YELLOW SANDS WITH GIBBSITE IN SEDIMENTS OF POCALA CAVE: PALEOENVIRONMENTAL CONSIDERATION

RUMENI PESKI Z GIBSITOM V SEDIMENTIH JAME POCALA: PALEOEKOLOŠKI POMEN

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Abstract UDC 552.55:551.44(450.361)

Cucchi, F., Finocchiaro, F. & F. Princivalle: Yellow sands with gibbsite in sediments of Pocala Cave: Paleoenvironmental consideraton

The granulometric and mineralogical characteristics of sediments at the bottom of Pocala cave (Karst of Trieste, Italy) are reported. In sandy lens ("Yellow quartz sand" *Auctorum*) included in the two clay layers, gibbsite (Al_2O_3 . $2H_2O$) was found.
This sediment may be transported into the cave by the water passing through soil of the interglacial origin. In fact the genesis of gibbsite may be ascribed to bauxitic deposit belonging to the warm-humid climate.

Izvleček UDK 552.55:551.44(450.361)

Cuchi,F., Finocchiaro F. & F.Princivalle: Paleoekološki pomen rumenega peska z gibsitom v sedimentih jame Pocala.

Predstavljene so granulometrične in mineraloške značilnosti sedimentov na dnu jame Pocala (Tržaški Kras, Italija). V peščenih lečah ("rumeni kremenov pesek *Auctorum*), ki leži med glinastima plastema je bil odkrit gibsit (Al_2O_3 . $2H_2O$).
Sediment je prinesla v jamo voda, ki je pritekala preko prsti interglacialnega izvora. Izvor gibsita lahko pripišemo boksitnim sedimentom iz toplo-vlažne klime.

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The lecture was held on the International Symposium Minerals in Karst Caves, Postojna, May 7-8, 1992

INTRODUCTION

The importance of the karst cave sediments lies in the posssibility to reconstruct the evolution of the karst systems. The texture and mineralogical analyses of the clastic sediments properties, in particular those, found near the surface, could provide useful indications on the paleoclimatic conditions in the time of the sediments deposition.

The studied sediments were collected at the bottom of the Pocala cave, a relic of a huge subhorizontal passage (33.5 m in depth, 137 m in length) opening on 134 m a.s.l. in the Cretaceous limestones near the Aurisina village (Trieste). The cave is important finding site of abundant quantities of *Ursus spelaeus* bone rests and Medium Palaeolithic remains (CANNARELLA, 1977).

The entrance lies in the strongly karstified area with some huge and deep dolines and other interesting and big caves (among them Grotta Lindner and Grotta Noè, f.e.).

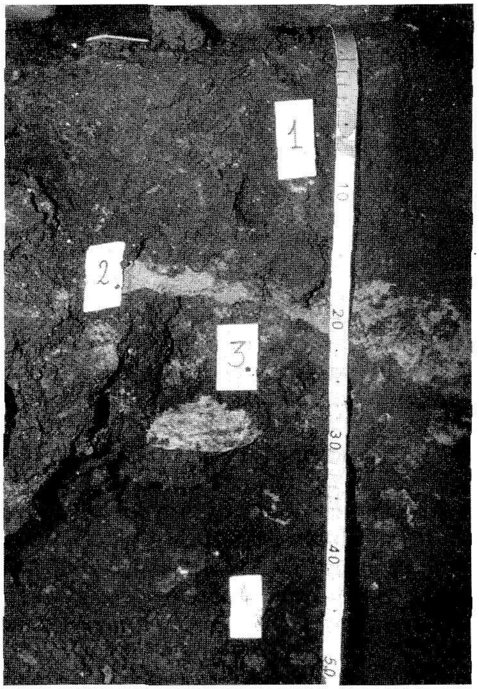
The bottom of the cave is levelled and covered by clastic material (clay and silt with pieces of limestone). All this material including big blocs of rocks, collapsed and still growing speleothems is without doubt very important. The genesis and the morphology of the caves in the vicinity offer the hypothesis that the cave was deepened by gravity for more than hundred meters and later filled up again almost entirely by the sediments. Now we are in the phase of the sediments erosion by local deepenings and water seeping down.

