5.3.3 Onshore coastal studies - coastal dynamics at key sites of the New Siberian Islands, Dmitry Laptev Strait, and Buor-Khaya Bay

Mikhail N. Grigoriev, Feliks E. Are, Hans-W., Hubberten, Volker Rachold, Sergey O. Razumov and Waldemar Schneider

5.3.3.1 Introduction

The main objective of the onshore coastal studies was to quantitatively assess coastal change rates (shoreline and cliff edge) focussing on erosive coasts. Twelve key sites along the coast of the Laptev and East-Siberian Seas were studied (Fig. 5.3.1-1):

New Siberian Archipelago:

1) north-eastern coast of Stolbovoy Island (Ice Complex and thermokarst deposits, ice-poor Pleistocene–Holocene coasts);
2) northern coast of Kotelny Island, Anisy Cape (Ice Complex and thermokarst deposits, ice-poor Pleistocene–Holocene coasts);
3) southern coast of Belkovsky Island, Skalisty Cape (rocky and other types of non-icy coasts);
4) south-eastern coast of Kotelny Island, Khomurgunnakh River mouth area (Ice Complex and thermokarst deposits, ice-poor Pleistocene–Holocene coasts);
5) south-western coast of Bunge Land, Bunge polar station ("high sand" area, marine terrace);
6) southern coast of Novoya Sibir Island, Wood Mountain Cape (rocky and other types of non-icy coasts, ice-poor Pleistocene coasts);
7) south-western coast of Novoya Sibir Island (Ice Complex and thermokarst deposits, ice-rich marine deposits, ice-poor Pleistocene–Holocene coasts);
8) southern coast of Bunge Land ("low sand" area, marine terrace);
9) north-western coast of Maly Lyakhovsky Island (Ice Complex and thermokarst deposits, ice-poor Pleistocene–Holocene coasts);

Dmitry Laptev Strait (mainland coast):

10) Svyatoy Nos Cape (ice-poor and ice-rich Pleistocene–Holocene coasts, rocky and other types of non-icy coasts);
11) Oyagossky Yar, mouth of Kondratev River area (Ice Complex and thermokarst deposits);

Buor-Khaya Bay:

12) north-western coast of Muostakh Island (Ice Complex).

5.3.3.2 Methods

A number of coastal segments, which are characterized by fast or slow retreat rate or almost stable dynamic regime, have been studied. Modern shoreline and cliff edge positions were measured using a laser theodolite and other methods.

Theodolite profiles and bench marks recorded in the field were identified on and compared with maps and aerial photographs taken in 1960th – 1980th. Detailed descriptions of the applied methods were published in the previous cruise reports (Rachold and Grigoriev, 2000, 2001; Pfeiffer and Grigoriev, 2002).

5.3.3.3 Results

The preliminary analysis of the field measurements at the selected coastal sites and other available data show that the average shore retreat rates of the New Siberian Islands are 0.1 - 3.5 m/yr for the long-term period (16-52 years), which is considerably less, than it was expected (Are, 1999; Grigorev and Kunitsky, 2000; Rachold and Grigoriev, 2000, 2001; Pfeiffer and Grigoriev, 2002). Most of the investigated continental coastal sections are characterized by significantly faster average shore retreat rates. The preliminary results are summarized in Table 5.3.3-1.

Table 5.3.3-1. Average retreat rates at the key sites (see Fig. 5.3.1-1).

key site (no.)	1	2	3	4	5	6	7	8	9	10	11	12
avg retreat. rate (m/yr)	0.1	0.4	0.5	0.7	0.3	0.4	1.9	-	0.9	0.3	3.0	13.0 (N); 5.0 (NE)

The fastest average coastal retreat rates were observed at the continental coast of Dmitry Laptev Strait west of the Kondratyeva River Mouth (key site 11, Oyagossky Yar,): 0.5-7 m/yr (Fig. 5.3.3-1 and Fig. 5.3.3-2). The average erosion rates at the western and eastern edges of the measured coastal profile (see Fig. 5.3.3-1) are 5 and 7 m/yr. In the central part of this profile, on the other hand, the recession is moderate: 1-2 m/yr. According to the preliminary analysis of the field data, highest erosion rates have to be expected for Muostakh Island (key site 12, central sector of the Laptev Sea): 13 m/yr on the northern cape and 4-6 m/yr on the north-eastern coast, which is approximately the same as we have determined during the last field seasons (Rachold and Grigoriev, 2000, 2001).

Figure 5.3.3-1. Complicated structure of the coastal relief at the Ice Complex coastal sections: a number of thermal terraces formed by thermal abrasive and thermal denudation processes. Oyagossky Yar, Dmitry Laptev Strait, East Siberian Sea, August 2002.

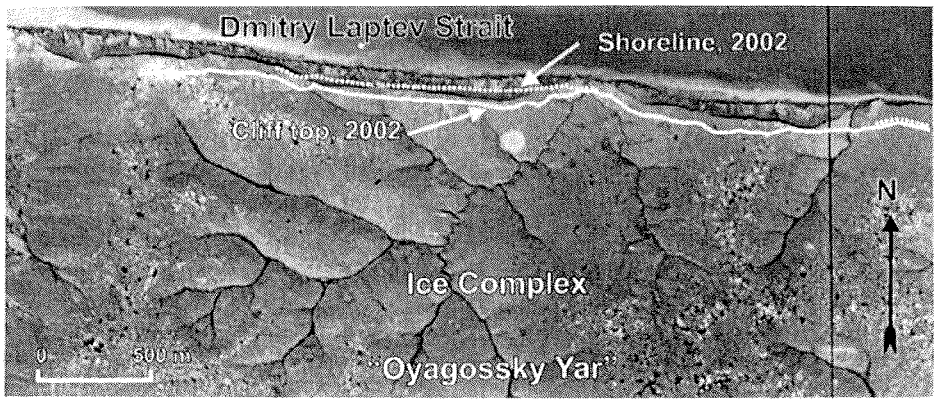

Figure 5.3.3-2. Aerial photograph taken in 1986 and modern positions of cliff top and shoreline. Oyagossky Yar, Dmitry Laptev Strait, East Siberian Sea, August 2002.

Comparably slow rates of coastal retreat were observed at most studied key sites along the coasts of the New Siberian Islands. A possible reason might be that there are many local sections consisting of rocks, which give rise to the formation of pebble beaches. These pebble beach formations are efficiently protecting the coast from wave erosion (Fig. 5.3.3-3). Even coasts consisting of the sensitive Ice Complex can be stable due to the blocking of a pebble beach.

We assume that this factor is one of the main reasons for the low retreat rates observed along the coastlines of the New Siberian Islands.

Figure 5.3.3-3. North-Eastern coastal section of Stolbovoy Island (ice-rich Pleistocene sediment). The non-active cliff is blocked by a pebble beach, which is reworked by ice-push. Laptev Sea, August 2002.