

Sandwaves and megaripples on Spitsbergenbanken, Barents Sea

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ABSTRACT: Multibeam echosounder data acquired from the shallowest part of Spitsbergenbanken, Barents Sea, reveal a large variety of bedforms indicating sediment erosion and transport. Bedforms with wavelength of a few metres and a few centimetres to a few decimetres height are interpreted as megaripples. These are formed by waves, bottom currents or a combination of the two and occur across most of the study area. Small, medium and large sandwaves occur mainly in the southwestern part of the study area. Different kinds of megaripples are observed on and around the sandwaves, indicating transport processes of different origins.

1 INTRODUCTION

The Norwegian seabed mapping programme MAREANO (www.mareano.no) was launched in 2005 to improve the knowledge of the Norwegian seafloor. The programme performs detailed mapping of bathymetry and topography, seabed sediments, contaminants, biodiversity and biotopes. The knowledge gained from MAREANO provides input to ecosystem-based management, organised through integrated management plans covering the Norwegian offshore areas. In the framework of this program, multibeam echosounder data were collected from the shallowest part of the Spitsbergen Bank, which is a large bank area in the Barents Sea, between the Bear Island and Svalbard. A large variety of bedforms was identified, varying from sand ripples to megaripples and sandwaves to sandbanks.

If sandwaves have been described on some places of the Norwegian continental shelf (Bøe et al., 2009, 2015; King et al., 2014), so far sandwaves and megaripples have not been described on the shallow banks in the Norwegian Barents Sea. In general, very little information is found on ripples and megaripples on the open sea, and their connection with sandwaves.

This study focuses on the megaripples and the large sandwaves and presents preliminary interpretation of their connection.

2 STUDY AREA AND METHODS

2.1 Study area

The study area is situated in the shallowest part of Spitsbergen Bank, close to the center of a clockwise current gyre formed by the cold Polar Water (Loeng, 1989; Slagstad and McClimans, 2005) (figure 1). Tidal currents are particularly strong over the shallow bank, with maximum speeds of up to 1 m/s, amplitude of 20-40 cm and a phase angle of about 330° on the top of the bank (Gjevik et al., 1994; Gjevik, 2008).

2.2 Methods

The study area was mapped in 2016 using Kongsberg EM2040 Dual Head multibeam echosounder (200-400 kHz). Both multibeam bathymetry and backscatter data were recorded. The bathymetry data were processed by the Norwegian Hydrographic Service with CARIS, and the backscatter data were processed internally with QPS FMGT software. The high data density allowed gridding at 20 cm.

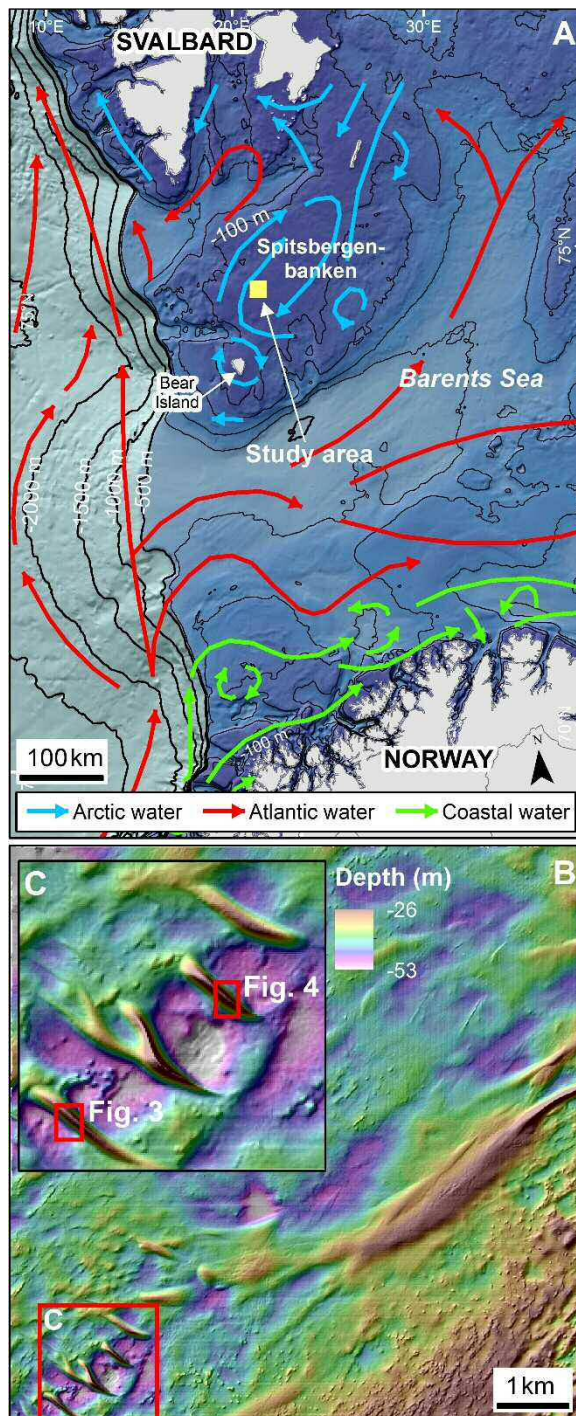


Figure 1. A) Location of the study area (yellow box) and main oceanographic currents (from Loeng, 1989). Background bathymetry: IBCAO (Jakobsson et al., 2012), B) Study area (bathymetry: MAREANO / Kartverket), C) Detail of the sandwave area.

