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The Late Pleistocene fauna from Ingarano (Gargano, Italy): biochronological, palaeoecological, paleoethnological and geochronological implications

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ABSTRACT - An abundant vertebrate fauna from an ossiferous breccia from Ingarano near Apricena (Foggia, Southern Italy) has been examined.

*Carnivores are very frequent with lynx, red fox, normal and small sized wolf, lion, leopard and brown bear, while erbivores are not so much represented by cervids, rhinos (two different species) and idruntine ass. Raptors (*Nyctea scandiaca *in particular) and corvids are the best represented taxa in avifauna.*

In the upper part of deposit some Middle Paleolithic artifacts (displaying evidence of the use of the Levallois technique) have been collected. The geochronological analysis of phosphatic encrustation of the speleothem give a measured age of 40±2ky.

The occurrence of the modern fallow deer, the idruntine ass and the woolly rhino fits well with geochronological and paleothnological data and allow us to refer the fauna to the Late Pleistocene and in particular to the isotopic stage 4.

RIASSUNTO - [La fauna tardo-Pleistocenica di Ingarano (Gargano): implicazioni biocronologiche, paleoecologiche, paleoetnografiche e geocronologiche] - *Viene esaminata in questo lavoro un'abbondante fauna a vertebrati rinvenuta in una breccia ossifera di una grotta scoperta in seguito ai lavori per la costruzione di una ferrovia nei dintorni di Apricena (Foggia, Italia meridionale). La stratigrafia dell'affioramento si presenta molto caotica nella parte basale, mentre è possibile intuire una certa sequenza nella parte più alta, dove sono stati rinvenuti alcuni manufatti litici. Le brecce affioranti contengono moltissimi resti di mammiferi e uccelli: fra i primi sono particolarmente abbondanti i resti di carnivori (in particolare linci, volpi, lupi di media e grande taglia, ma anche leoni, leopardi e orsi), meno frequenti quelli degli erbivori come cervidi, rinoceronti (sia* Coelodonta antiquitatis *che* Stephanorhinus hemitoechus*) ed* Equus hydruntinus. *L'avifauna è ricca di rapaci (soprattutto* Nyctea scandiaca*) e di corvidi. Nell'insieme la fauna presenta una composizione «disarmonica», con una maggiore frequenza dei resti di predatori. Vengono esaminate le probabili cause di tale disarmonia con riferimento alle condizioni paleoecologiche, tafonomiche e, forse, alle condizioni stagionali. Nella parte superiore del deposito sono stati rinvenuti una dozzina di reperti litici ottenuti con la tecnica Levallois (Paleolitico medio). Sono resi noti inoltre i risultati dell'analisi di campioni di calcite sui quali sono state effettuate datazioni assolute utilizzando il metodo $^{230}Th/^{234}U$ che hanno fornito una età di 40 ± 2 ka anni per la deposizione dei resti di vertebrati. Queste datazioni assolute, l'analisi della fauna e dell'industria litica permettono l'attribuzione del deposito di Ingarano alla parte alta del Pleistocene superiore. La presenza del daino moderno, del rinoceronte lanoso e dell'asino idruntino, unitamente alla composizione dell'avifauna consentono di restringere l'età del deposito allo stadio 4 della scala delle paleotemperature. Viene proposto un quadro fra questa associazione faunistica e altre associazioni provenienti da contesti stratigrafici ben definiti.*

INTRODUCTION

Along the Garganica Railway, near Ingarano (Foggia, Italy), 270 m a.s.l., a cave deposit of karst origin outcrops in an old quarry of the Calcari di Sannicandro Formation.

