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## SOME EVIDENCE OF QUATERNARY COLD PERIODS IN SOUTHERN ITALY: DATA AND REFLECTIONS

**ABSTRACT:** BOENZI F., *Some evidence of Quaternary cold periods in Southern Italy* (IT ISSN 0084-8948, 1980). In Southern Italy (Campania, Basilicata, Apulia and Calabria) the Quaternary cold periods left remarkable traces, mainly represented by debris deposits of congelifraction origin which somewhere look like periglacial deposits.

These traces probably show, first of all, that in this part of Italy, notwithstanding its not too high latitude, the Quaternary cold periods were characterized by rather cold climatic phases, which favour congelifraction activity. This moreover seems to have been stronger, during the same periods, on the western sides of the above mentioned regions, particularly, on the mountain slopes facing the Tyrrhenian Sea from Campania down to Northern Calabria.

**RIASSUNTO:** BOENZI F., *Tracce di periodi freddi quaternari in Italia Meridionale* (IT ISSN 0084-8948, 1980). Nell'Italia Meridionale (Campania, Basilicata, Puglia e Calabria) i periodi freddi del Quaternario hanno lasciato tracce non trascurabili, rappresentate soprattutto da accumuli detritici di origine crioclastica, che, a luoghi presentano l'aspetto di deposito periglaciale. Queste tracce indicherebbero, che in questa parte dell'Italia, nonostante la latitudine non elevata, i periodi freddi quaternari sono stati caratterizzati da fasi climatiche sensibilmente fredde favorevoli ai processi di gelificazione.

Inoltre, sembrerebbe che le azioni crioclastiche, nel corso di questi periodi, siano state più intense nelle parti occidentali delle menzionate regioni e in particolare sui versanti dei rilievi rivolti verso il Mar Tirreno dalla Campania alla Calabria settentrionale.

**TERMINI-CHIAVE:** periglaciale, Italia Meridionale.

### INTRODUCTION

It is well-known that Quaternary cold periods left numerous traces in Mediterranean countries. Apart from glacial forms, present on the highest mountains, such traces are mainly represented by « glaciais d'érosion » and by special debris deposits of congelifraction origin which somewhere look typically like periglacial deposits.

As far as Southern Italy is concerned and particularly the regions of Campania, Basilicata, Apulia and Calabria, scientists started passing on information on the presence of Quaternary-cold-periods traces only few years ago. These pages are preliminary and briefly offer the most important data on the subject for the above mentioned regions, starting from Campania. This work is based on extant writings as well as on personal observations.

Some reflections, moreover, are given on the paleoclimatic importance of the traces, particularly congelifraction deposits, in this part of Southern Italy.

### TRACES OF QUATERNARY COLD PERIODS: GEOGRAPHIC DISTRIBUTION

In Campania the commonest manifestations of Quaternary cold periods are represented by deposits of congelifraction which cover, more or less extensively, the slopes of limestone mountains and somewhere look typically like deposits formed in periglacial conditions.

What is interesting to point out, however, is the fact that such deposits fully outcrop on the western slopes near to the Tyrrhenian Sea. Large outcrops of congelifraction breccias have been found especially in the Peninsula of Sorrento. The oldest of these deposits could be ascribed to the Ancient Quaternary (GUZZETTA, 1963) and the most recent to the « Würm » (BRANCACCIO, 1968). Somewhere the breccias reach the sea-level. Other large, imposing congelifraction deposits can be seen in the valley of the River Sele on the western slopes of the Picentini Mountains.

According to BAGGIONI (1972) they might be two different, superimposed deposits. The oldest congelifraction deposit may be ascribed to the « Günz », the highest to the « Mindel ». On the Tyrrhenian side of Mount Bulgheria (Cilento), BAGGIONI (1975) reports the presence of congelifraction breccias outcropping as far down as the sea level and belonging to the « Würm ».

Also in the Apennines, in Basilicata, the commonest traces of the cold periods are represented by deposits of congelifraction breccias which somewhere look typically like deposits belonging to periglacial climates.

