2.22 Characteristics of wave-built sedimentary archives in Buor Khaya Bay

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Fieldwork period and location
August 15th to August 20th, 2017 (Buor Khaya Bay, southern Laptev Sea)

Objectives
Sequences of prograded beach deposits (so-called beach-ridge systems) are a wave-built coastal geomorphological feature of global occurrence. The deposits may preserve information on the environmental conditions during their formation and have been used as archives for the reconstruction of parameters such as relative sea-level, wave climate, extreme events, sediment supply or sea-ice extent (see e.g. Funder et al., 2011; Tamura, 2012; Sander et al., 2016). Buor Khaya Bay is one of the few places along the Russian arctic coast, where wide beach-ridge systems exist. The area was visited during an expedition in August 2017 in order to obtain baseline information on the morphology, lithology and surface properties at the different field sites (Figure 2.22-1). The overarching aim of the field campaign was to establish the potential of the beach-ridge systems for paleoenvironmental reconstructions of Holocene sea level and past sea-ice extent. A couple of other sedimentary systems (spits, barriers and coastal lagoons), which may serve as complementary archives for long-term coastal change, were likewise visited.

Methods
Basic field surveys of beach geomorphology, grain-size distribution, cross-ridge elevation and vegetation were conducted. Data collection was supplemented by GPS-RTK (Global Positioning System-Real Time Kinematic) measurements and Kite Aerial Photography (KAP) surveys. The analysis of Landsat satellite images provided background data for the assessment of the spatial arrangement of landforms and basic environmental properties at the field sites. The area was accessed by boat.