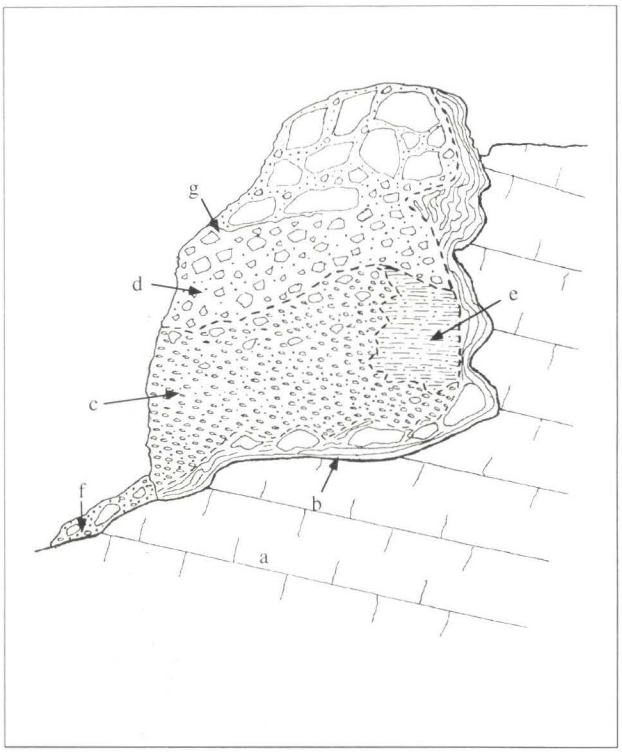
The fossiliferous deposit was described in a previous work (Capasso Barbato *et al.*, 1992), but new materials (vertebrate remains and lithic tools) have been discovered and studied in these years. These new data and a geochronological analysis allow us to draw a detailed biostratigraphical frame, a palaeoenvironmental reconstruction and the correlation with other fossiliferous localities of Apulia.

Three different layers (Text-fig. 1) can be distinguished in the deposit:

- the first one, of variable thickness, directly overlies the calcareus bedrock and is constituted of fallen blocks with calcitic concretions; the latter elements have been used for the absolute datations shown in this work;
- the second layer is a reddish breccia till 2 m tick, of variable cohesion, with isooriented roundened gravel pebbles and a great number of vertebrate bones;
- the third layer is almost 3 m tick and gradually originates from the second layer. It is a very compact breccia with calcareous breccias and vertebrate bones. The upper part of this level yielded lithic tools.

The deposit could have been originated by a main tectonic fracture, with other secondary ones, later interested by Karst phenomena which gave rise to some variably sized and connected fissures.

After this phase, the «cave» has been filled by fossiliferous sediments in a short period.



Text-fig. 1 - Stratigraphical sketch of the Ingarano deposit: (a) calcareous bedrock; (b) calcareous breccia with carbonatic phosphatic concretions; (c) calcareous breccia with roundened small pebbles and vertebrate remains; (d) calcareous breccia with vertebrate remains; (e) silty sands; (f) madeground; (g) «paleosoil» with human artifacts.

FAUNA

The fossiliferous deposit of Ingarano yielded a great number of taxa:

Pisces indet.

AMPHIBIA AND REPTILIA

Rana sp.
Lacerta sp.
Ophidae indet.

AVES

Aquila chrysaëtos (Linnaeus, 1758)
Falco peregrinus Tunstall, 1771
Falco tinnunculus Linnaeus, 1758
Alectoris graeca (Meisner, 1804)
Circus nov. sp.
Perdix perdix (Linnaeus, 1758)
Columba livia Gmelin, 1789
Nyctea scandiaca (Linnaeus, 1758)
Pyrrhocorax graculus (Linnaeus, 1758)
Pyrrhocorax sp.
Corvus corax Linnaeus, 1758
Corvus monedula (Linnaeus, 1758)

