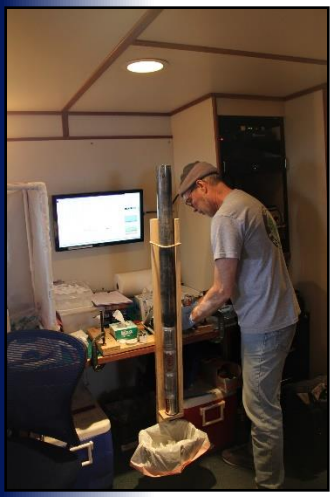
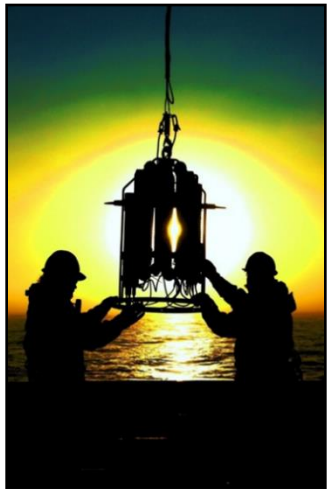




An Integrated Look at the Alaskan Beaufort Sea: ANIMIDA III (2013-2017)

Northern Oil & Gas Research Forum

October 11, 2017

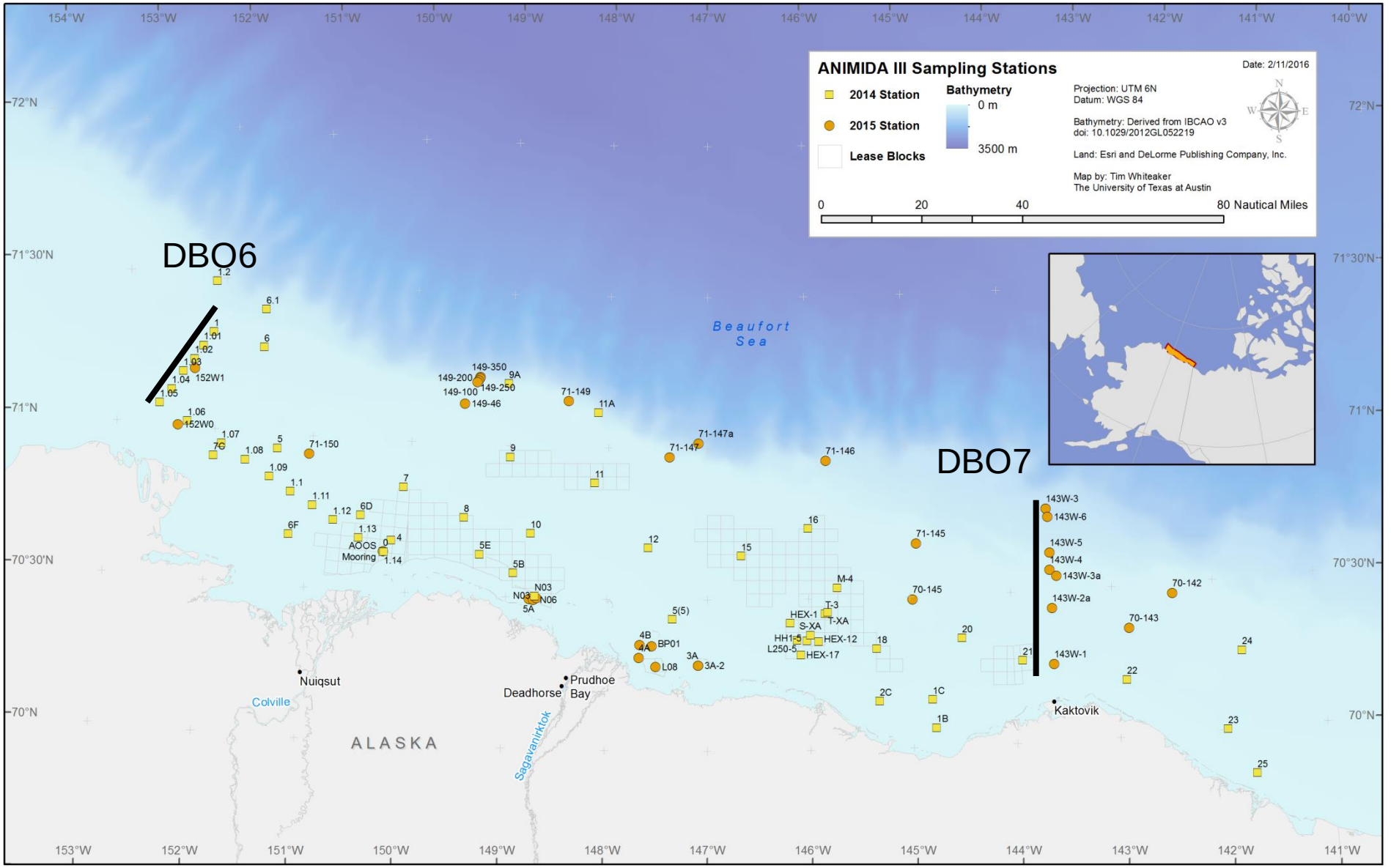
Jeremy Kasper (UAF), Kenneth Dunton (UT-A), Bodil Bluhm (UiT), Greg Durell (NewFields), John Trefry (FIT), Catherine Coon (BOEM), Dan Holiday (BOEM), Sheyna Wisdom (OF), Justin Blank (OF)