At about 10 - 20 m from the bottom on the floor there is an almost vertical bank, about 40 - 50 cm high (Fig. 1), followed by an inclined floor of the chaotic material connected by steep inclination with the terminal rocky wall.

The analysed sediments originate from the vertical bank where the stratigraphy of the most recent part of the sediments could be recognized: two sites for sampling were chosen, about 10 m distant one from the another and representing the whole front.

The site A is characterized by the following levels (from up down):
A 1: 15-20 cm of argillaceous clay with limestone clasts of the maximal diameter about 5-6 cm: 7.5 YR 4/4 (brown - dark brown)
A 2: 2-3 cm of well sorted sand: colour 2.5 Y 7/4 (pale yellow)
A 3: 2-3 cm of very compact clay: colour 2.5 YR 4/8 (red)
A 4: 30 cm of clay with limestone clasts with the maximal diameter of 8-10 cm; colour 10 YR 4/3 (brown - dark brown)

The B site is characterized by missed sand level (A 2) and by some irregularities (B2 and B3) in the medium level.
B 1: 8-10 cm of argillaceous clay with limestone clasts of the maximal diameter of 8-10 cm; colour 7.5 YR 4/4 (brown - dark brown)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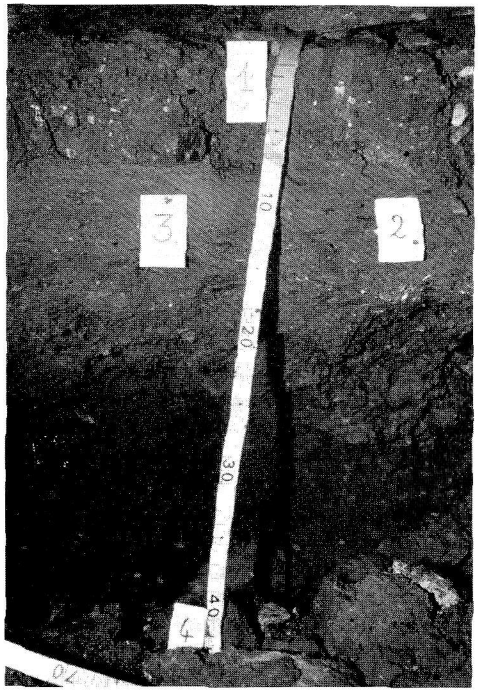
1
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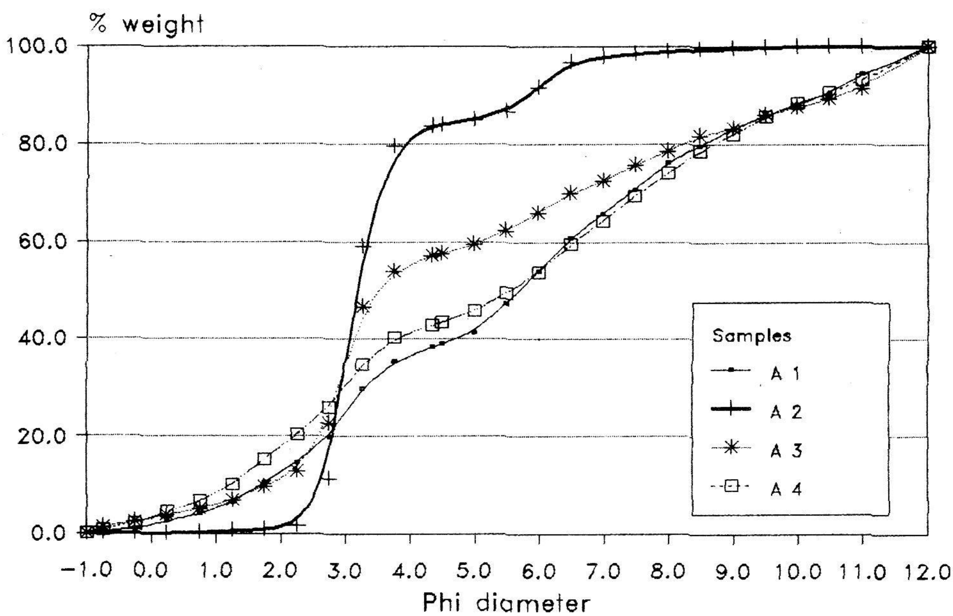
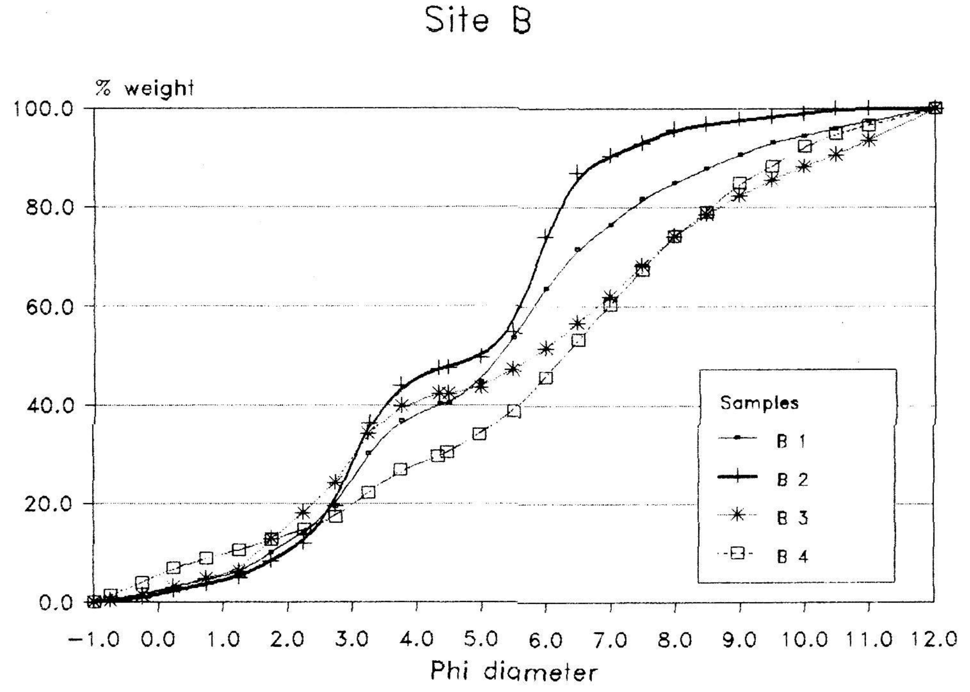
Site A


