

# SCICEX Phase 2

## *Accommodation Cruises*



Provided by T. Boyd

# **OBJECTIVES**

- **Re-invigorate the SCICEX Science Advisory Committee**
- **Maximize the contribution of SCICEX in understanding the Arctic Ocean processes and their role in the Earth's climate system**

# AGENDA

## *Setting the Stage*

- SAC: Role & responsibilities
- History of SCICEX: Scientific contributions
- SCICEX Today: Current assets and capabilities
- SCICEX Drivers:
  - Contributing perspectives
  - Discussion of intersecting points between current assets and capabilities, agency-level drivers and scientific needs

## *Getting Down to Business*

- Defining key activities
  - Guidance for SCICEX cruises of opportunity
  - Communicating with science community
  - Others
- Moving ahead:
  - Priority tasks & timeline
  - Assignments

# **SCICEX Phase 2**

## ***MOA: Signed April 2000***

### **Goals**

- Dual use of submarines**
- Support objectives of civilian and military communities**
- Data collected under agreement made publicly available as soon as possible**

# **SCICEX Phase 2**

## ***MOA***

### ***Science Accommodation Missions***

- Data collection during classified missions
- High priority environmental data
- Concentration on baseline data collection
- Continued monitoring
  - Oceanographic conditions
  - Ice distribution
  - Contaminant concentrations
- Individual proposals for experiments or equipment installation may be entertained
- Scientific riders not anticipated
- Data made widely available

# **Roles & Responsibilities**

## ***MOA: SCICEX Phase 2***

### **Functioning Bodies**

- US Submarine Force**
  - Obtain data specified in science plan
- Arctic Submarine Lab (ASL):**
  - Submarine Force Arctic Advisor
  - Coordinate operational and technical aspects of each cruise

# **Roles & Responsibilities**

## ***MOA: SCICEX Phase 2***

### **Functioning Bodies**

- Operational Planning Board (OPB):**  
ASL (Chair), COMSUBATLAT, COMSUBPAC, CNO
- Interagency Committee (IAC):**  
ONR (Chair), NSF, ASL, CNO, USARC
- Science Advisory Committee (SAC):**
  - IAC Designated Chair, ONR, NSF, ASL
  - 6 non-permanent members from scientific community, 3 each selected by NSF and ONR

# **Roles & Responsibilities**

## ***MOA: SCICEX Phase 2***

### **Operational Planning Board**

**Coordinate oversight of SCICEX program**

- Review proposed research**
  - Verify feasibility**
  - Limit extent due to operational or safety concerns**
- Approve Science Plan**



# **Roles & Responsibilities**

## ***MOA: SCICEX Phase 2***

### **Interagency Committee:**

#### **Orchestra definition of Science Plan**

- Baseline & one-time data collection**
- Establish broad scientific priorities**
- Define baseline data**
- Request proposals, when appropriate**
- Fund research**

# **Roles & Responsibilities**

## ***MOA: SCICEX Phase 2***

### **Science Advisory Committee**

#### **Advise Interagency Committee**

- Periodically review baseline data collection plan**
- Recommend modifications**
- Evaluate proposals, when necessary**

# **BASELINE DATA**

## ***MOA: SCICEX Phase 2***

### **General Expectations**

- Use of standard equipment and systems**
- CTD profiles taken with expendable probes**
- CTD from hull-mounted systems**
- Bathymetry by installed fathometers**
- Ice profile data from upward-looking sonar**
- Salinities from water samples**
- Supporting non-classified navigational and operational data**
- All data stored in national data repository, designated by ONR (currently NSIDC)**

# **SCICEX Phase 2**

## ***Recent SAC Guidance***

**January 2002**

- **Priorities for Opportunity Cruises**
  - **First**: Continue transpolar track over the North Pole
  - **Second**: Track along margin of the SCICEX Box as close as possible to the Canadian EEZ
    - Marked one time change in priorities
    - Evaluate hypothesis that Arctic sea ice is not thinning but, instead, is accumulating on the Canadian margin
  - **Third**: Track along the Eurasian margin of the box

# **SCICEX Phase 2**

## ***Recent SAC Guidance***

### **March 2005**

- **Priorities for Opportunity Cruises**
  - **Central Arctic transect remains top priority**
  - **Not likely to work on Canadian side of central transect**
    - **Second priority not likely to be achieved**
  - **Consider interest in ice thickness surveys, so-called 'rosette' survey**
  - **Guidance on oceanographic surveys**

# **SCICEX Phase 2**

## ***Recent SAC Guidance***

### **Spring/Summer 2005**

- **Guidance on oceanographic surveys**
  - Recommendation on SeaBird instrument model number for probe (Smethie)
  - Recommendation on fluorescence sensor (Whitledge)
  - Recommendation on smallest ADCP for useful data considering speed and depth of transit (Muench)
  - Details on the installation of nitrate sensor (Whitledge)
  - Recommendation on optimum water sampling rate (Muench)
  - Establish analytical facility agreement for routine analysis of water samples (Conlon)
  - Developed sample request form for special sampling (Smethie/Brass)