MAMMALIA

Erinaceus europaeus Linnaeus, 1758
Myotis blythi Tomes, 1857
Oryctolagus cuniculus (Linnaeus, 1758)
Lepus europaeus Pallas, 1778
Arvicolidae indet.
Microtus (Terricola) sp.
Microtus gr. *arvalis* Pallas, 1779 - *agrestis* (Linnaeus, 1761)
Apodemus sylvaticus (Linnaeus, 1758)
Eliomys quercinus (Linnaeus, 1758)
Canis lupus Linnaeus, 1758
Canis sp. (small form)
Vulpes vulpes (Linnaeus, 1758)
Ursus arctos Linnaeus, 1758
Mustela nivalis Linnaeus, 1766
Martes sp.
Crocuta crocuta (Erxleben, 1777)
Felis silvestris Schreber, 1777
Lynx lynx (Linnaeus, 1758)
Panthera pardus (Linnaeus, 1758)
Panthera spelaea (Goldfuss, 1810)
Stephanorhinus hemitoechus (Falconer)
Stephanorhinus sp.
Coelodonta antiquitatis Blumenbach, 1799
Equus hydruntinus Regalia, 1907
Hippopotamus sp.
Cervus elaphus Linnaeus, 1758
Dama dama dama (Linnaeus, 1758)
Capreolus capreolus (Linnaeus, 1758)
Rupicapra sp.
Bos primigenius Bojanus, 1827
Elephas antiquus Falconer & Cautley, 1845

Since the preliminary remarks by Capasso Barbato *et al.* (1992), new taxa may be added in the faunal list.

Rare fish, amphibian and reptil remains have been found; among birds is very interesting the occurrence of *Circus*, probably a new species, while two species of genus *Corvus* (*Corvus corax* and *Corvus monedula*) are frequent; among mammals, rare bones referable to *Erinaceus europaeus, Crocuta*

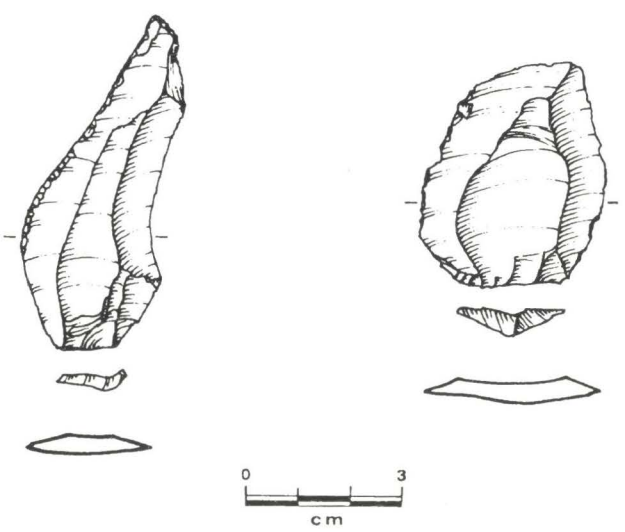
crocuta, Panthera pardus; Bos primigenius, Rupicapra sp. and *Elephas antiquus* have been collected. The occurrence of a small dog referable to «*Canis mosbachensis*» is very interesting. Small sized wolf-like dogs occurs in many Middle Pleistocene European sites, while in Italy similar forms have been found in Late Pleistocene deposits from Apulia, which can be correlated with Ingarano. Finally, a juvenile specimen of *Stephanorhinus hemitoechus* has been discovered.

The study of this fauna is at present in progress and it will be exhaustively illustrated in a next broader paper.

ARTIFACTS

A limited number of lithic implements was collected in the upper part of the stratigraphic sequence (Text-fig. 2). They are very fresh, with sharp edges and a white patina. The raw material used was flint which, as far as can be said, was originally dark coloured.

Only 12 flakes and blades have been collected so far, some still having fragments of the breccia deposit adhering to them. Cortex is found on part of the dorsal surface of two implements. The retouched tools are 2 scrapers on a laminar support – one being simple, and the other double – a denticulate (*pointe de Tayac*) on a thick flake, a retouched flake. There is also an elongated Levallois point, and two Levallois flakes. The *débitage* includes two flakes and a blade, and two resharpening flakes (one with laminar scars). A fragment of a burnt bone was also collected.



