EARLY FARMING IN THE ALGARVE (SOUTHERN PORTUGAL): A PRELIMINARY VIEW FROM TWO CAVE EXCAVATIONS NEAR FARO

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ABSTRACT

Test excavations in two caves in the Algarve (Portugal), one near the coast and the other in the mountainous interior in the region of Faro, help begin to fill the lacunae in knowledge of the developments of food production economies and their impact on the environments of SW Iberia. Goldra cave, on a hill dominating the fertile coastal plain, produced a rich Middle Neolithic midden layer dated to 5000 BP (uncal.), with elements of several human skeletons, remains of domesticated and possibly domesticated animals, pollen evidence of deforestation and cereal agriculture. An agricultural diet is corroborated by carbon and nitrogen stable isotope analyses of human bones and forest clearance is corroborated by wood charcoal analyses. There is little or no evidence of hunting and only minor evidence of (mollusc) gathering. Under conditions of early agriculture, however, people often died young and led stressful lives. Not only is agriculture well developed here within about a millennium of its introduction in southern Portugal, but ceramic technology has become quite refined, as evidenced by the diverse pottery assemblage from Goldra. Middle Neolithic ceramics are also present in a basal level in the cave of Soidos, which, because of its less favorable location, may have been a less permanent (herding?) camp. Soidos continued to be used in Chalcolithic times (perhaps for similar specialized, transitory functions), while elsewhere in southern Portugal impressive funerary monuments and towns were being constructed. U/th dating of travertine in Goldra indicates that the cave may have opened to the surface not long before the Neolithic and was not available for Paleolithic occupation.

KEY WORDS: Algarve, Portugal, Neolithic, Calcolithic, pollen, charcoal, human paleontology, U/Th and C-14 dating, stable isotopes, domesticated animals, cereals, deforestation.

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INTRODUCTION (L. G. S.)

The origins of the Neolithic and the nature of the processes by which food production economies replaced Mesolithic hunting and gathering in southern Portugal are the subjects of much current debate (e.g., Arnaud 1982; Lewthwaite 1986; Zvelebil & RowlyConwy 1986; Kalb 1989; Lubell et al. 1989; Tavares 1989; Straus n.d. — all with references). Similarly, the appearance of megalithic funerary monuments and of large masonary towns, mainly in the later Neolithic and Chalcolithic of southern Portugal, is an extensively published, much discussed phenomenon (e.g., Leisner 1965; Whittle & Arnaud 1975; Sangmeister & Schubart 1981; Kunst 1987; Kalb 1989 — all with references). However little is know and less is published concerning 1.) the intermediate period during which food production economies were being consolidated or 2) the the less spectacular aspects od Chalcolithic adaptations — those that took place away from such towns as Zambujal or Vila Nova de São Pedro (Estremadura) or such tombs as Alcalar (Algarve), Pai Mogo (Estremadura) or Reguengos de Monsaraz (Alentejo). Indeed, if agriculture «spread» to the Atlantic facade of the Iberian Peninsula (i.e., western Portugal) from the Mediterranean via Andalusia (see Lewthwaite 1986), our deficient knowledge of the late Stone Age prehistory of the Algarve represents a major gap in the extant data base for understanding the timing and nature of the adoption of animal husbandry and plant cultivation in the furthest outpost of southwestern Europe. Any, even preliminary, information on the age, environments, technologies, subsistence activities and diet of the early farmers and herders of the Algarve would provide valuable indications on the pace and character of a major adaptive shift in this region. Even test excavations have been able to shed considerable light on the differences and processes of change between the late Mesolithic, early Neolithic and Chalcolithic of other regions of western Portugal (e.g., Straus et al. 1990; Straus et al. 1988).

In 1987 and 1988 test excavations and surveys were conducted under the direction of one of us (LGS) in southwestern Portugal, in order to attempt to find and document Upper Paleolithic and Mesolithic settlements in areas of Estremadura, Alentejo and Algarve. During the course of the testing of 18 caves and rockshelters, Chalcolithic and/or Neolithic deposits were encoutered in several cases. The purpose of this article is to present the results of analyses of materials from limited excavations in two caves near the city of Faro in the central Algarve (Figure 1). The archeological potential of these two sites, Goldra and Soidos, was realized during preliminary visits in 1987 by J-A. Crispim (a hydro-geologist and spleleologist at the Universidade de Lisboa) and LGS.

ALGARÃO DE GOLDRA (L. G. S.)

Goldra is a collapsed solution cavity located near the eastern summit of a 288 m hill (Cerro do Nexe), dominating the coastal plain above Faro. The cave is 9 km from the present Atlantic shore of the south coast of Portugal. It would have had easy acess to excellent agricultural land both to the south on the coastal plain and to the north in the valley of Loulé at the foot of the Serra do Caldeirão (with maximum elevations above 500 m.). The slopes and summit of Goldra hill itself would have provided good grazing, especially for ovicaprines. Present vegetation surrounding the cave is typical Mediterranean matorral including scrub oaks and ericaceous plants, with karstified limestone outcrops. The site is threatened by tourist villa constructions.

The cave entrance has nearly vertical sides and measures about 10x7 m at ground surface, which is about 6 m above the top of the detrital cone in the center of the cavity (Figure 2). The cave contains several large blocks that represent pieces of the collapsed roof. At least the largest of these blocks fell well after the prehistoric use of the cave, which at the time must have had a considerably smaller entrance of unknown configuration. Based on the 1987 discovery of a mineralized horse mandible on the cave floor, a 2x1 m test trench was dug in 1988, immediately to the north of the huge central roof-fall block. The excavation was done by 10-30 cm spits, respecting natural stratigraphic subdivisions. All sediments were dry screened through fine mesh, as water was not available. The stratigraphy is as follows, from top to bottom, with depth measurements below datum (ground surface in the SE corner of the pit) (Figure 3):

0–40 cm: surface eboulis rubble;

40–125 cm: reddish-brown, crumbly, silty-clayey loam with an ash lens at the base (modern cultural and faunal remains);

125–130 cm: a continuous layer of rodent bones (probably deposited by owls);

140– 150 cm: light brown silty clay with another rodent bone lens (some prehistoric sherds);

150–200 cm: midden layer consisting of small eboulis, charcoal and ash lenses (molluscs, human and faunal remains, bone, lithic and especially ceramic artifacts);

200–245 cm: light reddish brown clay with localized concretions and flowstone crusts;

Travertine-covered bedrock or a massive flowstone.

THE ARCHEOLOGY OF GOLDRA (L. G. S.)

The artifactual inventory from the level between the main rodent layer and the midden consists of 10 body sherds from 8–9 jars. One sherd from one vessel has an exterior ridge and another from a second vessel has two ridges. Although undated, this level may represent a Chalcolithic utilization of the cave.

The midden horizon is very rich in artifacts, as well as in human and animal remains. The ceramics include:

1 whole bowl, 53 mm high x 195 mm wide at the mouth, with nearly straigh walls and a rouded base, a straight, slightly tapered rim bordered by an incised line around the exterior circumference. There are five decorative motifs, each consisting of 3 concentric semi-circles descending from the rim (Figure 4).