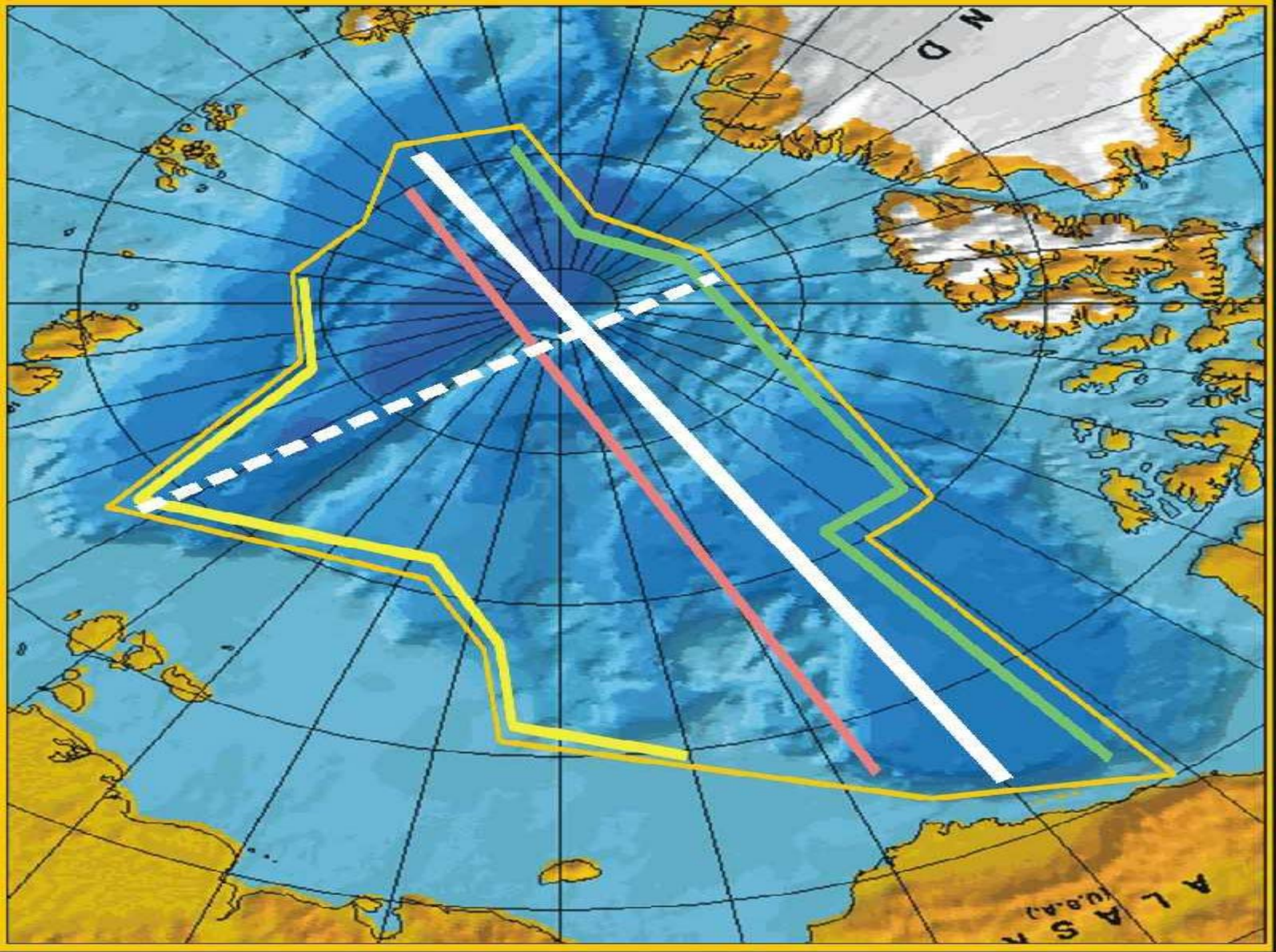
# **SCICEX Phase 2**

## ***Recent SAC Guidance***

### **Spring/Summer 2005**

- **Ice thickness surveys (Richter-Menge)**
  - **Primary, cross basin transect remains highest priority**
  - **Need to reconsider specific location**
  - **Rosette survey most useful if repeated on same piece of ice (complex requirement)**
  - **Interest in transect line running perpendicular to and across primary line**
    - **New priority #2?**
  - **Question remains on the ideal depth**
    - **Trade off in accuracy vs. coverage**





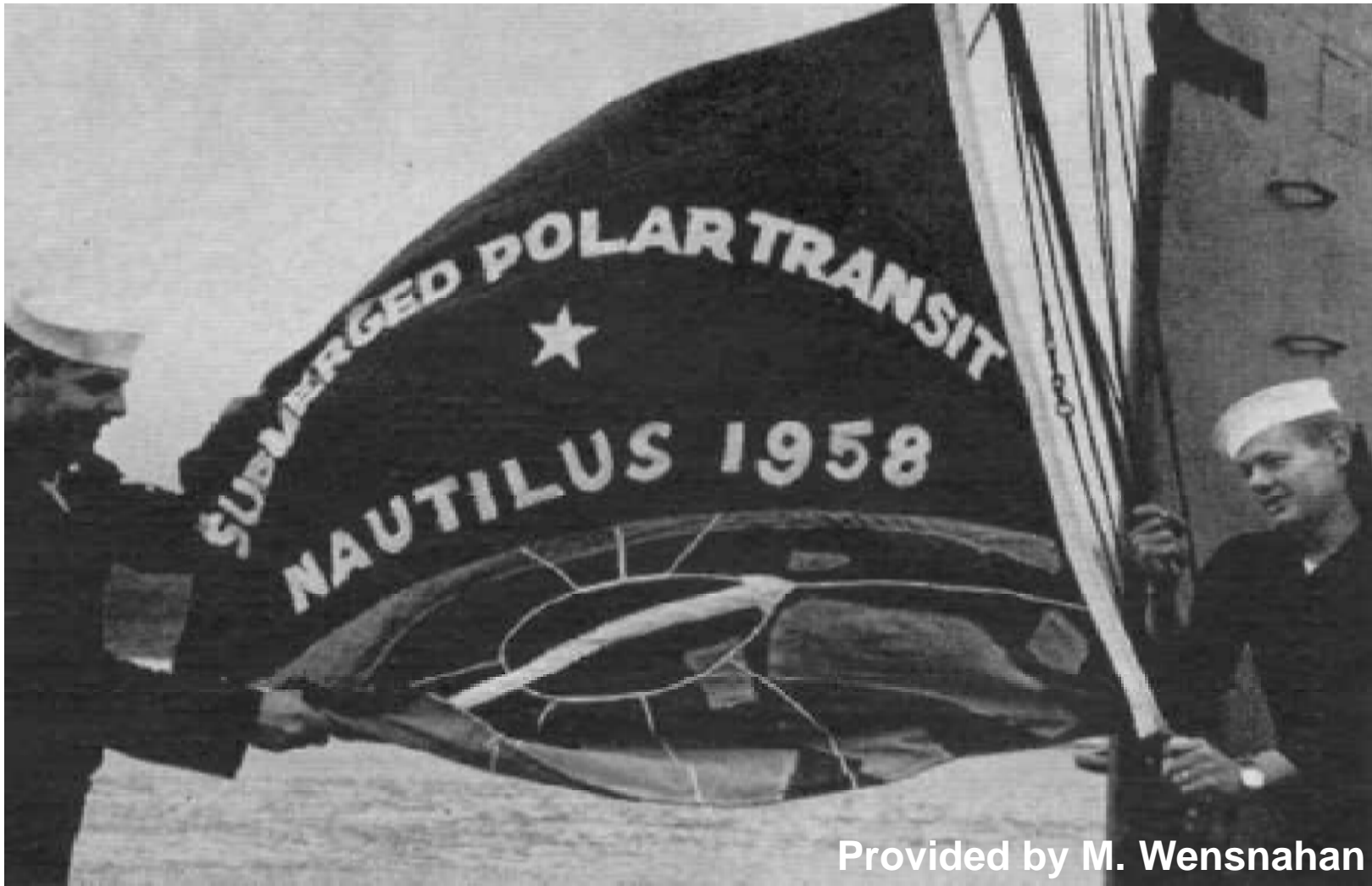


# History of SCICEX



Provided by T. Boyd

# History of SCICEX



Provided by M. Wensnahan

***Nuclear subs transit Arctic Ocean and collect environmental data***

# **PURPOSE OF SCICEX**

**Designed to simultaneously sample and map the ice canopy, physical, chemical and biological water properties, seafloor and seabed subsurface**

**Edwards and Coakley (2003)**

# History of SCICEX

- **1993: Proof of concept cruise**
- **1994: MOA signed for dedicated cruises**
- **6 dedicated cruises: 1995-1999**
- **1998: US Navy announces end of dedicated cruises**
  - Reduction in submarine force
- **2000: MOA signed for accommodation cruises**
- **4 accommodation cruises: 2000, '01, '03, '05**
- **All usable data has been released**

# Data Collection

## *Dedicated Cruises*

- All:
  - Topsounding
  - XCTD
  - Single-beam bottom sounding
  - Water sampling
  - Hull-mounted CTD
- Most: ADCP
- Two or three: Zero Angle Photon Spectrometer (ZAPS), measured dissolved organics
- Last 2: SCAMP

