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TOPOGRAPHY-BASED IDENTIFICATION OF A PALAEOPEAT-BOG AT ISERA, NEAR ROVERETO (TRENTO, ITALY) AND FIRST STRATIGRAPHIC, RADIOCARBON AND PALYNOLOGICAL RESULTS

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RIASSUNTO - *Individuazione topografica di una paleotorbiera a Isera, vicino a Rovereto (Trento, Italia) e primi risultati stratigrafici, radiometrici e palinologici* - Il Quaternario *Italian Journal of Quaternary Sciences,* **9**(2), 1996, 671-678 - Vengono forniti alcuni risultati preliminari su una paleo-torbiera planiziale individuata nella zona di Isera e situata a circa m 210 s.l.m., sul versante occidentale della Vallagarina e sulla destra idrografica dell'Adige. Le ricerche, a carattere geomorfologico e geofisico, sono state eseguite nell'area della torbiera in parallelo ad analisi radiometriche e palinologiche su sedimenti provenienti da un carotaggio. Nel lavoro viene evidenziata, soprattutto con l'ausilio dei dati radiometrici, l'evoluzione della storia climatico-forestale, compresa tra il Tardiglaciale e l'Olocene, nonché l'intervento antropico.

ABSTRACT - *Topography-based identification of a palaeopeat-bog at Isera, near Rovereto (Trento, Italy) and first stratigraphic, radiocarbon and palynological results* - Il Quaternario *Italian Journal of Quaternary Sciences,* **9**(2), 1996, 671-678 - The paper gives the preliminary results of a study carried out for the identification of a palaeopeat-bog located at approximately 210 m a.s.l., on the western slope of Vallagarina, on the hydrological right of the River Adige, near Isera in the neighborhood of Rovereto (prov. of Trento, N Italy). The research was based on geomorphological and geophysical studies on the area of the peat-bog, as well as on radiocarbon dating and pollen analyses of sediments from a core drilling. Climatic changes and forest history as put in evidence by radiocarbon dating are illustrated for a period ranging from the Late-Glacial to the Holocene. Environmental modifications ascribable to the Man impact are also highlighted.

Key-words: Geomorphology, stratigraphy, radiocarbon dating, pollen analysis, palaeoclimatology, Late-Glacial, Holocene, N Italy
Parole chiave: Geomorfologia, stratigrafia, radiocarbonio, palinologia, paleoclimatologia, Tardiglaciale, Olocene, Italia settentrionale

1. FOREWORD

In the southern part of the village of Isera (near Rovereto, in the province of Trento, Northern Italy), at about 210 m a.s.l. there is a very restricted area with a significant concentration of archeological sites (Gorini & Rigotti, 1980; de Vos *et al.*, 1992), which indicate the continuous human presence in the area (Figs. 1 and 2).

In the last century, Neolithic instruments were found at the ground level near the site known as "Alla Torretta" (Barfield, 1970). Close to this site, in the area of the present-day industrial zone of Isera, peat strata lying over muddy-sandy sediments had been found in the past, suggesting the presence of small interconnected lakes.

On the basis of these observations, a preliminary research based on topographical considerations was carried out to identify, as the first goal, the area of the supposed palaeo-basin. In a second phase, a drilling survey was undertaken for a palynological investigation, focused on the definition of the vegetational evolution and of environmental and climatic changes occurred in the site. Finally, we tried to establish the period in which Man appeared in the area. Radiocarbon datings were also used.

2. MATERIAL AND INVESTIGATION METHODS

In order to identify the peat-bog, a geophysical survey was preliminarily carried out. Seismic refraction and electric resistivity profiles were obtained with the new ERS (Electric Resistivity System) multi-array instruments with data automatically exported to Surfer software. The instruments were set up by Museo Civico of Rovereto and the Department of Geology, Paleontology and Geophysics of Padova University. Geophysical investigations were followed by a drilling survey which allowed for the identification of the peat seam, its depth and the thickness of lake sediment ovelying the bedrock. Grain-size analyses of the sediment are still in progress, whereas rather numerous palynological data are already available. A pollen analysis was performed on a core between 25 and 400 cm depth, and on two silt layers (at the depths of 420-430 cm and 450-463 cm, respectively) which are intercalated with gravel. Malacofauna was studied on some of the strata. Peat samples for radiocarbon dating were taken at 5 cm from one another, from both the top and the bottom of the peat-bed.

