DANMARKS OG GRØNLANDS GEOLOGISKE UNDERSØGELSE RAPPORT 2014/51

ICE-ARC project Cruise report

'Knud Rasmussen' August 14th–20th 2014

Naja Mikkelsen & John Boserup

GEOLOGICAL SURVEY OF DENMARK AND GREENLAND
DANISH MINISTRY OF CLIMATE, ENERGY AND BUILDING

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ICE-ARC project

Cruise report

I/F Knud Rasmussen August 14th – 20th 2014

Summary

A sediment coring program was undertaken from the Danish Navy Vessel I/F Knud Rasmussen August 14th – 20 th 2014. The Danish Navy had generously placed the ship for the use of the ICE-ARC project team. 26 sediment cores were collected during the cruise and more that 150 kilometers of depth profiles recorded. Coring was undertaken during daytime and depth surveys during night.

No seismic profiles or depth records existed of the Inglefield Bredning prior to the cruise and therefore ecco sounding profiles were run to located sea bottom depressions suitable for coring. The sounding profiles will also be used to establish a coarse topographic map of the fjord in order to outline the glaciation history of the fjord system.

The cores will be analyzed using a suite of different methods and techniques. Based on these data a record of 4500 years of past changes including past climate changes, changes in sea ice cover and productivity will be outlined.

ICE-ARC Work Package 3 holds in addition to the objective of investigating past climate changes also an important component of present socio economic conditions in the Qaanaaq region. Discussions were therefore undertaken with hunters from Qaanaaq Settlement after the cruise. These discussions revealed a strong interest from the community to obtain copies of all recorded depth data as this information is important for the community to locate the best locations for winter fishing from the sea ice.

Fig 1. *The Inglefield Bredning, northern NW Greenland was investigated during the cruise of the navy ship 'Knud Rasmussen' as part of the ICE-ARC project.*

Introduction

The EU funded *ICE-ARC project - Ice, Climate and Economics in the Arctic* – was launched in January 2014 to investigate ongoing climate changes in the high Arctic and study the impact of the changes on present day Arctic socio economy. A third dimension of the ICE-ARC project is the investigations of past climate changes and their possible impact on the various Inuit cultures that have existed in the high Arctic through time.

The purpose of the Knud Rasmussen cruise 2014 was to collect sediment cores form the Inglefield Bredning in Northern NW Greenland to enable studies of the past changes in the Northern NW Greenland (Figs. 1).

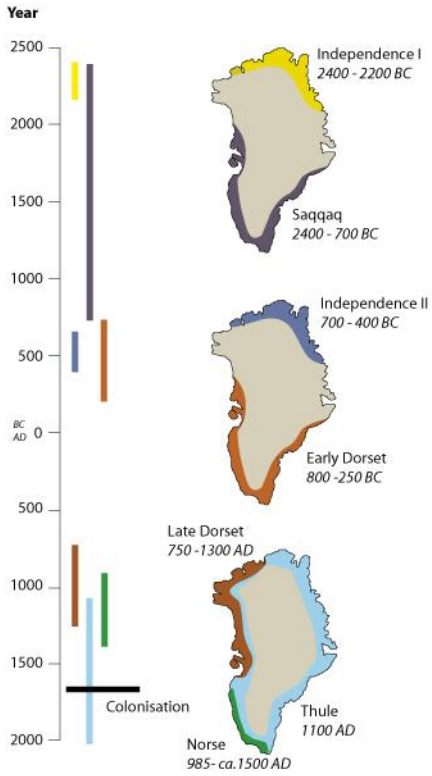

Fig. 2 The 4500 year record of Inuit cultures in Greenland unravel the migration history and succession of the cultures. Greenland has been uninhabited for several periods during the 4500 year long settlement history.

Greenland and northern NW Greenland has only been inhabited for 4500 years. During this short time span several highly developed and independent cultures has succeed each other (Fig. 2). Archeological investigations have shown that Greenland several times was uninhabited for longer

periods during these 4500 years. The question is therefore what caused this periodic depopulation of the country.