BOUSQUET & GUEREMY (1968), who studied the upper part of the Sinni Valley and the basin of the Mercure, classified four « generations » of congelifraction

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breccias; the oldest of them might be ascribed to the « Günz ».

Our personal observations have stated the undoubted existence of different kinds of breccias, but also the fact that their dating remains questionable for the time being. The most reddened and cemented deposits might be the oldest, while those that are not at all cemented or only little cemented might be considered more recent, probably belonging to the « Würm ».

The following three types have been identified: the first which somewhere looks like a gelifluction deposits is formed by angular stones of different size confusedly embedded in a hard, reddish matrix; the second is given by debris beds, alternatively cemented and not, with the same inclination as the slope and is made up of medium sized angular elements; finally the third type is represented, alternatively, by beds made up of more or less flat, medium-sized stones and by sandy-looking beds; on the whole it is a question of « éboulis ordonnés ».

As for the distribution and position of debris deposits, it must be remarked that they outcrop on almost all the slopes of the highest mountains in Basilicata; somewhere debris outcrops are located as far up as 500 to 600 m above sea-level.

Other traces of the cold periods are represented by « glaciais d'érosion »: but it must be stated beforehand that only residual strips of such traces are left in Basilicata; they are, moreover, small-sized and often too difficult to be recognized.

The « glaciais » are very few and small-sized, probably because many rocky masses in which they formed were easily subject to erosion and also because of the continuous uplifts the region had during the Quaternary: it is likely that such forms, with the passage of time, at first underwent a process of development and then one of destruction.

For instance local residues of « glaciais » are visible in the Apennines to the South of Mount La Spina and to the West of Mount Sirino.

As far as Apulia is concerned, data on the existence of debris deposits or of forms of erosion connected with Quaternary cold periods are still scantier. There are deposits of congelifraction breccias here and there on the Gargano northwestern slopes; they are made up of several generations of breccias. A detailed study is needed, however, to check this superficial observation and to establish whether there are sedimentological and stratigraphical differences within the breccias belonging to various outcrops.

The most important part of the Murge is the western edge where, between 500 and 600 m above sea-level, in the stretch of land between « Fermata di Acquatetta » to the North-West and « Murgia di Lamapera » to the South-East, there are outcrops of debris deposits formed by variously cemented breccias, arranged in layers and beds.

According to NEBOIT (1975) the breccias, probably belonging to the « Riss », are of congelifraction origin; BOENZI, DI GENNARO & PENNETTA (1977) who studied

the sediments, also from the sedimentological point of view, believe, instead, that they are deposits of periglacial environment.

Outcrops of breccias are to be found also elsewhere on the Murge; for instance, near Grottaglie (NEBOIT, 1975): anyway, in most cases, the deposits are not large and their dating is difficult.

Now, as for the Salento, it seems interesting to point out that along the coast between Otranto and S. Maria di Leuca, at about 100 m above sea-level there are limited breccia deposits, made up of stones of different size embedded in a sandy, reddish matrix; we cannot deny that they might be gelifraction products, but they offer no dating elements. It is well known, however, that gelifraction deposits of the « Würm » have been reported in the sediments of the « Grotta Romanelli » (BLANC, 1920; 1953) together with remains of cold fauna (*Alca impennis* L.).

In Calabria, we must first of all point out the existence of congelifraction breccia outcrops on the southwestern slope of Mount Pollino.

BOUSQUET & GUEREMY (1969), who studied those sediments, distinguished, as for the Apennines in Basilicata, four types of breccia deposits belonging to different ages. The oldest deposits (belonging to the « Günz » and the « Mindel ») are represented, according to them by cemented, reddened breccias; cemented grey breccias would belong to the Riss and finally little cemented or not at all cemented debris deposits, somewhere looking like « éboulis ordonnés », could be ascribed to the Würm.