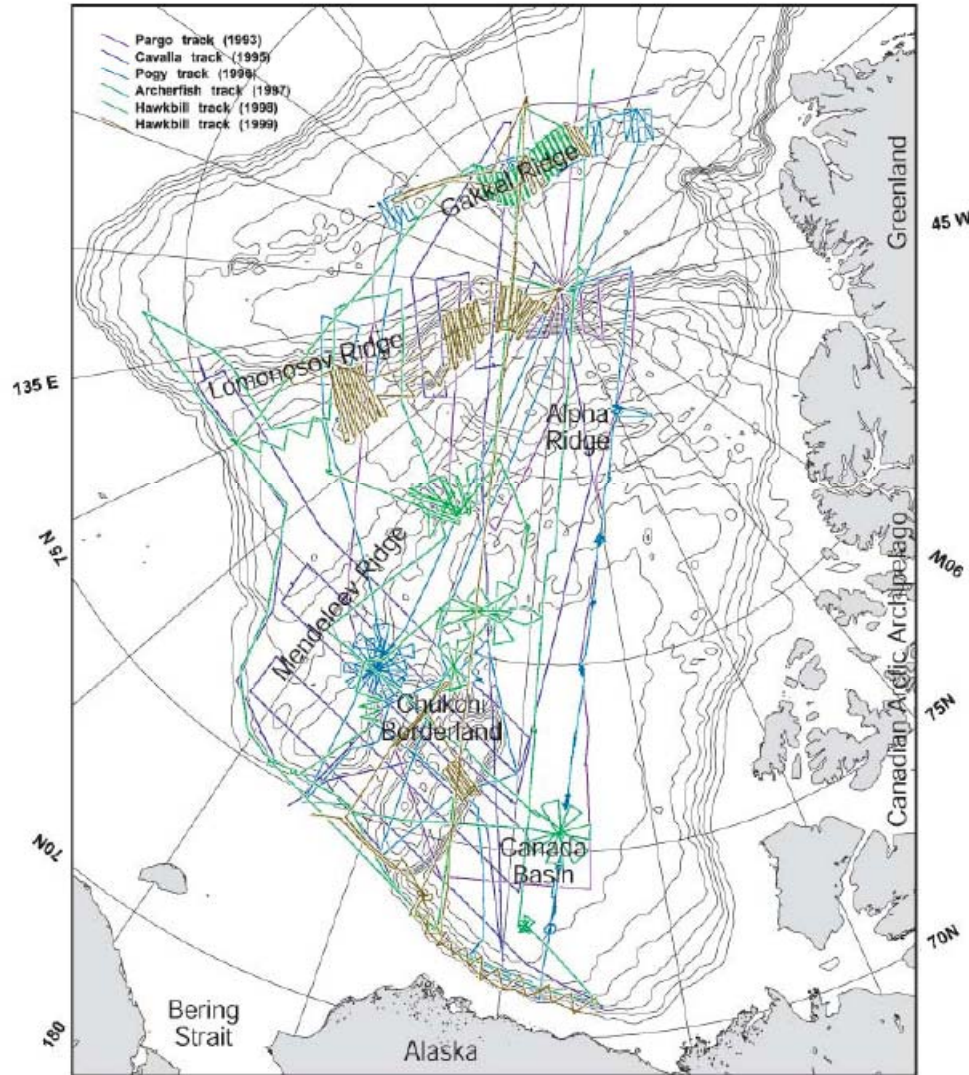
# Data Collection

## Accommodation Cruises

- All
  - Topsounding
  - Single-beam bottom sounding
  - Hull-mounted CTD
- All but last: XCTDs
- Last 2: Some limited water sampling

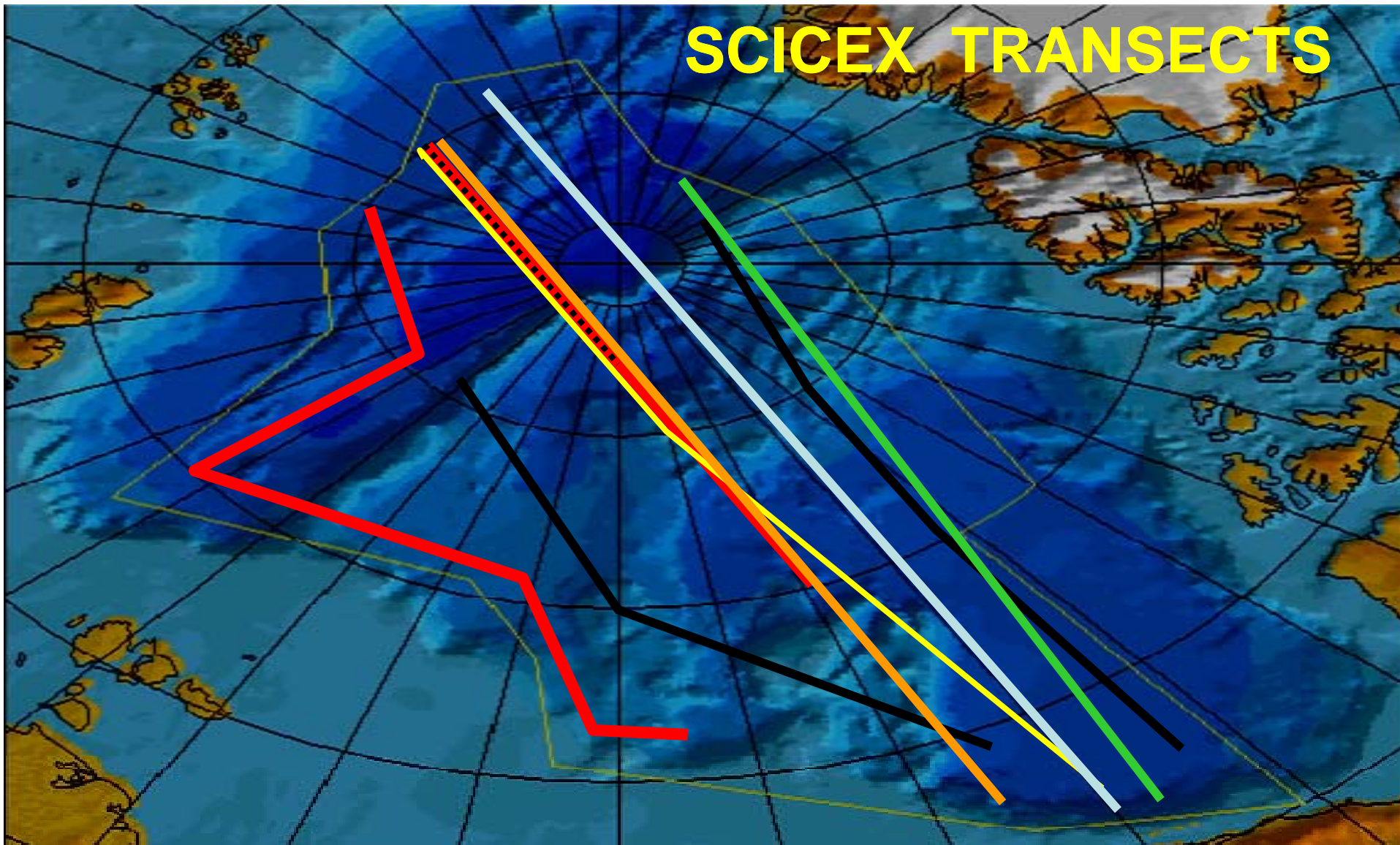
# History of SCICEX




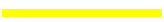





## *Cruise Tracks (1993-1999)*





# SCICEX TRANSECTS



- |  |  |  |
|--|--|--|
|  1993 |  1997 |  2001 |
|  1995 |  1998 |  2003 |
|  1996 |  1999 |  |
|  |  2000 |  |



