Dynamics of two active rock glaciers in the Hohe Gaisl massif, eastern Dolomites (South Tyrol)

Kathrin Lang & Karl Krainer

Institute of Geology and Paleontology, Faculty of Geo- and Atmospheric Sciences,
University of Innsbruck, Innrain 52, A-6020 Innsbruck

Two active rock glaciers occur in cirques on the northeastern (Gletscherkar) and eastern (Gaislkar) side of the Hohe Gaisl (Croda Rossa; 3.146 m) in the eastern Dolomites, South Tyrol. The bedrock of the catchment area of both rock glaciers is composed mainly of upper Triassic carbonate rocks (Hauptdolomit and Dachsteinkalk).
Gletscherkar rock glacier is 850 m long, 300–550 m wide and covers an area of 0.3 km?. The rock glacier terminates at an altitude of 2340 m; the highest point is at an elevation of 2500 m. The tongue-shaped Gaislkar rock glacier is 650 m long, 125–195 m wide and covers an area of 0.1 km?. The rock glacier ends at an altitude of 2425 m and extends to the highest point at 2525 m. The front slope of both rock glaciers is up to 50 m high, the gradient of the front slope measures 35–40°. The surface of both rock glaciers is characterized by well developed transverse ridges and furrows. Increased melting of ice below the debris layer in the upper part of Gletscherkar rock glacier caused the formation of an irregular surface topography with up to several m deep incised meltwater channels and small thermokarst ponds. Massive, almost pure, coarse-grained ice is exposed with thicknesses of up to 7 m in this part below a thin debris layer. Such ice exposures were not observed at Gaislkar rock glacier.
The surface of the debris layer of both rock glaciers is dominantly composed of clasts with diameters of 11–20cm at coarse-grained parts, where clasts > 50 cm are rare. At fine-grained parts of both rock glaciers 80–90 % of the clasts are in the range of 1–10 cm. Both rock glaciers are supported with high amounts of debris from fault zones at the eastern and northeastern side of Hohe Gaisl.
The presence of ice within both rock glaciers is also indicated by temperatures measured at the base of the winter snow cover (BTS), temperatures measured within the debris layer to a depth of 150 cm, and the water temperature of the springs at the front of both rock glaciers which remains constantly below 1 °C during the melt season.
The discharge of both rock glacier springs is very low measuring up to a few litres per second during peak discharge and < 1 litres per second during most of the time. The entire meltwater of both rock glaciers is released along karst systems below the rock glacier, surface streams are not developed.
Georadar measurements (GSS SIR System 2000 with a multiple low frequency antenna; center frequency 35 MHz, constant antenna spacing in point mode) provided information

on the internal structure and thickness of both rock glaciers. Gletscherkar rock glacier has a total thickness of approximately 25 m. In the lower and middle part the debris layer is 3–5 m thick. Below the debris layer numerous, well developed reflectors are visible indicating the presence of shear planes in the frozen body of the rock glacier. The debris layer at Gaislkar rock glacier is 3–5 m thick in the middle and lower part, thicker in the upper part. The frozen core, which also displays well developed reflectors, is 20–30 m thick. A thin sediment layer (?lodgement till) may be present at the base of both rock glaciers.

On Gletscherkar rock glacier 50 survey markers were installed on the rock glacier along 4 profiles and 2 fixed points outside the rock glacier. The survey markers were measured by using the differential GPS technique to estimate the flow velocity (horizontal displacements). Between August 6, 2004 and September 19, 2005, the highest flow velocities of 23 cm were recorded at the survey markers along the central part of the rock glacier, flow velocities gradually decreased towards both margins, and also towards the front.

Photogrammetrically estimated flow velocities of Gaislkar rock glacier are in the range of 20 cm/year.

Internal structures (shear planes) and particularly ice exposures at the upper part of Gletscherkar rock glacier clearly indicate that both rock glaciers developed from debris-covered cirque glaciers. We suggest that both rock glaciers have developed from small cirque glaciers during retreat through inefficiency of sediment transfer from the glacier ice to the meltwater. The presence of a cirque glacier at Gletscherkar is documented in the older literature and on older maps, for example on a topographic map published in 1902.