% weight
100.0
80.0
60.0
40.0
20.0
0.0
-1.0 0.0 1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0 10.0 11.0 12.0
Phi diameter
Samples
A 1
A 2
A 3
A 4



B 2: 8–10 cm thick layer of clay with small limestone clasts; colour 2.5 YR 4/6 (red)
B 3: 8–10 cm of very compact clay; colour 10 YR 4/2 (dark grayish - brown)
B 4: 20 cm of very fine clay with some limestone clasts; colour 7.5 YR 4/6 (strong brown).

The grain size and mineralogical analyses were carried out on 8 samples.

MATERIAL AND METHODS

The granulometrical analyses were done on the lower fraction of 2 mm: the sand fraction (2000-50 μm) was analysed by the sieves in the intervals of 1/2 size phi: for the pellitic fraction (ø < 50 μm) a sedigraph 5000ET, Micromeritics was used.

Diffractometric analyses were done on the lower fraction either at 50 μm or at 4 μm. This last fraction has undergone the effect of glycol in order to individualize the presence of expanded clayey minerals. Beside it, regarding the analyses results, a diffractometric analysis on the whole fraction of the sample A2 was done.

RESULTS

The results of the granulometric analyses are represented on the Table 1 which gives, besides the percents of the main fractions the granulometric parameters calculated by the FOLK & WARD (1957) equation: the curves of the cumulative frequency are given on the Fig. 2.