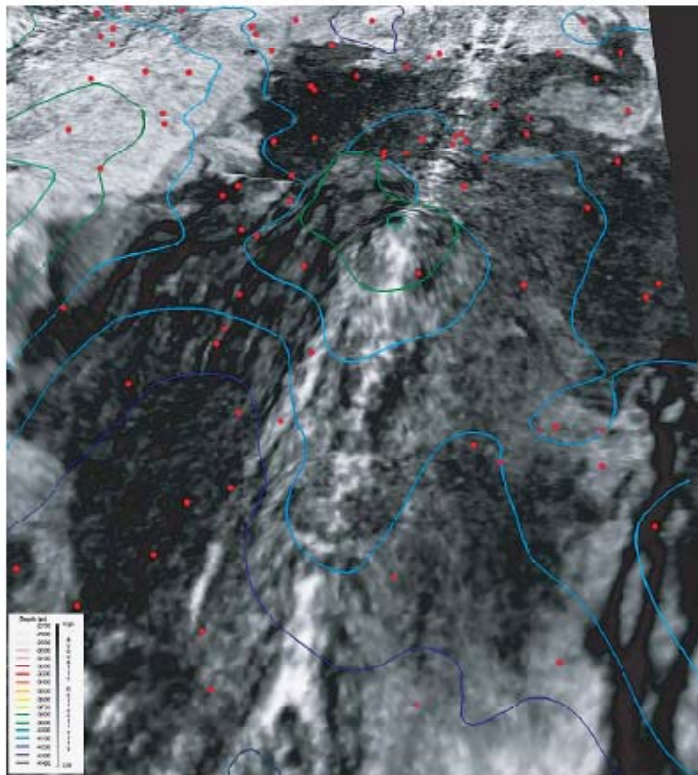
# **History of SCICEX**

## ***Scientific Contributions***

### **Highlights**

- Signs of recent volcanic eruptions**
- Evidence for ~ kilometer-thick ice shelf covering much of Arctic Ocean during Pleistocene glacial maximum**
- Pronounced changes in Arctic Ocean hydrography during 1990s**
- Detailed description of physical and chemical properties within an eddy system**
- Distribution and trends in ice thickness**
- 54 publications listed in Edwards and Coakley (2003)**

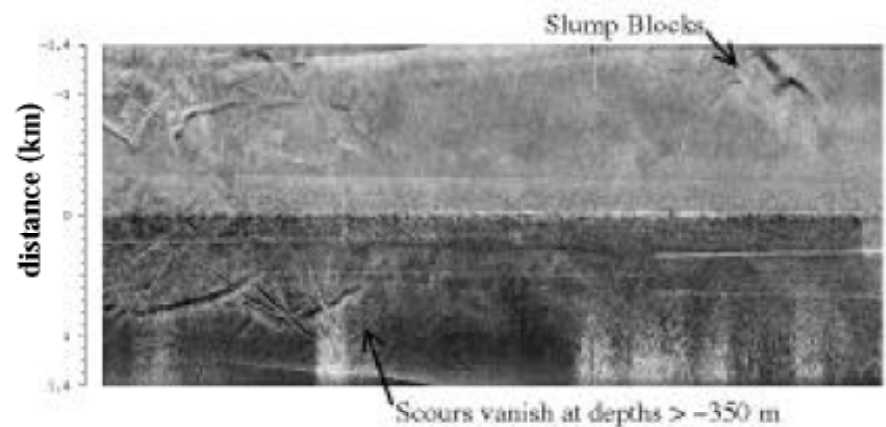
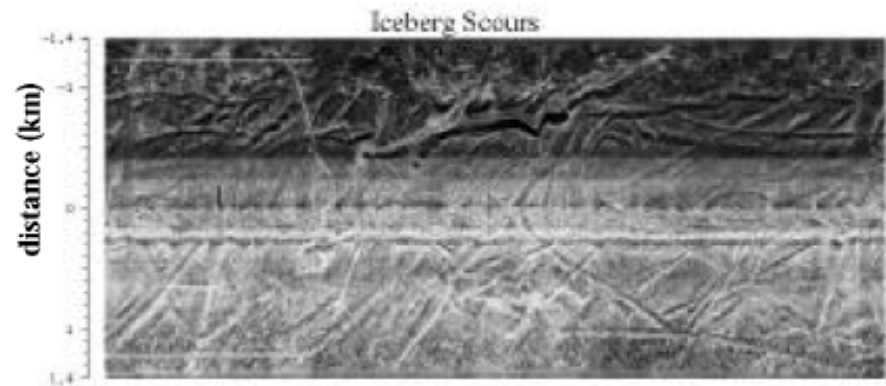
# Arctic Geology



M. Edwards

Active volcano on Gakkel Ridge

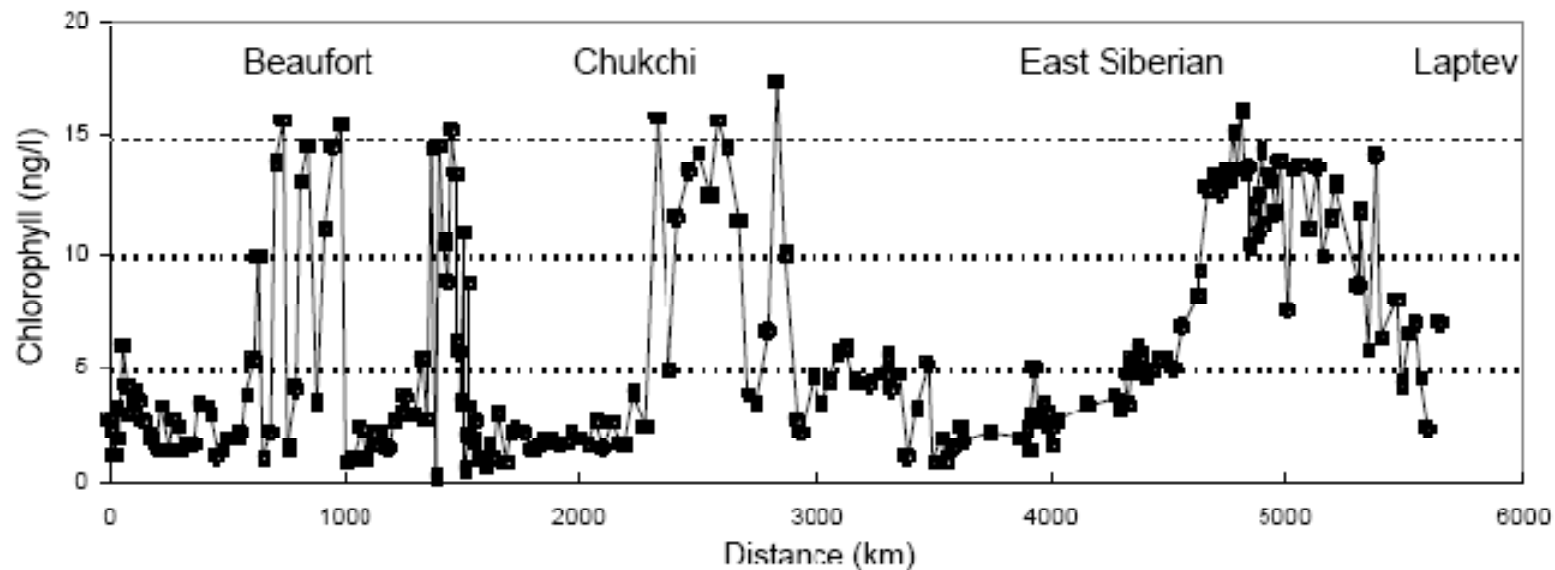
Evidence of glacial erosion and iceberg Scouring on Chukchi Borderland