The relatively high number of peat samples (10) for radiocarbon dating was decided to ensure the best chrono-

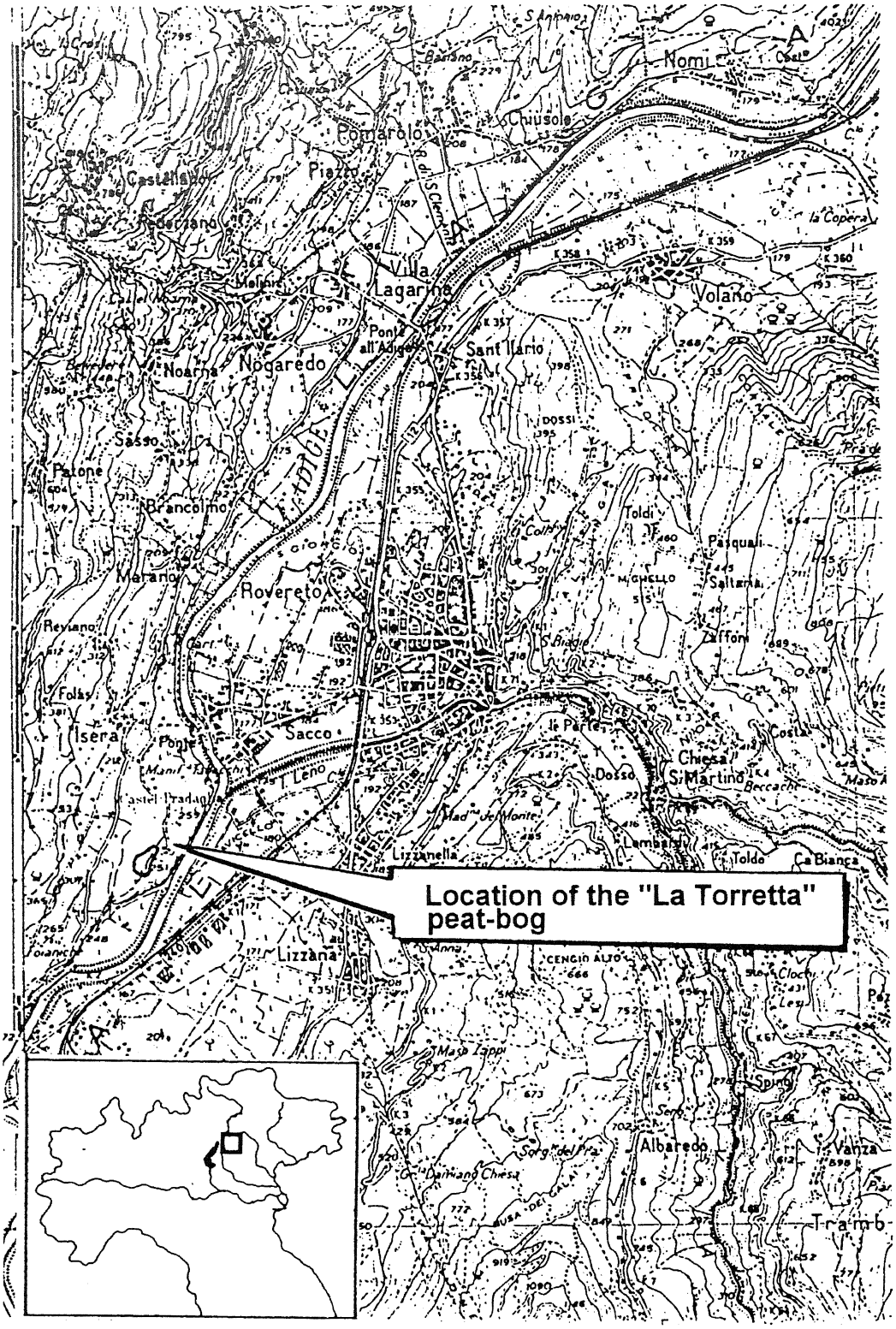


Fig. 1 - Topographic map (scale 1:50,000) of the Rovereto area and location of the "Alla Torretta" palaeopeat-bog.
Carta topografica (scala 1:50.000) dell'area nei dintorni di Rovereto e ubicazione della paleotorbiera "Alla Torretta".