The sediment cores may add some answer to this question as each of the successive cultures has developed their own hunting and living strategies to survive in these for man rather extreme environments during a specific climate regime. However with climate and environmental changes these very sophisticated skills were threatened and the culture perished until a new culture entered Greenland with the capability to cope with the new climate regimes.

Inglefield Bredning is close to the transit corridor where Inuit migrations from Canada into Greenland took place. Inglefield Bredning is therefore a key area to unravel the impact on the 4500 year long history of climate and environmental changes and to understand what caused the various cultures to vanish.

Department of Oceanography at DMI is part of the ICE-ARC project and their focus is the oceanography of the Inglefield Bredning. It was planned that a group of scientists from DMI should be part of the ship board party on Knud Rasmussen to collect hydrographic data – but their participation was unfortunately canceled for logistical reasons. Therefore a number of transects profiles were run specifically for DMI in addition to the GEUS lines.

Cruise participants

Naja Mikkelsen, GEUS
John Boserup, GEUS

Daily Log

August 13th 2014. Departure from Copenhagen to Kangerlussuaq and Iluilissat. Futher progress towards Qaanaaq was impossible due to weather conditions further to the north and accommodation was arranged at a youth hostel in Ilulissat.

August 14th 2014. Departure from Ilulissat and arrival in Qaanaaq 18.00 hr. Pick up by Zodiac at the shores of Qaanaaq and transfer to 'Knud Rasmussen'. Two east-west depth transects of the Inglefield Bredning were recorded by Ecco sounder during night.

August 15th 2014. Coring Equipment assembled on helicopter deck and test trails undertaken.

August 16th 2014. Coring operations in the inner part of the Inglefield Bredning. Repair of hydraulic pump.

August 17th 2014. Depth sounding in the Bowding Fjord and short visit to a Robert Peary site. Coring operations in the outer part of the Inglefield Bredning

August 18th 2014. Coring in the Nares strait off the mouth of Inglefield Bredning.

August 19th 2014. Coring in the canyon leading from the Inglefiels Bredning to the shelf. Strong under currents in the canyon. Hurricane in late afternoon. Packing of sediment cores.

August 20th 2014. Dismantling coring equipment; disembarking ship; discussion on ICEARC wp3 related questions with a hunter and head opf school in Qaanaaq. Flight to Ilulissat. Fog and poor visibility.

August 21th 2014. Departure for John Boserup from Ilulissat to Copenhagen. Naja Mikkelsen meetings with the Museum and the municipality of Ilulissat.

August 22th 2014. Departure for Naja Mikkelsen from Ilulissat to Copenhagen.

Area of investigation

Inglefield Bredning is an approximately 100 kilometer deep fjord system in northern NW Greenland (79^{o} N, 70^{o}W). A number of large outlet glaciers terminate in the inner part of the fjord. These glaciers are very productive and large icebergs calved from the glacier fronts are constantly drifting through the fjord.

No prominent moraines or major thresholds were observed on the recorded depth profiles during the cruise. This indicates that glacier advancement had left only minor imprints after the deglaciation and that no major thresholds restrict the hydrographic circulation of the fjord.

A major canyon extending from the mouth of the Inglefield Bredning in a SW direction into the shelf area of the Nares strait was mapped. Coring in the canyon proved the presence of strong under currents in the canyon.

Figs 3 and 4. Rumohr Lot corer is launched form the helicopter deck - and the sediment filled corer retrived.

Sampling methods

A Rumohr Lot corer (gravity corer) equipped with at a 50 kg lead weight and mounted with 2 m long plexi glass tubes were used for coring operations (Figs. 3 and 4). A GEUS winch system and hydraulic power unit was welded to a frame and attached with bolts to the deck (Fig. 5). The crane of the ship was used to facilitate operation of the corer system.