M. Edwards

# Arctic Oceanography

## *Chlorophyll concentrations*



T. Whitledge

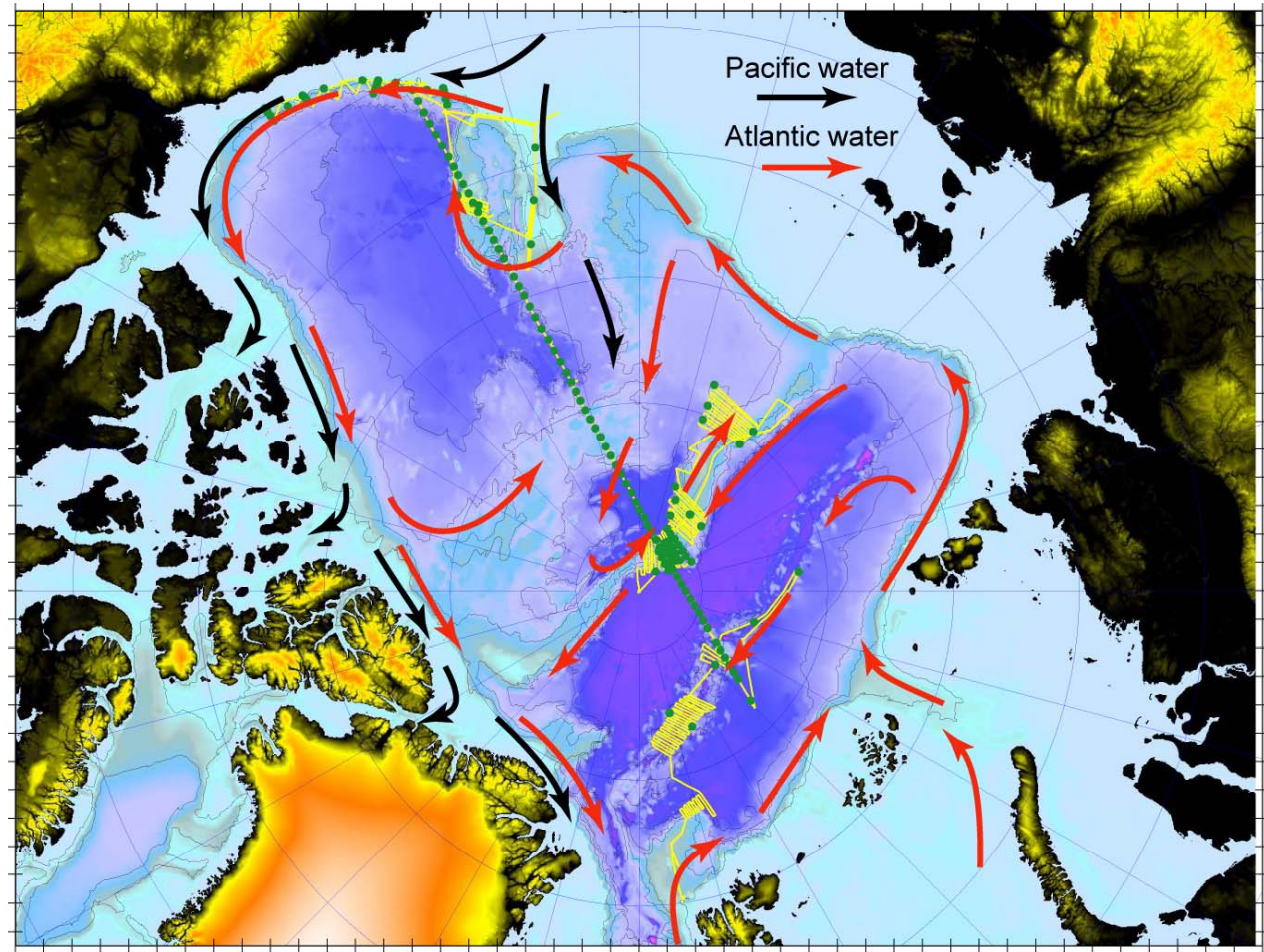
Transport across shelf occurs in confined plumes, apparently related to canyons or other depressions in the shelf topography

# Arctic Oceanography

## *Upper Ocean Circulation*

### SCICEX-99 Cruise

- 151 XCTDs launched
- 91% success rate
- 22,750 km of cruise track
- Typical speed 14 kts
- Duration 42 days