stratigraphic definition allowed for the amount of organic carbon required to make measurements. With the exception of the base level of the succession, measured ages refer to 5-cm spaced intervals in depth. As to conversion of measured ages into conventional ^{14}C age, reference is made to the works of Calderoni & Venanzi (1989) and Calderoni & Petrone (1992). Calibration of conventional ages was achieved using Stuiver & Reimer's (1993) dendrochronological derivation parameters. Correlation with climatic periods was obtained with con-

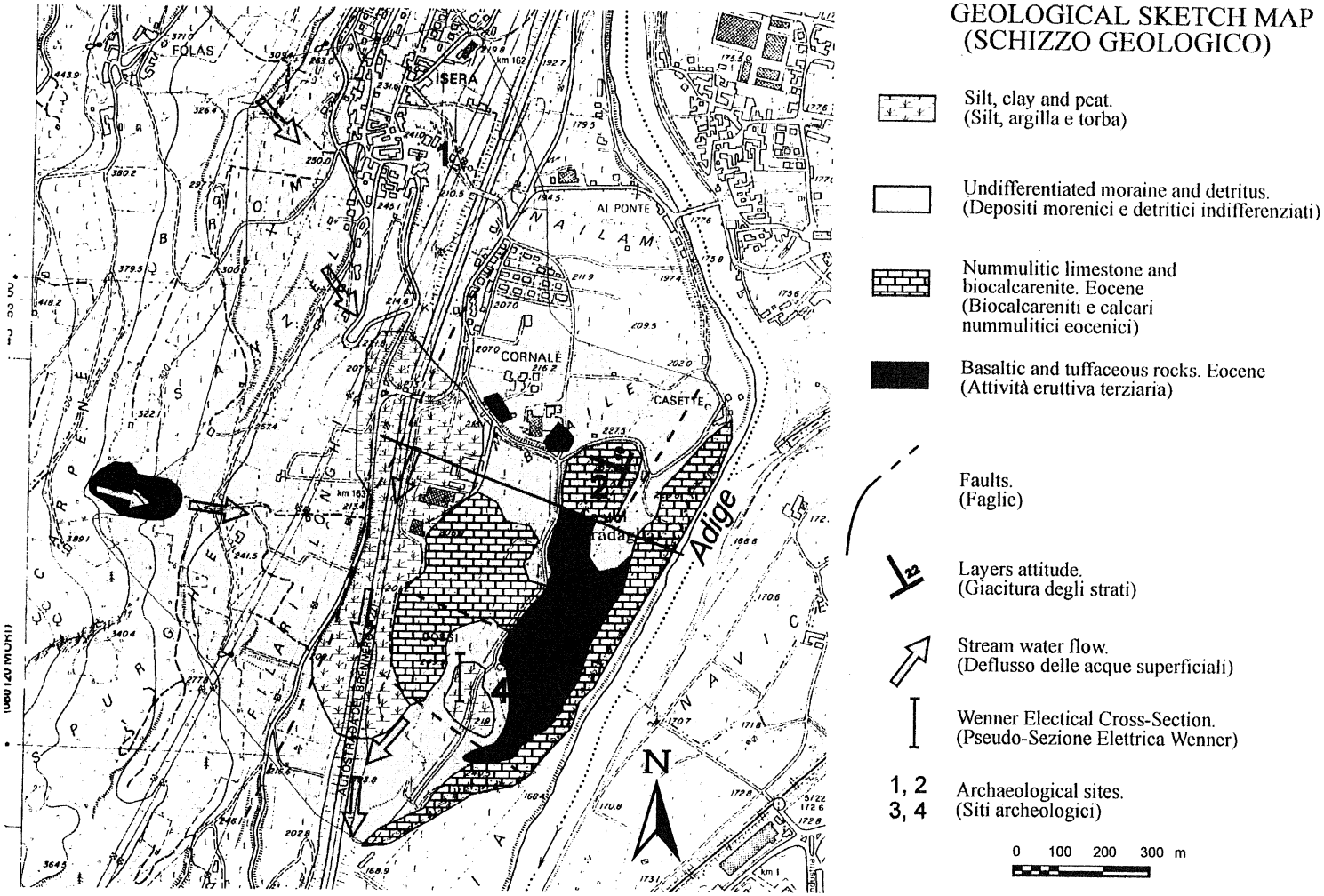


Fig. 2 - Geological map of the studied area.
Mappa geologica dell'area studiata.

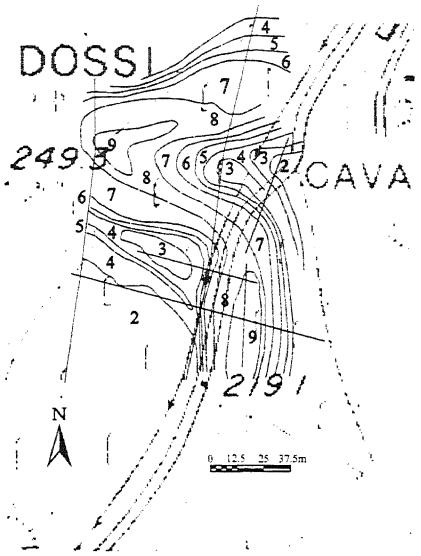


Fig. 3 - Isobath map of the bedrock as referred to ground level, and location of the 12 seismic refraction lines, allowing for the 3D reconstruction of the studied area.

Carta delle isobate del substrato roccioso, riferito al piano di campagna e localizzazione delle 12 linee di rifrazione sismica che hanno permesso la ricostruzione tridimensionale dell'area studiata.

ventional ^{14}C ages; the chronozones corresponding to the calibrated ages are reported in brackets in Figure 5.