BOEM
Bureau of Ocean Energy Management

Olgoonik Fairweather LLC

Arctic Nearshore Impact Monitoring in Development Area III (2013-2017)

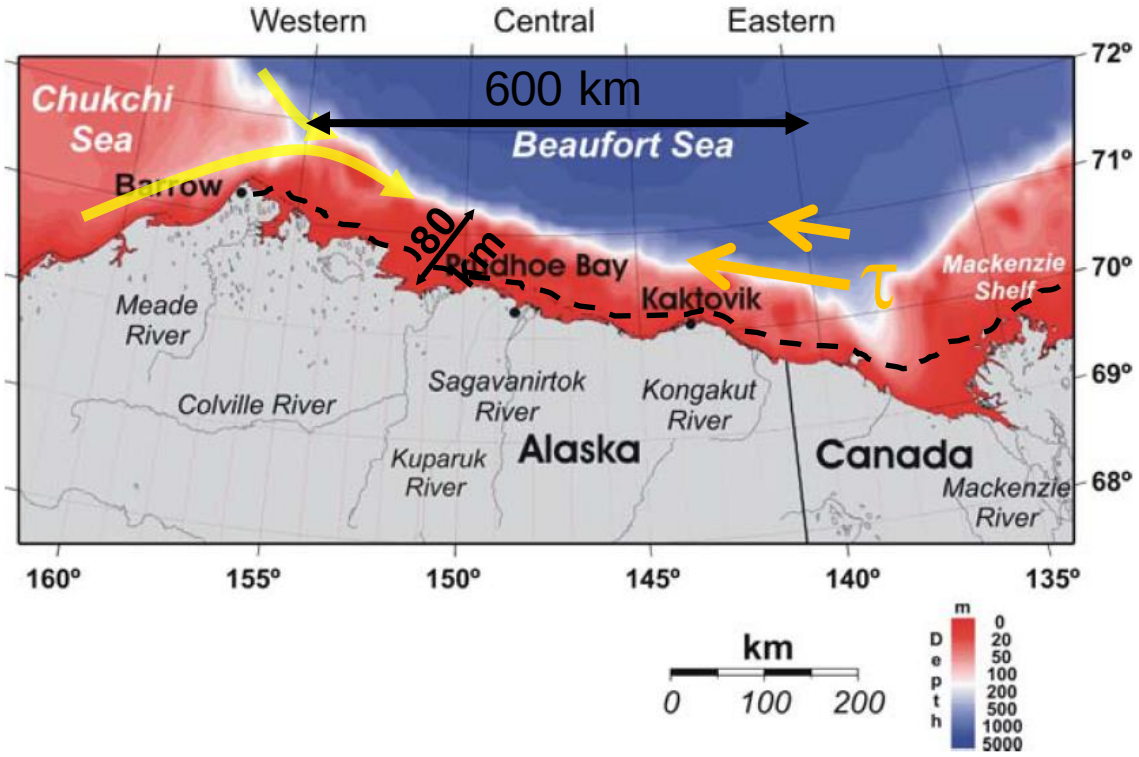
- Continuation of programs spanning several decades:
  - OCSEAP (Outer Continental Shelf Environment Assessment Program)
  - BSMP (Beaufort Sea Monitoring Program): 1984-1989
  - ANIMIDA I: 1999-2002
  - cANIMIDA: 2004-2007
- Objectives:
  - Expand ANIMIDA sampling to deeper water
  - Help establish new Beaufort Sea DBO lines
  - Trace contamination across the shelf and through food webs
- Sampling:
  - 2 10-day offshore cruises Aug 2014 & 2015
  - 1 14-day spring sampling May 2015