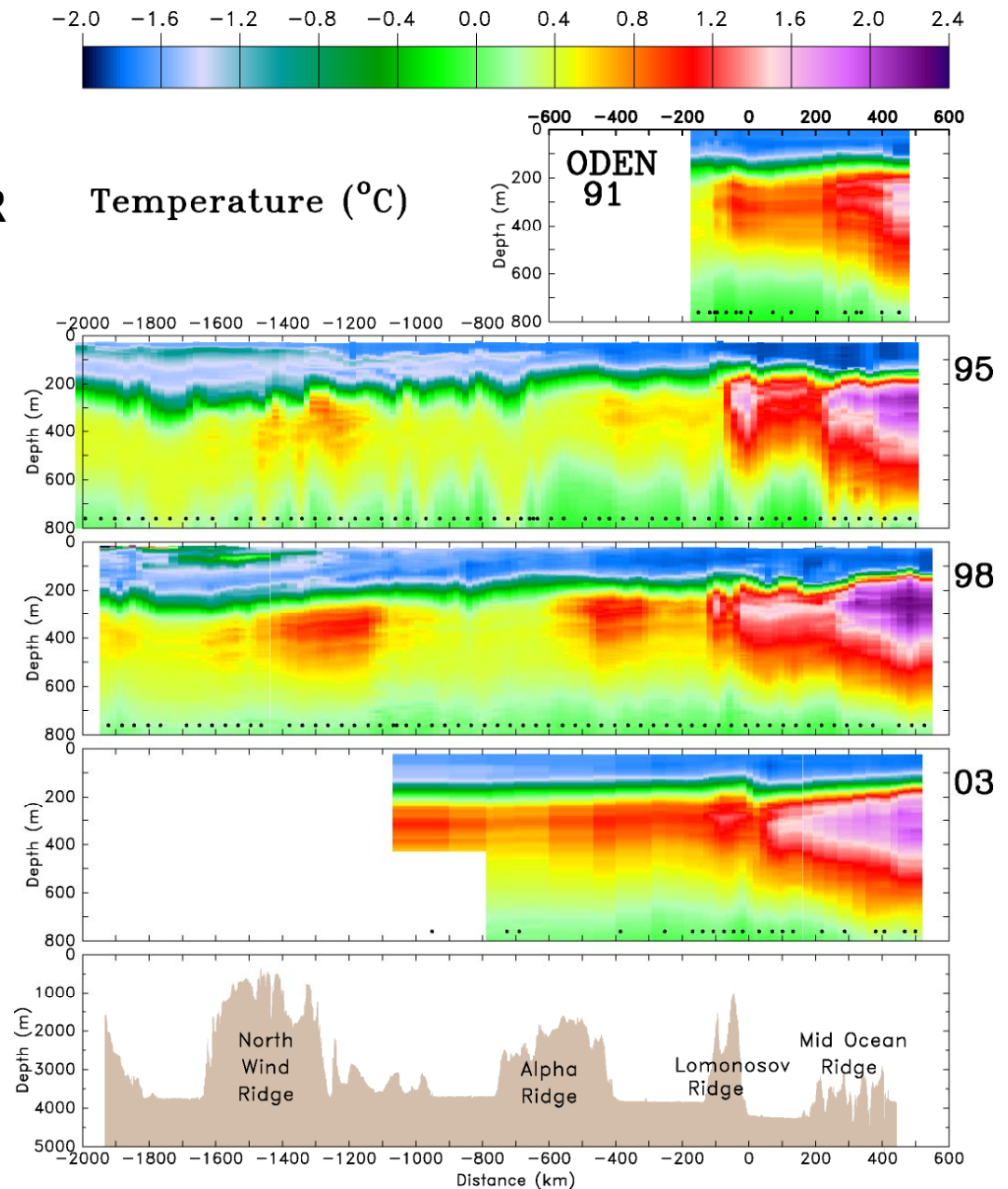
T. Boyd



# Arctic Ocean Temperature

## Across-Basin Transects

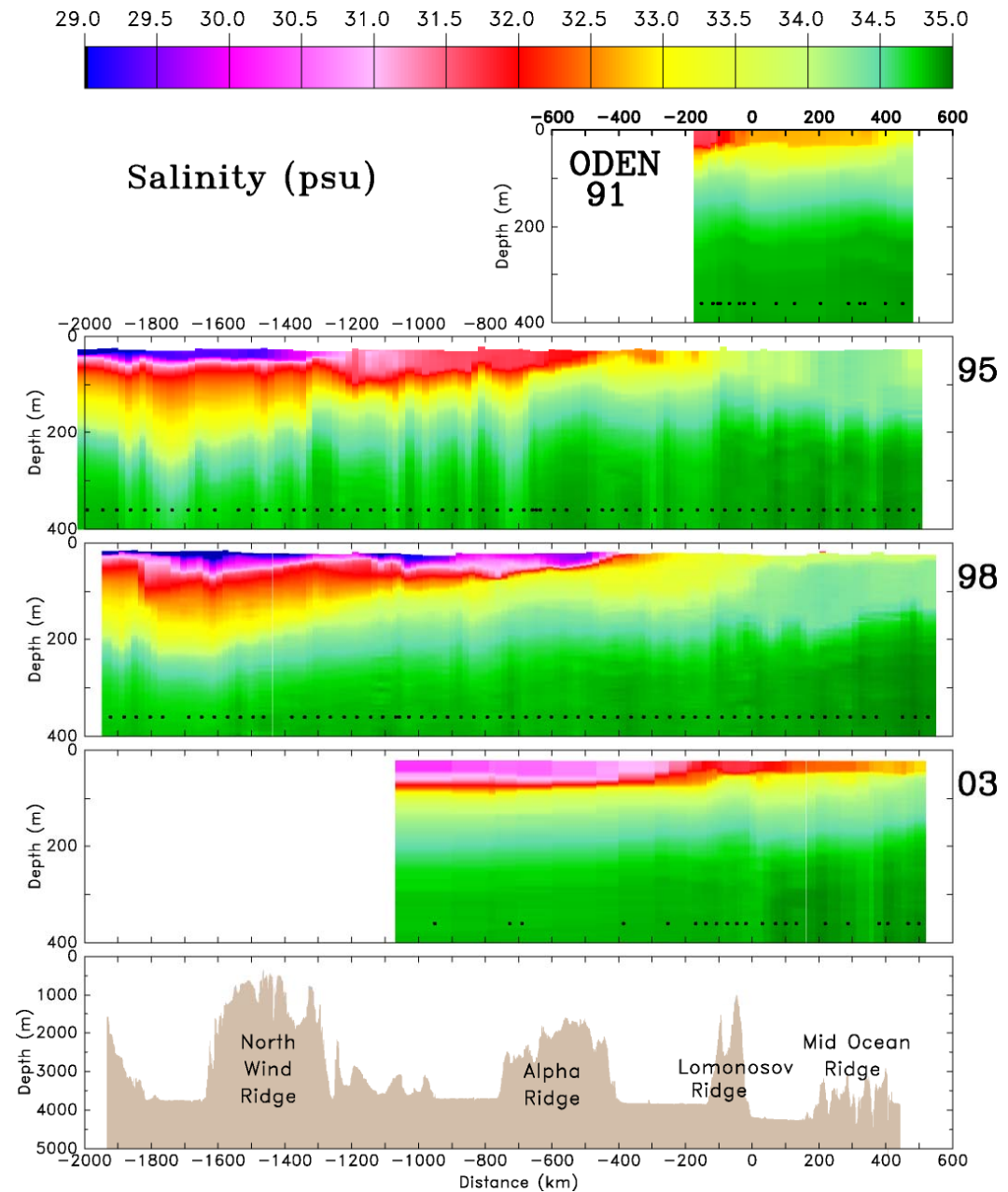
- Initial warming over Arctic MOR
- Warming over Lomonosov R.
- Warming over the Alpha R. and North Wind R.
- Continued warming at AMOR
- Continued warming in the CB, MB, and AB
- Cooling over the AMOR
- Ridges vs. interior of basins (circulation vs. mixing)



# Arctic Ocean Salinity

## Across-Basin Transects

- Large-scale Atlantic/Pacific salinity difference
- Reduction of fresh water in the Amundsen B.
- Increase of FW in the near-surface of the CB
- Increase of FW in the Makarov and Amundsen B.

