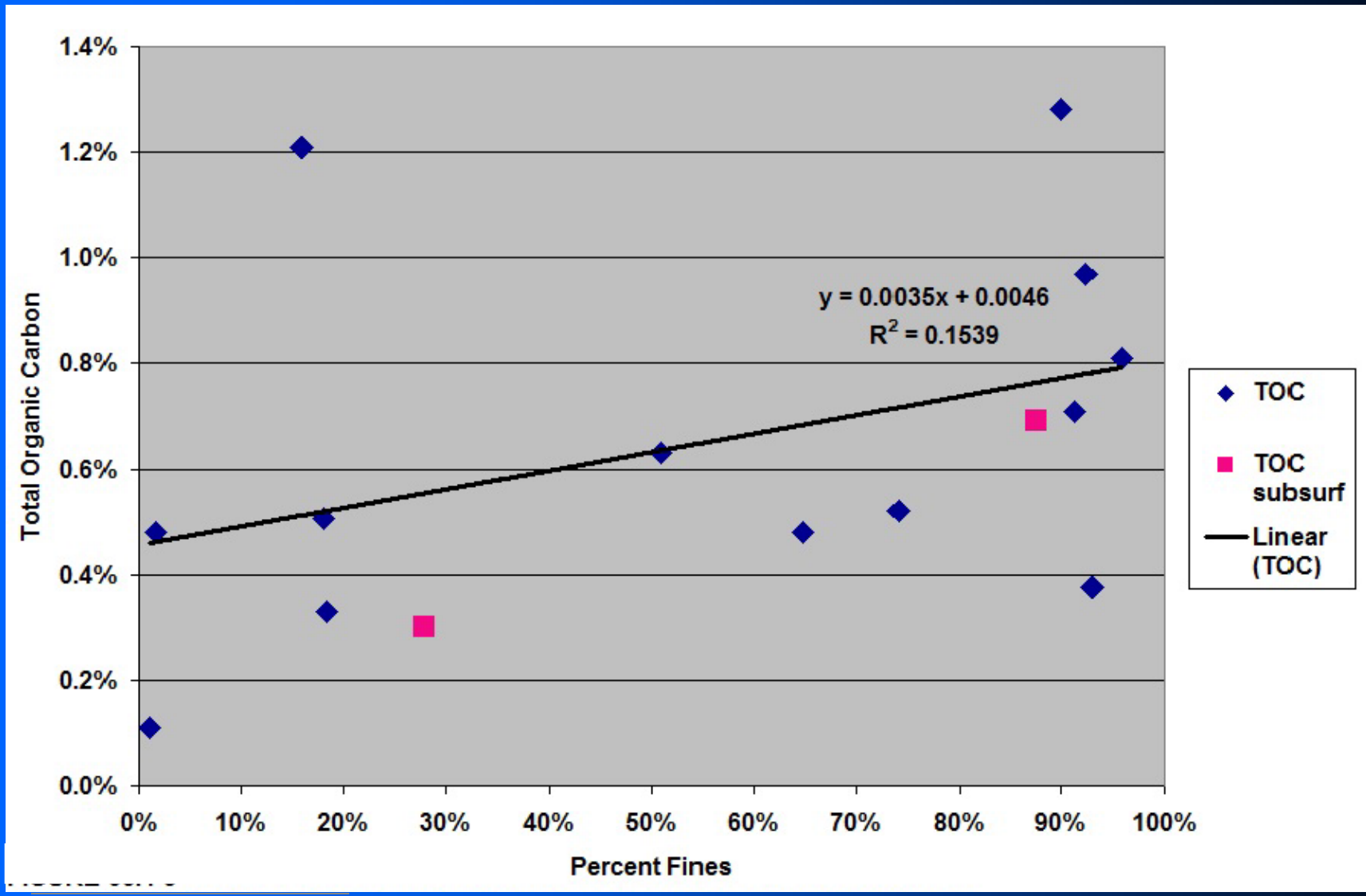
TOC on Fines - Intertidal



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Sediments highly variable

TOC on Fines - Subtidal

