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Permafrost-glacier interaction as revealed by geoelectrical tomography: experiences from rock glaciers and recently-deglaciated areas in the Central and Western Alps (Italy-France)

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Ground ice of permafrost origin and sedimentary ice of glacial origin can coexist in locations where rock glaciers and glaciers interacted, as well as in glacigenic sediments abandoned by a retreating glacier and subsequently exposed again to atmospheric cooling. Some of these geomorphological settings in the Central (Foscagno rock glacier) and Western Alps (Marinet, Laurichard and Schiantala rock glaciers, Schiantala debris-covered glacier, Maledia glacier) were explored by means of geoelectrical tomographies. The aim was that of inferring the presence of ice and cryologically interpreting electrical stratigraphies in order to test whether or not the internal structure of these landforms can be used for the reconstruction of recent permafrost and glacier evolution. Geomorphological data assisted these reconstructions and available borehole stratigraphies were used to calibrate the resitivities.
Along with the ice-debris mixture, massive ice has also been found as lenses both at the apex and the front of the studied rock glaciers. These lenses of sedimentary origin are thought to be transferred from a glacier snout to sectors of rock glacier and eventually embedded into the permafrost creep. The scarcity of frozen debris in the mid-upper part of the rock glaciers -as revealed by low resistivity values- can be due to the disruptive effect of the over-riding glacier over the permafrost.
The near-surface sedimentary ice masses detected along the slopes of the studied glacial cirques are interpreted as or debris-covered terminations of the glaciers still visible upward, or as fragments of it detached by the main bodies. These ice masses are locally associated to medium-high resistive sediments, consistent with permafrost occurrence. This indicates that the non-glacial environment established during the deglaciation allowed the onset of frozen sediments formation.
Overall, the results indicate that internal structure of rock glaciers and recent-deglaciated slopes can store the different climate-related episodes occurred in a specific area, such as those linked to the shifting between glacial to periglacial condition and vice-versa.