25 rim sherds from at least 13 vessels (Figure 5A–G). Rims include lipped, everted, rounded and tapered forms. Vessels include at least one large open-mouth bowl, a small bowl, 4 necked jars, a small jar and 2 straight-sided jars.

4 ridged body sherds (Figure 5 H)

1 incised body sherd

2 lug sherds (1 perforated)

188 plain body sherds. Thicknesses range from 6–18 mm.

Bone artifacts include:

2 ovicaprine distal metapodial awls (Figure 5L&K)

1 spadula on a large polished mammal mesial rib fragment (Figure 5J)

1 calcined, heavily polished ovicaprine distal metapodial with a possibly carved effigy face.

Chipped lithic artifacts are rare, consisting of only

3 unretouched flint blades (Figure 5I) and

4 flakes (all flint, except one which is milk quartz)

Groundstone artifacts include two physically associated handstone and slab millstone pairs, plus a possibly naturally grooved and perforated stone.

The ceramics have been characterized by J. Arnaud (personal communication) as «Middle Neolithic», a period which is very poorly know in the Algarve. This attribution is supported by a radiocarbon date on charcoal from the midden horizon of 4990 ± 320 BP (calibrated at one standard deviation: 4154 – 3431 BC) (SMU–2197) (H. Haas, in litteris).

In addition to the human, mammalian and bird remains reported on below, abundant marine molluscs are abundant in the midden. They include *Scrobicularia plana* (most abundant), *Solen marginatus, Pecten maximus* (rare) and an unidentified large bivalve (J. Arnaud, personal communication). The facts that we recovered a whole bowl (that certainly would not have survived intact had it benn dumped into the cave) and that there are definite ash and charcoal

pockets and lenses, suggest that the cave was actually lived in and not simply used as a dump for occupations on the ground surface above (where we found no obvious site traces). Nonethless, the cave was frequently used for human burial. Although there are no traces of graves, some of the anatomical elements of the fragmentary human skeletons reported on below (e.g., vertebrae) were found nearly in connection. The variety and richness of artifactual and faunal remains from the small test trench indicate intense human use of the cave in Middle Neolithic times, probably as a major residential settlement.

THE ARCHEOLOGY OF IGREJINHA DOS SOIDOS (L. G. S.)

This is a large cave with a narrow «walk-in» mouth facing southeast and a main chamber measuring about 21x16 m. It is located at an elevation just under 400 m above sea level on a high plateau in hill country flanking the Serra do Caldeirão, 18 km from the present coast. While itself situated in rocky, rather barren terrain, Soidos dominates the fertile, well-watered valley of Alte, and thus had access to both grazing and agricultural lands. Present vegetation around the cave is a sparse matorral with considerable areas of thin, barren red soil and exposed, karstified limestone.

The front of the cave contains a massive, steeply sloping detrital cone, but even the rear of the cavity, behind massive travertine-coated blocks, has a sedimentary deposit. Both areas were archeologically tested (Figure 6). Cut A (a 2x1 m trench) was excavated to the east of the cave entrance, adjacent to the cave wall near the top of the cone. The top 50–80 cm of the stratigraphy (Figure 7) were cleary disturbed, with roots, badger holes and large ash pockets, probably from fires built to flush the badgers from their burrows (a local practice). The crumbly, loose, reddish-brown silty loam matrix did yield prehistoric artifacts, including a ceramic «cheese strainer» attributable to the Chalcolithic (J. Arnaud, personal communication). The basal 20–80 cm of Cut A consisted of more compact reddish-brown silty clay topped by scattered eboulis and containing more roots. This less disturbed deposit lay atop steeply sloping bedrock which connects too the front wall of the cave. The cultural materials from the disturbed deposits included the following items:

14 rim sherds: all straight, 3 tapered, 11 rounded, 2 with lips, 1 everted, from 11 different vessels (Figure 8E-H)

45 plain body sherds

3 body sherds from a jar base

1 cheese strainer rim fragment (Figure 8D)

5 body sherds from one large jar

The more «in situ» materials include the following artifacts:

1 small cheese strainer rim sherd (possibly from the same object as the strainer fragment found in the disturbed deposit)

1 straight, pinched, tapered, lipped rim sherd

10 plain body sherds

1 flat-bottom jar base sherd

2 lumps of fired clay

Cut B, also a 2x1 m trench, was excavated in the western rear part of the cave at the foot of the detrital cone. The stratigraphy is shown in Figure 9.

1) The top 10 cm consisted of loose, rounded eboulis with modern trash lying atop

2) 20 cm loose reddish-brown silty clay with recent artifacts.

3) The underlying layer (15-20 cm thick) is composed mainly of small-medium size angular eboulis with some large blocks. There is a localized charcoal lense (3 cm) at the base of this rubble.

4) This is underlain by a reddish-brown silty clay level (30-40 cm thick). This layer yielded relatively abundant cultural materials.

5) It in turn lay atop bedrock at the eastern end of the trench and atop a thin flowstone in the center.

6) Below the flowstone was a 35 cm thick pure orange clay deposit that was archeologically sterile and in contact with.

7) limestone bedrock.

Level 3 yielded a large, 28 mm thick base sherd, 32 body sherds, 5 rim sherds from 4 vessels (including one straight, rounded rim sherd with an exterior ridge and others that are either rounded or tapered, one being everted). Level 4 produced 5 body sherds from various vessels, 26 other undecorated body sherds, plus one body sherd decorated with two subparallel lines composed of short vertical incisions (Figure 8C). There are two straight, squared rim sherds with indentations along the top of the rim (Figures 8A, B). All but the first 5 body sherds may be from one vessel. There were no lithics, faunal or human remains. The ceramics from Level 3 are characteristic of the Chalcolithic, while the crenalated and incised sherds of Level 4 are typical of the Middle Neolithic (J. Arnaud, personal communication). Though not dated at Soidos, the Chalcolithic of southern Portugal is C-14 dated between about 4500–3500 BP (ca. 4000–2000 cal. BC) (Kalb 1989; Straus 1990). The cheese strainers suggest a Chalcolithic «secondary products revolution» (Sherratt 1981).

TRAVERTINE DATING (D. F.)

Threee samples of calcite were analyzed to attempt to determine the ages of the opening of the cave and of the inception of subaerial sedimentation:

AGT1: flowstone crust underlying the Neolithic midden layer and adhering to the apparent bedrock floor of the cave;

AGT2: inclined flowstone adhering to the enormous limestone block immediately to the east of the excavation;

AGT3: vertical flowstone covering AGT 2.

