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Servizio Glaciologico Lombardo

The December 2020 rock-ice avalanche at Punta S. Matteo (Ortles-Cevedale Group, Italian Alps)

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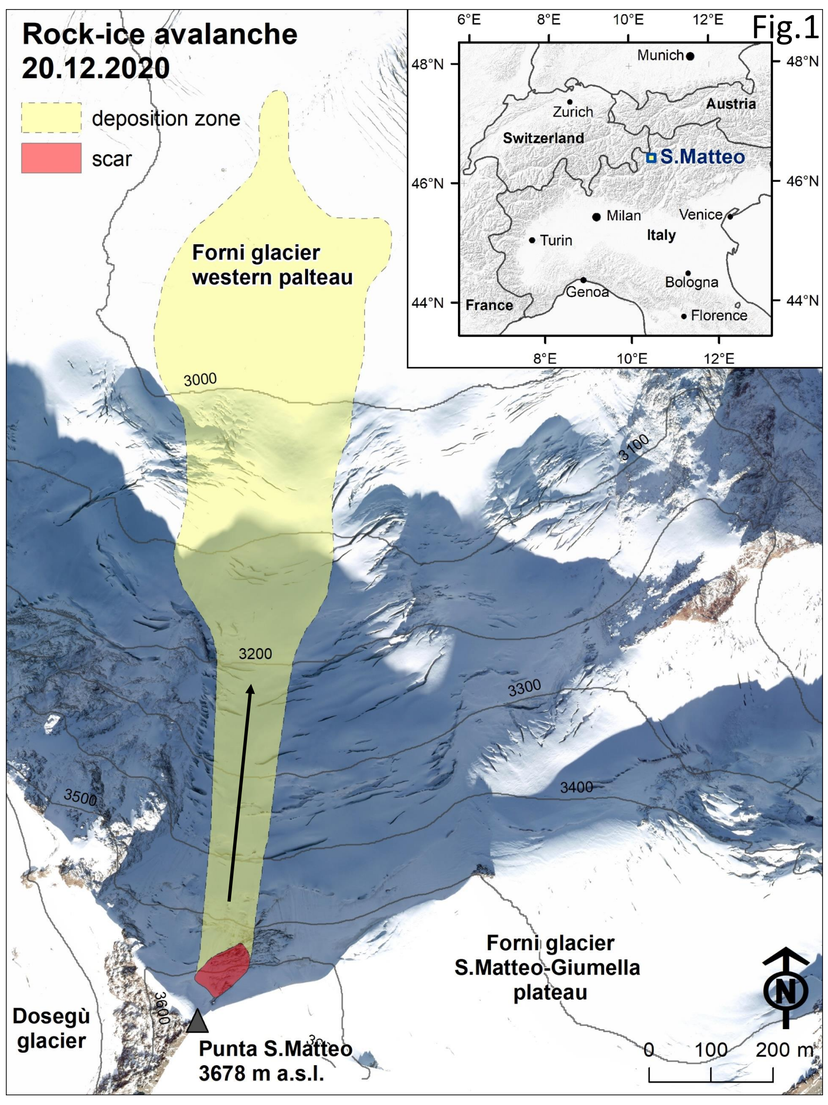
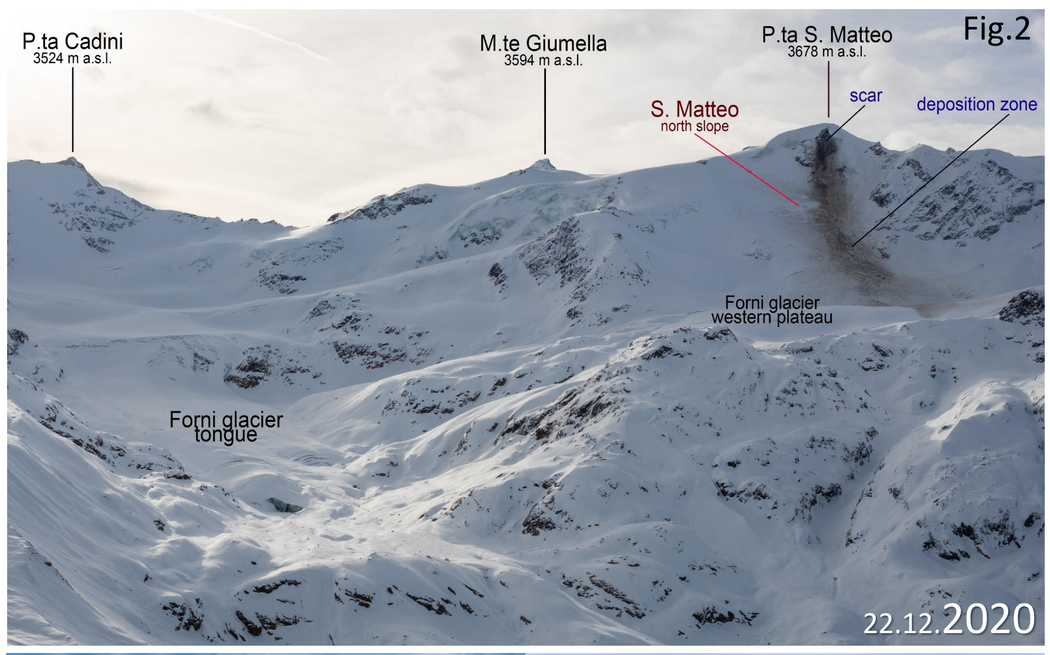
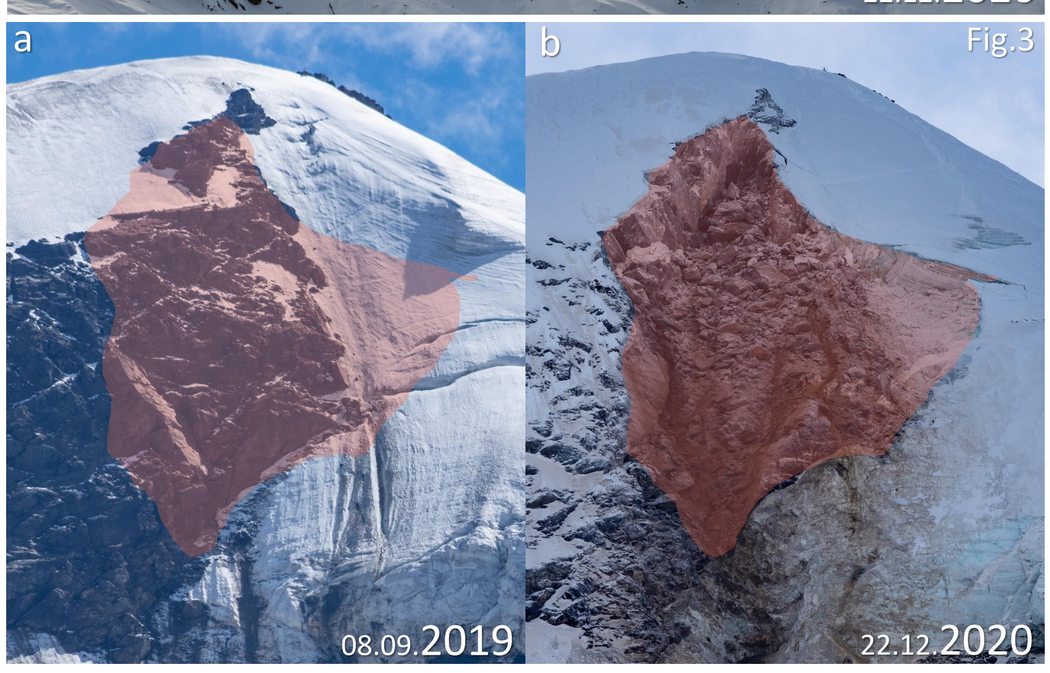
The rock-ice avalanche