Text-fig. 2 - Lithic tools from the «paleosoil» (g).

Both the typology and technology are indicative of a Mousterian assemblage (Mussi, 1992). The Levallois technique is a knapping method used since the Middle Pleistocene. In Italy it is mentioned, but not fully documented, as early as isotopic stage 9 (for a discussion, Mussi, in press). The earliest well dated site in which it was distinctly used is Torre in Pietra level d, now referred to the Vitinia formation and accordingly OIS 7 (Caloi *et al.*, in press). The Levallois technique is not anymore used in the Upper Paleolithic, i. e. from the second half of OIS 3 onwards and aproximately after 35-37.000 B. P. At late Mousterian sites such as San Francesco di Sanremo (Liguria) and Buca del Capriolo (Toscana), the industry is distinctly laminar and the Levallois technique is also used to produce blades.

As far as the Würm is concerned, the Levallois technique was in use both during the early glacial, with a temperate environment, and later on during fully glacial stages. It was used at sites at which *Mammuthus primigenius* remains occurred, and namely at Riparo Tagliente lev. 37-36 and Pagnano d'Asolo (Bartolomei *et al.*, 1982; Dal Piaz, 1922; Reggiani & Sala, 1992).

As a general rule, the Levallois technique requires good quality flint of a suitable size. As a consequence, it is mostly found at sites at which adequate raw material was available, as on the southern fringes of the Po Plain, and in the Marche region. The Levallois technique, however, was also used in other parts of the peninsula, even if less frequently. It is not reported in the assemblage from Grotta Paglicci (Riparo esterno), not far away from Ingarano, which also includes a few handaxes from the lower part of the deposit and is accordingly pre-OIS 5 in age. The Levallois technique is well developed at Piano di S. Vito on Monte Gargano, an open air site at which an undated Mousterian assemblage has been collected.

GEOCHRONOLOGICAL DATA

Sampling and methods

A sample of stalagmite encrustated by phosphatic material was collected in order to date it using ^{230}Th method. The stalagmite is 23 cm high with a diameter of about 12 cm (Text-fig. 3). The stalagmite is characterized by four toroidal-shaped parts of the same height (about 6 cm) made of overgrowths of hard calcite. The hole of each toroid was filled by a deposite of globular soft calcite (Ford & Williams, 1989).

The toroidal deposit could be interpreted as due to growth from the splattering of a central drop.

The splattering is interrupted when the walls of each hole reach a critical height and the splittered drops percolated downward the base of the hole. The evaporation of the water in the hole then produces the soft and porous calcite forming the nucleus of each toroidal part. The highest part is covered by a massive phosphatic concrection whose origin can be derived by reaction of guano and urea with bones and carbonatic material. Both phosphatic ions and carbon oxide are produced by attacking the material with hydrochloric acid. Two samples of about 6 grams have been collected from the basis (sample ING-1) and the top (sample ING-2) of the speleothem and their $^{230}Th/^{234}U$ and $^{234}U/^{238}U$ activity ratios were determined by alpha spectrometry. The sample ING-2 differs from the sample ING-1 for its high content of phosphate which gave analytical problem during the separation and purification of Th. Actually at about 2 mm from the outher surface a thin deposit of phosphatic material similar to the external encrustations was clearly visible when the speleothem was cut. In order to avoid the analytical interferences due to the phosphatic ions we have analyzed about 500 grams of a 5 cm thick slide (sample ING-4) dissected between 1.5 and 6.5 cm from the top of the speleothem. This sample and about 100 grams of the phosphatic material (sample ING-3) have been analyzed by high resolution gamma spectrometry. This analytical method allows to determine the $^{226}Ra/^{238}U$ activity ratio from which the age can be calculated when radioactive equilibrium between ^{234}U and ^{238}U and between ^{230}Th and ^{226}Ra is assumed.