Attempts were made to date these samples by the ^{230}Th: ^{234}U method using conventional alpha spectrometry. AGT3 was not suitable for dating, since its porosity had permitted preferential leaching of uranium and it was contaminated by mineral and organic detritus. Is clearly had been formed after the cave had opened to the surface. Clay contamination is also high in AGT2. Thus, although the result essentially suggests an infinite age (>350 kyr), this flowstone could be interpreted as a young deposit that has been given an apparent great age because of contamination. The upper and lower parts of AGT1 were dated separately. The result from the lower part of the sample was more satisfactory due to a lesser degree of contamination. The results are as follow:

AGT1	UPPER	LOWER
Uranium content	0.08 ppm	0.133 ppm
$^{234}U/^{238}U$	1.12	1.09
$^{230}Th/^{234}Th$	0.381	0.289
$^{230}Th/^{232}Th$	16.00	9.0
Uncorrected age	52+17 kyr	37 ± 7 kyr
Corrected age	48+26 kyr	32 ± 11 kyr

AGT1 is a calcite with a tight crystalline strucutre formed under high humidity, probably in a cave that was either sealed or only slightly open to the surface at the time. Most of its growth took place between 40–30,000 BP. Il would appear that the cave was not open to human use in the late Middle or at least early Upper Paleolithic. The stratigraphic relationship between AGT1 and the midden deposit would suggest significant cave opening not long before the Neolithic occupation ca. 5000 BP.

PALYNOLOGY (L. M.)

Goldra Cave is located on a hilltop presently vegetated with dense matorral including abundant scrub oaks. The palynological analysis presented here was done primarily to ascertain the possible effects of human activities on the vegetation of the area and region around the site. Samples numbered P1–P7 from bottom to top were taken by Straus from the stratigraphic section in square A1. Samples P2–4 correspond to the Middle Neolithic archeological deposit, dated to 3780 ± 370 cal. B.C. Sample P1 predates the human occupation of the cave, whereas samples P5 came from a lense of rodent bones deposited by raptorial birds and P6–7 came from the upper silty clay horizon containing more recent (but indeterminate) archeological materials.

The samples were sucessively processed in hydrochloric acid, hydrofluoric acid and potassium. The residue was concentrated by centrifugation in zinc chloride. The results of the analysis are presented in the form of a standard pollen diagram (Figure 10). The quantities of pollen per taxon are shown as percentages of the total of all pollens and spores per sample. In the center of the diagram, the relative frequencies of arboreal (AP) and nonarboreal (NAP) pollens are summarized.

The diagram shows the constant presence of Liguliflorae in percentages never below 50 % from the bottom to the top of the sequence. There are increases in Ericaceae and in fern spores beginning in Sample P5. Arboreal taxa are few in number; oaks and pines, the major trees are only

poorly represented palynologically.

The absence of oak and pine among the wood charcoal samples from Goldra (see below), despite their palynological representation, would suggest that these trees were present in the region, while not necessarily in the immediate vicinity of the cave. The abundance of Cichoriaceae is of particular interest. The uppermost sample (P7), from a level with relatively recent archeological materials, gives an idea of the modern pollen rain. In lieu of a modern botanical inventory of the vegetation of the Goldra area, this sample can provide some background information on the sub-current conditions, characterized by the association of Gramineae, Asteroideae and Ericaceae. Although the coexistence of Cichoriaceae with these plants is normal, their extremely high frequency (≤ 80%) poses an interpretative problem. According to the studies of modern pollination by Bottema (1975), such a high frequency cannot be just the result of local pollen rain, but is rather the product of contamination by insects. This may be the explanation for the high percentages of these pollens throughout the Goldra sequence.

Thus the interpretation of the Goldra pollen spectra should not take the Cichoriaceae into account when calculating the pollen totals and percentages. When these pollens are excluded (as was not done in the diagram), the AP/NAP ratio changes significantly for Sample 1, becoming grater than 50%. However the percentage of non-arboreal pollens is always greater than that of the arboreal pollens in the other samples. Those samples, from the Middle Neolithic and more recently, evoke a more open vegetation with many Gramineae, Asteroideae, and, in recent times, Ericaceae.

These data and the presence of plants that selectively grow in debris and trash heaps *(Plantago, Artemisia, Rumex)* such as those associated with agriculture, animal husbandry and human habitation, all indicate that the people of Goldra had a significant effect on the area's environment beginning at least in Middle Neolithic times. The existence of cultivated fields is perceptible in Samples P2, 3 & 4 in which the percentage of arboreal pollens decreases; Plantago and Chenopodiaceae are present, and, in P3, there is a cereal pollen grain. It is possible to hypothesize that in Neolithic times, as in the present, the agricultural fields were on the coastal plain and in the Loulé valley right below Goldra to the south and north respectively. Ovicaprine pasturing would have been concentrated on the steep, rocky slopes of the Goldra hill itself. The presence of poorly disseminated cereal pollen in the cave gives a hint of the relative importance of agriculture on the plain, about 250 m below.

There is a major change in the vegetation in Sample 5 (from the archeologically sterile rodent bone lense): a significant increase in fern spores (33%). The absence of anthropogenic materials means that people were not bringing ferns into the cave, but this change suggests the initial revegetation of abandoned fields by ferns. It is impossible to tell from this isolated sprectrum whether this was a regional or purely local phenomenon. Heaths grew in importance later, with the increase in Ericaceae in Samples P6–7, suggesting degradation of the vegetal cover as a result of increased pasturing in more recent times.

This palynological study at Goldra is the first to be done in the Algarve. The only extant comparative were done on samples far removed in space from Goldra: in lagoons at Carvalhal and Albufeira on the open Atlantic southwest coast of Portuguese Estremadura (Mateus 1985; Queiroz 1985) and in the lower Tagus valley of Ribatejo (Van Leeuwaarden and Janssen 1985). These spectra also show the increase in Ericaceae as a result of anthropogenic factors beginning as early as 6580 BP. However, the distance of these sites from Goldra, as well as the lack of palynological data from the region of southern Spain adjacent to the Algarve, make it impossible to do any further comparisons at this time.

WOOD CHARCOAL (J-L. V.)

Slightly more than 200 fragments of wood charcoal were collected from the Neolithic horizon in the collapsed cave of Goldra, dated to 4990+320 BP (3780+370 cal. BC) (SMU–2197). They come from squares A1 and A2:

Sample 1: A1. -150 to -175 cm.
Sample 2: A2. -150 to -180 cm.
Sample 3: A2. -180 to -190 cm.

Sample 3 corresponds closely to pollen spectra P2 and P3 in the analysis of L. Marambat and Sample 2 corresponds to pollen spectrum P4, while charcoal Sample 1 can be considered essentially contemporaneous with the other two.

The wood charcoals were freshly broken in the lab and identified under reflecting microscope. The results are given in Table 1.