ANIMIDA III Sampling Stations
Date: 2/11/2016
2014 Station
2015 Station
Lease Blocks
Bathymetry
0 m
3500 m
Projection: UTM 6N
Datum: WGS 84
Bathymetry: Derived from IBCAO v3
doi: 10.1029/2012GL052219
Land: Esri and DeLorme Publishing Company, Inc.
Map by: Tim Whiteaker
The University of Texas at Austin
0
20
40
80 Nautical Miles
DBO6
DBO7
Beaufort Sea
ALASKA
Nuiqsut
Colville
Deadhorse
Prudhoe Bay
Kaktovik
Sagavanirktok
AOOS Mooring
154°W
153°W
152°W
151°W
150°W
149°W
148°W
147°W
146°W
145°W
144°W
143°W
142°W
141°W
140°W
72°N
71°30'N
71°N
70°30'N
70°N

Physical Oceanography

Jeremy Kasper, UAF

- Bounded by Mackenzie & Chukchi shelves
- Surface waters strongly stratified from river input
- Seasonally covered by ice
- Winds primarily upwelling along-shore (east to west)



Physical Oceanography

Jeremy Kasper, UAF

- Sampling:
  - CTD at all stations (2014 & 2015)
  - *Norseman II* had ADCP & TSG (2014 & 2015)
  - Bottom-mounted mooring with ADCP* & CTD (2015)
- Conclusions:
  - Nutrient concentrations and salinity increase with increasing distance from shore and depth.
  - Mackenzie River water noted in eastern portion (strong stratification, warm temperatures, elevated Ba).
  - Surface waters vary with salinity from 0-30.
  - Frontal system between freshwater from rivers and offshore water masses not well understood; affects cross-shelf transport of suspended and dissolved materials.

Trace Metals

John Trefry, FIT

- Sampling:
  - Sediment: double van Veen grab at most stations and gravity core at 5 locations each year
  - Water: CTD at all stations
  - Biota: Clam rakes & amphipod traps
- Results:
  - Analyzed 23 trace metals
  - 17 trace metals in sediment and water samples at baseline values
  - Anomalous concentrations of Ba in 4 samples
  - Anomalous concentrations of 1 each for Be, Hg, Sb, V, Zn
  - Elevated As, Mn, Hg in surface sediments at depths >200 m

Trace Metals

John Trefry, FIT

- Conclusions:
  - Sediments from coastal Beaufort Sea essentially uncontaminated with respect to trace metals.
  - No evidence that metal concentrations exceed sediment quality criteria.
  - Long-term records from sediment cores show uniform concentrations of most metals (Pb, Ag, Cd, Zn).
  - Surface sediments from outer shelf have elevated concentrations of As, Mn, Hg from natural processes.
  - Suspended particles are valuable tracer of drilling fluids as shown by Ba/Al ratios.
  - Metal concentrations in biota provide baseline for future reference, but there is considerable variability.

Hydrocarbons

Greg Durell, NewFields

- Sampling:
  - Sediment: double van Veen grab at most stations
  - Biota: clam rake, amphipod traps, benthic trawl
- Analyses:
  - Parent and alkylated polycyclic aromatic hydrocarbons (PAH)
  - Petroleum biomarkers (S/T: sterane and triterpane)
  - Saturated hydrocarbons (SHC)
  - Total organic carbon (TOC): sediment only
  - Total lipids: biota only

Hydrocarbons

Greg Durell, NewFields

- Conclusions:
  - Sediment Hydrocarbon (HC) concentrations are about twice as high, and more uniform, at offshore stations.
  - Tissue contaminant levels are uniform; clam and amphipod concentrations correlate with the lipid content.
  - HC levels fairly constant over the past 20 years and likely longer than that based on sediment coring.
  - The HC are primarily petrogenic and biogenic.