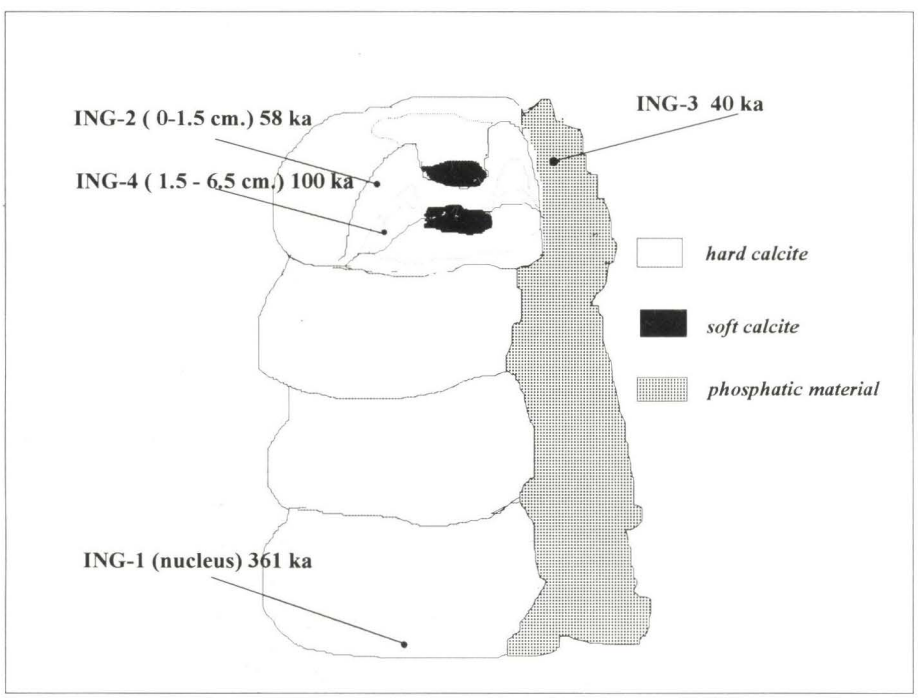
Analytical data and measured ages are reported on Tab. 1 and Text-fig. 3.

Results and discussion

All materials are characterized by negligible amounts of ^{232}Th and no correction due to initial detrital ^{230}Th is necessary. The U content of the carbonatic material at the basis of the speleothem (ING-1) is notably lower than that of the others carbonatic samples of the top. The occurrence of thin deposits of the U-enriched phosphatic material inside the upper part of the speleothem justifies this difference. In spite of this U content heterogeneity, the measured ages are internally consistent.

The main result is that the speleothem stopped its growing at about 58 ± 2 ky likely during a period of cave dwelling animal presence as testified by the thin phosphatic encrustations interbedded in the last carbonatic layers.

The measured ages allow to estimate both the long-term mean extension rate (between 361 and 58 ky) and the most recent mean extension rate (between 100 and 58 ky). The estimated values do not differ significantly and are close to about 1 mm/1000



Text-fig. 3 - Sample of the speleothem and absolute ages.

Sample	U_{ppm}	Th_{ppm}	$^{234}U/^{238}U$	$^{230}Th/^{234}U$	$^{226}Ra/^{238}U$	Age ka
ING-1	0.172 ± 0.002	< 0.005	1.015 ± 0.020	0.969 ± 0.018	n.d	**361** + 110 - 34
ING-2	2.768 ± 0.038	0.055 ± 0.005	1.122 ± 0.022	0.417 ± 0.010	n.d.	**58** ± 2
ING-3	2.487 ± 0.074	0.060 ± 0.006	n.d.	n.d.	0.604 ± 0.025	**100** ± 7
ING-4	6.759 ± 0.170	0.175 ± 0.010	n.d.	n.d.	0.310 ± 0.010	**40** ± 2

Tab. 1 - Absolute ages from the speleothem sample.

years. Similar low extension rates have been reported for other stalagmites of temperate zones (Maitre, 1990; Taddeucci *et al.*, 1992).