The cores were left to settle after retrieval and water was sipped off by drilling small holes in the core barrel before the cores liner was cut, equipped with a foam plug at the top and sealed for storage and transport.

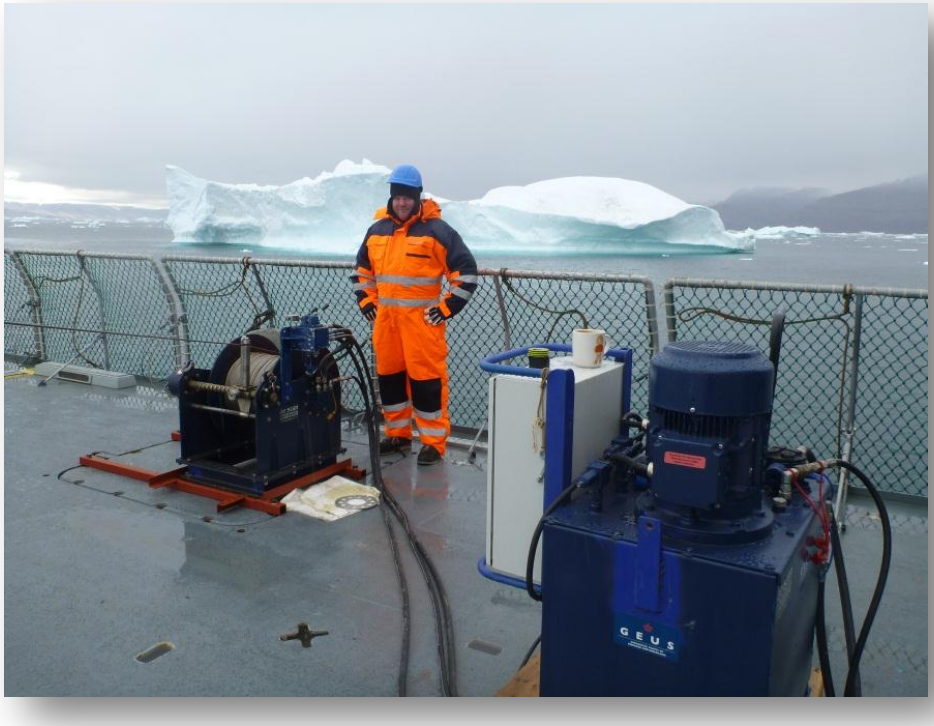

Fig 5. The GEUS hydraulic power unit and winch system. The winch was welded onto a frame and bolted to the helicopter deck

The depth recording was performed from the bridge of the ship by a Furuno system Sparry Marine Elac ES 5100 (Fig. 6) and data stored in Ascii formated files with a resolution of one second. It was not possible during the cruise to make an acquisition of the displayed ECCO sound data. The data will be processed at GEUS to produce a map of the bottom topography and fjord morphology. A preliminary investigation of the data indicates that no major thresh holds are present in the fjord system.

