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Man: agent of accumulation and alteration of natural deposits

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Abstract

Human alteration and accumulation in caves and rock-shelter deposits have changed interpretation of grain size distribution, which cannot differentiate between natural deposits and human ones. Therefore, it is necessary to undertake further complementary sedimentologic analyses, such as the description of the minerals that form the sediment, so that it would help understanding the pattern of each deposit.

1. Introduction

Sediments placed in caves and rock shelters have preserved not only the answers of nature faced with Holocene climatic fluctuations, but also the contributions of different natural agents. Studies of such padding managed to reveal the important circumstances which took place in its deposition. One of the most used methods to the paleoenvironmental study in sedimentology has been the histogram. The study of the different diameters which shape the fine fraction has allowed characterization of the sediment, and the knowledge of the agents involved in transport and deposition (Straus, 1990).

However, the deposits which have suffered human activity, including rubbish and the effects of domestic animals, can promote distortions in the interpretation. The accumulative curves can promote alterations, for they do not differentiate between the natural material and the human one (which is very obvious in caves and Neolithic rock shelters). Thus, a complementary sedimentary study should be made to differentiate between these kinds of materials, and to determine if grain size curves are useful in this interpretation.

2. Methodology

The laboratory study has not been different from the usual one, as grain size curves have been made, but there has been one difference: use of petrographic microscopy. This allows us to know the composition of the fragment and, therefore, to look for peculiar characteristics of each sample.

We made semiquantitative estimations of descriptors elements observed in the muddy fraction. The estimation is made from the extrapolation of several longitudinal views noticed in the thin section made from decantation of the muddy fraction (MAGNA-type). Calculation of appearance frequencies of these descriptors is made from a frequency code consisting of five variants, subdivided as: 0 or absent; 1 or present; 2 or rare; 3 or frequent; 4 or abundant; 5 or predominant. These elements allow us to describe the deposit and to observe the development of each of the samples collected from the cross-section. The descriptors used are:

Microscopic particles of charcoal: The term 'micro-charcoal' refers to the remains observed in the muddy fraction.

Spherulites produced by ovicaprine faune: are spheres of calcium carbonate which are made of the union of thousands of microcrystals arranged radially. They have a diameter which fluctuates between 20 and 5 μm, so they can be distinguished from the spherical forms produced by the stromatolite colonies in semiarid environments (which have a similar origin (Castanier, 1984; Verrecchia et al., 1995; Fernandez-Díaz et al., 1996; Chafetz and Butler, 1980). Spherulites form in the small intestine of some ruminants during their digestive process. The crystallization has a bacterial origin, perhaps remains of them (Buczynski et al., 1991; Krumbein and Giele, 1979). This descriptor allows us to distinguish the sediment in a particular way, for it shows the presence of ovicaprine fauna inside the cave and, so, the use of these places as sheep and goat folds (Verdasco, 1999).

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Phytoliths: During its growth, plants accumulate silica both around and inside of their cells, making exact copies of them. Here, the term "phytolith" is used to indicate the plants' silica remains (Piperno, 1988). The phytolith is a mineral remain from the plant. Its origin may be related to the decomposition in situ of the organic structure of the plant, and also to the decomposition of the ovicaprine coprolites (which are for the most part formed by spherulites and phytoliths).

Calcite pseudomorphs after calcium oxalate crystals: They are the most characteristic elements of ashes. They are the result of the transformation, because of heat, of the calcium oxalate crystals which woody plants have inside their cells. The original structure of the cell is preserved, and only the quimic nature changes. Their diameters fluctuate between 80 and 15 μm. These distinguish a deposit formed by wood ashes (Brochier et al., 1992).

Detrital limestone: is made up of micritic and microsparite derived from the disgregation and/or alteration, both climatic and microorganic, of the bedrock of the cave.