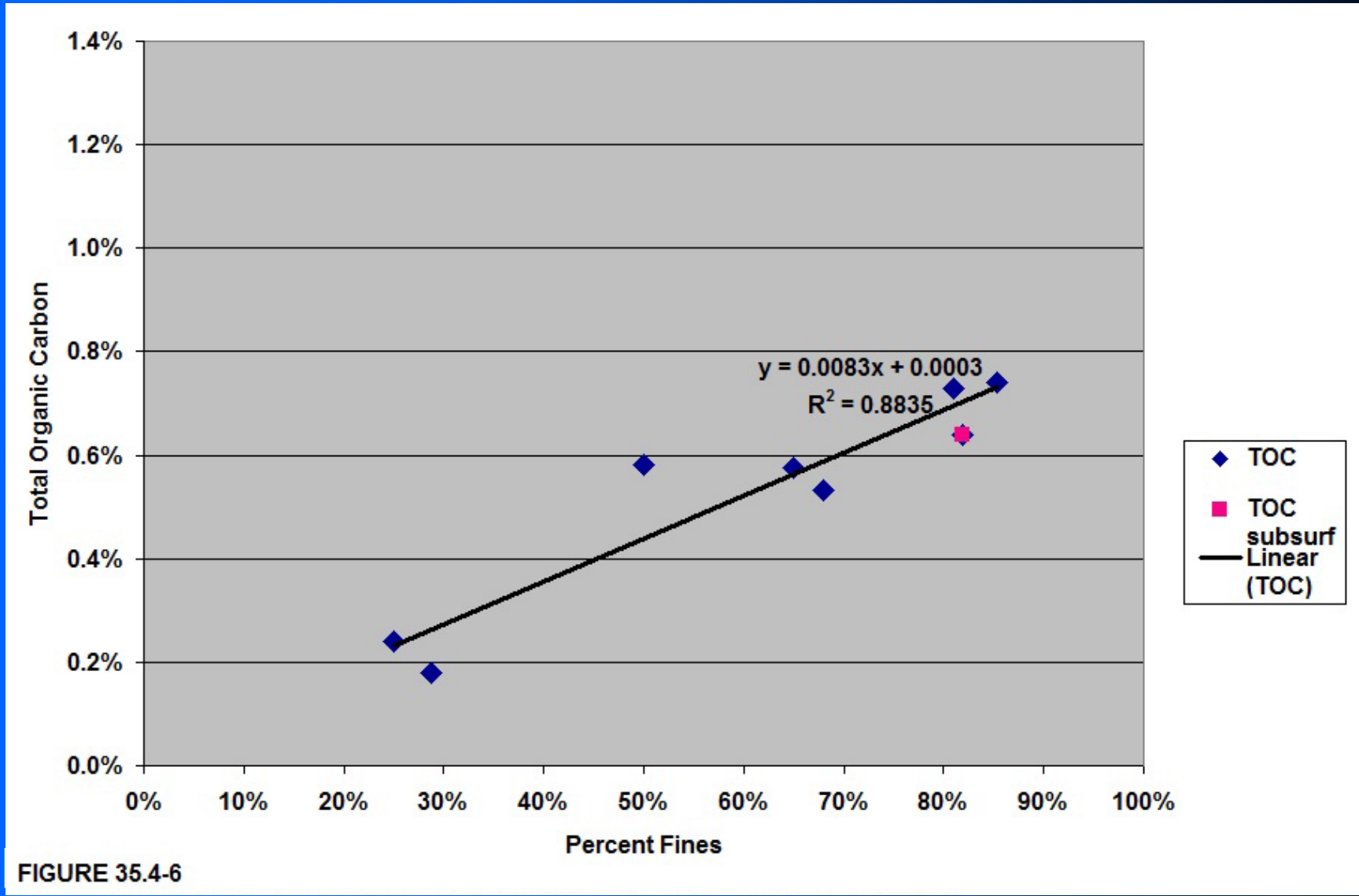

FIGURE 35.4-6

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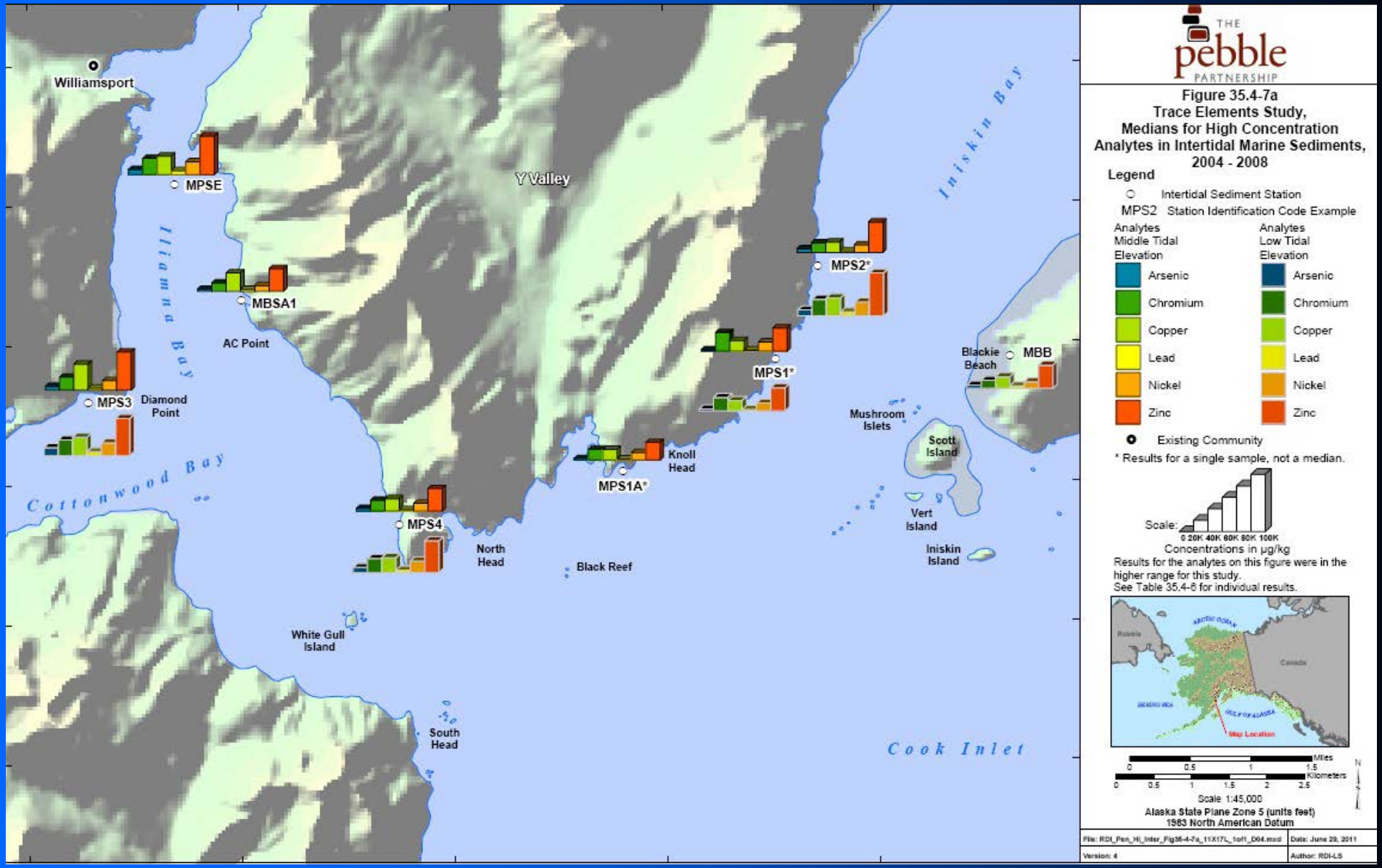
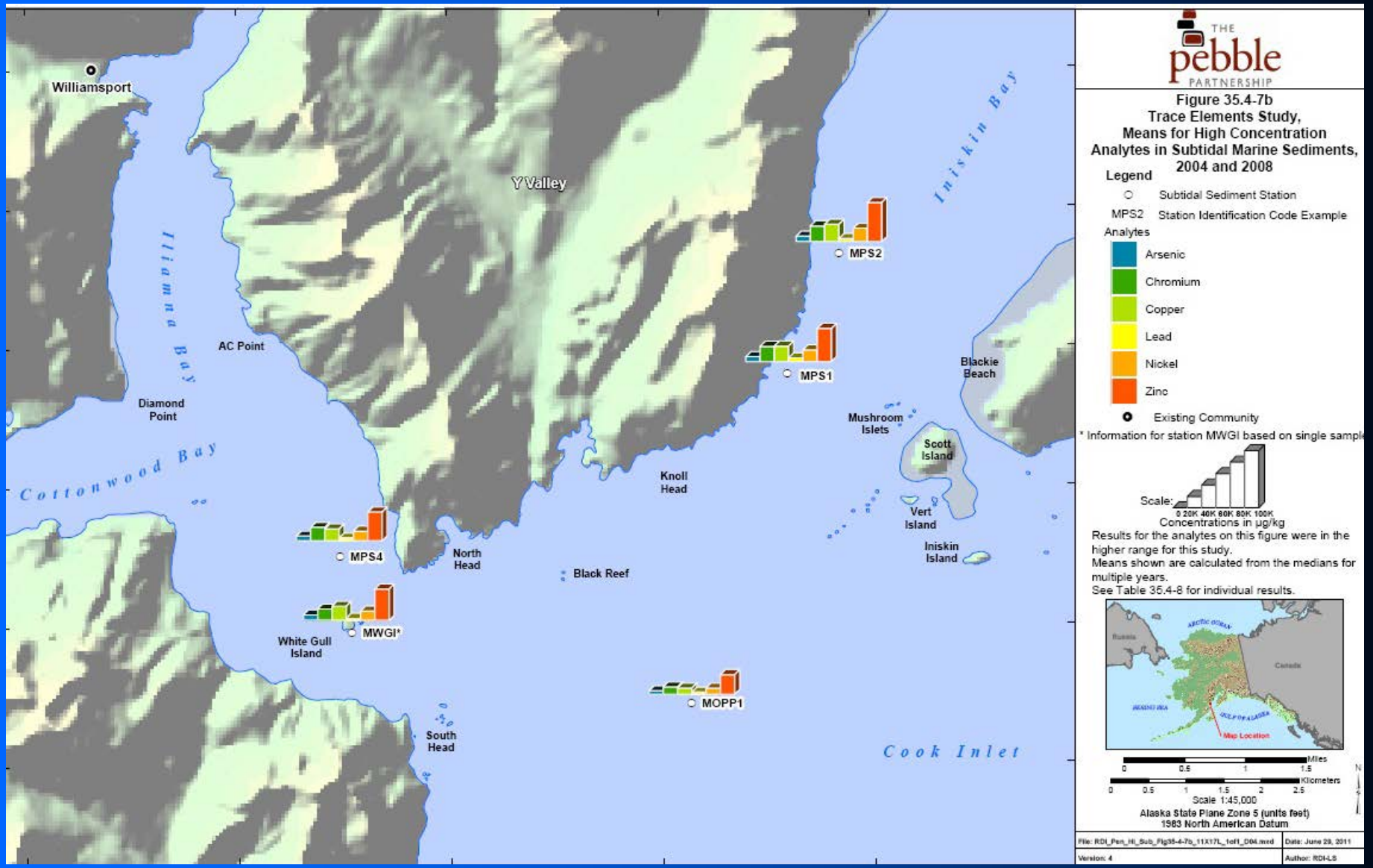
Sediments more uniform

