

PRELIMINARY CRUISE REPORT FORM

State Department Cruise No: 2001-112

Ship Name: R/V Knorr

Operating Institute or Agency: Woods Hole Oceanographic Institution

Project Title: Collaborative Research - The Nordic Seas: Water Mass Structure, Circulation and Connections Between the Arctic and Atlantic Oceans

Cruise Dates: May 30 - July 1, 2002

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Clearance Countries: Denmark, Greenland, Iceland, Norway, United Kingdom

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Description of Scientific Program:

To understand the link between the high northern latitude oceans and the Atlantic Ocean, as well as the effect of this link on the large scale thermohaline circulation, the exchange of waters between these oceans and their modification in the Nordic Seas, must be understood. The Nordic Seas produce dense outflow waters from waters that reach their central gyres, including fresh waters from the Arctic Ocean spreading east from the East Greenland Current. This rapidly transmits shifts in the upper layer fresh water patterns into the deep North Atlantic. Dense intermediate waters - primarily modified Atlantic waters - are also produced in the Nordic Seas, as well as exported from the Arctic Ocean. They pass the western margins of the Greenland and Iceland seas and are modified by mixing with cold, fresh waters from the gyres. They also spread eastward into the Greenland and Iceland gyres and into the Norwegian Sea.

It is important to understand the role of the Nordic Seas in the connection of the Arctic Ocean to the mid-latitudes now in a systematic way because of the large variability that has recently been observed in the eastern portion of the Nordic Seas and the Arctic Ocean. This variability will be transmitted into the western Nordic seas through the Arctic outflows. Better understanding of the links between thermohaline variability internal to the Arctic Ocean and Nordic Seas and the hydrography of the northern North Atlantic is required to address the question of the sensitivity of the North Atlantic to oceanic climate changes.

The objectives of this project are to study the interactions of the Arctic Ocean outflow waters and Nordic Sea waters as they create Denmark Strait Overflow Water (DSOW) and Iceland-Scotland Overflow Water (ISOW) on the one hand and Arctic Ocean influenced layers in the Nordic Seas on the other. The specific goals include:

1. Determine the sources and pathways of fresh water out of the Arctic Ocean and study the processes by which this fresh water becomes incorporated into and influences the formation of water masses in the Nordic Seas and the properties of the waters exported into the North Atlantic Ocean.
2. Determine the sources and characteristics of intermediate and deep waters of Arctic origin in the Nordic Seas, how Arctic and Nordic water masses modify each other within the Nordic Seas, and how these modified water masses are exported into the Atlantic Ocean.
3. Determine the Arctic and Nordic Sea components of Denmark Strait Overflow Water and Iceland-Scotland Overflow Water.
4. Determine the pathways of Atlantic water through the Nordic Seas and into the Arctic Ocean and how it transforms Nordic Sea water masses, for example by recirculation and mixing.
5. Obtain a synoptic survey of the major water masses in the Nordic Seas.

This survey will provide a key baseline observation to bridge past and future studies of the link between the Arctic Ocean, the Nordic Seas, and the Atlantic Ocean.

6. Use the new survey in conjunction with previous observations to determine the evolution of 1) deep and intermediate water mass characteristics in the Nordic Seas and 2) deep exchange between the Arctic Ocean and the Nordic Seas, in response to the major reduction in Greenland Sea Deep Water formation in the early 1980s, as well as the increased penetration of Atlantic-derived water into the Arctic Ocean since the late 1980s.

To meet these objectives a two-ship survey of hydrographic and chemical properties of the Nordic Seas was carried out with the Swedish Icebreaker Oden sampling the ice-covered waters north of Fram Strait and along the east coast of Greenland and the R/V Knorr sampling the ice-free waters in the Iceland, Greenland and Norwegian seas. This report concerns only the R/V Knorr cruise.

On the R/V Knorr, CTD and LADCP measurements were carried out at 159 stations and water samples were collected with a 36-place rosette interfaced to the CTD. Water samples were analyzed on board by US scientists for salinity, oxygen, nutrients and chlorofluorocarbons and water samples were collected for shore based analysis at US laboratories for tritium, helium isotopes, oxygen isotopes, noble gases and carbon isotopes. Samples were also analyzed on board by foreign scientists for total carbon dioxide and alkalinity (Dr. Richard Belleraby, Norway), and sulfur hexafluoride (Dr. Marie-Jose Messias, United Kingdom). Samples were collected for shore based analysis by foreign scientists for iodine-129 (Vassile Alfimov, Sweden and Sandra De Sequeira, France).

Schedule of Data Delivery for data collected by US scientists:

Data Description

Principle Investigator

Principle Investigator affiliation

Date of Expected Delivery to Dept. of State

CTD

James Swift

Scripps Inst. of Oceanography

July 2004

Salinity

James Swift

Scripps Inst. of Oceanography

July 2004

Oxygen concentration

James Swift

Scripps Inst. of Oceanography

July 2004

Nutrients

James Swift

Scripps Inst. of Oceanography

July 2004

Chlorofluorocarbons

William Smethie, Jr.

Lamont-Doherty Earth Observatory

July 2004
Tritium
Peter Schlosser
Lamont-Doherty Earth Observatory
January 2005
Helium isotopes
Peter Schlosser
Lamont-Doherty Earth Observatory
January 2005
Oxygen isotopes
Peter Schlosser
Lamont-Doherty Earth Observatory
January 2005
Noble gas concentrations
Steve Emerson
University of Washington
January 2005
Carbon isotopes
Paul Quay
University of Washington
January 2005
LADCP
Daniel Torres
Woods Hole Oceanographic Inst.
July 2004
Final Cruise Report
William Smethie, Jr.
Lamont-Doherty Earth Observatory
January 2005