Statosphores of Chrisophicees: are spheres of silica opal produced by unicellular algae/seaweed. These are very sensitive to the changes of nourishment, and they can reach the point of developing a cyst in their statosphores when there is a strong food stress. In calcareous environments, the seaweed colonies bring about the corrosion and dissolution of the rock they occupy (Pomar, 1975). Thus, the appearance of the statosphores is a good indicator of the presence of these microorganisms and, consequently, of possible dissolution of the calcareous material.

Fig. 1. Location map. Sites prehistorics.

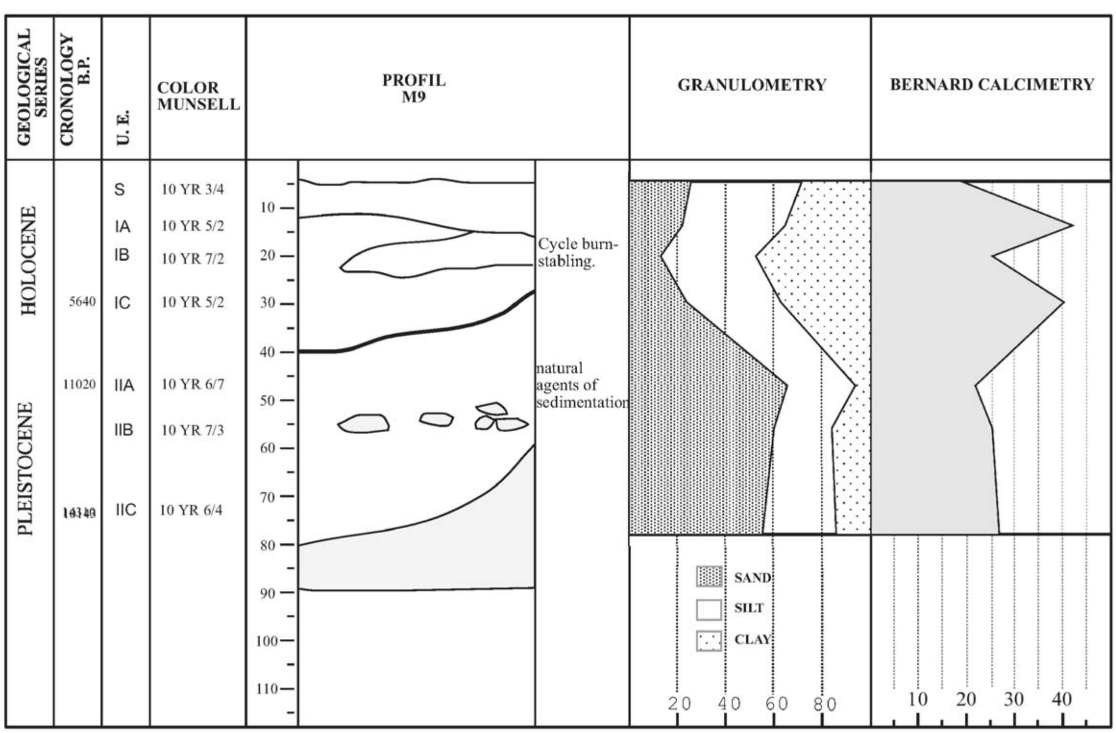

Fig. 2. Cross-section M9.

Further discussion of the techniques and methods of analysis can be found in the works cited in the list of references.

3. Description of the deposit

In order to explain the process followed to identify and interpret the sediments, it is useful to include here the frontal–distal cross-section of El Corral del Gordo, which belongs to a system of karstic forms called Les Coves de Santa Maira (Castell de Castells, Alacant province, Mediterranean Spain, Fig. 1) 600 m a.s.l. It is located in the interior Prebetic valleys of El País Valenciano, inside a system of Mesozoic calcareous mountain ranges.

This cavity is a really auspicious place for sheep stabling in the hottest hours of the day. Inside the cave, shepherds used to burn the organic remains produced by their animals, and as a result there is ash-coloured sediment. This burn-stabling cycle could be clearly noticed in the sampling made in El Corral del Gordo (Seguí, 1995).