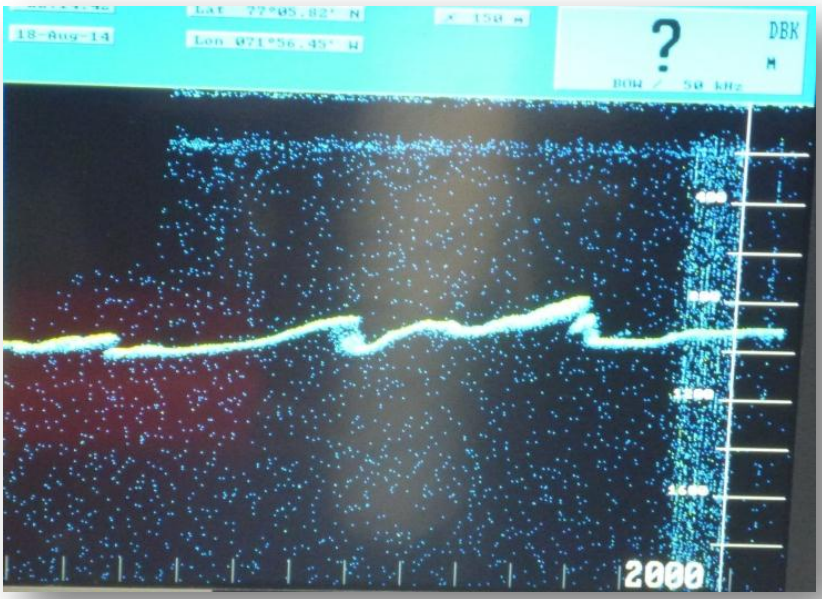

Fig 6. Example of ECCO sounder depth plot showing wave ripples in the canyon south west of the mouth of Inglefield Bredning.

Collected cores

Sediment coring was attempted on 44 separate locations and cores were retrieved on 26 of these sites (Fig. 7; Table 1). Well defined sediment-water surfaces were obtained in all cores and some displayed biological activity including worm tubes (Fig. 8).

The reason for the rather low score of cores was the initial failure of the Rumohr Lot to maintain vacuum when retrieved above the water surface. A close inspection of the corer revealed that the top lid did not close completely. This situation made the sediment to flush the core barrel when above water line. The crew generously corrected the problem in their mechanics workshop.

Another problem was the character of the sediment. The sediment in the Inglefield Bredning thus seemed fairly compact compared to similar Greenlandic fjord systems previously cored by GEUS. The sediment in the inner part of the Inglefield Bredning proved to have a fairly high content of drop stones which further reduced the penetration of the corer into the sediment (Fig. 9). Strong under currents in the in the outer fjord mouth and in the canyon made coring operations a challenge.