Table 1: Goldra Wood Charcoal Identifications

TAXON	*NUMBER OF FRAGMENTS*	*PERCENTAGE*
SAMPLE 1		
Quercus ilex	16	21
Juniperus sp.	15	20
Olea europaea	21	27
Olea europaea var. oleaster	7	9
Quercus suber	1	1
Leguminosae indet.	2	3
Pistacia lentiscus	1	1
Ramnus or Phillyrea	2	3
Phillyrea sp.	1	1
Pistacia sp.	2	3
Indeterminate	9	11
TOTAL	77	100%
SAMPLE 2		
Quercus ilex	14	18
Quercus suber	8	10
Olea europaea	36	45
Olea europaea var. oleaster	3	4
Arbutus unedo	1	1
Juniperus sp.	7	9
Pistacia lentiscus	2	2
Phillyrea sp.	3	4
Rhamnus or Phillyrea	1	1
Pinus sp. (cone scales)	2	2
Other leafy trees	3	4
TOTAL	80	100%
SAMPLE 3		
Juniperus	9	19
Olea europaea	27	56
Quercus ilex	7	15
Olea europaea var. oleaster	1	2
Rhamnus or Phillyrea	2	3
Other leafy trees	3	5
TOTAL	49	100%
GRAND TOTAL	206	

The data deserve a few preliminary comments, particularly given the present scarcity of other paleoethnobotanical analyses from Portugal. Despite the small total number of charcoal fragments recovered from this limited excavation — too small for quantitative analysis — it is apparent that the samples are quite homogeneous in terms of their basic taxonomic composition.

The charcoal assemblages from Goldra are consistent with a local mid-Holocene vegetation made up of taxa typical of the thermomediterranean life zone, specifically the Querco-lentiscetum community. The samples of Olea europaea (olive) can almost all be attributed to the wild variety. However, the identification criteria are based solely on growth characteristics. In fact, studies of modern wild olives have found that they grow slowly in comparison to the cultivated variety, which generally has growth rings wider than 1 mm.

Although this trait is not absolute, we have every reason to believe that most of the Goldra olives were wild.

The presence of two species of oaks *(Quercus ilex and Q. suber)* suggests the existence of oak groves in the cave vicinity, but it is difficult to estimate the proportion of forest cover in the environment surronding the site. The small size of the samples and the lack of a long, stratified series prevent an accurate assessment of the strucutre of the vegetation — particularly the relative proportions of forest and matorral. Nonetheless we can hypothesize the existence of an already fairly open local vegetation, given the numerical importance of matorral taxa. This can be expressed as the ratio of numbers of matorral taxa (*Olea. Juniperus, Pistacia lentiscus,* Pistacia sp., Phillyrea, *Rhamnus/Phillyrea, Pinus*, Leguminosae indet.) to the total number of taxa per sample:

Sample 1=6/8; Sample 2=7/9; Sample 3=3/4.

The pollen analysis is in agreement with this interpretation; it suggests a slightly wooded environment dominated by herbaceous plants, with palynological traces of mesophile trees (such as *Corylus* and *Abies*, the latter only present in the upper levels, which were lacking in charcoal). Otherwise, the list of arboreal taxa represented in the pollen spectra is very similar to the list of taxa represented by charcoal in the same levels of the site: *Pinus, Quercus ilex,* Phillyrea, Pistacia. For these levels, deciduous *Quercus, Corylus,* Alnus, Viburnum, *Buxus* and *Ligustrum* are only present in the pollen spectra, while *Olea, Quercus suber., Arbustus unedo* and *Juniperus* are only represented in the charcal samples. It is surprising to find that the taxa represented by pollen, but not by charcoal fragments (e.g., pine), are those that pertain to the natural mesophile communities of this region. These pollens were thus probably transported from some distance, and were not significant elements of the local Neolithic vegetation around Goldra Cave. On the other hand, the narcoal samples are suggestive of a thermomediterranean matorral with Olea, Pistacia and *Phillyrea* in the vicinity of the site. Recent wood charcoal studies done in the thermomediterranean biome of the Iberian Peninsula (Vernet et al. 1983; Badal et al. n.d.) have shown that the period around 6000 BP was one of change in the structure of regional vegetative communities. The early Holocene had been a period of well developed arboreal cover, especially characterized by woods dominated by *Quercus ilex,* as well as deciduous oaks *(Quercus faginea).* This humid, wooded period still included some mesophile taxa and especially microthermal ones such as *Pinus nigra,* a supra mediterranean tree. Then, around 6000 BP, in Cova de l'Or (coastal Valencia) and probably in other sites, there was expansion of Aleppo pine and recession of large forest communities. At the same time, Olea europaea *var. sylvestris* (wild olive) attains its maximum densities. (Two charcoal fragments of *Olea europaea* were also identified from the Middle Neolithic deposit in Igrejinha dos Soidos Cave, inland of Goldra).

In conclusion, the wood charcoal samples indicate that the Middle Neolithic occupation of Goldra Gave existed in the context of an environment that had already been heavily deforested, probably for about a millennium.

FAUNAL REMAINS (J.A.)

The test excavation in Goldra Cave yielded 37 identifiable mammalian remains from the Neolithic cultural layer (28 of ungulates, 7 of a carnivore and 1 of a lagomorph). In addition there

are 3 identifiable bird remains. All these finds are listed in Table 2:

All the mammalian bones are fragmented, except the ulna and one of the radii of *Sus*, but even these lack their epiphyses, which were not yet fused. Because all the *Sus* remains are of young individuals (one less than 9 months old and the other less than 3 years old), it is impossible to determine whether these are wild boards (*Sus scrofa*) or domesticated pigs (*S. domesticus*). It is likewise impossible to distinguish between domesticated goat and sheep from the ovicaprine remains present at Goldra. The individual in question was about 2.5 years old when killed. The cow was an adult.

The dog mandible is of an adult, whose carnassial (M_1) measures 20,5 mm long by 8.0 mm wide. The scapula yields the following measurements:

Maximum length of the articular process:	21,5 mm
Minimum lenght of the neck:	18,4 mm
Length of the articular surface:	19,9 mm
Width of the articular surface:	13,7 mm

It belonged to a different dog of small size, but within the range of the small Neolithic dogs from such sites as Burgäschisee Süd (Boessneck et al. 1963). The discs of the dog vertebrae are not fused. Thus they belonged to at least one young individual. Since it is probable that the carnassial was from a dog larger than the one represented by the scapula, there is probably a minimum of three dogs in the sample of remains from Goldra.

It is striking that, if the pigs are indeed domesticates, there would be no wild, hunted animals in the admittedly small sample of mammalian remains from this Middle Neolithic site, suggesting that the subsistence economy had become heavily dependent on domesticated resources by this period in the Algarve. The data are too few to permit speculation about the economic significance of the young age of the slaughtered sheep/goat and possible pigs or the adult age of the cow. It is certainly conceivable that the former animals (and at least one of the dogs) were killed as food early in their life, whereas the cow was kept alive for breeding or milk. As for the birds, the red-legged partridge (*Alectoris rufa*) and three species of wild pigeons (*Columba livia, C. oenas, C. palumbus*) are native to southern Iberia — the latter two at least in winter (Peterson et al. 1982). Whether the birds were caught by hominids or by raptors or other carnivores cannot be determined, although the former hypothesis seems likely given the context of the finds.

Although scanty, these faunal remains provide a valuable glimpse of the animal subsistence base of Neolithic people in southern Iberia around 5000 years ago.