Pollen extraction was made according to Bertolani Marchetti's method (1960).

Pollen grains of *Pinus sylvestris* L., *P. mugo* Turra and *P. cembra* L. were determined following Hormann's (1929) and Erdtman & Wodehouse's (1943) indications, in addition to other pollen iconographies (Accorsi *et al.*, 1983).

Taxonomic distinction between arboreal birches and *Betula nana* L., and between *Alnus viridis* (Chaix) DC. and other alders was based on both morphological and morphometrical characters (Erdtman & Wodehouse, 1943; Erdtman *et al.*, 1961; Poli & Perini, 1979). Similarly, an attempt was made to distinguish between arboreal and dwarf willows (Erdtman & Wodehouse, 1943; Erdtman *et al.*, 1961); however, the results were sometimes not satisfactory. Personal experience played, however, an important role for the taxonomic identification of pollen grains.

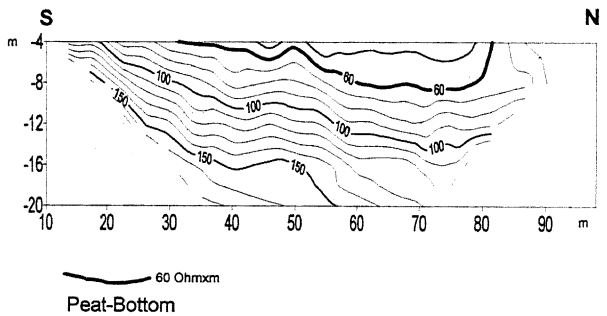


Fig. 4 - Wenner electrical pseudo-section of "Alla Torretta" (Isera) peat-bog indicating the palaeo-environmental evolution along the N-S direction.

Pseudo-sezione Wenner che ben schematizza l'evoluzione paleoambientale della torbiera "Alla Torretta" di Isera secondo la sezione nord-sud.