Between 19 and 20 December 2020 a rock-ice avalanche detached from the northern side of Punta S. Matteo (3678 m a.s.l. – Upper Valtellina – Italian Alps) travelling along the steep glacier-covered northern slope of the mountain and stopped on the western plateau of Forni glacier at 2945 m a.s.l.. The scar ranges in elevation from 3535 to 3650 m a.s.l. and a preliminary estimation of its depth (~ 10 m with maximum values of 25-30 m) was crucial in quantifying the event volume (~ 87000 m^3). The avalanche was composed by 90% of rock (phyllite) and 10% of glacier ice and firn that used to cover part of the detached bedrock. The deposition zone covers a surface of 255.000 m^2 with a maximum runout of 1.4 km (Figs. 1-4).





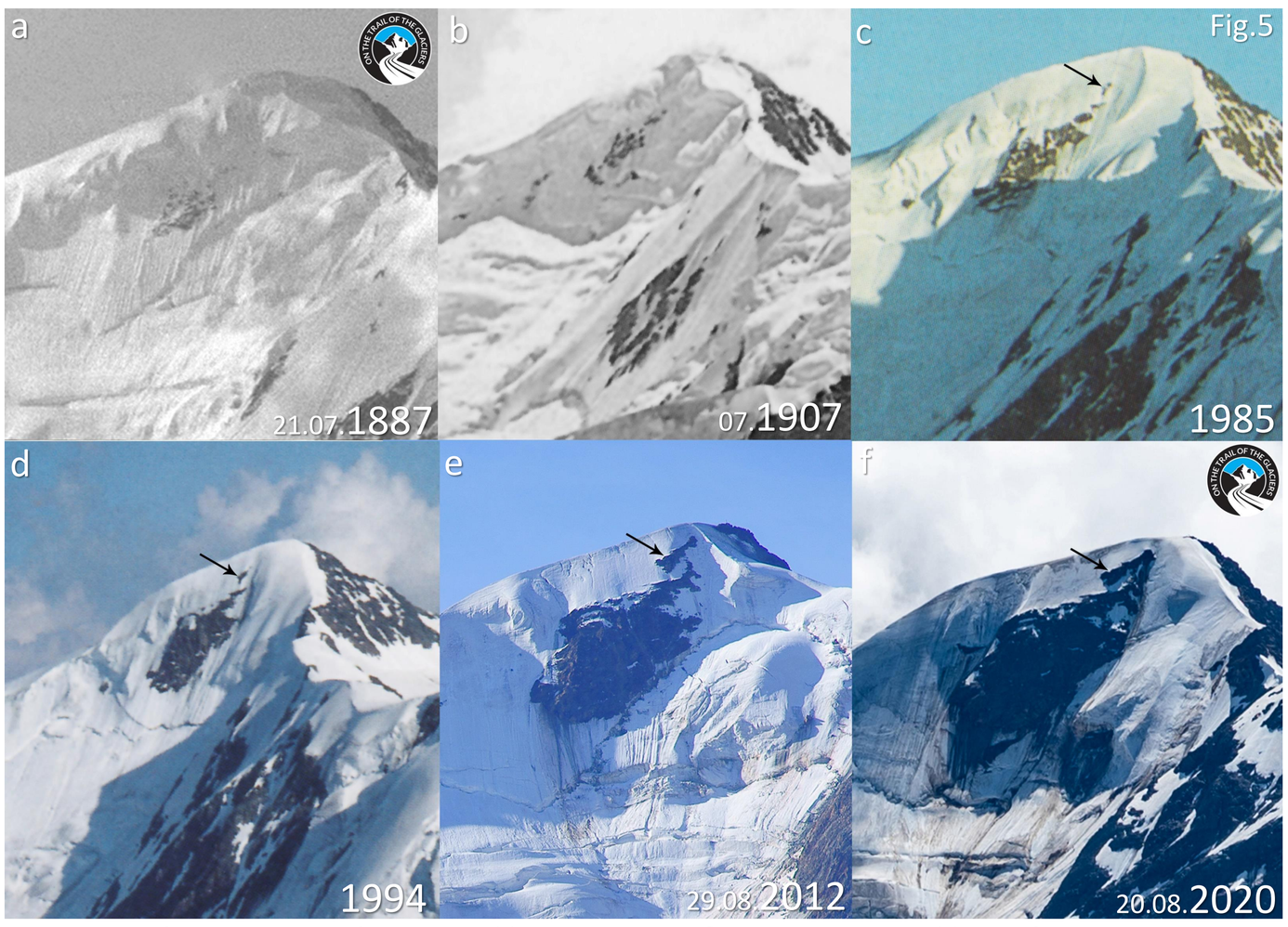


Scar	data
Surface (2d)	4500 m^2
Surface (3d)	7900 m^2
Volume	~ 87000 m^3 (90% rock – 10% ice)
Max depth	~ 25-30 m
Eelevation range	3650-3535 m a.s.l.
Deposition zone	
Surface (2d)	255000 m^2
Max runout	1.4 km
Min elevation	2945 m a.s.l.

