



Pleistocene glaciers at Mount Etna volcano (Italy) and their impact on its morpho-structural evolution

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Morphological and geological investigations were carried out to reconstruct the extension and the volume of the late-Pleistocene ice covers hosted on top of Mt Etna volcano. The analysis suggested that these glaciers covered an area less than 40 square km and that were not very thick because of the steep sides of the summit. The existence of these glaciers and their disappearance occurred over an important period of the evolution of the volcano, i.e. the transition from the volcanism of the Ellittico volcanic centre (34.00-15.000 years ago) to the present Etna. The clastic deposits emplaced during the last phase of activity (20.000-15.000 years ago) of the Ellittico, and characterizing the uppermost part of its stratigraphic sequence, are believed to have been generated owing to fragmentation of the erupted products as result of the partial melting of the ice cover. One of these deposits crops out at the top of the Ellittico stratigraphic sequence (~2200 m a.s.l.), and consists of pyroclastic material confined by a smoothed crust suggesting deposition occurred under ice cover. Samples were collected in the proximal area of the flow at the bottom, centre and top of the deposit, this latter including the smooth outer layer. Up to dm-size fragments of the broken outer crust were also collected a few tens of meters down-flow the previous outcrop location. Slices from selected samples were cut and thin sectioned. In the thickest samples, care was devoted to the preparation of thin sections oriented along two mutually perpendicular planes, one of which always included the top crust. Preliminary observations at the optical microscope revealed that different portions of the deposits are interested by different microscopic textures. All samples have a breccia-like chaotic aspect typical of epiclastic deposit characterized by a strongly weathered and oxidized yellowish to reddish matrix. In samples from the bottom and centre of the deposit this matrix contains ubiquitous, oxidized and broken mm-sized crystals and crystal frag-

ments (<1 mm) of plagioclase, olivine, pyroxene and oxides. These samples are also characterized by abundant crystal aggregates and inclusions of effusive and scoria products exhibiting heterogeneous crystal and vesicle content and groundmass textures. Colour banding given by the alternation of fine and coarse layers, the former with decreasing void content, is present only in the bottom samples. Finally, the thin (2-4 mm) top crust outer layer presents a much finer texture compared to the main body of the deposit and, mostly, a higher degree of compaction. Crystals and crystal fragments are smaller, there are fewer crystal aggregates and lava/scoria inclusions, and the void content is lower. The textural investigation represents a further constraint to the geological and morphological interpretation of the deposit, and suggests that smoothing and compaction of the outer carapace of the flow during emplacement was generated by the action of melting ice from a glacial cover on the top of the volcano. About 16.000-15.000 years ago a sharp retreat of the glaciers may have occurred in response to thinning of the ice cover. This may have determined the decompression of the volcano's upper part, which in turn could have triggered the final explosive events of the Ellittico. In this view, the released energy could have been enough to destroy the last 700-800 m of the unit, causing melting of all or most of the ice cover and the sudden release of large volumes of water and mud that were largely canalized along an existing East-West impluvium located on the eastern flank of Etna. Therefore, an accelerated erosion could have taken place in that sector of the volcano, triggering considerable gravitational collapses, and significantly contributing to the morphological and structural instability characterizing the eastern flank of Etna. This could have largely affected the subsequent formation of the large Valle del Bove depression.