



## **The impacts of permafrost degradation in paraglacial environments in Elephant Point (Livingston Island, Antarctica)**

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Elephant Point constitutes an ice-free environment of only 1.16 km<sup>2</sup> in the south-western corner of Livingston Island (South Shetland Islands, Antarctica). In January 2014 we conducted a detailed geomorphological mapping in situ, examining the distribution of processes and landforms in Elephant Point. Four main geomorphological environments were identified: proglacial area, moraine system, bedrock plateaus and marine terraces.

The ice cap covering most part of the western half of this island has significantly retreated during the last decades in parallel to the accelerated warming trend recorded in the Antarctic Peninsula. Between 1956 and 2010 this rapid retreat has exposed 17.3% of the present-day land surface in Elephant Point.

Two of these geomorphological units are located in this new ice-free area: a polygenic moraine stretching from the western to the eastern edges of the peninsula and a relatively flat proglacial environment. The glacier sat next to the northern slope of the moraine in 1956, but the retreat of the Rotch dome glacier during the last decades left these environments free of glacier ice. Following the deglaciation, the postglacial dynamics in these areas showed the characteristic response of paraglacial systems.

Very different geomorphological processes occur today in the northern and southern slopes of the moraine, which is related to the different stage of paraglacial adjustment in both sides. The southern slope shows a low to moderate activity of slope processes operating on coarser sediments that have built pronival ramparts, debris flows and alluvial fans. By contrast, mass wasting processes are very active in the northern slope, which is composed of fine-grained unconsolidated sediments. Here, ice-rich permafrost has been observed in slumps degrading the moraine. The sediments of the moraine are being mobilized down-slope in large amounts by landslides and slumps. Up to 9.6% of the surface of the moraine is affected by retrogressive-thaw slumps. Other features indicative of the degradation of the ground ice were found in Elephant Point, such as the kettle lakes distributed in the hummocky terrain between the moraine ridges and in the proglacial environment.

It is expected that paraglacial processes and permafrost degradation will continue in this maritime permafrost environment in the near future, though their intensity and extension will depend on the future climate conditions prevailing in the northern Antarctic Peninsula.

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