TERRAIN RELIEF

The principal landform types in western Sørkapp Land are coastal lowlands, mountains and mountain valleys (Fig. 3).

Coastal lowlands constitute more than half of the study area and were formed as a shallow sea bed offshore during the Pleistocene and the Holocene, and uplifted due to isostatic movements afterwards.

There are two coastal lowlands along Hornsund Fjord, which are isolated from other lowlands by the slopes of the Tsjebysjovfjellet and Wurmbrandegga massifs running down to the sea in the northeastern part of the study area. The narrow (up to 250 m wide) and short (ca. 1.5 km long) lowland with the Stonehengesteinane group of rocks lies at the foot of the northern wall of Tsjebysjovfjellet called Rasstupet. The second lowland, Gåshamnøyra, consists of the virtually flat outlet of a wide valley covered by extensive (2 km x 2 km) extramarginal sandur formed by proglacial waters of Gåsbreen glacier.

The Kulmstranda lowland (1.5–2.0 km wide), built of resistant Early Carboniferous sandstones, adjoins from the south of the outlet of Hornsund Fjord. The lowland is formed of extensive rock terraces, which are covered by a thin layer of quartzitic marine pebbles or devoid of them in many places. The lowland's higher part forms a ridge reaching 123 m. Lisbetdalen valley is located behind this ridge. Kulmstranda is incised by the gorge of the Lisbetelva river (ca. 10 m deep). The second, more shallow and already inactive, incision in the lowland is situated 300 m further to the east. This lowland experiences extremely strong and frequent winds, which blow away fine-grained rock material and limit plant life.

The Hornsundneset lowland, 1.5–3.0 km wide, with the hut near Palffyodden, stretches from the fjord's outlet towards the south and southeast. Successive (ever older) marine terraces are formed in tiers from the coastline up to the foot of the Struvefjella mountain range, at an altitude of 5–70 m (Fig. 4, cover photo). As was the case in Kulmstranda, the terraces also cut into resistant Early Carboniferous quartzitic sandstones. The terraces' small dip into the land side brings out their edges, and their rock surfaces are mostly covered by old coastal ridges built of marine pebbles. The lowland is fertilized by small auks *Alle alle* that nest in the mountain slopes above it, which helps promote vegetation and soil formation.

Breinesflya, the largest of the Sørkapp Land lowlands, is completely different from the aforementioned lowlands: 3–4 km wide, boggy, gradually rising from

the beach to the foot of Wiederfjellet massif at an elevation of ca. 50 m, built of less resistant Triassic sedimentary rocks. The lowland is almost completely covered by a thick (most often 1–2 m) layer of fine-grained marine sediments along with an admixture of material washed away from the slopes above them as well as fluvial material ranging from clay to debris. This type of Quaternary cover favors vegetation and soil formation (Fig. 5).

Three narrow (up to 1 km wide) lowlands lie further to the southeast. Tørrflya is the accumulation marine terrace up to 10 m high and thick, with the cliff coast on Triassic bedrock, between the formerly major Vinda river and the large Bungeelva glacial river. The extra-marginal sandurs of Bungebreen glacier adjoin Tørrflya. The next lowland, Bjørnbeinflya, stretches to the southeast of the Bungeelva river. This lowland is at first more narrow between Vitkovskibreen glacier's marginal zone and the sea, and then wider at the foot of Hilmarfjellet, featuring erosion karst forms such as holes and underground channels. The next lowland, Olsokflya, is located along Stormbukta bay. Thin Triassic layers overlie the limestone Pre-Old Red basement only along the coastal belt up to 300 m wide.

The large (5 km x 4 km) Stormbukta bay did not exist at the end of the Little Ice Age in 1900 (Wassiliew 1925). The only tidewater glacier found along the western

Fig. 5. Northwestern Sørkapp Land seen from the Breinesflya low and wet coastal plain to the northwest. The following mountains are visible in the background (from left to right): Hohenlohefjellet and Sergeijevfjellet (joined together), Lidfjellet, Gavrilovfjellet, and the northwestern fragment of Wiederfjellet. Photo: J. Niedźwiecki, 2008

Sørkapp Land coast, Olsokbreen, covered the bay's present-day area. At the time, the glacier was much thicker and larger than it is today. Its northern (right) lateral moraine has changed into a wide marginal zone due to the glacier's retreat. A new coastline has also appeared in the area.

All the coastal lowlands are shaped by weathering and frost segregation, which can be observed in the form of characteristic micro-relief.

Mountains dominate the landscape despite the fact that they occupy less than half of western Sørkapp Land. The largest quantities of water and deposits flow to the lowlands and the sea from the mountains due to higher precipitation and intensive erosion-denudation processes taking place therein.