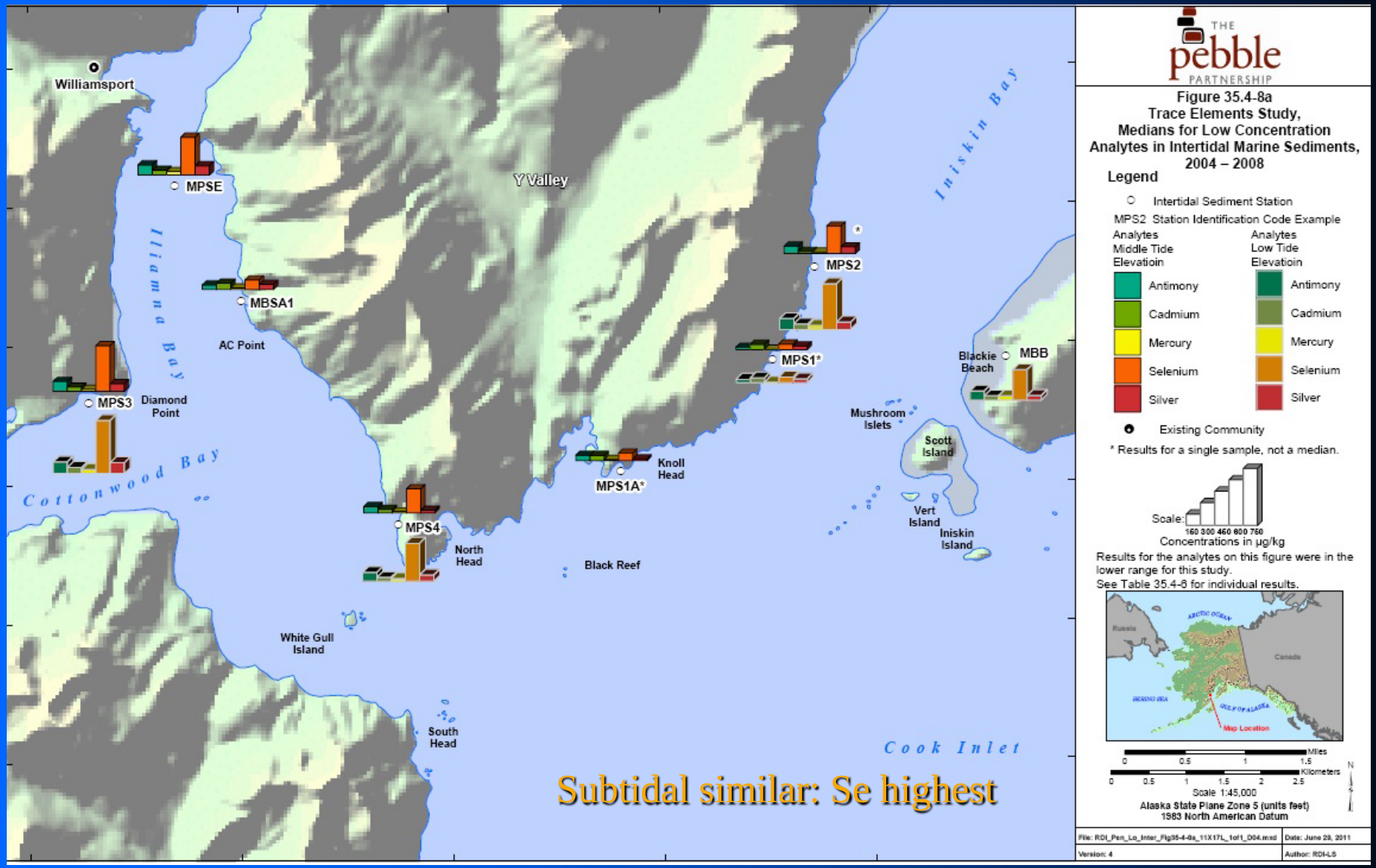
Intertidal Trace Elements (high range)



Subtidal Trace Elements (high range)



Intertidal Trace Elements (low range)