Table 1

SIGLA	Sand	Silt	Clay	Mz	o	Sk	Kg
A1	38.2	44.9	16.9	5.73	3.19	0.04	0.85
A2	83.7	15.8	0.5	3.49	0.98	0.61	2.23
A3	57.2	26.2	16.6	5.00	3.23	0.57	0.93
A4	42.8	39.3	17.9	5.52	3.46	0.02	0.80
B1	40.1	50.5	9.4	5.18	2.73	0.00	0.99
B1	47.4	50.2	2.4	4.62	1.93	- 0.22	0.87
B3	42.3	40.1	17.6	5.69	3.32	- 0.01	0.79
B4	29.4	55.5	15.1	5.89	3.18	- 0.19	0.96

In general the sediments are poorly sorted with various percents of sand, silt and clay. Silt is usually the prevailing granulometric fraction with the exception of samples 2 and 3 of the site A. The samples are always bimodal, the first being the fine sand (105 - 150 μm) and the second in the array of silt (11.3 - 16.9 μm in 5 samples).

Table 2

SIGLA	Chert	Calcite	Feldspar	Illite	Kaolinite	Chlorite	Gibbsit
Fraction < 50 μm							
A1	69	16	3	6	1	5	/
A2	42	/	/	8	/	/	50
A3	66	5	9	15	2	3	/
A4	40	21	9	17	5	8	/
B1	48	15	8	17	6	6	/
B2	76	1	4	9	4	6	/
B3	29	28	7	21	7	7	/
B4	30	29	4	21	8	8	/
Fraction < 4 μm							
A1	20	/	/	38	22	20	/
A2	/	/	/	40	20	/	40
A3	14	/	/	46	6	34	/
A4	22	/	/	36	23	19	/
B1	7	/	/	53	19	21	/
B2	21	/	/	35	24	22	/
B3	12	/	/	52	20	16	/
B 4	29	/	7	29	6	29	/

The exception is sample of the level A 2 where the sand is the preponderant fraction (83.7%): the class 105-150 µm assumes 47.7% of the total. This sediment could be defined as well sorted sand.

Regarding the mineralogical composition it must be said, that all the samples, with the only exception of the sample A 2 have a similar mineralogical association.

The results of the X-ray spectra are given on the following Table 2.

In general the samples present analogous mineralogical properties: in lower fraction of 50 µm the chert prevails (from 30% to 80%) with associated calcite of diverse percents (1% to 30%), feldspar (6%), illite (10% - 20%), kaolinite (5% - 10%), chlorite (6% - 7%).

Consequently the chert is prevailing, if not exclusive component.

The exception is the sample A 2 (the yellow sands) where beside the chert and illite a lot of gibbsite (about 50% in the fraction < 50 um and 40% in the fraction < 4 µm) was found.

The presence of gibbsite was confirmed by the chemical analyses as well (fluorescence RX) confirming besides 82% of silica the presence of 10% of aluminium which are not justified by the illite only.

CONCLUSIONS

The sediments in the Pocala cave have in major part the external origin; it means that they were transported and sedimented in the successive periods as occured the floods in the cave.

The level A2 (yellow sands), presented in a lense shape is in particular connected with these phenomena.

In the level is gibbsite, the mineral which is usually found in big quantities in the sediments of bauxite extremely rich in silica which is the consequence of the alteration in soils in the ambiance of the tropical and subtropical climate where dry periods and rain periods alternate.

Thus the gibbsite present in the Pocala cave could originate either inside or outside the cave: in both cases the origin is in favour of warm climate. This is testified by the index of the illite crystalization, always > 3 (TESTA et al., 1990).

As the yellow sands are present on the walls and the floors of some of the caves in the vicinity the presence of diffused gibbsite in various morphological conditions speaks in favour of the transport of the superficial sediments to the cave occurring in the warm-humid climatic conditions.

REFERENCES

Cannarella, D., 1977: Catalogo delle cavità e dei ripari di interesse paletnologica sul Carso Triestino.- Atti della Società per la Preistoria e Protostoria della Regione Friuli Venezia Giulia, vol. 3, 47-124, Pisa

Folk, R.L. & Ward, W.C., 1957: Barzos river bar: a study in the significance of the grain size parameters.- Journal of Sedimentology and Petrology, vol. 27 (1), 3-26