These laminae were difficult to interpret following the classical method, by comparing them with the grain size curves of deposits made by natural agents, for the main part of this accumulation springs from the inorganic materials which contain the ovicaprine

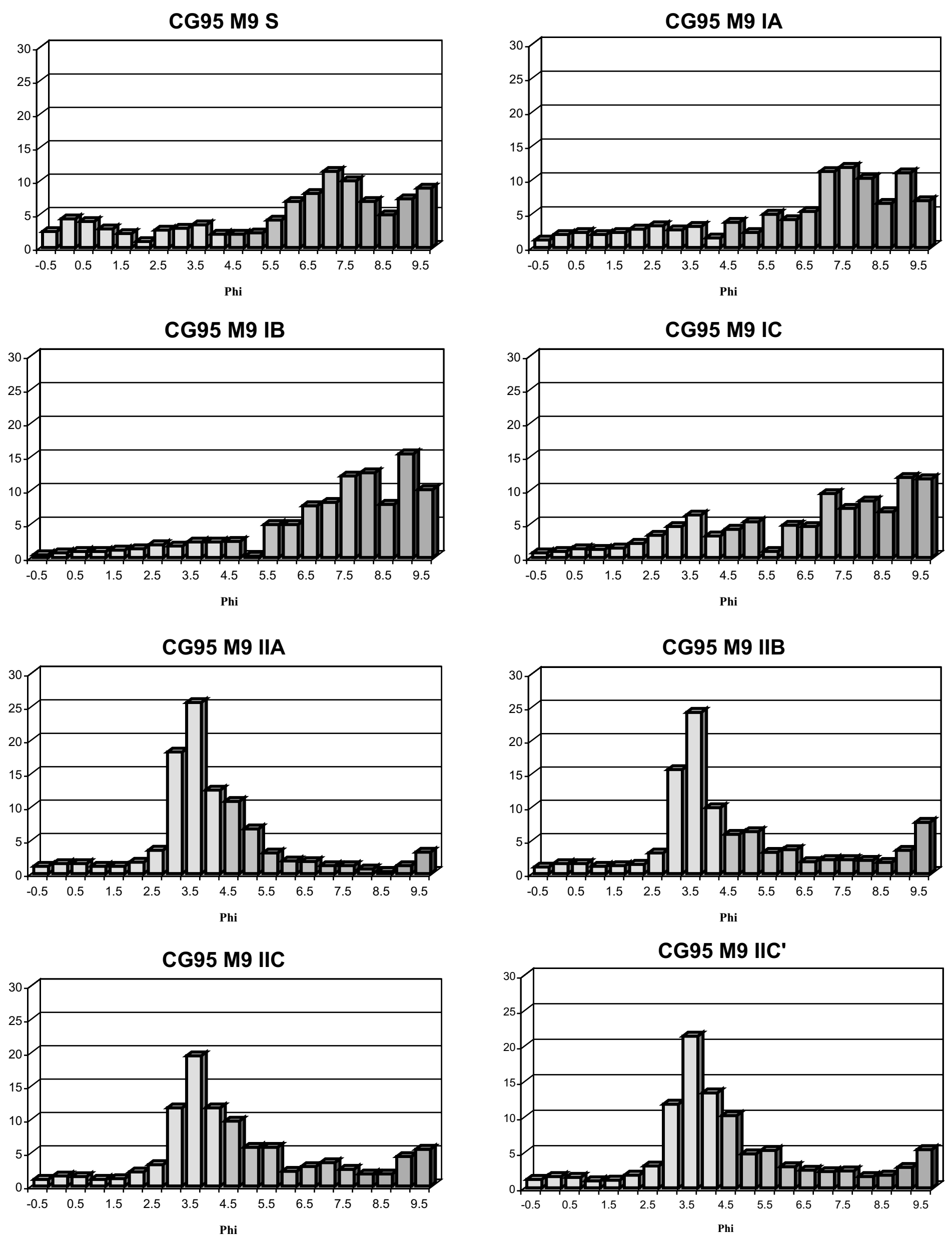

Fig. 3. (a) frequency curves, (b) accumulation curves.