3 RESULTS

3.1 Megaripples

Five main types of megaripples occur in our study area (figure 2): elongated megaripples (formed by either wave or bottom

currents), interference megaripples and lingoid/lunate megaripples. The elongated megaripples show various orientations and morphologies. Wave megaripples, with N-S crest orientation, mostly occur on low lying areas, while bottom current megaripples occur on high and low areas. Two main crest orientations are observed: NW-SE (the most common) and NE-SW. The lunate/lingoid megaripples, with generally a NW-SE crest orientation, mostly occur around large sandwaves.

3.2 Sandwaves

Four large sandwaves with NW-SE crest orientation occur in the southwestern part of the study area. The three southernmost sandwaves are the highest and display sharp crests whereas the northernmost sandwave only displays a sharp crest along 250 m. Smaller sandwaves occur around and north of the large sandwaves. Their crests are often smooth and they have generally a NW-SE crest orientation and shows a NE migration.

3.3 Megaripples around sandwaves

Sandwaves have different types of megaripples covering their flanks (figures 3 and 4), but also at their feet. In the example of figures 3 and 4, wave megaripples occur on both sides of the sandwaves. On the west side, they are bordered by lunate/lingoid megaripples, while on the east side, they occur close to interference megaripples and/or lunate/lingoid megaripples. The flanks of the sandwave are mostly covered by current megaripples.

4 DISCUSSION

The large sandwaves have sharp crest, indicating that they are active. They show a northward migration which is in accordance with tidal current directions (Gjevik et al., 1994) indicating they are likely of tidal origin. The different types of megaripples around sandwaves indicate different types of transport processes, and that they can evolve quickly from one type to another.

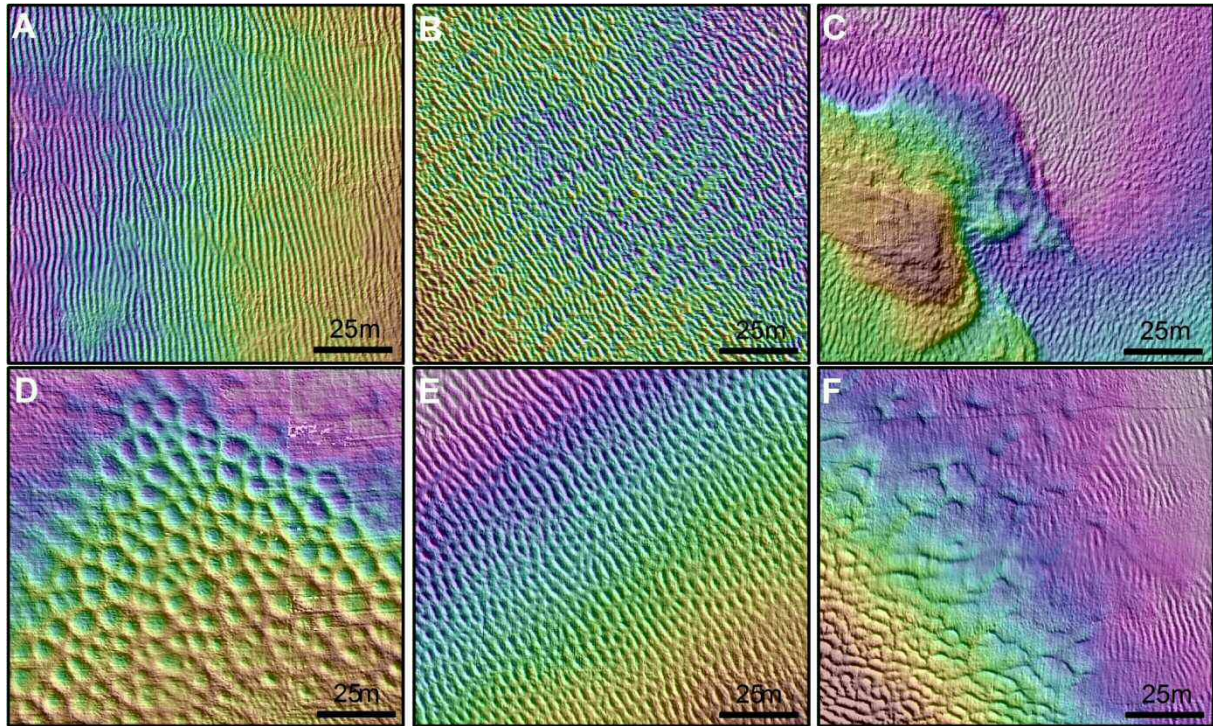


Figure 2. The different types of megaripples observed in the study area. 20 cm bathymetry grids. A) N-S wave megaripples, B) NW-SE current megaripples, C) NE-SW current megaripples, D) Interference megaripples, E) Interference megaripples, F) Lunate/lingoid megaripples. Bathymetry: MAREANO / Kartverket.