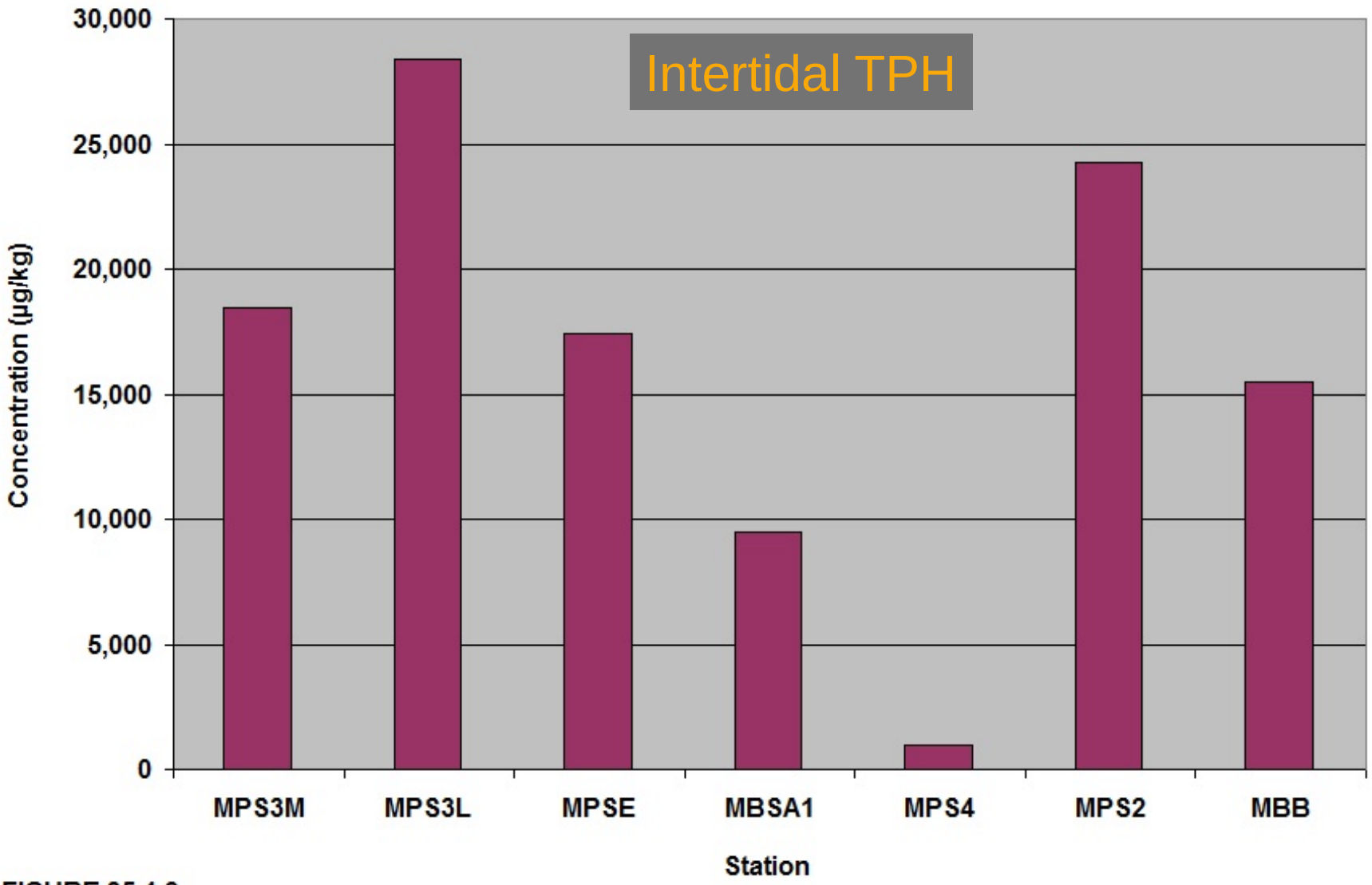


FIGURE 35.4-9
Total Petroleum Hydrocarbons in Intertidal Sediments, July 2008

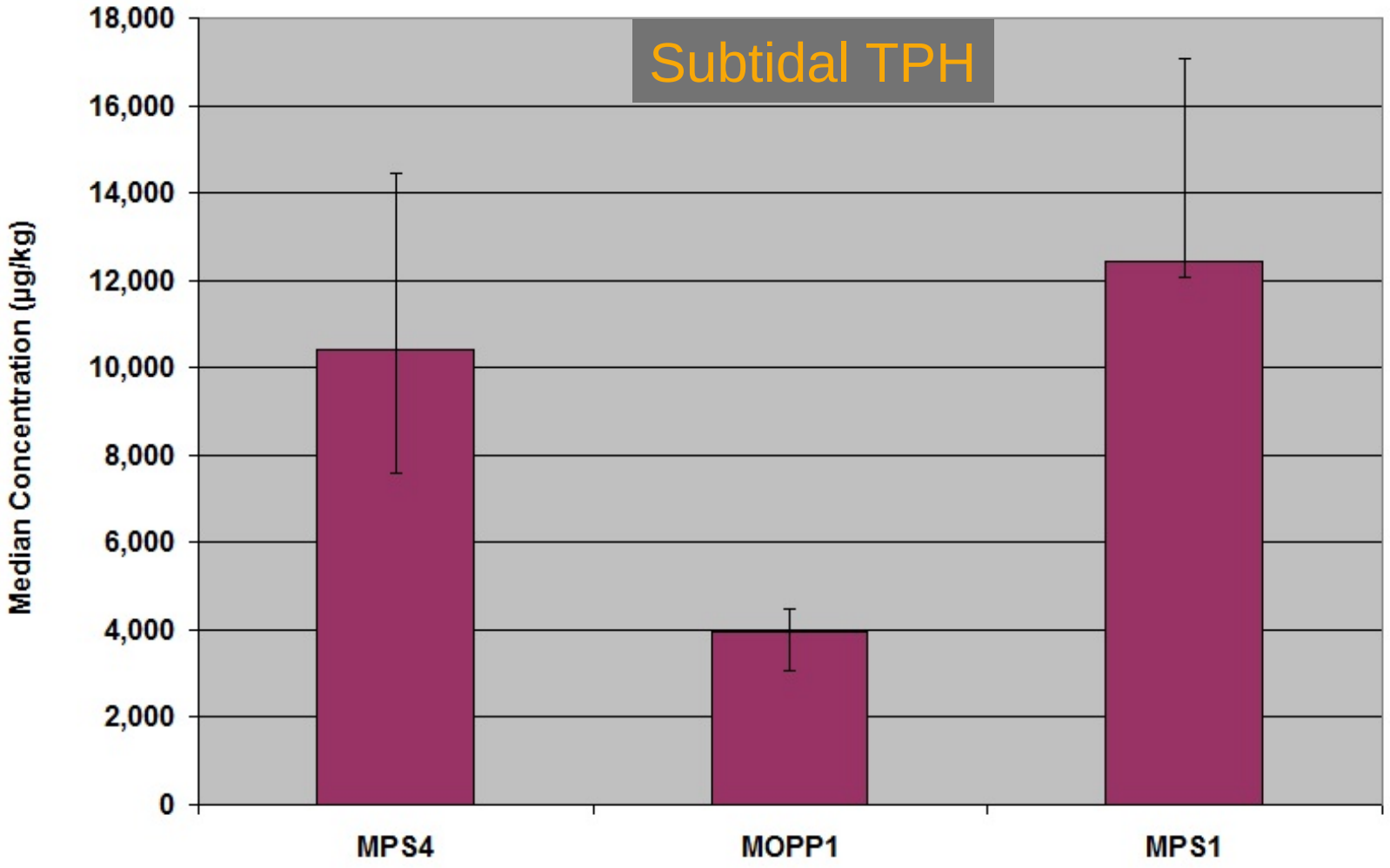


FIGURE 35.4-10
Total Petroleum Hydrocarbons in Subtidal Sediments, July 2008

Note: Vertical lines with "whiskers" indicate ranges of concentrations.