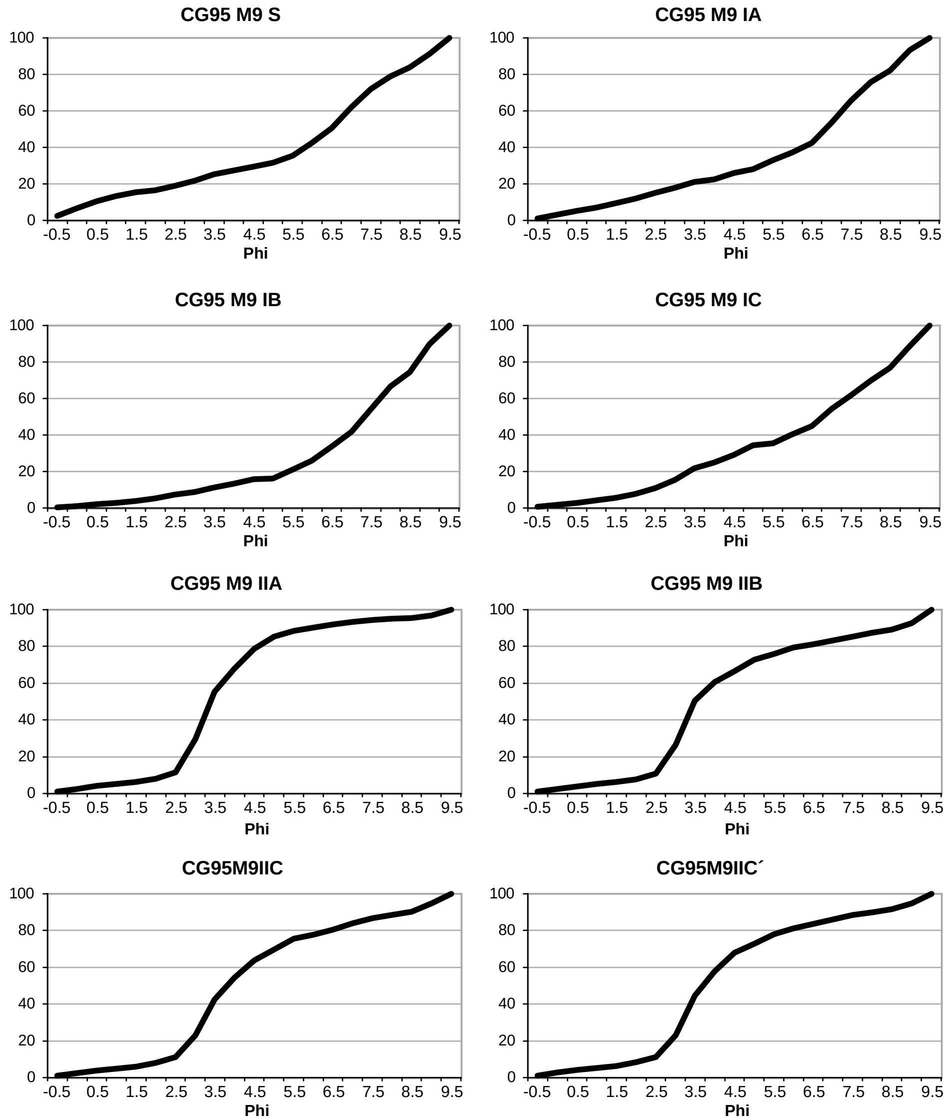

Fig. 3 (*continued*).

excrements (Beeching and Moulin, 1983; Brochier, 1993). Our primary interest is not focused on comparison between different kind of curves, but in the determination and description of the laminae made by ruminant animals.