TABLE 2: MAMMALIAN & AVIAN REMAINS FROM GOLDRA

MAMMALIA

Bos taurus: NISP=7, MNI=1
1 maxilla, 3 femur diaphyses, 3 ribs

Capra hircus/Ovis aries: NISP=3, MNI=1
2 maxillary fragments, 1 metacarpal diaphysis

Sus sp.: NISP=18, MNI=2
2 cranial fragments, 1 mandible, 3 lower teeth, 4 vertebrae, 1 scapula, 1 humerus, 2 radii, 1 ulna, 2 metapodials, 1 phalanx

Canis familiaris: NISP=7, MNI= 2 or 3
1 mandible, 5 vertbrae, 1 scapula

Oryctolagus cuniculus: NISP=2, MNI=1
1 maxilla, 1 distal tibia

AVES

Columba sp.: NISP=2, MNI=1
1 proximal humerus, 1 distal humerus

Alectoris rufa: NISP=1, MNI=1
1 distal tibia

HUMAN REMAINS (J. R. S.)

The skeletal remains from the Neolithic layer in Goldra cave were solid and well-preserved though very incomplete. They had been stained a light brown color by exposure to the soil, and displayed a number of fresh fractures produced at the time of recovery. The bones had been firmly imbedded in a particularly hard and resistent matrix, and the identifiable remains are listed in Table 3. The remains were not found in anatomical connection (although some of the vertebrae were clustered) and seem to have been scattered in the midden fill like the faunal remains and other trash. The mixture of bones from different individuals would argue against deliberate entombment; a more casual burial procedure would seem to be the case.

Square A1 (150-170 cm. below surface) yielded remains of as many as four individuals. Individual Nº 1 is represented by 10 virtually complete vertebrae; cervicals 3-7, thoracics 1-3 and 12. The remaining material was very fragmentary; 22 rib. fragments, 5 skull vault fragments, clavicles, 12 hand and foot bones, an incomplete femoral or humeral head, the manubrium, a proximal right ulna, a distal ulna and part of the shaft, and a fibular shaft. All bones were relatively small. The femoral or humeral head was too incomplete to measure. Based solely on size, it is likely that this person was female. The vertebral bodies all show rounded contours on their superior and inferior margins. All long and short bones show complete epiphyseal fusion. But there is a trace of epiphyseal line on the first three thoracic vertebrae, and some «pinching» of the body of the 12th thoracic. These factors are all consistent with the person having just achieved skeletal maturity, and is thus probably between about 20 and 25 years. The individual was in reasonably good health and there is no evidence to suggest the cause of death. Stature could not be estimated from the remains available.

Individual Nº 2 is a «juvenile». There is a clavicular fragment which is demonstrably not a part of the clavicle fragments noted above in the adult female remains. Two metatarsal shafts, a phalanx and a damaged metacarpal shaft lack their epiphyses. About all that can be said with assurance is that the individual was under the age of 18, but judging from size. It may be a younger teenager.

Individual Nº 3 is represented by a mandible and several axial and limb bones. The mandible is complete, save for the freshly fractured right ascending ramus: all adult teeth have erupted. A fragmentary first cervical vertebra articulated well with a complete second. There were 10 rib fragments, a proximal humerus, proximal ulna and distal radius, all from the right side. A left calcaneus was anteriorly imbedded in hard matrix, and part of the left scapula was present. A proximal thumb phalanx, an almost complete metacarpal (both lacking epiphyses) and the central portion of a hand phalanx completed the human remains. The vertical diameter of the humeral head measured 37.5 mm, within the female range for modern European populations (Olivier 1969) and the chin is quite pointed, also a female trait. Only the hand epiphyses were unfused. All of the mandibular teeth present are quite worn with major exposure of dentin on the first molars. The incisors were worn about one-fourth of the way throught the crowns, and alveolar recession has exposed about half the lenght of the first molar roots. The margins of the articular surface of the calcaneus were sharp, but there was no ostophytic development on any of the articular surfaces. These all suggest an age of probably not more than 30 years. The hand epiphyses should fuse at about the age of 17 (Bass 1987) and the arm bones slightly later. The fact that the third molar is in occlusion and worn suggests that the hand bones are from a younger person. The duplication of the proximal ulnae in this person and the one represented by Individual Nº 1 is conclusive evidence that these fragments represent two individuals, while the hand bones are probably from still another person, probably under 18 years (Individual Nº 2). The stature of Individual Nº 3 could not be confidently estimated from these remains.

Matrix was carefully removed from the mandible and teeth. One caries had completely

destroyed dentin of the second left premolar, leaving only an enamel shell on the lingual and distal sides. No abscess was present, but had she lived, one would probably have developed shortly. Such a major destruction of the tooth should have been most painful. Occlusal wear and alveolar recession, as noted above, were also present. The odontoid process and its associated articular surface on the first vertebra both showed osteophyte development, and the superior and inferior margins of the vertebral bodies both hinted at incipient osteophyte growth.

Individual Nº 4 is represented by only a clavicle fragment and a vertebral body. This body was not yet fused to the arches, making the age less than 6 years (Bass 1987).

Square A2 (180-190 cm below surface) produced remains of another three individuals. Individual Nº 5 is represented by a lower (probably 12th) thoracic vertebra, a piece of neural arch of a cervical vertebra, the lower shaft and distal end of the right fibula, the distal end of the left fibula, a complete right clavicle and the acromial end of the left clavicle. Since the one clavicle fragment is much smaller than the complete clavicle, another individual may be represented. However, some assymetry between clavicles has been recorded, and without fuller representation of the skeleton, a more far-reaching assymmetry cannot be documented. There were also 3 incisors, a canine and 2 premolars, 8 rib fragments and 10 hand and foot bones, all adult in size. A separate bag contained four fragments of long bones, 1 thick piece of skull vault, 11 more hand and foot bones, and 3 teeth (all with some occlusal wear).

The bones are of an adult and the size of the teeth is consistent with a male, suggesting that all these additional remains could also pertain to Individual Nº 5. The complete clavicle measures ca. 150 mm in length, typical for males (Olivier 1969). The size of the thoracic vertebra and muscle markings on the fibula are also of sizes consistent with males. The medial end of the clavicle is unfused. Other epiphyses are complete, including those of the vertebra. All of the loose teeth show some occlusal wear, but not as great as the female adults. These suggest an age close to 25 years. No bone was sufficiently complete for estimation of stature. The margins of the superior and inferior articular surfaces of the thoracic vertebra show hints of sharoness. This would signal the onset of ossification of Sharpies fibers, too small to acore, but indicating that this young adult had engaged in some stressful activity.

Individual Nº 6 is represented by a part of an immature occipital including the right condyle and a portion of the foramen magnum. This fragment was not fused to the basilar portion, though the squama is fused. The latter event takes place in the third year, and the former in the 4th or 5th year. Hence, this fragment belongs to an individual of less than 5 years (Bass 1987). There are also a 12th rib fragment, a sternal segment, 2 vertebral bodies, one proximal right ulna with part of the shaft and one proximal right radius with part of its shaft. Determination of the sex of young children is difficult. However, in this case, the sciatic notch is so narrow and the auricular surface so recessed, that it is likely that this individual is male (Weaver 1980). Lack of fusion of the arches to the vertebral bodies would indicate an age of less than 6 years (Bass 1987). The estimated length of the ulna would yield an age over 4 years (Johnston 1962), so all these bones could be from the same child as the occipital.