PALEONTOLOGY

Discussion

The taphonomical features of the Ingarano deposit are peculiar and allow some palaeoecological remarks.

The sedimentological and geochronological data show that the deposition of sediments occours in relatively short period. The fossil remains are present completely isolated or in partial anatomical connection (an almost complete skeleton of *Cervus elaphus* has also been found).

The occurence of natural encephalic casts and the preservation of delicate anatomical structures (nasal choanes), testifies a quick fossilization process, due also to the riches of mineralization agents.

Such a taphonomical pattern may be explained with the presence of different wide fissures, which allowed the carcasses to enter. A great number of carnivores, because the abundance of food, probably reached the area and fell in the fissures.

The analysis of the rich avifauna points out that some species inhabited the rock cliffs near the cave producing a great guano deposit, which is the main element of the phosphatic colloid covering a lot of bones and the calcareus concretions.

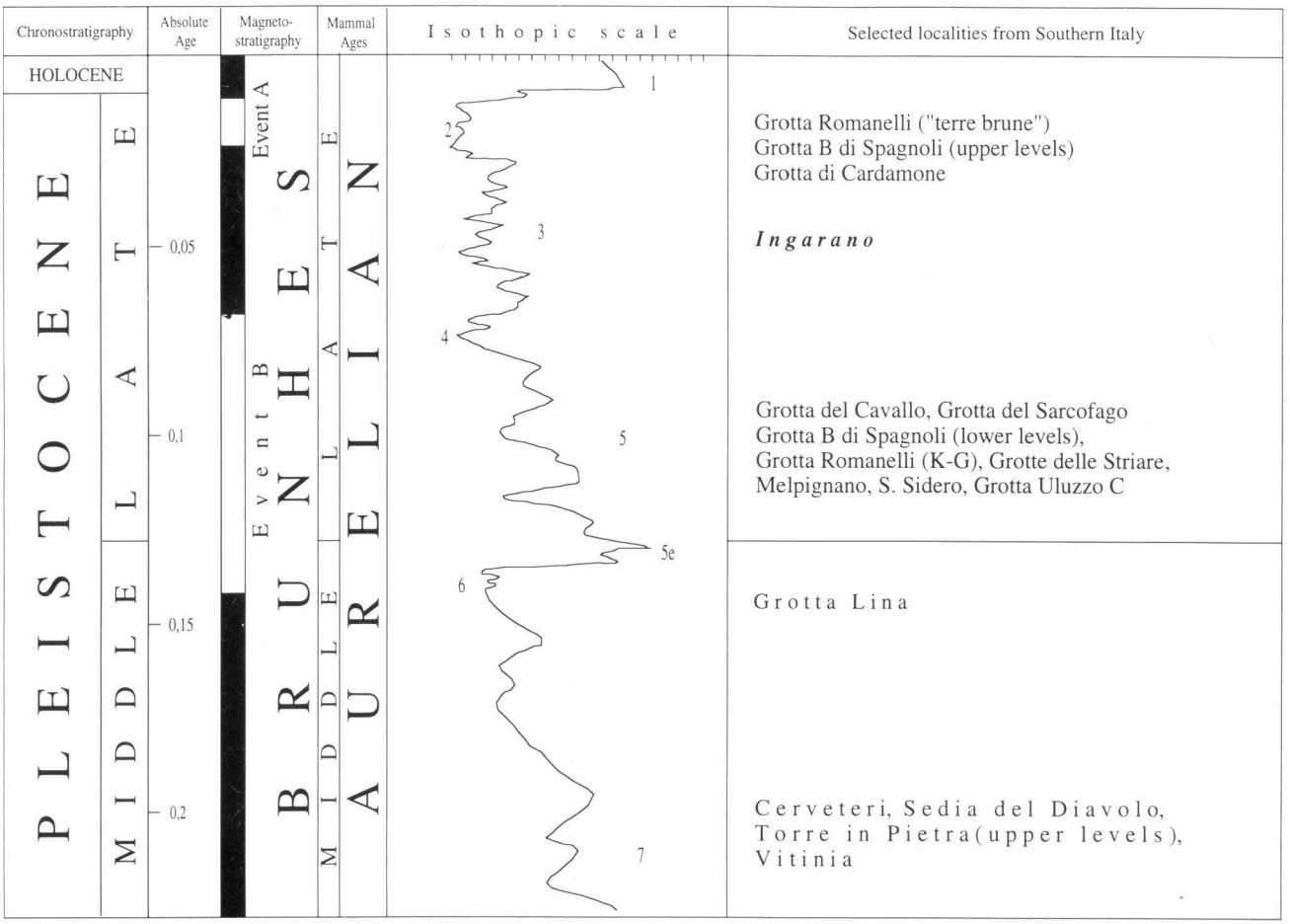
The faunal assemblage of Ingarano shows a dishomogeneous composition: both temperate-cold forms (*Coelododonta antiquitatis, Nyctea scandiaca*) and temperate-warm species (*Elephas antiquus, Dama dama dama*) occur. Such a composition could be explained with a great influence of seasonability.