4. Results

We can observe two moments clearly differentiated by a very rough contact in the cross-section analysed (Fig. 2, cross-section M9). For both levels there are two absolute dates, one for the top of Level II, with a result of 11029 ± 140 BP; whereas the base of Level I is placed at 5640 ± 140 BP. In the morphologic field this differentiation is also obvious, and we find in Level II a predominant diameter of 3.4ϕ, while in the underlying level the predominant diameter is 6.0ϕ (Fig. 3). In this respect differentiation of levels, observation and quantification of each descriptor of the muddy fraction allows us to characterize and see the evolutive differences inside the same cross-section (Fig. 4).

The histogram of both levels show a clear differentiation in their formation. Level I displays a general histogram, which does not allow us to know its origin. In contrast, Level II indicates a clear example of a hydromorphic medium. Although we do not have clear clues to its formation through the curves, we can recognize a medium which has suffered little movement of diffuse flowing water.

The strong human activity which this level has suffered does not allow us to obtain more information about the means of transport. However, Level II retains the peculiar characteristics of the environment in which it was created. The curves show a uniform and constant circulation indicating karst reactivation.

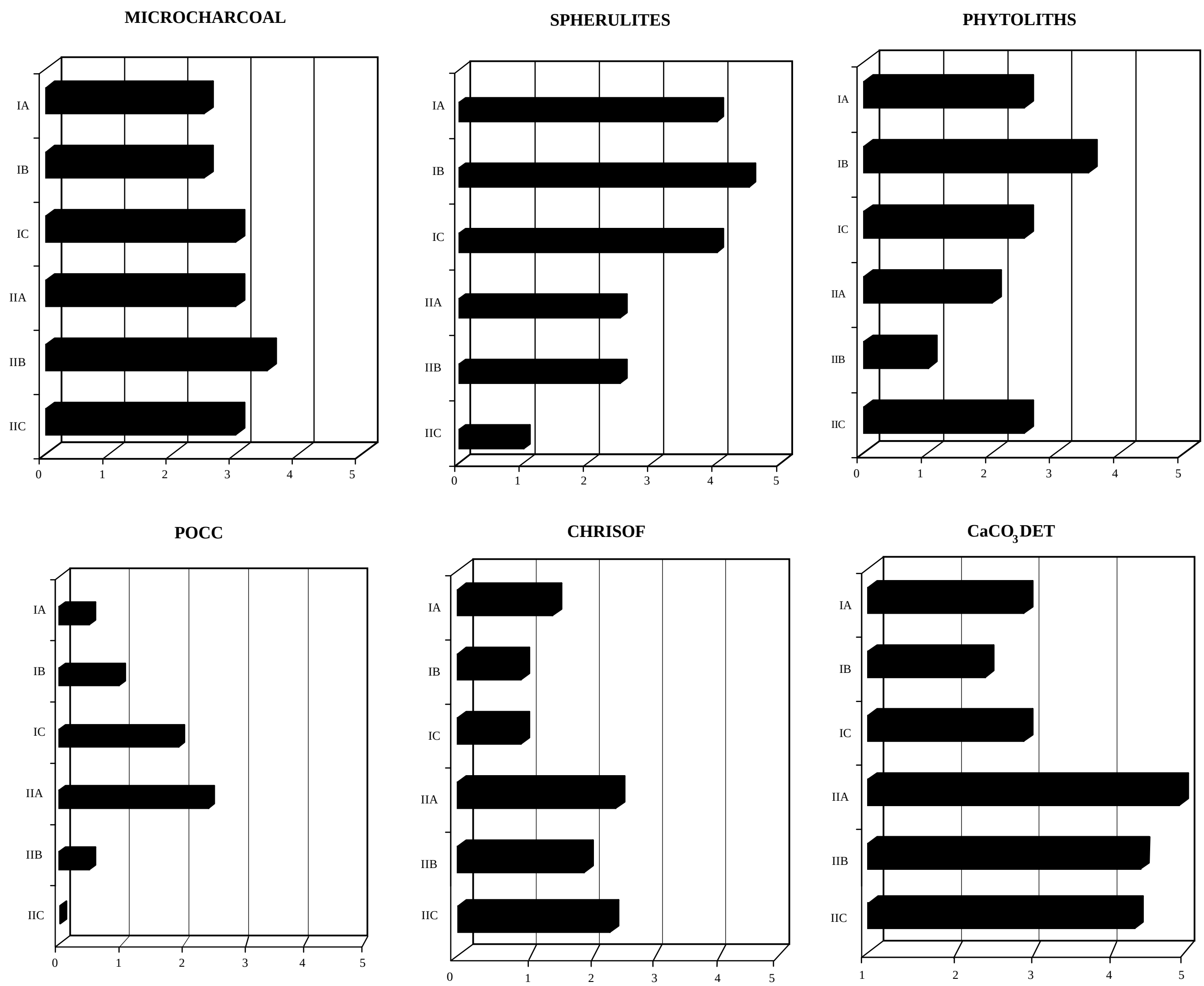

Fig. 4. Histograms of descriptors.

Observation of the sediments through petrographic microscopy leads to differentiation of both levels. The majority of Level I was formed by spherulites and phytoliths, inorganic remains of ovicaprine excrements. The classifications observed in the last types of mud of the grain size curve which the statistic parameters relate to a irregular films of water are the high frequency of spherulites and phytoliths. In Level II, the grain size curves have a strong hydromorphic character that requires care, because these caves are, from a sedimentological point of view, special places where sediments rarely managed to obtain an evolution similar to other superficial formations. To test this, we broke up some fragments of calcareous bedrock of the cave with hydrochloric acid. Once the reaction finished, we observed a large quantity of dolomitic crystals. These dolomitic crystals belong, because of their dimension, to the classification related to a hydromorphic medium. The pronounced classification of the crystals made us hesitate regarding the previous interpretation; the dissolution of the walls and roof of the cave can, by itself, produce this kind of frequency curve, and the reactivation of the karst would not be needed for its appearance.