Individual nª 7 is apparently represented by a left femur with both epiphyses, a left patella, a proximal tibial epiphysis, a left ilium, a left pubis, 24 rib fragments, 5 vertebrae and coccyx, clavicle fragments, foot bones, cranial fragments and an incisor. The femoral shaft measures 25.3 cm, which would correspond to an age of about 7 years on Stewart's (1968) chart, and beyond 6 according to Johnston's tables (1962). Total lenght of about 28 cm with epiphyses approximated, corresponds to age 6, as determined radiographically for males by Anderson et al. (1964). The one lumbar vertebra shows recent fusion of the neural arch to the body, wich is consistent with an age of six or slightly above. The bulk of the bones also appear to be an immature skeleton. The 3 thoracic vertebrae, all with fused arches, lack the epiphyseal plates. The pubis is unfused, missing the ascending ramus. The fragment of the iliac blade appears not to have had its epiphysis fused. The ribs could also be from this person, as could be 2 foot bones, 2 pieces of skull ault, the first coccygeal vertebra and the left patella. Although nothing is truly diagnostic, the shortness of the horizontal pubic ramus would be consistent with a male. Fairly recent fusion of the vertebral arches may suggest an age slightly beyond 6 years. The incomplete incisal root would be consistent with this age. Finally, a lower premolar could belong to any one of the adults.

The minimum number of individuals can be summarized as follows: Square A1 (150-170 cm) produced A) a young adult female 20-25 years, B) a juvenile under the age of 18, C) a second young adult female in her 20s, D) a child of less than 6 years, and E) a juvenile under 18. Since B and E cannot be shown to be different individuals, the count stands at four individuals:

1. Female 20-25
2. Juvenile, probably under the age of 18
3. Female in her 20s
4. Child, about 5 years.

Square A2 (180-190 cm) produced A) a young adult male, just under 25 years, B) a child of 4-5 years, C) a child 6+, D) a child about 7, E) an adult, possibly male. Neither A and E nor C and D can be separated on any justifiable grounds. Thus, the count would seem to be:

5. Male, ca. 25
6. A child under 5
7. A child 6-7 years old.

Consequently, the excavation at Goldra seems to have produced fragmentary but compelling evidence for the presence of 7 individuals; two females and one male, all in their 20s, an adolescent probably under 13, and three children, one 6-7, a second about 5 and a third less than 5. Individuals 4 and 6 could be one and the same; their distinction here is based essentially on vertical and horizontal separation of their bones within the archeologically homogeneous midden deposit.

All of the skeletal remains recovered from Goldra weigh approximately 1,000 gm. Since the dry weight of a complete adult human skeleton according to Trotter (Krogman and Iscan 1986) is about 4,500 gm, it can be seen that the 7 individuals from Goldra together bulk about 1/4 of one complete skeleton. This is one way of expressing the incompleteness of these remains and the fact that pristine burials are not represented. However one looks at these bones, it is evident that none of these individuals is well represented. In view of their incompleteness, conclusions must be somewhat limited.

Nonetheless, one fact stands out: none of these individuals can be said to be past his or her prime. All three adults are in their 20s, a juvenile is probably under 18, and the three children under 7. While 7 skeletons cannot surely present a reliable demographic picture, it hints that Neolithic lifespans in this region were not lengthy. Yet, the skeletons provide no clue as to the reasons for their deaths. Indeed, the individuals appear to have been in robust health. It may well be that the causes of death would have left their mark on some of the missing bones. But valid conclusions can only be drawn from the material that is present, not from that which is absent.

In prehistoric populations, the environment plays a considerable role in growth and survival (Johnston and Zimmer 1989), and one typically sees a mortality peak at about the time of weaning. This would represent the stresses resulting from a change to solid (adult) food, a diet often inadequate to sustain the rapid growth of childhood. As Johansson and Horowitz (1986) show, there are high death rates in the 0-5 year age range for hunting and gathering, transitional and agricultural groups alike. Beyond this hazard lies a more benign and largely risk-free path, as indicated by lower death rates, until the twin challenges of childbirth for females and participation in hunting or intergroup conflict for males, are encoutered.

Where low population densities exist, there is insufficient fodder for childhood diseases. One thus expects a higher mortality in the 1-2 year range rather than around age six. However, the adolescent may have just entered the period of reproductive challenge and succumbed before reproducing himself. He and the 3 or 4 children would have made no genetic contribution to subsequent generations. Of these 7 individuals, only the two adults were old enough to have reproduced, but even they were cut off before raising any offspring to maturity. The loss of life so early in adulthood suggests that young children must have had to depend upon their kin for a part of their support.

Another minor point of interest in this skeletal sample is the pathology noted on two of the

adults. The more complete skeleton was that of the female from Square A1 (Individual Nº 3). In addition to considerable tooth wear and alveolar recession, as noted above, one of the teeth had been virtually destroyed by caries. The state of osteophyte formation on the cervical vertebrae is advanced beyond what would be expected for a person of this age, and may have resulted from stresses to the neck, caused by carrying loads on the head. The second paleopathological observation concerns the very beginning of the ossification of Sharpies fibers on the neural arches of the vertebrae of the male from Square A2 (Individual Nº 5). This ossification seems to occur independent of osteophytes on the bodies, and signals that some stresses were already present on this skeleton. However, the precise meaning of both dental and skeletal changes described here must wait for a comparison to others from the same region.

TABLE 3: INVENTORY OF HUMAN REMAINS

Individual	Age(yrs)	Skull	Teeth	Axial	Arms/Legs	Hand/Foot Bones
1. Female	20-25	5 frag	3	10 vertebrae, 22 rib frags, clavicles, manubrium	R ulna frag, R dist. ulna, fibula shaft, femur/humerus head	23
2. Juvenile	18			2 clavicle frags		4
3. Female	20s	mandible		2 vertebrae, 10 rib frags, L scapula frag	L calcaneus, prox. humerus, prox. ulna, dist. radius	3
4. Child	6			clavicle frag, vertebral body		
5. Male	ca. 25	1 frag	9	2 vertebrae, 8 rib frags, clavicle & clavicle frag	R dist. fibula L fibula frag, 4 indet. frags	21
6. Child	4-5	occipital		2 vertebral bodies, 12th rib, sternal segment	prox. R ulna, prox. R radius	
7. Child (male?)	6-7	2 frags	1	5 vertebrae + coccyx, 24 rib frags, clavicle frags, ilium frag, L pubis	L femur, prox. tibia epiphysis, L patella	8

In addition to these remains, separated at the time of excavation, the following human bones were identified by J. Altuna among the mammalian remains send to him in San Sebastian: 1 rib, 1 phalanx, 1 radius fragment and 3 metapodial fragments.