In north-western Calabria, precisely on the mountains of the coastal chain, recently VERSTAPPEN (1977) remarked the presence of periglacial environment deposits; the sediments the author generically ascribes to the Pleistocene are visible, according to him, up from 900 to 1000 m above sea-level.

It seems, however, interesting to point out that breccia deposits, probably of congelifraction origin, outcrop on the whole Tyrrhenian side of north-western Calabria; near Praia a Mare these breccias are visible at 10 to 20 m above sea-level; moreover, always near the same place, on a marine terrace (about 100 m above sea-level) the highest part of the sediments, ascribed to the Sicilian age (BRANCACCIO L. & VALLARIO A., 1965) shows some effects of periglacial events which are perhaps ascribable to the « Riss » and are represented, in particular, by cryoturbations (BOENZI & PALMENTOLA, 1976).

In the Crati Valley VERSTAPPEN (1977) distinguished four types of « glaciais d'érosion », respectively located at a height of 900 to 1000 m, 400 to 600 m, 250 to 350 m and 200 to 250 m above sea-level. The author believes that these forms developed during the glacial periods; he, particularly, maintains that the « glaciais d'érosion » are the products of a washing away process, especially strong in spring, when melted snow waters contributed to the transporting down the slopes of debris material formed in winter time in periglacial climates.

We lack sufficient data for the other zones of Calabria; for information we may call to mind that on the highest places of Aspromonte at about 1600 to 1700 m above sea-level there are debris deposits with periglacial characteristics, as NANGERONI (1952) reports. We may also remember that GIGOUT (1962) tells about the presence of a « glacia », ascribed to the « Günz », on the south-western slope of Aspromonte at about 200 m above sea-level.

## CONCLUSIONS

From what has been written above, it seems obvious that the Quaternary cold periods left, on the whole, numerous traces in Southern Italy. Generally speaking,

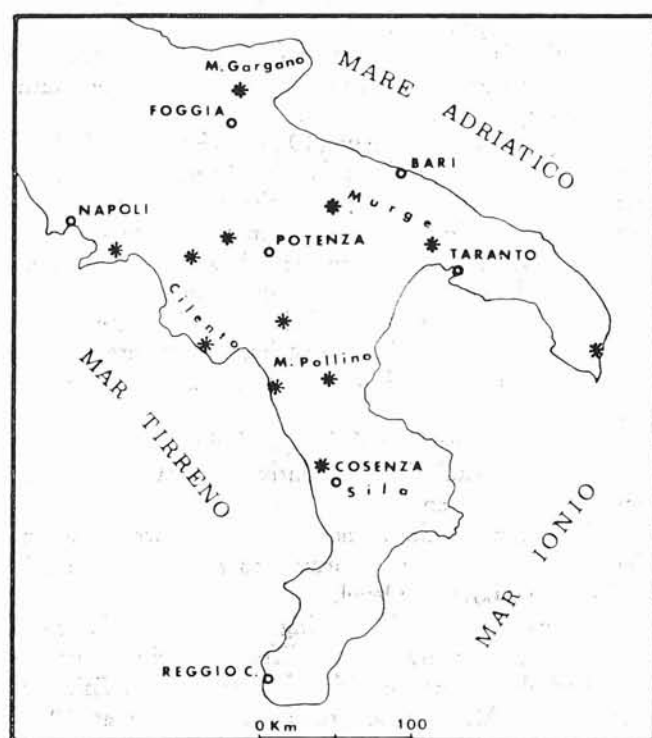


FIG. 1 - Geographic distribution of debris-deposits outcrops mentioned in the Text.

on the mountain slopes facing the Tyrrhenian Sea it is possible to recognize from Campania to Northern Calabria, the presence of congelifraction debris deposits, belonging to different ages, being particularly large and sometimes almost reaching as far as the sea-level. This situation shows that during glacial periods, the western exposure especially favoured such process as congelifraction and solifluction.

Moving eastwards to Apulia, the traces left by the cold here, are, on the whole, less widespread owing to its conditions in the matter of altimetry, morphology and, perhaps, climatology.