Fig. 1. Location of the rock-ice fall scar and the deposition zone (ortophoto AGEA 2018 – accessed through WMS service of Regione Lombardia)
Fig. 2. The Forni glacier and the P.ta S. Matteo (ph. Riccardo Scotti)
Fig. 3. The rock-ice fall scar highlighted (a) before the event and (b) after from Branca Hut (ph. Riccardo Scotti)
Fig. 4. Aerial view of the north-slope of P.ta S. Matteo after the rock-ice fall event (ph. Marco Confortola)

Multitemporal evolution of the upper S. Matteo north slope

Our speculation about the possible failure triggering factors focuses on the glacial history of the site. At least since the Little Ice Age, most of the depletion zone was covered by glacier ice until 1980-1990 when, due to glacier thinning, a major rock outcrop started to appear in its upper portion (Fig. 5). Given both elevation and aspect, the small portion of the depletion zone that was not covered by ice, at least since the end of the XIX century, was likely in permafrost conditions with probable cold ice in the surroundings. In the last 30 years, without the ice layer protecting the rock wall and due to the increase in availability of both meltwater and summer rainstorms, water circulation in rock discontinuities significantly increased. Moreover, the intensification in water percolation and refreezing in both firn-ice cover and bedrock could have enhanced latent heat dissipation and permafrost warming (Fig. 7). This transition could have triggered various possible mechanisms of rock mass deformation until the final collapse.