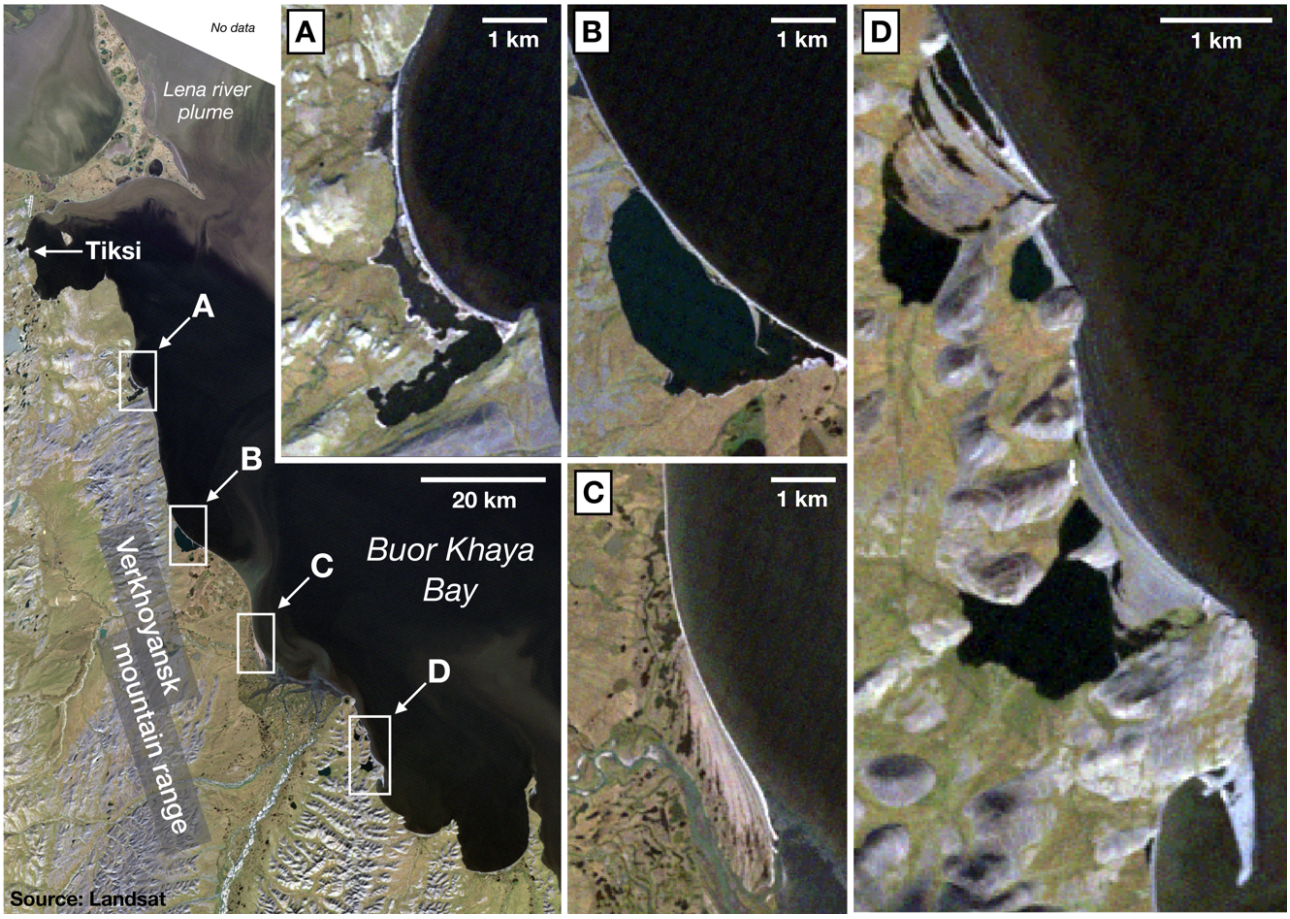

Figure 2.22-1: *The southwestern shoreline of Buor Khaya Bay is located at the transition of the Verkhoyansk mountain range and the southern Laptev Sea. Several lagoons (A, B, D), barriers (A, B, C), spits (B, C, D) and beach-ridge systems (C, D) formed in topographic depressions within the denudated mountain relief. Weathering products from protruding headlands and cliffs are the most important source of sediment for the formation of wave-built deposits. Image source: Landsat OLI color composite*

Preliminary results

The modern shoreline at both beach-ridge sites (Figure 2.22-1 D) is composed of a low gradient upper shoreface with longshore bars primarily composed of sands and gravels, and a steeply inclined beachface characterized by pebble to cobble sized material and the presence of ample amounts of debris (driftwood, anthropogenic debris). The headlands show clear indication of wave erosion (in the form of active and palaeocliffs) and thick layers of regolith cover the slopes. The minerogenic beach deposits are composed of shales and are probably of local origin, given their high degree of similarity (color, lithology) with the weathering products from the bedrock cliffs. No aeolian deposits were observed. The elevation and composition of the beach deposits suggests a construction during energetic (storm-) wave conditions. Both systems can be divided into distinct sets of ridges, suggesting (1) continuous progradation under conditions of high sediment availability, and (2) unconformities evidencing periods with an increase in allogenic perturbation or reduced sediment supply. The beach ridges lie at elevations of between 2 and 5 m above mean sea level and are separated by swales (Figure 2.22-2). Material for the establishment of age control was sampled in the field.

The slim barriers at the lagoon sites A and B are much lower and indication of recent barrier breaching and overwashing have been observed. Patterns of resilience and disturbance are reflected in the species distribution within the sparse vegetation cover.

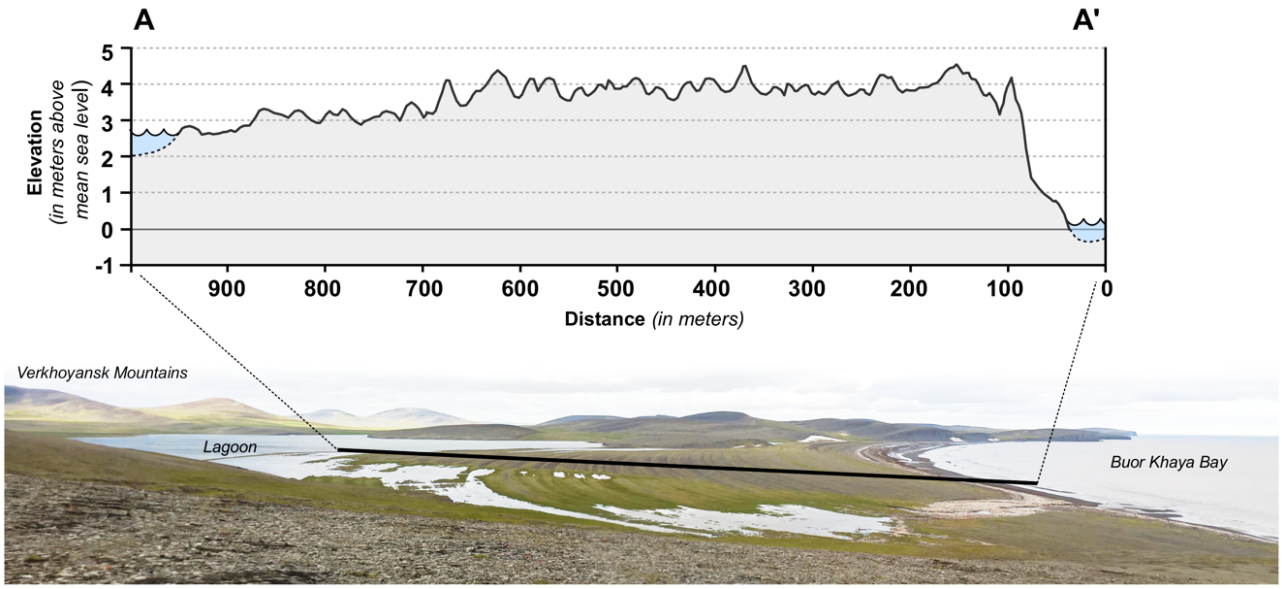

Figure 2.22-2: *Elevation transect and panoramic overview of the southern beach-ridge system (see Figure 2.22-1 D for location)*

The observations made during this first expedition to southwestern Buor Khaya Bay have shown that all visited field sites have a great potential for further investigation and the information obtained will be used to plan and design more directed and comprehensive field investigations in the near future.