PENTEC ENVIRONMENTAL

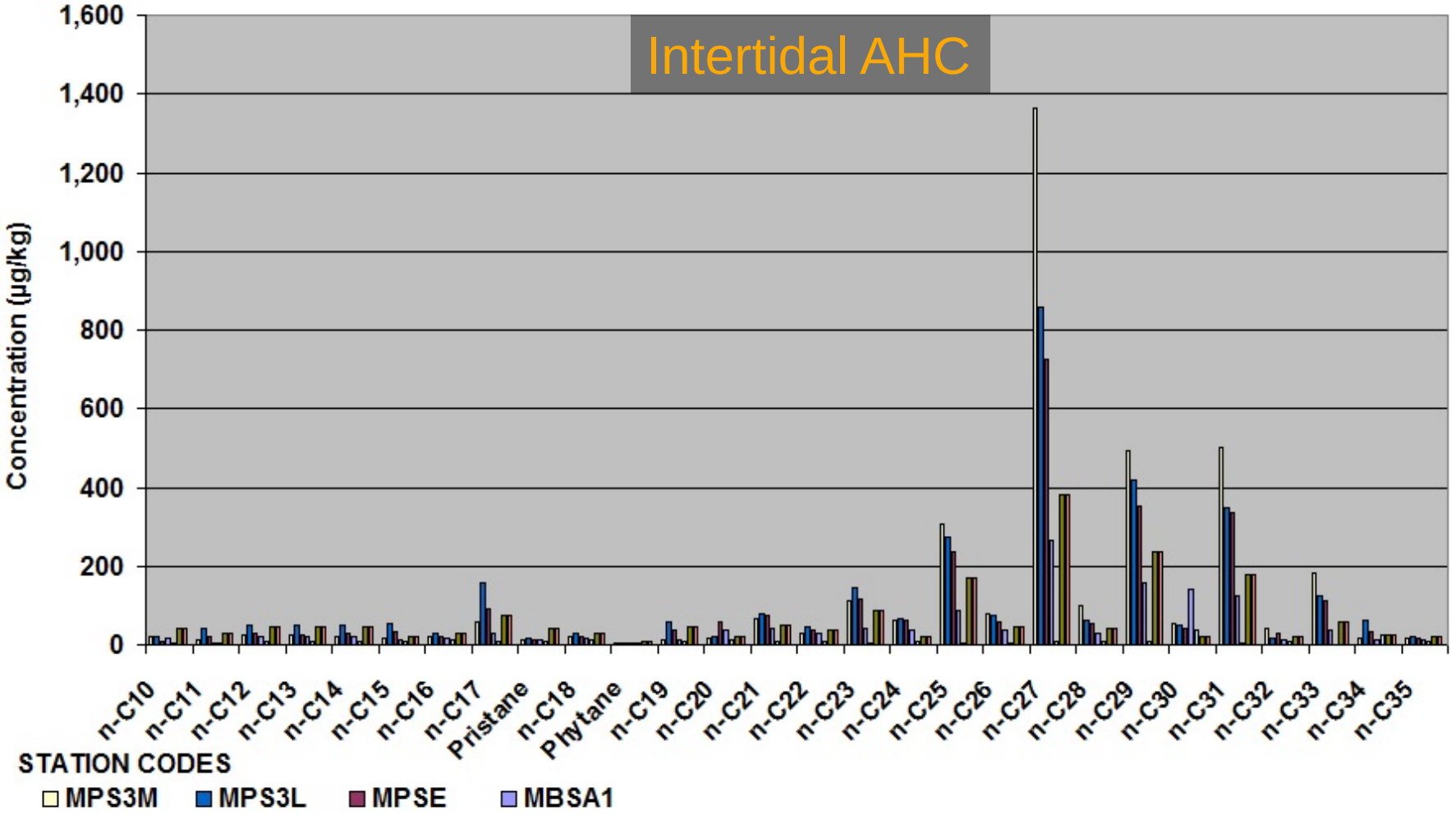


FIGURE 35.4-11

Concentrations of Aliphatic Hydrocarbons (AHCs) in Intertidal Sediments, July 2008

Note: Compound abbreviations are expanded in Table 35.4-3

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Higher conc. of odd # compounds indicates biogenic origin

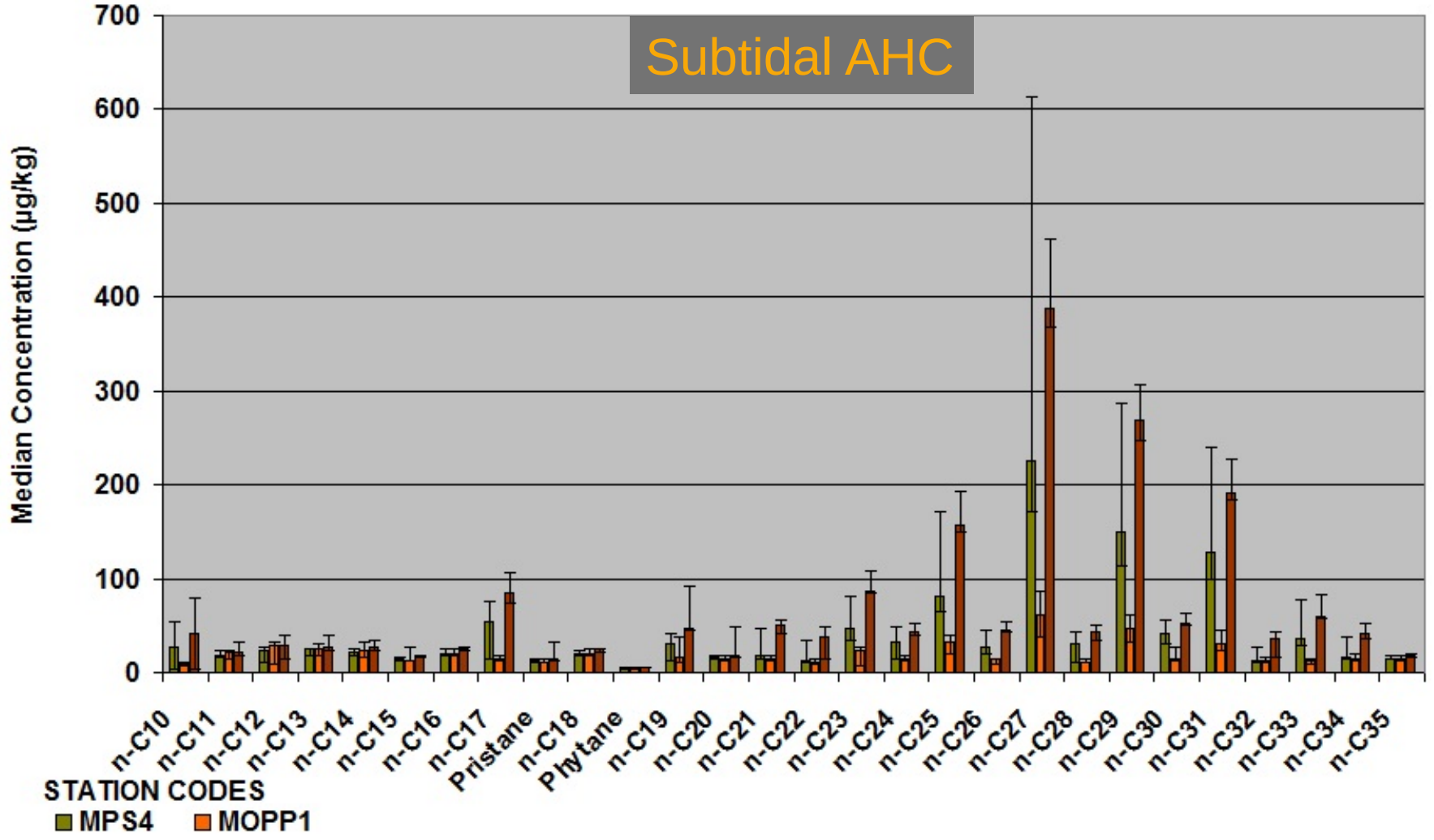

FIGURE 35.4-12

Concentrations of Aliphatic Hydrocarbons (AHCs) in Subtidal Sediments, July 2008

Notes: Compound abbreviations are expanded in Table 35.4-3.
Vertical lines with "whiskers" indicate ranges of concentrations.