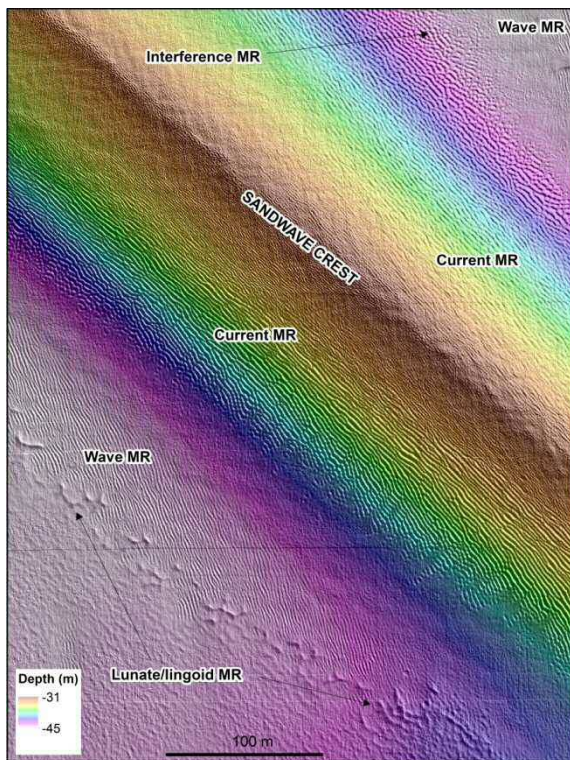


Figure 3. Different types of megaripples occur around and on the flanks of the sandwaves. MR: Megaripples. Bathymetry: MAREANO / Kartverket.

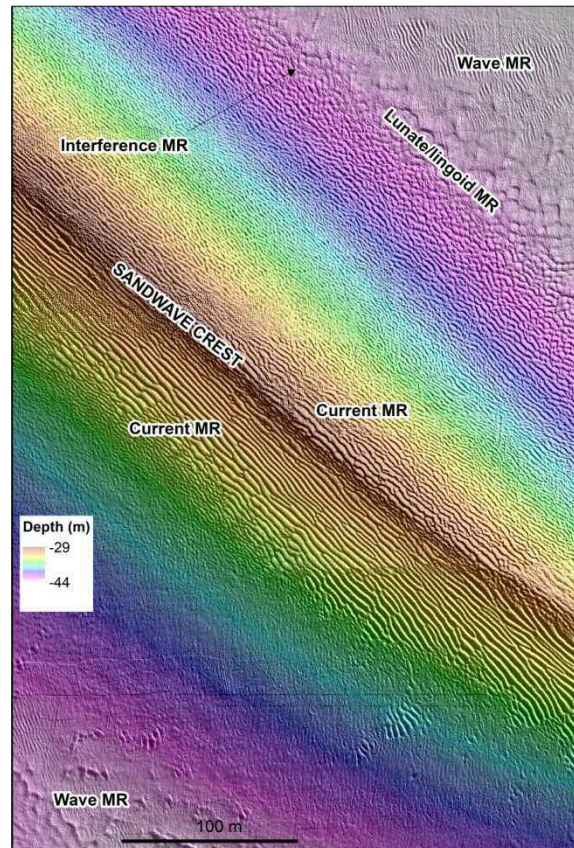


Figure 4. A sandwave showing megaripple pattern similar to the one in figure 4. MR: Megaripples. Bathymetry: MAREANO / Kartverket.

Bottom currents seem to dominate the sandwaves, while wave energy may create megaripples at the feet or between the sandwaves. Interferences megaripples, located at their feet mostly on the east flanks, indicate influence of both processes. Lunate/lingoid megaripples, which normally occur under stronger current than elongated megaripples, only occur between the sandwaves.

5 CONCLUSIONS

6 Megaripples are clearly observed on the 20 cm bathymetry grid. Five main types occur in the study area. Wave megaripples indicate a N-S wave energy, while current megaripples are more complex and show two main crest orientations: NW-SE and NE-SW. Wave energy and bottom current together can create interference ripples. Around sandwaves, lunate/lingoid megaripples occur, indicating a stronger current there.

The megaripples pattern is complex around the sandwaves, and four different types of megaripples occur at close range, indicating interactions of different current/wave processes around the sandwaves.

Future research could include more current studies and their influence on the formation of the megaripples and the migration of the sandwaves.

7 ACKNOWLEDGEMENT

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