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GEOMORPHOLOGIC FEATURES AND RADIOCARBON DATING OF SOME QUATERNARY DEPOSITS AT DIFESELLA DEL TRIONTO (CALABRIA, SOUTHERN ITALY) (***)

Abstract: CALDERONI G., CICCACCI S., FREDI P. & PAMBIANCHI G., *Geomorphological features and radiocarbon dating of some Quaternary deposits at Difesella del Trionto (Calabria, Southern Italy)* (ISSN 0084-8948, 1989).

The sedimentary deposits, Pleistocene in age, outcropping at Difesella del Trionto (Calabria) are examined. The main geologic and morphologic characters, along with the results of radiocarbon dating and organic geochemical analysis of some layers rich in organic carbon are reported. The results, strongly suggesting that about 31,000 yr. B.P. a lake formed in the area, are in line with landsliding events which occurred downvalley of Difesella, as it is recorded by several morphologic features. It is inferred that such processes triggered the valley damming, thus determining lacustrine sedimentation.

KEY-WORDS: Quaternary deposits; 14-C dating; Calabria.

Riassunto: CALDERONI G., CICCACCI S., FREDI P. & PAMBIANCHI G., *Lineamenti geomorfologici ed età radiometrica di alcuni depositi quaternari a Difesella del Trionto (Calabria)* (ISSN 0084-8948, 1989).

Vengono esaminati alcuni depositi pleistocenici affioranti a Difesella del Trionto (Calabria ionica). Dopo aver tracciato i principali lineamenti geomorfologici dell'area, si espongono i risultati della datazione radiometrica e l'analisi geochimica di alcuni livelli contenenti materiale organico. Tali risultati consentono di ipotizzare che circa 31.000 anni fa l'area è stata interessata dalla formazione di uno specchio lacustre. Numerose evidenze morfologiche a valle di Difesella indicano che alcuni fenomeni franosi possono considerarsi i responsabili dello sbarramento della valle e della conseguente sedimentazione lacustre.

TERMINI CHIAVE: Depositi quaternari, Datazione C-14, Calabria.

Some deposits, Pleistocene in age, outcropping at Difesella del Trionto, in the upper basin of the Fiume Trionto (Sila di Greco, Central Calabria) are examined. This research is addressed to gain general information to be used for outlining properly the geomorphologic evolution of the study area. In this view has been chosen a multidisciplinary approach including the definition of the main geological and morphological characters of the area, radiocarbon dating and organic geochemical analyses of some organic carbon-bearing layers sampled within the study deposits.

GEOLOGICAL AND MORPHOLOGICAL FEATURES OF THE AREA

The most spread lithotypes outcropping in the study area are intensively tectonized granites and granodiorites of Devonian age (GURRIERI & *alii*, 1978). The present struc-

tural and morphological assessment of the area mainly depends on the Mio-Pliocene and Quaternary tectonics (TORRICI, 1980). All the outcropping rocks, folded and displaced by the pre-Quaternary compressive tectonics, underwent severe denudational processes and a low relief surface originated. Because of the Quaternary uplift and faulting, this surface was deeply cut and displaced along direct faults; just downvalley the study area, the most uplifted fault-block of Mount Paleparto (1 480 m a.s.l.) — Mount Forgiari (1 424 m a.s.l.) occurs. This block is bordered westward by faults, trending NNE-SSW and NW-SE, which have downthrown the headwater of the upper Trionto basin (Piani del Barone area). Faults trending WNW-ESE are also of some concern and in the Difesella area originated a small graben where the upper Trionto valley emplaced. Geomorphologically the area of Difesella represents the transitional zone between the headwater and the central part of the upper basin of Fiume Trionto, the latter corresponding to the Mt. Paleparto — Mt. Forgiari block. The valley head shows a low relief energy landscape, and its almost horizontal summit areas, representing the paleosurface, are cut by wide, shallow valleys. In the central part the landscape becomes sharper; here the fluvial

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deepening still in progress, originated gorge-like valleys, and caused the breaking up of the summit erosion surface into small relict features. At Difesella an overall progressive narrowing and deepening of the valley is apparent, although a flat-floored valley still exists. Here, about 40 m above the present talweg, some terraced surfaces made up by the studied deposits crop out. The terraces are almost continuous along the main valley, but they may occur also along the main subordinate valleys, as, e.g., at I Cotri and Cerasella sites. Only relics of terraced surfaces are observed downvalley and they completely disappear in the area of Mt. Paleparto-Mt. Forgiari. Here the very steep valley slopes underwent and are undergoing recurrent, sometimes extensive landsliding, as it is recorded by many landslide niches and trenches occurring up to about 100-150 m above the present talweg.

The give a comprehensive stratigraphical account of the studied deposits two sections are described. They have been selected for including the overall sedimentological features most typical for the deposits and further for they show and interbedded dark layer suitable for radiocarbon dating. The sections are located at I Cotri and Camporotondo sites, respectively (fig. 1).