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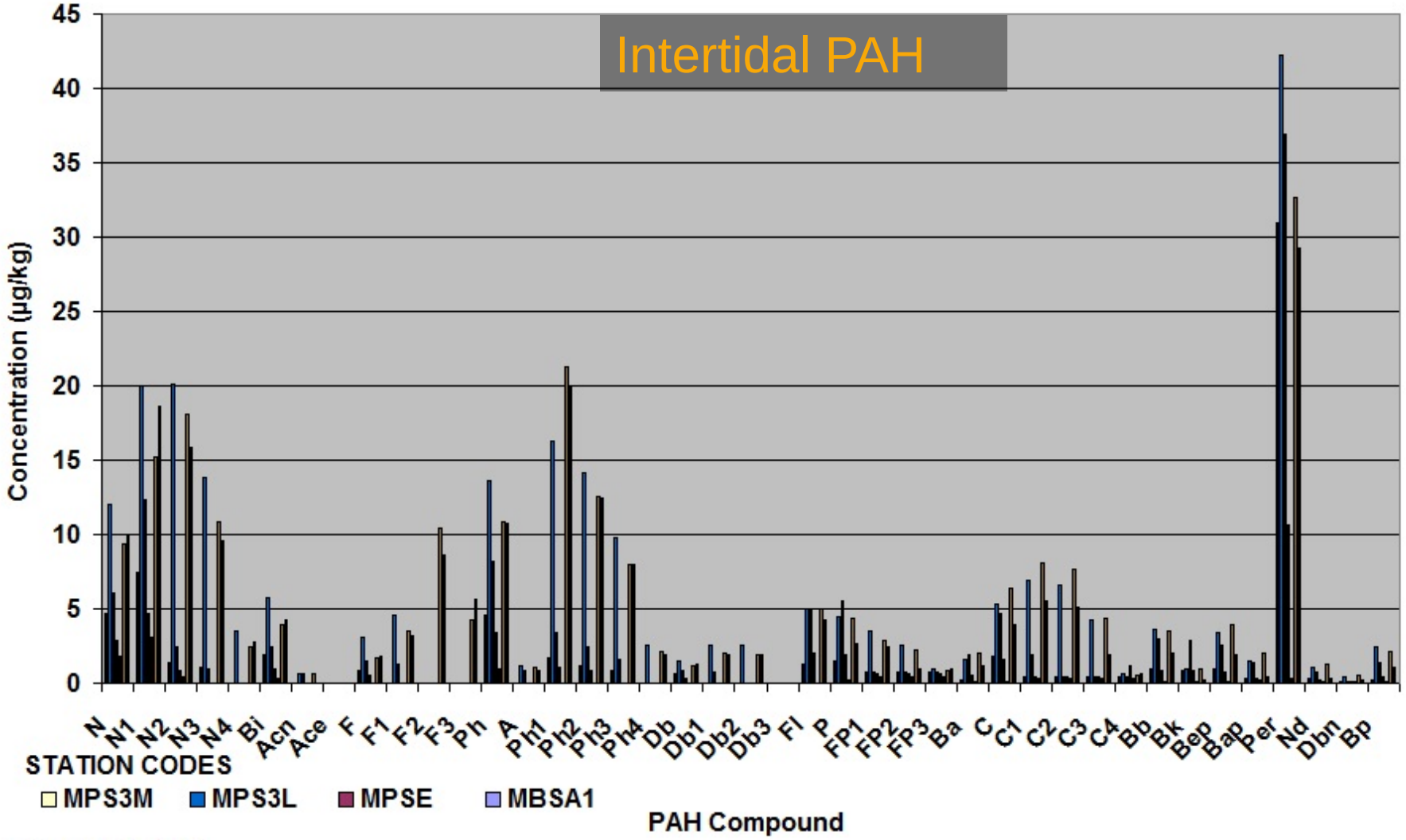

FIGURE 35.4-13
Concentrations of Polynuclear Aromatic Hydrocarbons (PAHs) in Intertidal Sediments, July 2008

Note: Compound abbreviations are expanded in Table 35.4-3

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*High conc. of perylene suggests biogenic origin

