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INVESTIGATING EVIDENCES OF QUATERNARY GLACIATIONS IN THE PREALPINE ENVIRONMENT OF THE ASTICO VALLEY

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ABSTRACT: Rossato S., Monegato G. & Mozzi P., *Investigating evidences of Quaternary glaciations in the Prealpine environment of the Astico valley.* (IT ISSN 0394-3356, 2011)
In the Astico valley (Venetian Prealps) some glacial, fluvioglacial and glaciolacustrine deposits were found. They are attributed to a pre-LGM glacial advance which reached further out in the valley. Geomorphological and stratigraphic data support this hypothesis. It is also pointed out the presence of a tectonic guidance in the developing of the Astico fluvial network.

RIASSUNTO: Rossato S., Monegato G. & Mozzi P., Studio di affioramenti attribuibili a glaciazioni quaternarie nell'ambiente prealpino della Valdastico. (IT ISSN 0394-3356, 2011)
Nella Valdastico (Prealpi Venete) sono state rinvenute prove di un'avanzata glaciale precedente il LGM, che ha raggiunto posizioni più avanzate rispetto a esso. I dati geomorfologici e stratigrafici finora raccolti concorrono alla caratterizzazione e interpretazione di questi depositi. Emerge inoltre un probabile controllo tettonico sullo sviluppo dell'attuale forra del Fiume Astico.

Key words: Quaternary glaciations, Astico valley, sand petrography

Parole chiave: glaciazione, Astico, petrografia delle sabbie.

The Astico valley is located in the Venetian Prealps (eastern Southern Alps), NW of the city of Vicenza (Italy).
The valley is named after the Astico River, which has its source between the Sommo Alto and the Plaut peaks, and flows initially N/S and then NW/SE. The river flows on the valley bottom up to the village of Piovene Rocchette, where it enters a narrow and 50-m deep canyon until reaching the Venetian alluvial plain, about 10 km downstream.
The valley is cut mostly in Triassic to Cretaceous limestones and dolostones, Triassic and Cenozoic volcanic rocks; the latter can be found in the final reach of the valley, which is carved almost entirely in Oligocenic volcanic rocks, both intrusive and effusive.
Concerning the tectonic aspects, the whole area is interested by two main deformative systems related to the neoalpine tectonic phase (CASTELLARIN & CANTELLI, 2000). They are the "Giudicariense" system (oriented SSE/NNW) and the "Scledense" system (oriented SE/NW), which cuts the previous one with a left-strike-slip cinematic. In addition, a third system (oriented roughly E-W) is related to the thrust propagation front of the eastern Southern Alps towards SSE.
Concerning the Quaternary succession, the presence of terminal moraines, attributed to the Last Glacial Maximum (LGM) (CUCATO, 2001), is well documented since the late 19th century (e.g.: NEGRI, 1887). These deposits are located near the Cogollo del Cengio village, almost at the beginning of the canyon. Other glacial deposits are scattered along the valley up to the northern watershed, where a low-elevation saddle divides the Astico basin from the larger Brenta River catchment.

The terminal part of the Astico valley presents an interesting situation, according to the geomorphological and geological configuration. The river flows in the canyon before described instead of entering the piedmont alluvial plain through the large gap (approximately 2.5 km wide) between Piovene Rocchette and Chiuppano. According to the geological setting, the direction followed by the Astico River seems even more strange. In fact, the canyon is cut in hard Mesozoic -Cenozoic carbonates and volcanic rocks, whereas the gap is made of easily erodible quaternary gravels, deposited by the Astico River itself during the Late Pleistocene (CUCATO, 2001).
During field survey, previously unknown glacial, fluvioglacial and glaciolacustrine deposits were found in the canyon about 4.5 km south of the LGM terminal moraines.
Remote sensing was applied in the early steps of the research, in order to define the main landforms and related sedimentary bodies and calibrate the field survey. Aerial photographs and satellite images were used, along with some oblique images, taken from a light aircraft.
Also, a Digital Terrain Model (DTM) was realized