Struvefjella, the westernmost mountain range, consists of three different massifs (Fig. 5). Hohenlohefjellet (Fig. 6), the northernmost and the highest (> 600 m) of the massifs, cuts into resistant Lower Carboniferous sandstones. It is primarily covered by quartzitic debris, which creeps gravitationally (especially on the eastern slopes) or reaches its angle of repose (especially on other slopes). High nivation moraines, which often overlie old glacial moraines, and talus and talus-torrent fans are situated at the foot of the slope and slope gullies. High nivation moraines are built of coarse sandstone blocks. Sergeijevfjellet is a ridge 3 km long and built of less-resistant Lower Carboniferous and Triassic sedimentary rocks, thus lower (ca. 400 m) and with more gentle slopes (up to 30°) under a weathering-solifluction cover. The high (> 500 m) Lidfjellet massif is shaped like a truncated pyramid built of Mesozoic sedimentary rocks. Its steep slopes primarily undergo weathering and gravitational creeping. Its top is shaped like a triangle with a regular inclination gradient of ca. 10°.

The Struvefjella range is dissected by two narrow, short (1.0–1.5 km) and deep (altitude: below 145 m) tectonic valleys: Hohenloheskardet (Fig. 6) and Sergeijevskardet, shaped by the Barents Ice Sheet and the sea during the Pleistocene as well as slope processes during the Holocene. There is a Young Pleistocene glacial moraine ridge at the mouth of the Sergeijevskardet. There are also numerous limestone (Slaklidalen formation) erratics in the valleys and on the slopes of Sergeijevfjellet and Lidfjellet.

The Lisbetdalen mountain valley (Fig. 6), located east of Struvefjella, is expansive and cuts deep (altitude: below 180 m) into resistant Lower Carboniferous sedimentary rock. Traces of the presence of the Pleistocene ice sheet (deep basin of Svartvatnet lake, limestone erratics) and the sea (marine gravels) can be observed in this area. The valley was shaped during the Holocene by weathering, solifluction, sheet wash, nivation and fluvial processes. The lateral Kovalevskidalen falls into the Lisbetdalen from the east.

The second unglaciated (and unnamed) mountain range in western Sørkapp Land towers over the Lisbetdalen from the east. The range consists of the following four mountain massifs: the narrow and steep Wurmbrandegga ridge built of Proterozoic dolomites (ca. 400 m), and further to the south, the Savitsjtoppen (almost 500 m), the Kovalevskifjellet (640 m) and the Gavrilovfjellet (almost 600 m) mas-

Fig. 6. Lisbetdalen valley with Svartvatnet lake seen from the east. In the background: the eastern slopes of Hohenlohefjellet, which fall down to the lake and the northeastern slopes of Sergeijevfjellet. Large talus-torrent fans and nival moraines are visible at the base of Hohenlohefjellet on the lake. Photo: W. Ziaja, 2008

sifs. More gentle western slopes and top plateaus of the last three massifs are primarily built of Lower Carboniferous and Triassic sedimentary rocks and have been shaped by geomorphic processes similar to those in Lisbetdalen (apart from fluvial processes). The steep eastern slopes of these three massifs, built of non-resistant Proterozoic phyllites, undergo intensive weathering and creeping. These slopes fall down to two valleys, which form the boundary between western and central Sørkapp Land: the northern unnamed valley with Gåsbreen glacier's marginal zone and the Slaklidalen valley, which runs to the south.

Limestone erratics can be found on the top plateau of Kovalevskifjellet. Hence, this mountain range must have been covered by the ice sheet at the end of the Pleistocene (Ziaja 1989; Salvigsen, Elgersma 1993).

The deep and narrow V-shaped Liddalen valley can be found at the junction of the two aforementioned ranges (Sruvefjella and the unnamed range), south of Lisbetdalen, between Gavrilovfjellet and Lidfjellet.

The long (6 km) and high (> 700 m) Wiederfjellet-Stupryggen mountain range stretches to the southeast from Slaklidalen to Bungebreen glacier. This range, wide in the northwest and narrow in the southeast, is built of different types of rocks of the Pre-Old Red Basement. The slopes of the range's northwestern part are cut in the aforementioned phyllites and undergo weathering, sheet wash and solifluction. The rest of the range, built of dolomitic sandstones and metamorphic limestones, is extremely asymmetric. Its gentle eastern slopes are covered partly by Wiederfjellet glacier. Its steep western slopes (weathering and creeping) fall down to the bend (on the fault) between the range and the Breinesflya coastal plain. A narrow belt of gentle solifluction slopes has formed on this bend.

The Plogen massif, almost 700 m high and with steep slopes, is located between the valleys of the Bungebreen and Vitkovskibreen glaciers. The Hilmarfjellet-Karentoppen massif (> 800 m) is located in the southeastern corner of the study area between the Vitkovskibreen and Olsokbreen glaciers. Both massifs are built of metamorphic limestones and sandstones of the Pre-Old Red Basement, while their peaks are built of Triassic sedimentary rocks. The highest marine raised terraces in Spitsbergen (up to 338 m) are preserved on the slopes of Hilmarfjellet (Werenskiöld 1953).

The last three mountain massifs are at least partly glaciated from the land side. However, their slopes, which fall down to the coastal lowlands, are free of glaciers.