5. Conclusions

Man, and in this case, his domestic animals work as transport agents. They introduce materials which are not associated with natural transport into the caves, so they actively work in both sedimentation and post-sedimentation processes. Human activities produce random variations into the sediment, so it is inadvisable to offer an interpretation of the deposit through histograms (Brochier, 1995). Using microsedimentology procedures (taking that concept as the study of the sediment through the magnifying glass and the petrographic microscopy) can be decisive to identify the material which forms the deposit and, therefore, to understand in a more accurate way the functioning of it (FitzPatrick, 1993). From our point of view, knowing the composition of the material is essential to infer its process of formation. The appearance of anthropic indicators, in a microscopic scale, helps us to know the degree of alterations which the natural accumulation has suffered and, therefore, the truthfulness of the histograms.

Man works as a transport and deposition agent and must be always considered, and a method adapted to its sedimentation way must be used. The case of the accumulative curves of the cross-section of El Corral del Gordo is representative of that. Following the statistic parameters, we can recognize a first moment (Level II) where there is a constant hydromorphic medium, followed by an accumulation moment and some seasonal moments of functioning of the karst (Level I). The interpretation, consequently, is very different to that given after looking at the thinnest types of ashes and muds. The dissolution of the rock, although indicates some humidity, does not indicate a period so humid as the first interpretation.

On the other hand, the granulometry of Level I, characterized by the laminae of combustion, can give us an essential key to analyse other deposits where, whatever the reason, man never deliberately burned the dung, for there is a mineralization of the manure. These are the natural deposits, where excrement has suffered a natural mineralization. There is also a sediment with a texture and a colour whose origin is almost impossible to notice, needing much more detailed study of the sedimentology.

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