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NEW RADAR SURVEYS IN MONITORING THE EVOLUTION OF THE CALDERONE GLACIER (CENTRAL APENNINES, ITALY)

ABSTRACT: PECCI M., DE SISTI G., MARINO A. & SMIRAGLIA C., *New radar surveys in monitoring the evolution of the Calderone Glacier (Central Apennines, Italy).* (IT ISSN 0391-9838, 2001).

The Calderone Glacier on the Gran Sasso d'Italia massif (Central Apennines) is a small *debris-covered glacier* of less than 5 ha. Located in the center of Mediterranean area the little apparatus well shows the generalized retreat phase of mid-latitudes European glaciers. The current thickness of the residual ice (27 m maximum) was evaluated by ground-probing radar surveying and in addition the morphology of the bedrock was determined. The comparison with previous surveys revealed a clear-cut reduction in the thickness of the ice near the terminal moraine and in the central part of the glacier. The overall results lend support to the possibility of developments in the use of ground-penetrating radar for detailed site investigations. In this regard, indirect mass balance evaluations carried out on the basis of the annual evaluation of ice thickness variations at control points seem to present interesting prospects.

KEY WORDS: Glacier retreat, GPR (Ground-Penetrating Radar), Calderone Glacier, Central Apennines, Italy.

RIASSUNTO: PECCI M., DE SISTI G., MARINO A. & SMIRAGLIA C., *Un nuovo rilievo radar per valutare l'evoluzione del Ghiacciaio del Calderone (Appennino Centrale, Italia).* (IT ISSN 0391-9838, 2001).

Il Ghiacciaio del Calderone, situato nel massiccio del Gran Sasso d'Italia (Appennino Centrale) è attualmente un piccolo *debris-covered glacier* con una superficie inferiore a 5 ha. Questo piccolo apparato, ubicato al centro dell'area mediterranea, ben evidenzia la fase di ritiro generalizzato che caratterizza i ghiacciai europei delle medie latitudini. L'attuale spessore del ghiaccio residuo è stato valutato con GPR (*Ground Penetrating Radar*) (spessore massimo di circa 27 m) ed è stata anche ricostruita la morfologia del fondo roccioso. Il confronto con altri rilievi radar mette in evidenza una netta riduzione di spessore nei pressi della morena frontale e nel settore centrale del ghiacciaio. I risultati ottenuti fanno ipotizzare un possibile sviluppo dell'uso del georadar per indagini glaciologiche di dettaglio. A questo proposito sembra presentare interessanti prospettive la misura del bilancio di massa mediante la valutazione annuale delle variazioni di spessore in determinati punti di controllo.

TERMINI CHIAVE: Ritiro glaciale, Indagini radar (GPR), Ghiacciaio del Calderone, Appennino Centrale.

INTRODUZIONE

The only glacier in the Apennines and Europe's southernmost glacier, the Calderone Glacier (fig. 1), is located within a cirque that is cut deeply on the side of Corno Grande of the Gran Sasso d'Italia, the highest peak in the Apennines (2912 m). At present, the glacier appears as a small debris-covered glacier, completely covered by a debris cover that is highly variable in thickness. This debris acts as a protective shield for the underlying ice. The contact between the glacier and rock are masked by the debris almost everywhere; yet, a surface area of less than 5 ha is a reasonable estimate. The glacier has been undergoing a phase of strong reduction since the mid-eighties and has managed to survive because of the considerable accumulation of snow transported by the wind and avalanches, its NNE aspect, the protection offered by the tall cirque walls, and its exposure to the wet NE winds from the Adriatic Sea. Together with the relatively easy access to the glacier, its location and features make it an ideal study area for environmental research. The main objective of this paper is to present the results of surveys carried out recently using the ground-penetrating radar (GPR) method. In addition, the present thickness of the residual ice was assessed and the relative interpretative profiles were prepared. The latter reveal the usefulness of these methods in glaciological investigations. In fact, the comparison with

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