I Cotri section - The stratigraphic section at I Cotri is exposed on a fluvial scarp, about 25 m high. At the bottom, a 7 to 8 m thick deposit of heterometric, chaotic, mainly coarse gravels with abundant sandy matrix directly overlies the crystalline basement. A grading upward is observed for the further 3-4 m; finally, through the uppermost 2 m, a notable increase of the sandy matrix along with a prevailing parallel-bedding is shown. Upward sands grade into clayey sediments; three levels are observed: a) a very thin, brown level with rare gravels; b) a 40 cm thick, blackish leve enriched in organic matter which was sampled for radiocarbon dating (sample R-1930) and c) a 20 to 30 cm thick, light-grey sandy clayey level with fine angular clasts.

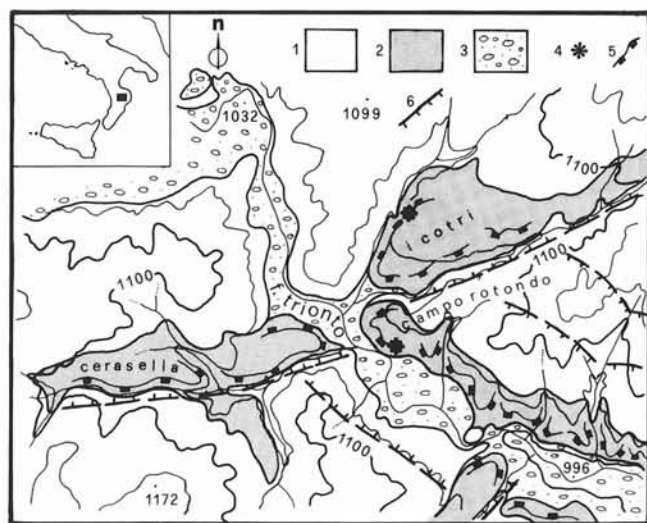


FIG. 1 - Geomorphological sketch of Difesella del Trionto area. 1) Crystalline rocks; 2) Fluvio-lacustrine deposits; 3) Recent and present alluvium; 4) Sampling sites; 6) Fault.

The clayish levels are overlain by about 1 m of sandy deposit; upward the gravel amount progressively increases and the parallel-bedding is lost. As such variation of bedding is paralleled by the appearance of frequent, up to several meters wide channellized structures, it is inferred that the water dynamics changed notably. Most of the channel axes point to an overall NE-SW paleoflow, that is a drainage direction quite comparable to that of the present water courses.

Campo Rotondo section - The stratigraphic sequence here exposed, about 20 m high, shows at the bottom a 5 m thick, parallel-bedded deposit made up by heterometric, medium-size gravels with abundant sandy matrix. Upward about 5 m of sandy gravels outcrop; their parallel-levels are rarely truncated by the often wide channellized structures which here are filled up by coarse pebbles. In the uppermost 2 meters such structures are overlain by fine to medium size sediments showing parallel-bedding.

Upward about 3 m of parallel-bedded sand, clay and rare gravel interbeddings, crop out. This layer provided an additional sample of clay, enriched in organic carbon (sample R-1979), for radiocarbon dating. Finally, through the topmost 5 to 6 m of the section, wide channels are shown; they are generally filled up by clayey sediments and commonly overlain by parallel-bedded sandy gravels showing relics of fossil soils.

GEOCHEMICAL DATA

Before running radiocarbon dating and organic geochemical analysis, the two samples of clayish, organic carbon bearing sediments were submitted to the routinary chemical treatment.

Table 1 shows ^{14}C ages, organic C and N contents displayed by the analysed samples. The radiometric ages, in fair agreement within 1σ , are in line with the field evidence suggesting that the dark layer deposition occurred at the same time over the area. As radiocarbon dating was performed on dispersed organic matter (macroscopic organic debris were not found in this sedimentary suite), the resulting weighted mean age, e.g. $31,026 \pm 668$ yr BP, should be regarded as the apparent age of the layer. Further, the formation of a carbonaceous layer significantly high in C_{org} ($\text{C}_{\text{org}} = 3.91\%$) in a geologic context as that of the study area should involve notable sources, which had been active for a significant time-span in supplying

TABLE 1

Conventional ^{14}C age, organic C and N contents for the studied samples.

File number	Sampling site	^{14}C AGE (yr BP)	C (%)	N (%)	C/N
R-1930	I Cotri	$30,240 \pm 900$	4.01	0.32	12.53
R-1979	Camporotondo	$32,000 \pm 1000$	3.82	0.28	13.64

the parental organic matter. In this view, the best-fitting pathways of organic matter recruitment should be related to an increased organic production inside an eutrophic lacustrine basin and/or prolonged leaching of the catchment topsoil in response to a phase of deforestation.