Subtidal PAH

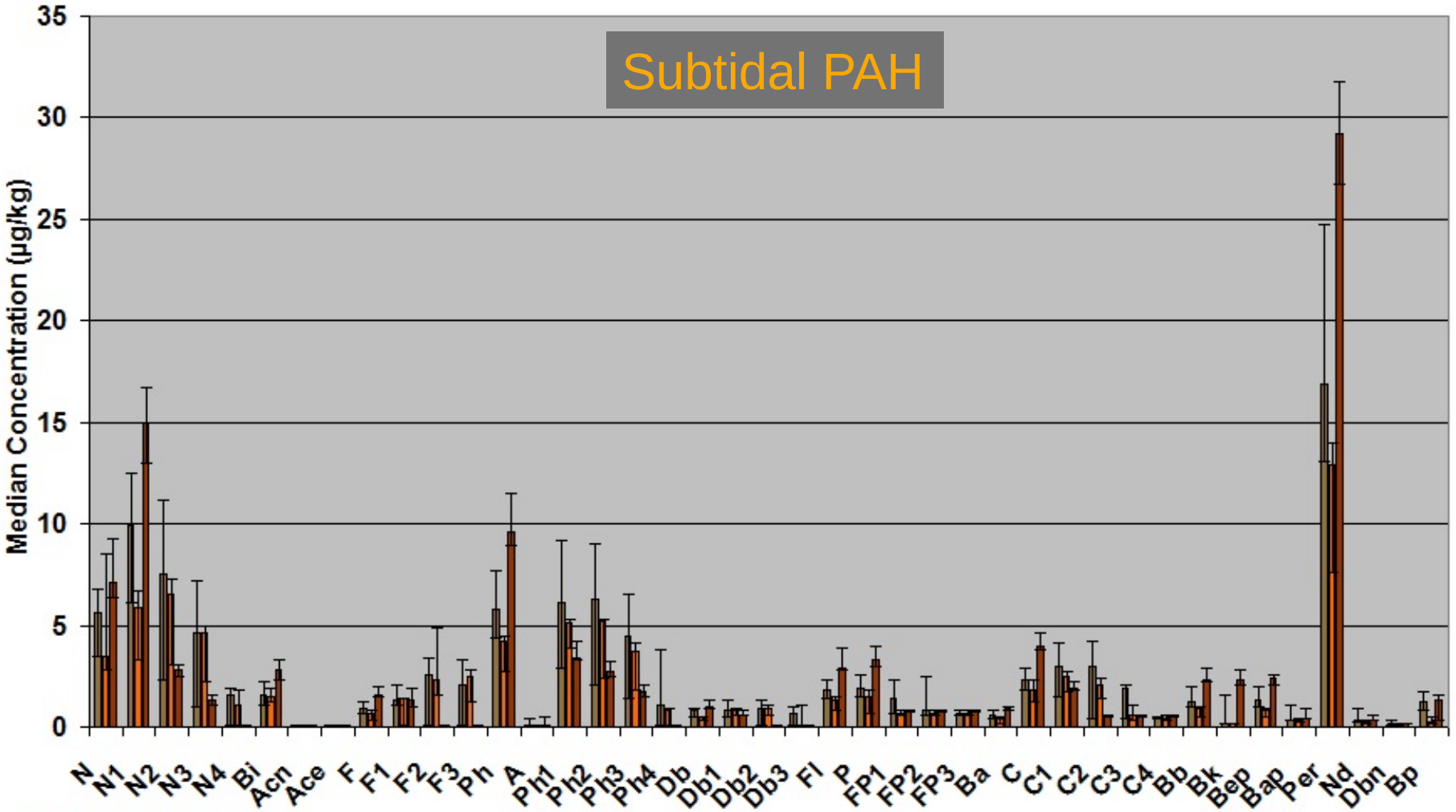

FIGURE 35.4-14
Concentrations of Polynuclear Aromatic Hydrocarbons (PAHs) in Subtidal Sediments, July 2008

Notes: Compound abbreviations are expanded in Table 35.4-3.
Vertical lines with "whiskers" indicate ranges of concentrations.

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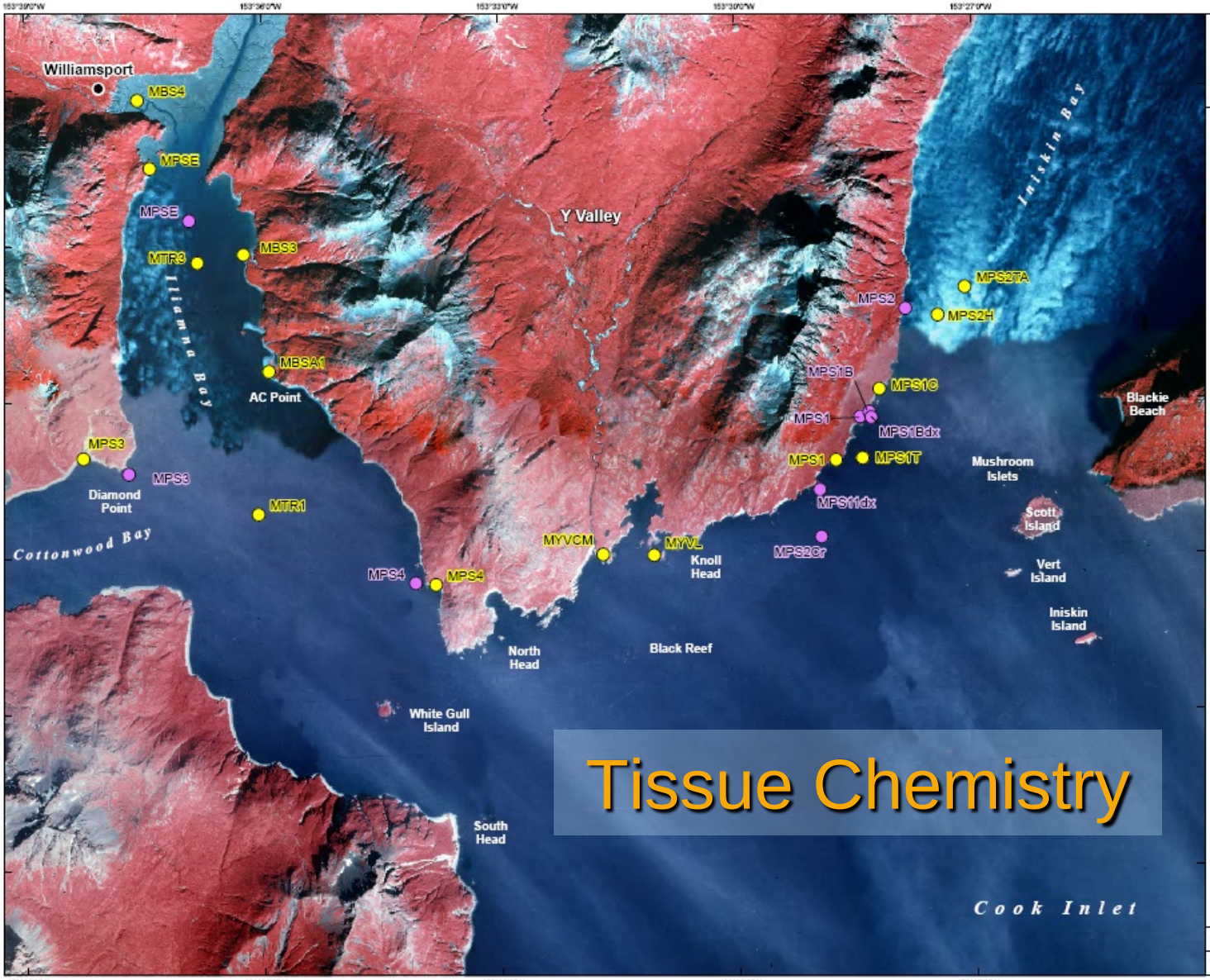
*High conc. of perylene suggests biogenic origin



Tissue Chemistry

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Figure 35.4-2b
Trace Elements Study,
Sampling Stations for Marine Tissue,
2004 and 2008

Legend

- Fish Tissue Sampling Stations
  - MPS1 Fish Tissue Station Identification Code, Example
- Invertebrate and Plant Tissue Sampling Stations
  - MPS1 Invertebrate and Plant Tissue Station Identification Code, Example
- Existing Community

Note:
Sampling locations varied slightly for each sampling event; therefore, station locations depicted here are approximate.