For the time being, it is very difficult to get infor-

mation on the climatic features of the different glacial periods, particularly, of the oldest of them; anyway, it seems useful to offer the following reflections:

1) - As regards the oldest glacial periods (« Günz » or « Mindel »?) the only thing we can state at present is this: the considerable thickness of debris deposits from congelifraction, ascribable, perhaps, to these periods, shows an intense freeze - thaw activity.

2) - Information on the climatic conditions of the « Riss » are offered by the study of the pollen found out in lacustrine sediments in the Mercure basin generally ascribed to a period of time between the « Mindel » and the « Riss » (VEZZANI, 1967; BOUSQUET & GUEREMY, 1968).

The pollen found out in the upper part of the deposits shows the passage to cold periods which are likely to be ascribed to the « Riss » (BOUSQUET & GUEREMY, 1968). As regards this subject we have to point out that lacustrine sediments, stratigraphically speaking, seem to change, nearby the basin edges, into debris deposits, very likely, of congelifraction origin. They are similar in sedimentological characteristics to other deposits outcropping on the slopes of the Apennines and presenting, somewhere, the features of typical periglacial deposits.

Of course, available data do not give us the certainty of stating the climatic characteristic of the « Riss » and, for instance, whether it was characterized by dry cold or by damp cold; anyway, it is obvious that frost action was intense.

The presence, moreover, nearby Praia a Mare, of cryoturbations ascribable, probably, to a phase of the « Riss », would suggest that cold intensity, in this phase, was stronger on the Tyrrhenian side and weaker on the Adriatic side, particularly, in Apulia.

In this region, as we have already said, the manifestations of the « Riss » are mainly represented by debris deposits of congelifraction origin outcropping on the western edge of the Murge (NEBOIT, 1975; BOENZI, DI GENNARO & PENNETTA, 1977).

These deposits, somewhere, present such characteristics as to be assimilated to the « éboulis ordonnés » (BOENZI, DI GENNARO & PENNETTA, 1977) which may have developed on slight slopes and, according to TRICART & CAILLEUX (1967), under marginal and weakened periglacial climatic conditions.

3) - Passing to the « Würm », we can remark how in the western part of southern Italian regions, particularly on the Apennines, this period left several traces which evidence the aggressiveness of the cold. On this subject we have to point out that the altitude reached by the snow-line on these uplands during the Würm maximum expansion was surely not high: it was, in fact, about 1 650 m above sea-level (present altitude) on the Apennines of Calabria and Basilicata and about 1 750 m above sea-level in the central part of Calabria, particularly on the Sila (BOENZI & PALMENTOLA, 1972; 1975). A stratigraphical study of some fossil dunes visible on the Tyrrhenian coast near Marina di Camerota in the province of Salerno (GAMBASSINI & PALMA DE





FIG. 2 - An aspect of the stratified slope deposits outcropping in the « Appennino Campano-lucano » to the south-east of the Buccino.



FIG. 3) - A detail of the debris deposits of congelifraction origin outcropping to the western edge of the Murge.

CESNOLA, 1972) probably shows, even if approximately, the presence of a dry, cold climate during the phase of the Würm maximum expansion.

On the whole, « Würm » manifestations seem not to be present in Apulia; apart from the lack of detailed researches on the subject, it is interesting, however, to remember that recent studies (KELLETTAT, 1978; ROGNON, 1978) have pointed out that a very cold climatic phase probably took place in the Mediterranean area during the late « Würm » so, vast regions to the North of the Mediterranean Sea (ROGNON, 1978), including this

part of Southern Italy, belonged once more to an area where the tundra and the steppe were dominant.

On the same subject we have to hint at a very recent finding out of proboscidean remains in the Salento ascribable to the species *Elephas primigenius* BLUM. The remains are at present being studied by E. LUPERTO SINNI.

Finally, it is likely to admit that some of the congelifraction deposits outcropping between Otranto and S. Maria di Leuca could be ascribed to one of the last phases of the « Würm ».

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