STABLE ISOTOPES (H. P. S)

It is possible to place some limits on the diet of the Goldra Neolithic humans through isotopic analysis of collagen extracted from the bones. Collagen was extracted following the procedure of Chisholm et al. (1983). The collagen was oxidized *in vacuo* with cupric oxide, and CO_2 and N_2 gases were analysed on a mass spectrometer. The isotopic data on the collagen are as follows:

	$\partial^{13}C$ (‰, PDB)	$\partial^{15}N$ (‰, ATM)
Goldra A1 (adult female, 20-25 yrs)	-19.55	8.78
Goldra A2 (adult male, ca. 25 yrs)	-19.27	8.74

These s-values give the enrichment or depletion in the given isotope with respect to a standard (carbon from PDB calcite; atmospheric nitrogen). The typical reproducibility of the analyses is ±0.2‰ for both $\partial^{13}C$ and $\partial^{15}N$. The results on the two specimens are indistinguishable.

The $\partial^{13}C$ values are typical of collagen from consumers of either C3 plants, or of the flesh of herbivores who are, in turn, C3 consumers. C3 plants dominant in temperate and sub-arctic terrains. Higher values of $\partial^{13}C$ would indicate consumption of either marine foods, or C4 plants such as millet or sorghum, neither of which are know to have been cultivated here. Alternately, higher $\partial^{13}C$ values could have indicated consumption of the flesh of herbivores grazing on C4 grasses, typical of hot, dry climates. Since such grasses are likely to have been prevalent in this region, the dominant flesh-sources was probably a browser rather than a grazer, such as goats.

The $\partial^{15}N$ values can give us an indication of the source of nitrogen (as protein) in the diet, and could, in principle, distinguish between herbivorous and carnivorous populations. The values obtained that these people were carnivorous and consumed the flesh of herbivores. Higher values would be indicative of either marine or aquatic foods (fish, molluscs). Marine foods apparently did not make up a significant part of the diet of the Goldra population, despite proximity to the coast and presence of shells in the deposit. The result is consistent with our results obtained from central and southern Portugal (Straus 1988; Lubell et al., in prep.), which give essentially identical $\partial^{13}C$ and $\partial^{15}N$ to these, for Neolithic populations (e.g., $\partial^{13}C$: -19.6 and $\partial^{15}N$: 8.5 at Casa da Moura; ca. 6000 bp), while higher values were obtained for Mesolithic skeletal remains from the same general region, indicating extensive use of marine resources (e.g., $\partial^{13}C$: -16.4 and $\partial^{15}N$: 11.8 average values for 5 bones from the shell midden of Moita do Sebastião, ca. 7000 bp) (Lubell et al. 1989). These «Neolithic» and «Mesolithic» $\partial^{13}C$ and $\partial^{15}N$ values are consistent with results obtained elsewhere in Europe for agriculturalists and foragers (Schoeninger et al. 1983).

CONCLUSIONS (L. G. S.)

Despite the small size of the excavations, considerable preliminary data on the environments and adaptations of the Middle Neolithic of the Algarve are now available from Soidos and especially Goldra. Indications from pollen and charcoal, as well as from mammalian faunal remains and from the ceramic and lithic artifacts, all point to the facts that humans were by 5000 BP heavily dependent on agriculture and pastoralism and that they were beginning to significantly alter the local environments of the Algarve. This situation had developed relatively rapidly (within perhaps not much more than a millennium) after the initial introduction of domesticates in southwestern Iberia.

Although the small sizes of the samples make generalizations risky, a number of working hypotheses concerning Goldra and Soidos can be put forth at this time, obviously subject to any future research that might be done in these sites.

The thickness and content richness and diversity of the midden deposit in Goldra, as well as the presence of the remains of at least 7 human individuals (all from a 2x1 m test pit!), all tend to indicate that this cave was an important residential site. This would make sense in relation to the ample, good-quality agricultural and pastoral lands in the immediate vicinity of the cave. The abundant remains of foods and fire and the many different types of ceramic, lithic and osseous artifacts in the midden all suggest that a wide variety of activites took place in the cave — not just burials.

The botanical indicators of deforestation indicate an extensive dependence on cultigens and domesticated animals. The presence of cereal pollens in the midden deposit is *prima facie* evidence of cultivation, whereas the pairs of grinding stones are secondary indicators of cereal processing at the site. Presumably many of the diverse forms of well-made ceramic vessels were used for the transport and storage of cereal grains, as well as water. The unretouched flint blades may have been used as reaping knives (or blanks for making them).

That all or most of the large-medium mammal remains are of domesticated species is a clear indication of the importance of food *production* in this region by 5000 BP. However, the presence of marine molluscs, bird and rabbit remains shows that foraging continued to play a role (albeit secondary) in Middle Neolithic diet. However, at least in the area excavated, there are no arrowheads or other apparent elements of hunting equipment, and the only bone tools could have been used in the working of hides from domesticated animals, for example. The stable nitrogen and carbon isotope analyses of bones from two of the humans indicate that diet consisting of C3 plants and herbivores, with an isotopically imperceptible marine component.

Whatever other benefits may have resulted from such a rapid and thorough adoption of food production (e.g., the ability to support a larger population) among people who, at least locally were still «cave-dwellers», there seem to have been some draw-backs, as indicated by their skeletons. There is evidence of early death: none of the 7 individuals lived beyond age 25 and 3 are young children. Causes of death are unknow, but increased sedentism could bring about increased mortality by contagious disease. There does not seem to be evidence of dietary stress in the remains found at Goldra, but one young adult female exhibits considerable dental pathology, typical among cereal-eating populations. The same woman suffered from cervical vertebral pathologies, perhaps the result of carrying heavy loads (e.g., pots of water and/or grain) on

her head. A young adult male also exhibits pathological evidence of vertebral stress. The Middle Neolithic of the Algarve was no more a Garden of Eden than it is for the modern-day peasants in the Serra do Caldeirão (in sharp contrast to the lives of the tourists inhabiting the villas of Goldra or the hotels of Albufeira!).

In contrast to Goldra, the cave of Soidos is located in a mountainous area with more limited agricultural potential than the coastal plain. The Middle Neolithic occupation of the cave seems to have been more limited and ephemeral, perhaps a specialized seasonal camp. Economic data are entirely absent, but it is interesting to note that there are no indications that the cave was used in this time as a hunting location. The Chalcolithic occupation, evidenced both in the cave mouth and rear, may have been somewhat more substantial, although the only indirect economic datum is the presence of one or two cheese strainers, suggesting the presence (at least seasonally) of goat and/or cow herds. It is entirely possible that Soidos served as a herders' camp in both periods, although the possibility of farming, particularly around the major spring at Alte, cannot be ruled out. Nonetheless, by Middle Neolithic times there was already a definite presence of agricultural groups in the mountainous interior of the Algarve. Since these times, humans have continued to eek out an agricultural existence on the poor, generally dry, rocky soils of this part of the region.

It is not unlikely that, in the Neolithic, transhumant pastoral systems were established to take advantage both of the good farming lands along the coast and along the few major streams of the Algarve and of its hill country grazing lands. Not an easy existence, it nonetheless was one that supported substantial populations and the eventual development of a high degree of social complexity, as manifested in such Chalcolithic village settlements and monumental tombs as those of Alcalar. The preliminary excavations at Goldra and Soidos help shed light on the timing, rapidity, nature and completeness of the adaptative transformation in human lifeways that had occurred by 5000 years ago in this remote Atlantic outpost of the Mediterranean world.