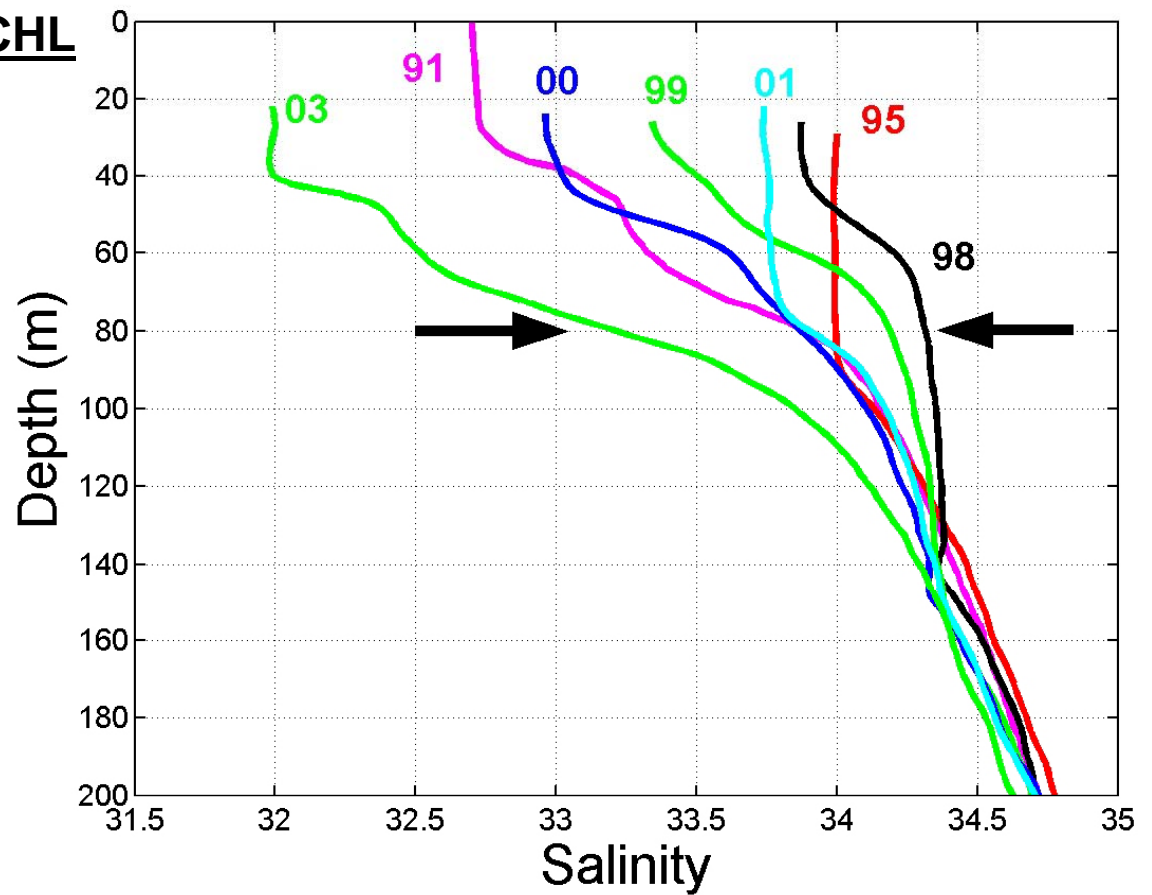


# Arctic Oceanography

## *Arctic Cold Halocline*

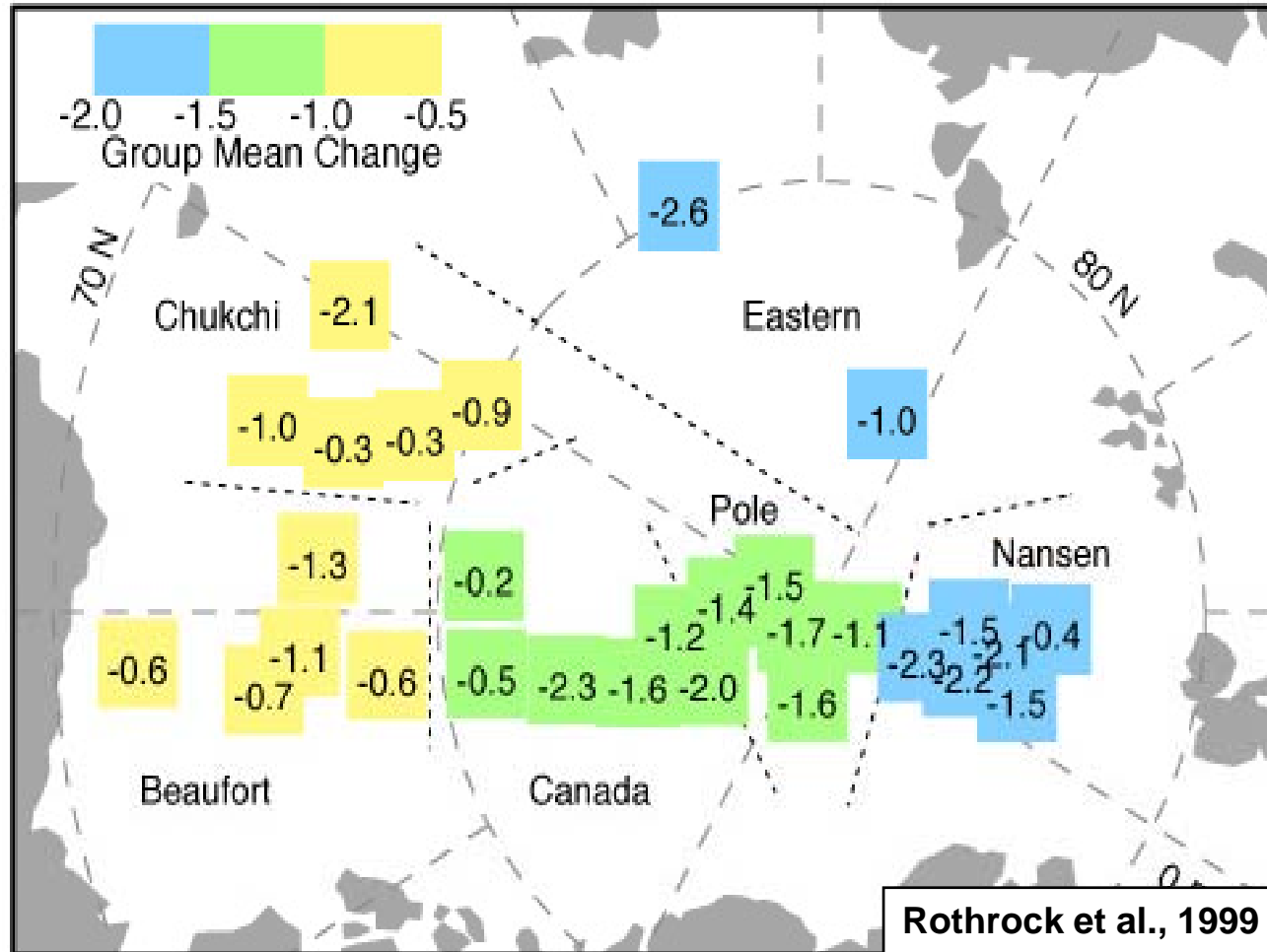
### Variability in strength of the CHL

- Profiles from a single location in the Amundsen Basin
- S at 80m is a measure of stratification
- High S at 80m = weak stratification (S at 200 m is constant)