3. RESULTS AND DISCUSSION

3.1 Geomorphological features of the area

The numerous rocky outcrops all around "Alla Torretta" peat-bog may suggest that the bedrock is not more than a few metres deep underneath a rather thin sediment cover. Actually, boreholes showed that the thickness of the cover is remarkable (> 9.5 m), and problems arise about genesis of the basin and underground morphology. A map of underground isobaths and a precise definition of the peat-bog area (Fig. 3) were obtained by means of geophysics. In this respect, a Wenner simulated section was carried out with the ERS along the N-S direction. This shows that the bottom of "Alla Torretta" peat-bog faces north, at the depth of the isoresistivity line 60 Ohm x m. A complex profile has been processed using ERS. The sequential batch processing automatically craters three different files, and shows the peat-bog vertical section following its north-south orientation (Fig. 4).

3.2 Stratigraphy

Boreholes (Fig. 5) showed a sedimentary succession composed, from top to bottom, of the following lithotypes:

– arable soil up to the depth of 25 cm;

– silt with no evident traces of erosion up to 150 cm in depth;

– a peat layer follows up to -385 cm; very few pelitic layers are also present. From -385 to -400 cm a silty layer was found, whereas traces of erosion are present from -400 to -420 cm and from -430 to -450 cm, with alternating gravel and silt layers (at -420 to -430 and from -450 to -463 cm). Towards the core bottom (-950 cm), the stratigraphic series continues with sand and gravel.

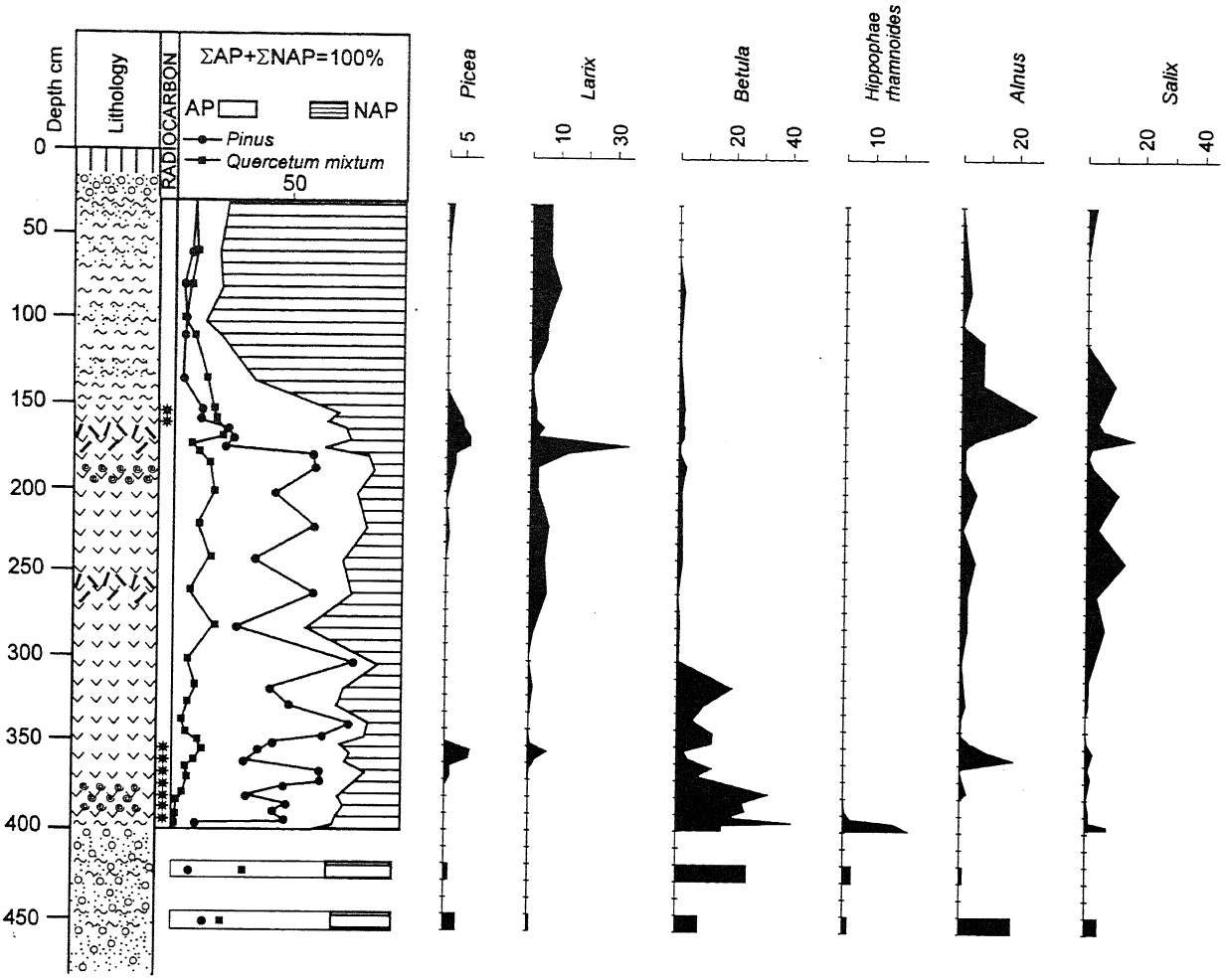
A water table was found at -280 cm, and remains of malacofauna are present at about -200 cm and -400 cm. Malacofauna, which was studied by Prof. D. Esu, is composed of both shallow water (*Lymnaea truncatula* Müller, *L. palustris* Müller, *Pisidium* cf. *amnicum* Müller, *Gyraulus laevis* Alder, *Anisus spirorbis* Linneus, etc.) and stagnant water species (*Pisidium pseudosphaerium* Schlesch together with *Lymnaea, Bithynia,* etc.) and, probably, also of running water species (*Pisidium subtruncatum* Malm.).