Miles 0 0.5 1 1.5
Kilometers 0 0.5 1 1.5 2
Scale 1:45,000

Alaska State Plane Zone 5 (units feet)
1983 North American Datum

File: RDI_Pen_Fig35-4-2b_11x17L_V05.mxd	Date: June 28, 2011
Version: 5	Author: RDI-LS

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Tissue Species Analyzed

Plant
Rockweed *Fucus distichus* ssp. *evanescens*

Crustaceans
Lyre Crab *Hyas lyratus*
Helmet Crab *Telmessus cheiragonus*

Gastropods
Oregon Triton *Fusitriton oregonensis*
Lyre Whelk *Neptunea lyrata*

Bivalves
Cockle *Clinocardium nuttalli*
Oblique Macoma *Macoma obliqua*
Surf Clam *Mactromeris polynyma*
Horse Mussel *Modiolus modiolus*
Eastern Softshell Clam *Mya arenaria*
Mussel *Mytilus trossulus*

Fish
Chum Salmon *Oncorhynchus keta*
Pink Salmon *Oncorhynchus gorbuscha*
Dolly Varden *Salvelinus malma*
Starry Flounder *Platichthys stellatus*
Yellowfin Sole *Limanda aspera*
White Spot Greenling *Hexagrammos stelleri*
Pacific Staghorn Sculpin *Leptocottus armatus*
Pacific Halibut *Hippoglossus stenolepis*

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Tissue Chemistry

Analytical Results for Mussel Tissue, Organic

Month	Station	Lipids (%)	Total AHCs (µg/kg)	Total PAHs without Perylene (µg/kg)
May	MPS4 [a]	4.5	7,479	198
May	MPS1B [a]	4.7	10,325	233
Jul	MPS3	5.3	13,684	116
Jul	MPS4	9.1	17,231	109
Jul	MPS1B	4.1	27,943	45
Jul	MPS2	5.8	25,691	135
Sep	MPS4	5.2	14,392	99
Sep	MPS1B	1[(b)]	25,918	43

AHCs = aliphatic hydrocarbons.
PAHs = polynuclear aromatic hydrocarbons.
µg/kg = micrograms per kilogram. (Analytical results in Apr
for AHCs [total alkanes] are presented in µg/gram [g];
1 µg/g equals 1,000 µg/kg.)

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Tissue Chemistry Notes

- Hg in edible tissue (mussles, salmon) all <150 ppb

Salmon liver 2 – 3 OM higher than muscle for several metals (Cd, Cu, Pb, Ag)

Levels generally comparable to limited data sets available for Alaska

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Chemistry Summary

- Levels of TE, AH, PAH typical of BG
- BETX not detected in sediments
- Concentrations of As, Cu, Ni >threshold of biol. response
- Little indication of anthropogenic input in water, sediments, or biological tissues

- Questions?

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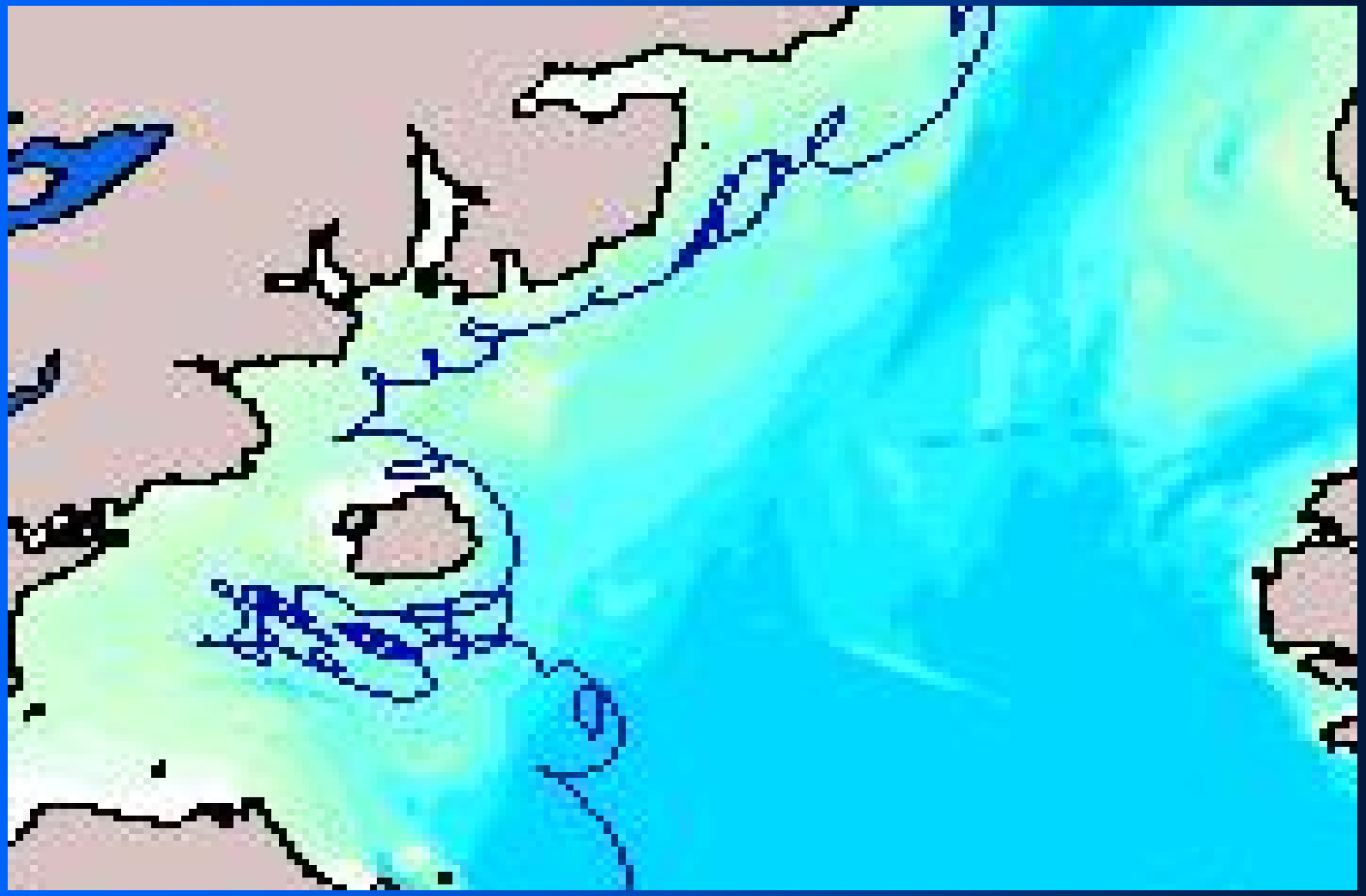
Drogue Track near IIE



Work of Mark Johnson, supported by Bureau of Ocean Energy Management through Coastal Marine Institute at The University of Alaska Fairbanks

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Cook Inlet Tides

	Mean			Extreme	
	tide	range	HHW	high	low
Homer	9.5	15.7	18.1	23.4	-6
Port Chatham	7.5	11.9	14.3	18.1	-5.5
Iliamna Bay	7.5	12.3	14.5	18.6	-4.9
Anchorage	15.2	25.9	28.8	34.1	-5.9

measurements in ft MLLW

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Lower Cook Inlet Mixing

Tide Rips

- Rips develop with current shears, collect debris
- Mid-channel Rip: well developed, major feature north of Iniskin Bay (Anchor Point)
- Mid-channel Rip: weakly developed in south, follows ~10m contour in Kamishak Bay (south)
- East and West Rips less well developed in north

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