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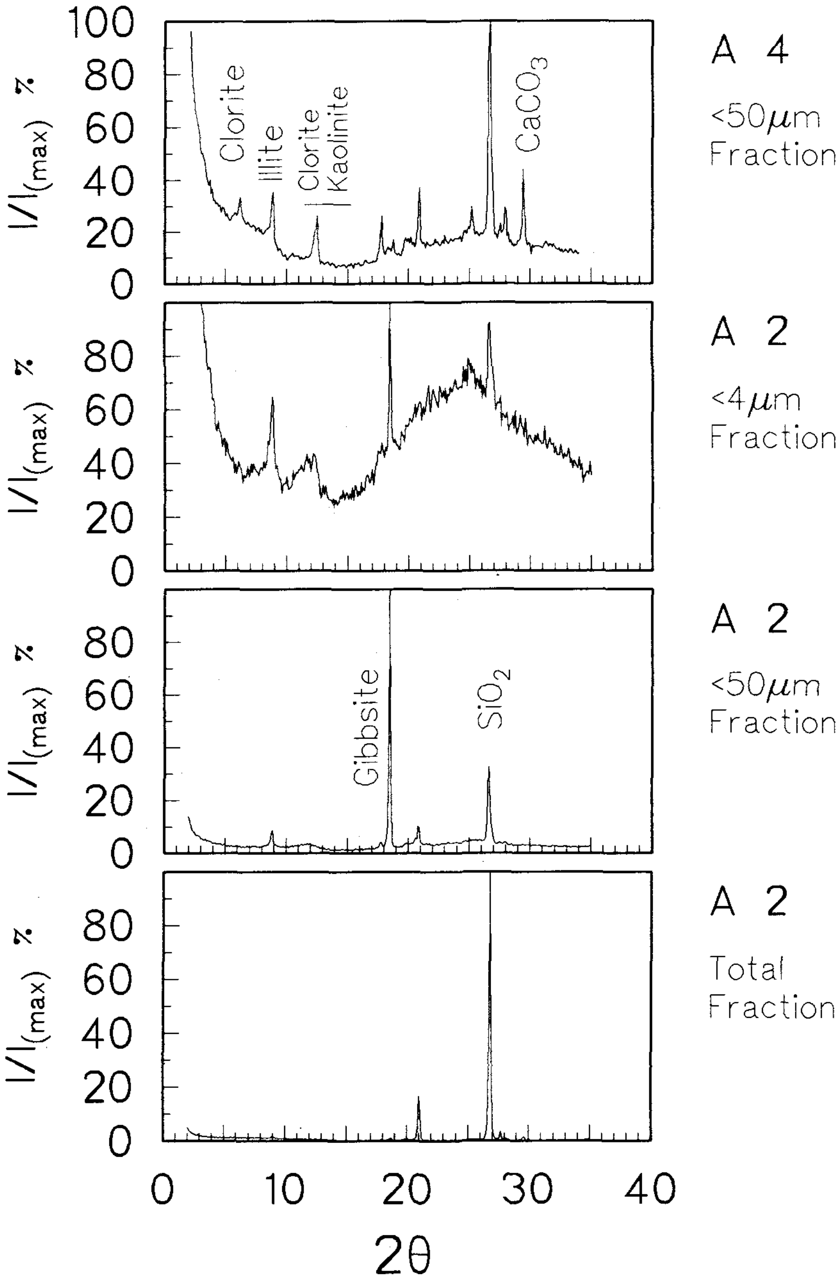
100
80
60
40
20
0
I/I(max) %
Clorite
Illite
Clorite
Kaolinite
CaCO3
A 4
<50μm
Fraction
A 2
<4μm
Fraction
Gibbsite
SiO2
A 2
<50μm
Fraction
A 2
Total
Fraction
0
10
20
30
40
2θ

Forti, F., 1973: Considerazioni sui depositi di riempimento delle cavità carsiche nel Carso triestino.- Atti e memorie della Commissione Grotte "E.Boegan", vol. 13, 27-29, Trieste

Munsell Soil Color Charts, 1975. Soil test Inc-. 2205 Lee St. Evanson Ill., USA

Testa, S. & Marocco, R., & Pirini Radrizzani, C., Princivalle, F. & Vergnauld Grazzini, C., 1990: Paleoclimatic record of the past 30.000 years in the Ligurian Sea: evidence provided by oxygen isotopes, foraminifera and clay minerals.- Bolletino Ocean. Teor. e Appl., vol. 8, no. 3, 177-195