The faunal assemblage of Ingarano can be referred to the Late Aurelian (AIQUA Working Group on Continental Stratigraphy, 1995) for its composition and for the frequence of the different taxa. In fact the occurrence of *Nyctea scandiaca* which usually is present in Italy in deposits referred to the Late Pleistocene (isotopic stages 3-2) (Capasso Barbato *et al.*, 1992), and of the European fallow deer, surely testifying an age older than isotopic stage 2 (Di Stefano, 1995), confirm this hypothesis. The biochronological significance of these two taxa allow us to confirm the geochronological attribution to Late Pleistocene (last part of isothopic stage 4) (Text-fig. 4).

The association of «temperate-warm» large mammals of Ingarano (*Elephas antiquus, Stephanorhinus hemitoechus, Hippopotamus* sp.) is very important because it testifies the latest coeval occurrence of these taxa.

The faunal association of Ingarano shows «mixed» features and is different for this characteristic to the other fossiliferous sites of southern Italy. The comparison with Apulian deposits considered a little older (isotopic stage 5c) - Grotta Romanelli (K-G levels), Melpignano, Grotta delle Striare and others (Di Stefano *et al.*, 1992) - points out in these sites the lack of «cold» taxa, with the predominance of «warm» species (Bologna *et al.*, 1994). Otherwise, the comparison with a little younger Apulian deposits (Cardamone and others), shows the lack of «warm» taxa. The occurrence of a «mixed» fauna at Grotta B di Spagnoli is due to two faunal assemblages of different age and palaeoecological settings (Sala, 1978).

A preliminary taphonomical analysis of the deposit of Ingarano, allows us to exclude the presence of different fossiliferous assemblages. The «dishomogeneity» of the fauna can be due probably to the influence of seasonability, with a marked termical excursion, typical of south-eastern Italy during the glacial phases of the Late Pleistocene. Such climatical setting and the cohexistence of forest elephant, hippos and fallow deer with hydruntine



Text-fig. 4 - Chronology of some late Middle and Late Pleistocene selected localities from Southern Italy.

ass, wholly rhinos and snow-owl are referable to a paleoenvironment characterized by partially wooded hills and wide grassland.

CONCLUSIONS

The qualitative and quantitative analysis of the faunal assemblage confirms the results obtained from the absolute ages on the speleothem and on encrusting phosphatic colloid; as already reported these ages are respectively 58 ± 2 ky (on the speleothem surface) and 40 ± 2 ky (on the phosphatic colloid). The later age could be considered as the most probably to attribute to the faunal remains. The study of the human Levallois artifacts, that characterize Italian deposits earlier than the second part of isotopic stage 3 also confirm the previous data.

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