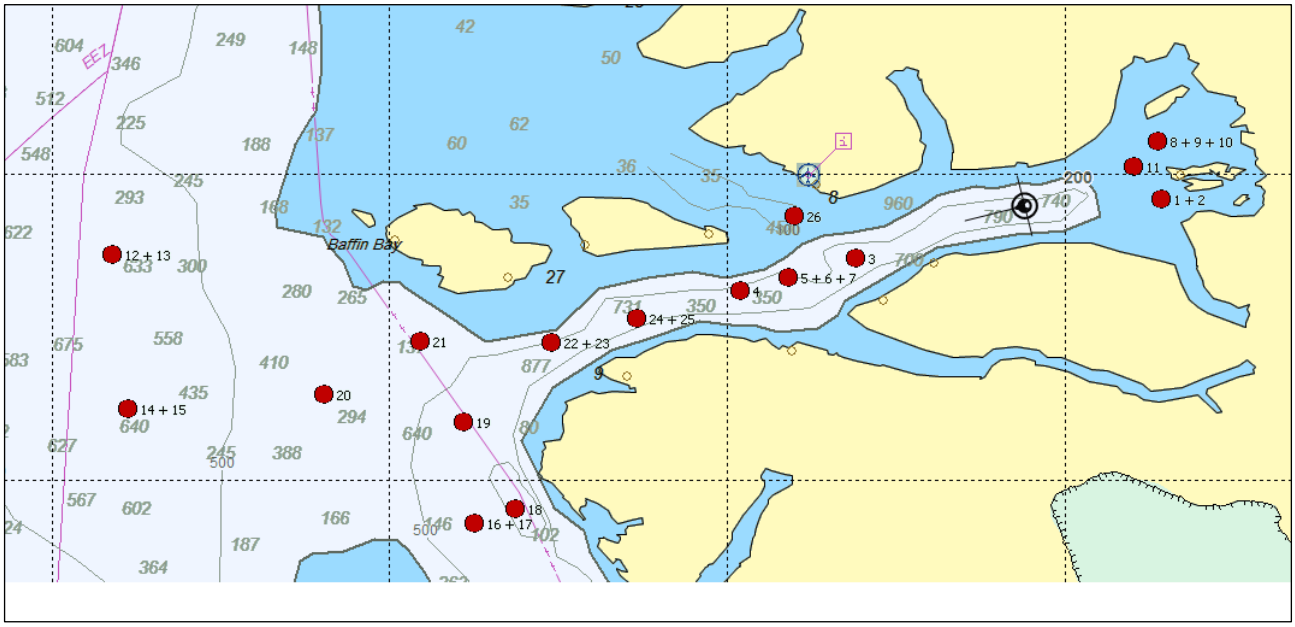

Fig . 7. Core locations in the Inglefield Bredning region. Duplicate and triple cores were retrieved on some locations. The map is kindly compiled by Kaptajnløjnant Morten Brandt, Knud Rasmussen.

Figs.8 and 9. Examples of undisturbed sediment-water interfaces of Cores ICE-ARC #19 with biological remains (worm tubes) and ICE-ARC #21 with drop stones.

Acknowledgement

The GEUS cruise participants extend their gratitude to Major General S. Østergaard Nielsen, Joint Arctic Command in Nuuk, who granted us permission to be onboard the Navy ship Knud Rasmussen for a one week ICE-ARC related operation in the Thule area.

The success of the ICE-ARC cruise 2014 was entirely due to the engaged and helpful crew on board the ship and we therefore direct our sincere thanks to Captain Kristian Daugaard and the crew members who assisted in all aspect of the coring and sounding operations.

This work was supported by funding from the ICE-ARC programme from the European Union 7th Framework Programme, grant number 603887.

Table 1. Core data. The given core length includes the inserted foam plug in top of core barrel.

Core number	Length (cm)	Coordinates	Water depth (m)	Comments
ICE-ARC 2014 #1	106	77°27'66N – 66°47'83W	572	
ICE-ARC 2014 #2	138	77°27'66N – 66°47'83W	596	
ICE-ARC 2014 #3	112	77°21'94N – 69°03'39W	920	
ICE-ARC 2014 #4	91	77°18'85N – 69°54'89W	970	
ICE-ARC 2014 #5	14	77°20'10N – 69°33'30W	973	
ICE-ARC 2014 #6	95	77°20'10N – 69°33'30W	877	
ICE-ARC 2014 #7	43	77°20'10N – 69°33'30W	869	
ICE-ARC 2014 #8	125 + bottom 17	77°33'23N – 66°49'30W	621	
ICE-ARC 2014 #9	Bulk	77°33'23N – 66°49'30W	611	
ICE-ARC 2014 #10	140	77°33'23N – 66°49'30W	613	
ICE-ARC 2014 #11	110	77°33'23N – 67°00'05W	628	
ICE-ARC 2014 #12	145	77°22'32N – 74°33'59W	733	
ICE-ARC 2014 #13	126	77°22'32N – 74°33'59W	733	
ICE-ARC 2014 #14	130	77°07'19N – 74°26'91W	668	
ICE-ARC 2014 #15	127	77°07'19N – 74°26'91W	671	
ICE-ARC 2014 #16	68	76°55'85N – 71°53'05W	893	
ICE-ARC 2014 #17	38	76°55'85N – 71°53'05W	953	
ICE-ARC 2014 #18	28	76°57'28N – 71°34'44W	952	
ICE-ARC 2014 #19	45	77°05'95N – 71°57'51W	891	
ICE-ARC 2014 #20	Bulk	77°08'65N – 72°59'48W	376	
ICE-ARC 2014 #21	30	77°13'89N – 72°17'05W	429	
ICE-ARC 2014 #22	65	77°16'14N – 70°40'96W	925	
ICE-ARC 2014 #23	52	77°16'14N – 70°40'96W	924	
ICE-ARC 2014 #24	87	77°16'14N – 70°40'96W	944	
ICE-ARC 2014 #25	81	77°16'14N – 70°40'96W	940	
ICE-ARC 2014 #26	30	77°26'08N – 69°30'84W	135	