# SEA ICE DRAFT

*Changes: 1950s-1970s to 1990s*

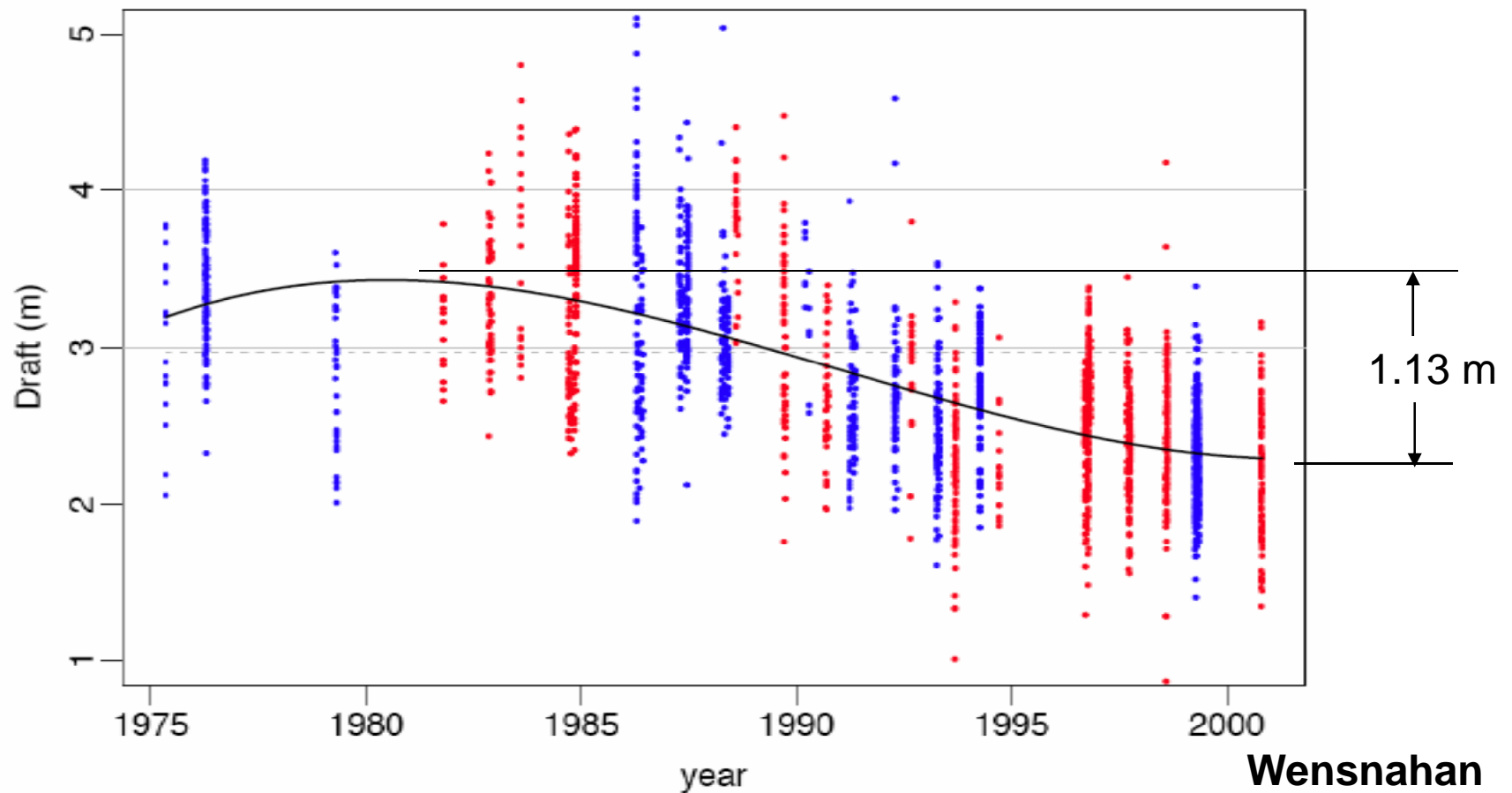


*Evidence that Arctic sea ice cover is thinning*



# SEA ICE DRAFT

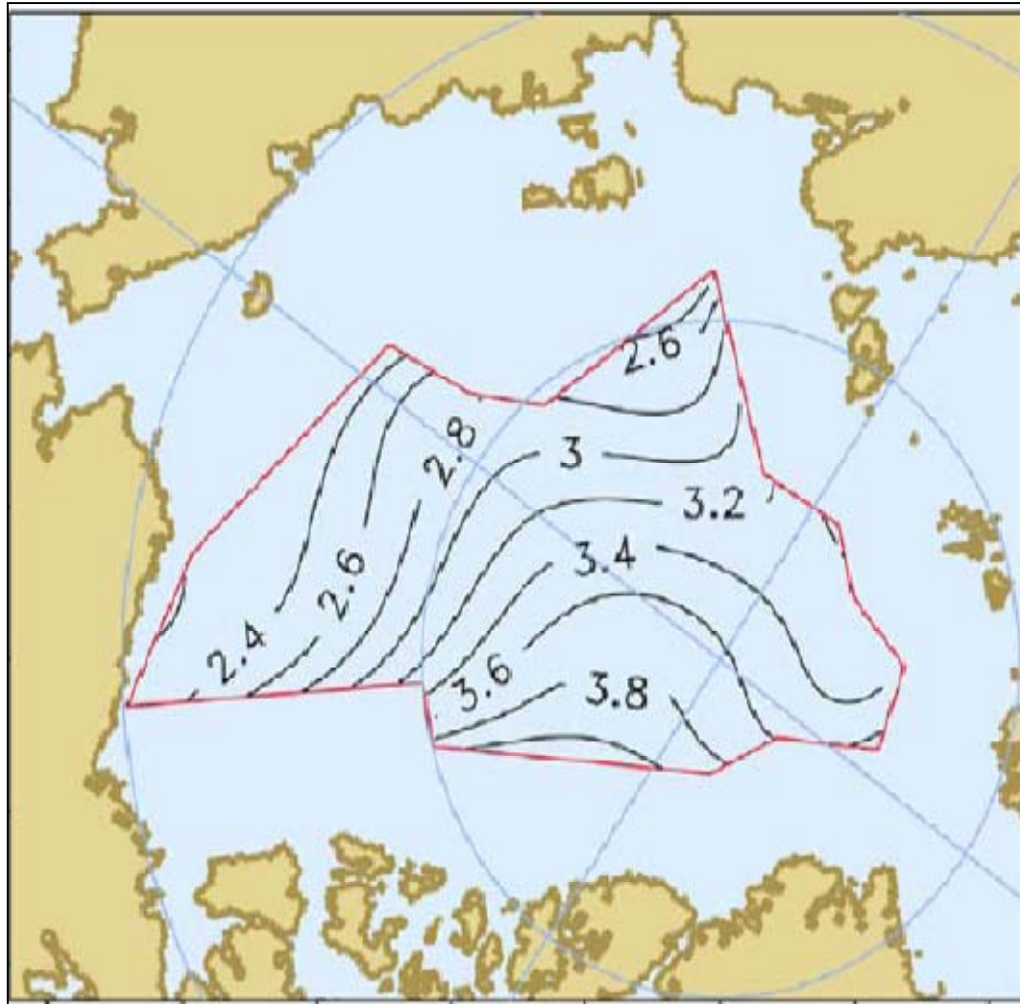
## *Interannual Variation*



***Multiple regression of all data at NSIDC***

# SEA ICE DRAFT

## *Spatial Distribution*



Wensnahan

# SUMMARY

- Unique program
- Key insights on characteristics of Arctic Ocean
  - Seafloor
  - Ocean
  - Ice cover
- Region remains of high interest
  - Bellwether of climate change
- Possible increase in operational activities
- Strong motivation to maximize utilization of SCICEX agreement



Provided by T. Boyd