3.3 Radiocarbon dating

Samples for radiocarbon age determinations were taken at the top (2 samples) and at the bottom (7 samples) of the peat-bed. The obtained results give conventional and calendar ages between 6530±75 and 12,250±110 years B.P. and between 7470-7300 and 14,510-14,120 years B.P., respectively (Fig. 5).

3.4 Palynological aspects

Figure 5 shows the presence of a forest at the depth of the core bottom. This forest, qualitatively and



Lab. nb.	Depht in core (cm)	Conventional ^{14}C age (yr B.P.)	Calibrated age* (yr B.P.)	Climatic period
Rome-723	150 - 155	6,530 ± 75	7,470 - 7,300	Early Atlantic
Rome-724	155 - 160	6,510 ± 75	7,420 - 7,290	Early Atlantic
	.....	.....	.....	.....
Rome-731	350 - 355	6,930 ± 75	7,800 - 7,640	Early Atlantic (Boreal)
Rome-730	355 - 360	7,200 ± 70	8,060 - 7,920	Early Atlantic (Boreal)
Rome-729	360 - 365	9,545 ± 90	10,900 - 10,420	Pre-Boreal (Alleröd-Dryas 3)
Rome-728	365 - 370	9,730 ± 90	11,000 - 10,890	Pre-Boreal (Alleröd)
Rome-727	370 - 375	11,000 ± 100	13,020 - 12,810	Alleröd (Bölling)
Rome-726	375 - 380	11,720 ± 110	13,830 - 13,510	Dryas 2-Alleröd (Dryas 1)
Rome-725	380 - 390	12,250 ± 110	14,510 - 14,120	Bölling -Dryas 2 (Dryas 1)

* Stuiver & Reimer, 1993

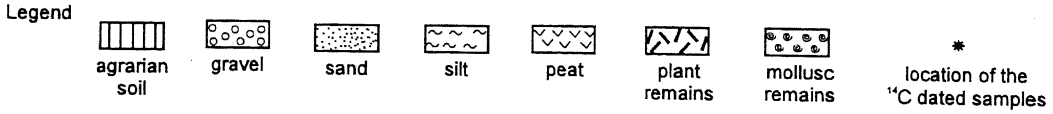


Fig. 5 - "Alla Torretta" palaeopeat-bog: pollen diagram with stratigraphy and radiocarbon ages (conventional and calibrated). Climatic periods are also given (the chronozones corresponding to the calibrated ages are given in brackets).