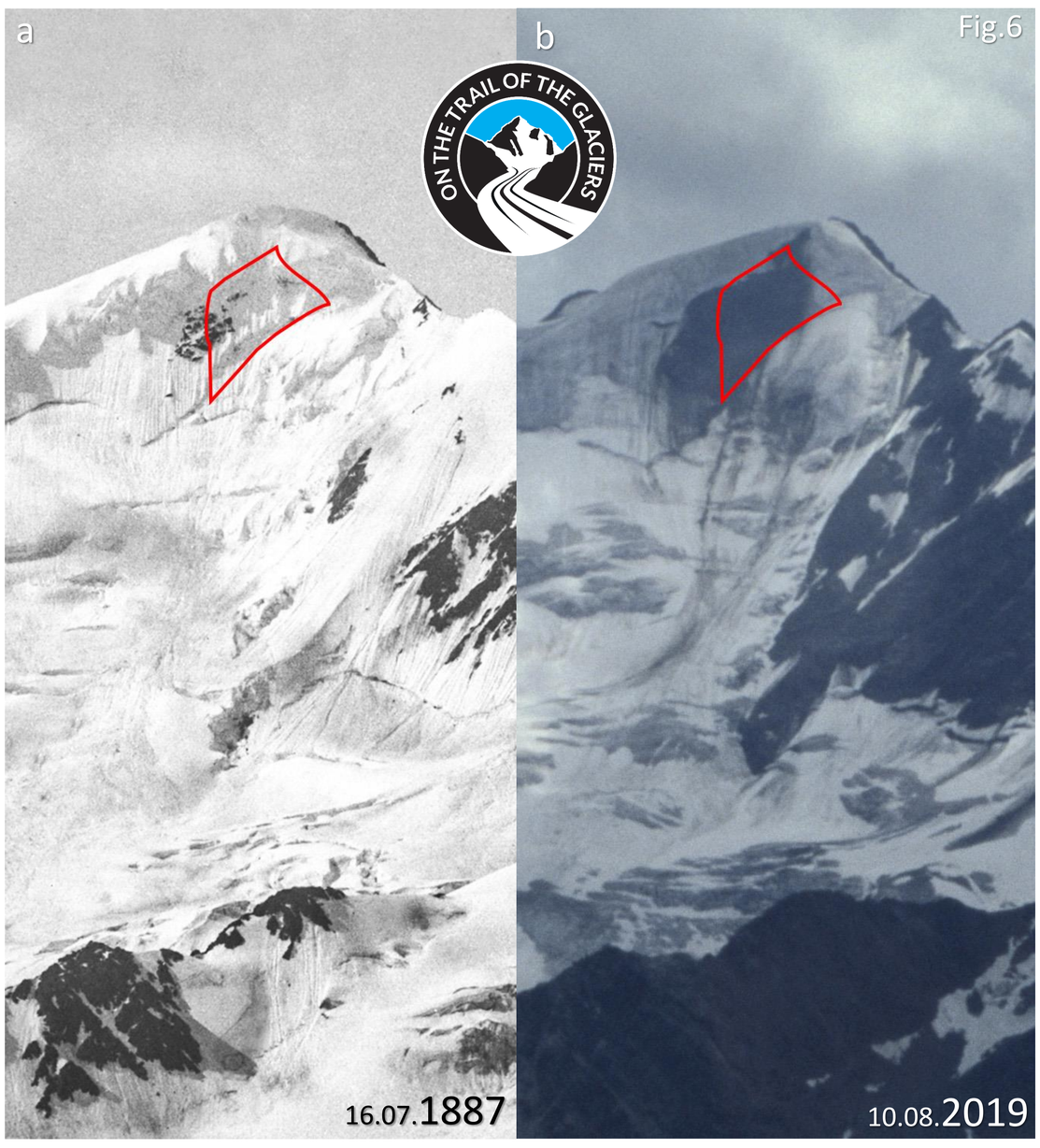


Fig. 5. Evolution of the northern slope of P.ta S. Matteo (a) 1887 Vittorio Sella - © Fondazione Sella onlus; (b) 1907 Alfredo Corti – Archivio Corti – CAI sez. Valtellinese www.archiviocorti.it; (c) 1985 Antonio Galluccio – Arch. SGL; (d) 1994 Jacopo Merizzi – from the book «aria di valtellina»; (e) 2012 Gionata Neri – Arch. SGL; (f) 2020 Riccardo Scotti – © Associazione Macromicro. The black arrow points at the rock outcrop located at the top of the rock-ice fall scar

Fig. 6. The northern slope of P.ta S. Matteo in (a) 1887 Vittorio Sella - © Fondazione Sella onlus; 2019 Fabiano Vantura – © Associazione Macromicro – www.sulletraccedeighiacciai.com. The December 2020 rock-ice fall scar surface is highlighted in red

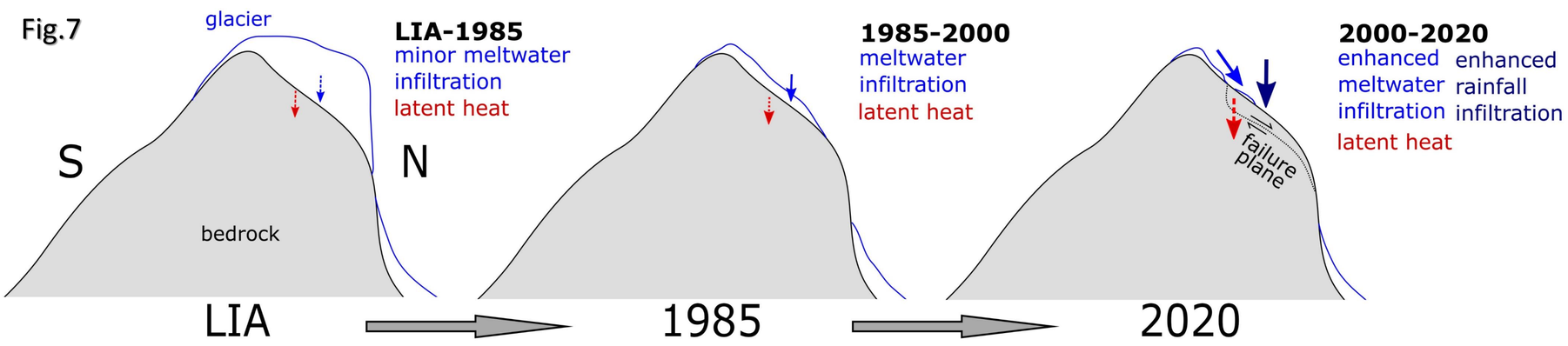


Fig. 7. Conceptual scheme of the evolution of both the glacier cover and the possibile thermal perturbations at the ice-rock interface at P.ta S. Matteo. Modified after: Huggel, Christian. "Recent extreme slope failures in glacial environments: effects of thermal perturbation." Quaternary Science Reviews 28.11-12 (2009): 1119-1130

Post-event evolution

In the three months following the major event, other minor rock and ice falls occurred (Fig. 9) until March 2, when another significant rock portion broke of from the central section of the original scar (Fig. 8). In the next few years, if the destabilization phase will cease, despite the ongoing climate warming trend that caused the progressive de-glaciation of the rock wall, given the after-event deep concave morphology of the upper portion of the scar, is it possible that enhanced windblown snow accumulation would lead to a partial re-glaciation of the site.

Fig. 8. The March, 2 event (ph. Fausto Compagnoni)
Fig. 9. Upper part of the scar with highlighted the portions of rock and ice collapsed between December 23, 2020 and February 4, 2021. (a) ph. Riccardo Scotti and (b) ph. Marco Maurizio Foffano

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