

Geomorphological map and morphodynamic analysis of rock glaciers in Val di Spluga (SO) from field and remote sensing surveys

Pietrogrande S.^{1*}, Azzoni R.S.¹, Tantardini D.¹, Pezzotta A.¹, Tartarotti P.¹ & Zerboni A.¹

¹Dipartimento di Scienze della Terra “A. Desio”, Università degli Studi di Milano, Via Mangiagalli 34, Milano.

Corresponding author e-mail: sofia.pietrogrande@studenti.unimi.it

Keywords: Geomorphology, Map, Quaternary, Rockglacier, Periglacial.

The high Val di Spluga (Central Alps, Sondrio) exhibits a complex interplay of glacial, periglacial, gravitational, and fluvial processes that have shaped its forms. The realisation of “Foglio 038 - Chiavenna” of the Geological Map of Italy (CARG project) offered the opportunity to conduct a geological and geomorphological survey at altitudes range between 1300 and 3000m asl, and to produce, using the data acquired during two summer campaigns (2022, 2023) and through the analysis of orthophotos (2012, 2018, 2021) provided by the Regione Lombardia bureau, a new geomorphological map and recent deposits at a scale of 1:5.000, and to investigate in detail the dynamism of the periglacial forms. The Val di Spluga is a medium-high mountain valley with valley axis structurally oriented NW-SE. From the area of the lakes towards the ridges, the slope rises gently with a series of rock steps, abraded by the glacier. From the area of the lakes towards the ridges, the slope rises gently with a series of rock steps, abraded by the glacier. The main signs of glaciation in the valley are represented by several moraines, striae on sheepback rocks and erratic boulders, visible up to 2600m asl. Deglaciation following the Last Glacial Maximum (LGM) can be seen with small moraines presents at higher altitudes. During this phase the dominant geomorphological processes passing from glacial to periglacial. Five rock glaciers, ranging from 25.000 to 120.000m², are identified, mainly in the southern part. This area is particularly favourable for the maintenance of permafrost, as it is the portion of the valley that is least exposed to the sun throughout the year. Other rock glaciers are identified in the adjacent Val Visogno. Debris at the base of steeper slopes show reworking by nivo-gravitational processes that arrange larger boulders in lobes, named protalus ramparts. The recognized gravity deposits have a genesis mainly from gelifaction and cryoclastism, the resulting material being accumulated by collapse at the foot of slopes, forming scree. This material can then be transported by debris flows and sedimented with juxtaposition and overlapping, forming conoids dominated by debris flows. Landslide deposits are numerous in the valley, with blocks up to decametre in size. Fluvial processes in the valley are limited, with small streams originating from various sources, including the rock glacier identified at Bocchetta di Spluga. These latter flow into the Spluga Lake below, from which the Cavrocco stream originates, cutting through the deposits and bedrock that it crosses. To understand the dynamics of the larger rock glacier, in Val Visogno, photogrammetric drone surveys were carried out, which made it possible to obtain the Digital Terrain Models with a resolution of up to 0.20 m. The available orthophotos and those acquired by drone were compared with each other using the technique of feature tracking of moving points, to trace the movements over time associated with deformation due to creep. The results showed that the central and southern portions of the rock body undergo downstream movements defining an active rock glacier.