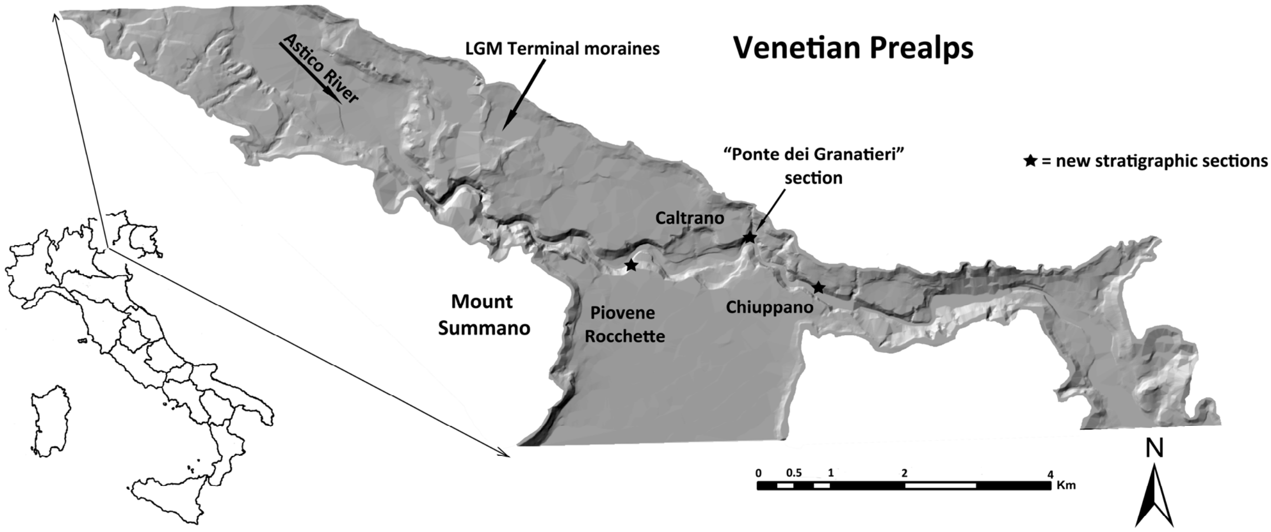

Fig. 1, Terminal part of the Astico valley floor (DTM, hillshade elaboration).
Il fondovalle della porzione terminale della Valdastico (elaborazione hillshade da DTM).

using elevation data from the Carta Tecnica Regionale (CTR) maps at scale 1:5000. Attention was paid to the elimination of artifacts (streets, built-up areas, etc) from the DTM. According to starting datum (contour lines spacing 5 m), the accuracy can be estimated as about the same value.
Basing on the remote sensing initial results, an intense field survey was run. A key site was the stratigraphic section "Ponte dei Granatieri", about 43 m high and 35 m wide, where the following 6 different sedimentary bodies were recognized:
A: sand layer at least 2.5 m thick (lower boundary not visible), constituted by sand bodies showing cross- to planar-lamination. Grain size varies from fine to coarse sand. This layer was deposited in a low-energy fluvial environment.
B: conglomeratic layer of about 6 m, mainly made by rounded limestone clasts (0.5 cm < b-axis < 20 cm), locally organized in channel structures. This body is heteropic with C and D layers, in the upper boundary; while, the lower boundary is sub-horizontal and abrupt, with erosive structures. This level could be attributed to a braided-type fluvial environment.
C: it is 3-m thick and consists of fine to medium sand; this layer can be observed only in the eastern part of the section, where it is inclined up to 60°. The lower boundary is visible only in a small part of the section: it is abrupt and inclined of about 60°-70°. This strata is interpreted as a low-energy fluvial deposit, possibly passing upwards to a lacustrine delta (see D layer). As for the sedimentary body D, the high inclination is interpreted as the result of sedimentary collapse due to deglaciation of a contiguous ice mass.
D: 8,45 m thick, this layer consists of laminated grey clay. The laminas show a variable inclination from sub-horizontal to 60°, moving from west to east in the section. The lower limit is gradual, with an increase of the grain size up to the medium sand. These deposits are lacustrine. Looking in detail, the inclination appears to be caused by a collapse and points to a glacio-lacustrine setting, exposed to soft-sediment deformation during deglaciation, due to the lack of lateral support by the shrinking ice-mass.
E: this layer is made of clay and gravelly interbeddings, with thickness varying from 0.3 m to 2.5 m. The former are mainly made of red clay (7,5YR 6/6 Munsell colour), the latter are made of sub-rounded to angular clasts, whose size varies from 2 to 8 cm (b-axis). The lower boundary is abrupt and plain. As a whole, this unit can be interpreted as slope deposits made of Terra Rossa soil sediments, eroded from the above valley flanks, alternated with scree deposits made of limestone clasts.
F: the uppermost layer is constituted by a ca. 21-m thick carbonate heterometric conglomerate (average pebble dimensions of 3-5 cm,with boulders up to 60 cm), crudely bedded and matrix-supported; clasts are angular to sub-rounded. The upper half is slightly more resistant to erosion, due to cementation. The lower limit is gradual, plain. The sedimentary body is interpreted as an alluvial deposit related to a proximal fan.
In order to carry out pollen analysis the lacustrine deposits were sampled. Pollen analysis is a good environmental proxy (MOORE *et al.*, 1991) and may validate the hypothesis that the lake formed in a glacial environment. Analyses are currently under way and results are not yet available.
Some more precise age constraints will be

hopefully provided in the next months by luminescence dating. This dating method is based on the accumulation of electrons in the crystalline reticulate defects, leading to the burial time of the sediment (WINTLE, 2008). Even if the luminesce dating is not yet of common use, there are some encouraging studies on proglacial sediments (e.g: PREUSSER *et al*, 2007). The better known method of C^{14} is inapplicable, due to the lack of organic material; moreover ages may easily go beyond the resolution limit (CURRIE, 2004).

In order to distinguish various sedimentary events, some petrographic analysis were run, both in the described section and in some others. Looking at the abundance of dolomitic and calcareous components it was possible to distinguish the fluvial deposits (richer in carbonates) from the glacial/fluvioglacial ones, in which volcanic/ metamorphic rock fragments are more abundant. These elements support the hypothesis that there was a connection between the Astico and Brenta glaciers, but they are not enough to provide a univocal conclusion.

All the elements point to a pre-LGM glacial advance of the Astico glacier, which reached further out in the valley. Without any other chronological data it is not possible to hypothesize the age of the event (MIS 6 or older?). Nevertheless, it is clear that the canyon of the Astico valley already existed before this glacial advance took place. It is likely that its formation has been guided by fractures and faults related to the Neoalpine phase, aligned along the Southern Alpine thrusts front, and that it developed on long time-scales, possibly encompassing large part, if not the totality, of the Pleistocene.

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