Benthic Infauna & Food Web

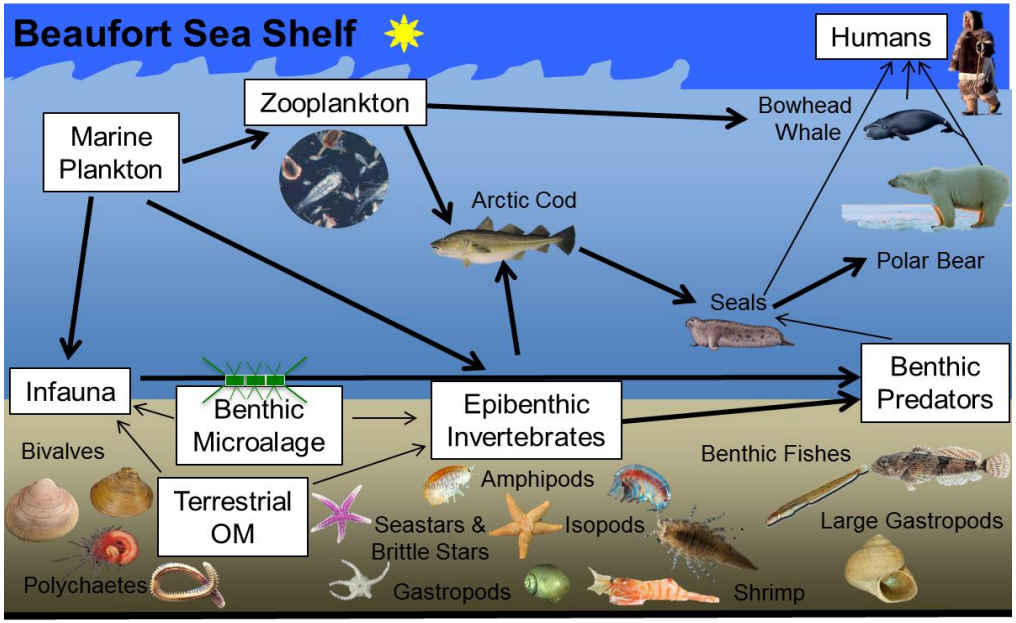
Kenneth Dunton, UT-A

- Sampling:
  - Plankton: 20 µm phytoplankton; 335 µm zooplankton nets
  - Surface sediments: double van Veen grab
  - Benthic infauna: double van Veen grab
  - Benthic epifauna: 3.05 m plumb staff beam trawl
- Analyses:
  - POM: particulate organic matter (CTD)
  - SPOM: sediment particulate organic matter
  - Pigments: chlorophyll, pheopigments, accessory pigments
  - TOC/TON: total organic carbon, total organic nitrogen
  - TL: trophic level determination
  - C/N: carbon and nitrogen isotopic analyses
  - Species abundance and biomass

Benthic Infauna & Food Web

Kenneth Dunton, UT-A

- Results:
  - Infaunal abundance dominated by polychaetes, bivalves, and amphipods.
  - Water depth, TOC, and salinity correlated with infaunal abundance.
  - Infaunal populations had low diversity and biomass in Colville River Delta; sediments are sandy and nutrient poor.
  - Benthic microalgal carbon important source of carbon (not just terrestrial and phytoplankton).



Epibenthic & Demersal Fish

Bodil Bluhm, UiT

- Sampling:
  - 3.05 m plumb staff beam trawl
- Results:
  - Epibenthos:
    - ✓ Abundance/diversity correlated with depth
    - ✓ Nearshore (<20 m): mobile crustaceans; due to ice scour and extreme salinity changes from breakup.
    - ✓ Shelf-break and upper slope: echinoderms and mollusks.
  - Demersal fish:
    - ✓ Overall less abundant and less species rich than epibenthos
    - ✓ Abundance/diversity correlated with depth, but not as strong as epibenthos
    - ✓ Sculpins *(Cottidae)* and sand lances *(Ammodytidae)* most common
    - ✓ Snail fishes (*Liparidae*), cods and haddocks (*Gadidae*), and eel pouts (*Zoarcidae*) also present

Thank you!

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BOEM contract: M13PC00019
BOEM 2017-032
http://arcticstudies.org/animida_iii/index.html
NCEI Accession 0162530; doi:10.7289/V5VQ30R3