The elemental composition of the organic matter provided a rough information on the sources of organic material (tab. 1). The overall C/N range (12.53 - 13.64) lies intermediate between values generally reported for a) planktonic organisms (6-8; REDFIELD & *alii*, 1963) and sediments for oligotrophic lakes (7-10; KAWAMURA & ISHIWATARI, 1981) and b) plant tissues and peats (20-100; BRENNER & *alii*, 1978). In this view our results suggest a mixed organic matter source, but it must be interpreted with caution owing to the known sensitivity of organic C/N ratio to diagenetic alteration and the large variability displayed by both peats and terrestrial plants.

To have further information on its origin and significance, the organic matter was analysed for determining the distribution pattern of the *n*-alkanes in the C₁₅ - C₃₃ range. In fact a pool of the saturated hydrocarbons belonging to the *n*-alkanes group are successfully used as organic geochemical markers to distinguish between terrestrial (allochthonous) and aquatic (autochthonous) organic input to sedimentation basins.

Figure 2 shows the results of the gas chromatographic analyses for the *n*-alkanes; both samples seem to share the same *n*-alkanes signature. This finding points out that the organic matter assemblage is rather constant and that the parental organic input was recruited through an unvarying pathway which, besides lasting significantly over the time, accounted for the whole sedimentation basin. The recovered *n*-alkanes show a marked predominance of the odd-carbon number over the even-carbon number homologs in the C₂₂ - C₃₃ range, thus matching the pattern displayed by *n*-alkanes in almost the totality of recent sediments as well as higher plants (DEMBICKI & *alii*, 1976). Further, the *n*-alkanes exhibit in both samples a bimodal distribution, the first one maximizing at C₁₇ in both samples and the second one, shifted towards long-chain mem-

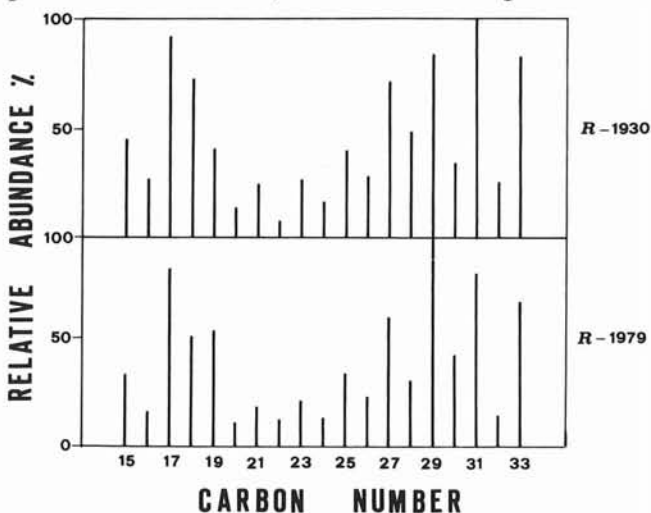


FIG. 2 - Distribution pattern of the *n*-alkanes extracted from the two studied samples. The measured concentration levels were normalized to the most abundant *n*-alkane in each sample.

bers, which is centered at C₃₁ and at C₂₉ for sample R-1930 and R-1979, respectively. The occurrence of two maxima in the *n*-alkanes distribution is suggestive of two distinct sources for the primitive organic matter. On one side the significant abundance of long-chain (>C₂₀) alkanes along with the appearance of C₃₁ and C₂₉ maxima are in line with a notable contribution of terrestrial higher-plant material (ISHIWATARI & *alii*, 1980). On the other side, the abundance of *n*-neptadecane, as well as that of the successive odd member (e.g., *n*-C₁₉) are features fairly matching the known hydrocarbon composition of algae (GELPI & *alii*, 1970; BLUMER & *alii*, 1971) and, in this respect, the short-chain hydrocarbons may be derived from algal (autochthonous) sources. Therefore, the significant occurrence of short-chain *n*-alkanes in the studied layer records an episode of high productivity in the water column of the sedimentation basin. High concentration of nutrients, coupled with extensive input of terrestrial organic material in a low-energy sedimentation basin, provides a reasonable explanation for the high productivity.

REMARKS

Geomorphological and stratigraphical observations, radiometric ages and the organic geochemical data allowed the following conclusion to be drawn.

The sedimentation conditions in the study area changed abruptly about 31,000 yr B.P., at that time the energy of the water basin dropped dramatically and a lake is likely to have formed. This event is marked by the occurrence of parallel-bedded, organic matter rich, clayish layers in the sedimentary suite. From a morphological point of view the energy dropping might have been caused by valley dammings due to landslides, at present inactive. Actually many evidences of landslidings exist downvalley of Difessella, where the Trionto valley becomes narrower and deeper while cutting the uplifted block of Mt. Paleparto-Mt. Forgiari.

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