Paleotorbiera "Alla Torretta": diagramma pollinico con relativa colonna stratigrafica, radiodatazioni convenzionali e età calibrate. Sono indicati anche i corrispondenti periodi climatici (tra parentesi, le cronozone corrispondenti all'età calibrata).

quantitatively well established (73.7% AP/NAP) was mainly composed by pollen grains of plants of Euro-Siberian type (*Pinus mugo, P. cembra, Picea, Larix, Betula, Alnus viridis*) and of arctic-alpine plants (*Betula nana,* dwarf forms of *Salix*). Thermophilous components (*Quercetum mixtum*) were also present (22.6%). The percentage of thermophilous components falls abruptly (up to 0.9%) at -400 cm with a remarkable increase in *Pinus*. At lower depths, pollen grains of *Ephedra, Hippophae rhamnoides, Artemisia, Juniperus,* etc. have been identified.

By examining the pollen diagram, we can see a continuous fluctuation in the AP curve, especially Pines, up to -175 cm; *Betula,* which is abundant at the beginning, falls to minimum values towards more superficial levels, whereas *Larix* shows a marked increase.

Just before the top of the peat-bed (150-165 cm in depth) Cereal pollen grains (*Hordeum*-type) were found, which evidence Man presence. At the passage from peat to silt layers (-150 cm), a marked fall in the AP curve and constant presence of *Castanea* pollen can be observed.

4. CONCLUSIONS

The results of the pollen analysis, which match radiocarbon datings, indicate a climatic and forest history covering the period from the Late-Glacial to the Early Atlantic, corresponding to the top of the peat-bed. If the chronozones are calculated on the basis of conventional ^{14}C ages (Mangerud *et al.*, 1974), some Late-Glacial periods are scarcely defined or not defined at all. This happens also for the Holocene, the Boreal period being absent. It is assumed that the passage from peat to silt marks Man activity (exploitation of the peat-bog) which cancelled most of the traces of successive climatic variations. Man presence is, however, also indicated by the presence of *Cerealia* in the most superficial peat levels.

A chrono-palyno-stratigraphic interpretation is that the two older pollen spectra — if the high percentage of *Quercetum mixtum* is taken into consideration— may be attributed to the climatic amelioration occurred during the Lascaux interstage (Leroi-Gourhan Arl. & Leroi-Gourhan A.,1965) — also known as pre-Bölling interstage (Zoller, 1970) — between 16,000 and 14,000 yr B.C., or to the slight temperature increase occurred between 12,900 and 12,000 yr B.C. (Kozlowski, 1962; Leroi-Gourhan Arl. & Leroi-Gourhan A., 1965). The first hypothesis seems to be more probable.

If peat is considered in detail, the forest history appears very compressed in chronostratigraphic terms. In fact, during the Late-Glacial cold periods, peat seems to have not either formed or deposited in very small amounts, as evidenced by pollen stratigraphy and radiocarbon age determinations as well. Therefore, to explain pollen results and to define the vegetation evolution, much emphasis must be given to radiocarbon dating. A reliable chronostratigraphic interpretation is not possible on the basis of palinological data alone.

An aspect that is worth mentioning is the different thickness of peat depending upon climatic periods: a greater development is noted during warm climatic periods whereas peat deposition is very scarce or lacking during the cold periods.

Peat dating back to the Boreal period was not found, the reason being probably the dry climatic conditions occurring at that time.

In our opinion (Paganelli), calibrated ages should always be taken into consideration in interpreting pollen diagrams. In the present case, a good agreement between pollen curves and climatic changes is observed if the chronozones are defined based on calibrated ages.

In conclusion, the results of this interdisciplinary study, although preliminary, have given indications for a future palynological study to be carried out on new areas where deposits and peat seams are thicker and untouched by human activity, and where each climatic period may be represented by numerous pollen spectra. Only in this case, our knowledge on climate and vegetation history of this interesting area of Isera may be completed up to modern times.

Moreover, the geophysical results have highlighted a series of problems involving, besides the studied site, also a much wider area with palaeo-geographical and geomorphological implications for the reconstruction of the Adige River valley in the southern Trento region.

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