In the context of evidence from southern and eastern Spain at around the same period, the pollen and charcoal data from Goldra are suggestive of widespread deforestation by means of fire, perhaps to create grazing land for domesticated livestock (K. Butzer, pers. comm.) Dupré (1988: 124-7) summarizes the evidence from Levante (e.g., Covas de l'Or & Foscoa, Torreblanca, Almenara). At La Cueva del Nacimiento in Jaen, between ca. 7400 and 6000 BP, there is a sharp drop in the arboreal pollen percentage, and the nonarboreal pollen are dominated by composites (Lopez 1982). Menéndez Amor and Florschütz (1964a) show a big decline in arboreal pollen percentages at the top of the Padual (Granada)

core dated to about 5000 BP. Manéndez Amor and Florschütz (1964b) also see evidence of nearly complete deforestation in a bog core near the city of Huelva, about 100 km. east of Faro. Another core from the same Laguna de las Madres bog confirmed rather massive deforestation around 4500 BP, associated with the fire-indicator plant *Halimium*, as well with possible cultivation of grapevine, which is well represented palynologically (Stevenson 1985). The neolithization process in southern Iberia included a phase of extensive fire clearance, perhaps largely to provide pasture, although some cereal agriculture was practiced. The exact mix of pastoral and agricultural activities and diets remains to be determined in detail for these regions, which is why the Goldra stable isotope data are of interest. The ecological consequences of deforestation were severe and long-lasting, resulting in the ubiquitous matorral vegetation communities of this and other Mediterranean regions, althouh local reforestations did occur at times.

Finally, in terms of the original reason for doing exploratory research in the Algarve, the travertine dates clearly show that Goldra could not have been occupied in Upper Palcolithic. In several other caves we excavated, both in the Algarve and in other regions of southern Portugal, the earliest human occupations occurred in post-Paleolithic times (Neolithic or Calcolithic). In some cases this was because the caves had not yet been opened to the surface enough to permit habitation. But in others, this phenomenon may be an indication of significantly lower human Upper Paleolithic population density in areas of Portugal outside the favored parts of Estremadura (e.g., Rio Maior) (see Zilhão 1990) than in subsequent periods. It might also suggest that Upper Paleolithic landuse was concentrated on the now-flooded continental shelf of southern Portugal.

ACKNOWLEDGEMENTS

Archeological discovery, geological mapping and considerable advise in the study of Goldra and Soidos were generously provided by J-A. Crispim, who drew the site maps. The excavation permits (from the Instituto Português do Património Cultural, F. Real Director), logistical help, ceramic and mollusc identifications were provided by J. Arnaud. B. J. Vierra and P. Fonseca were essential participants in the fieldwork directed by LGS. In addition, Vierra provided considerable expertise in the artifact analyses and Fonseca did the original artifact drawings (redrawn by C. Meneses and A. Wilmer). The radiocarbon date was obtained by H. Haas of Southern Methodist University. The research was funded by grants from the College of Arts and Sciences of the University of New Mexico and from the L.S.B. Leakey Foundation and National Geographic Society. Our sincere thanks go to one and all for their collaboration. LGS wishes to acknowledge constructive criticism by Karl Butzer.

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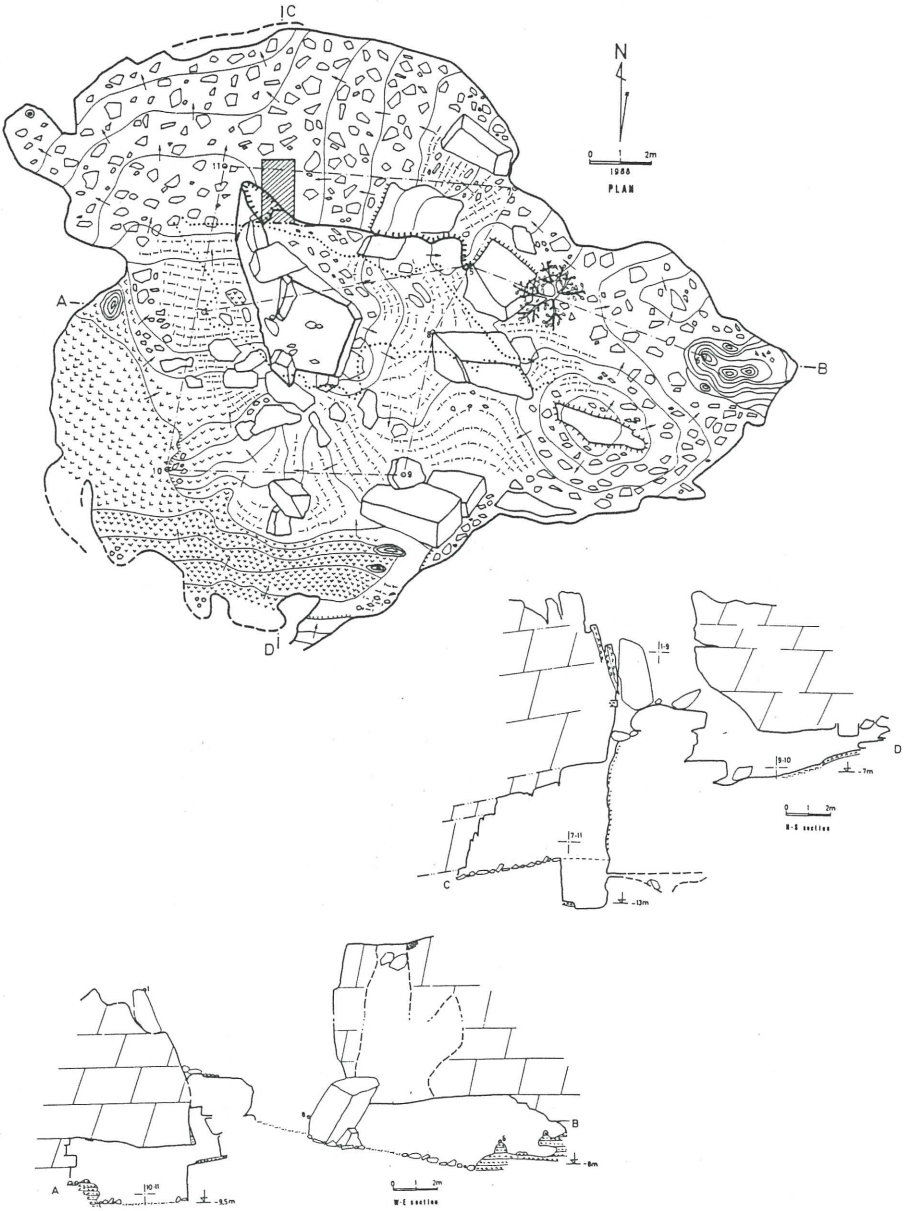
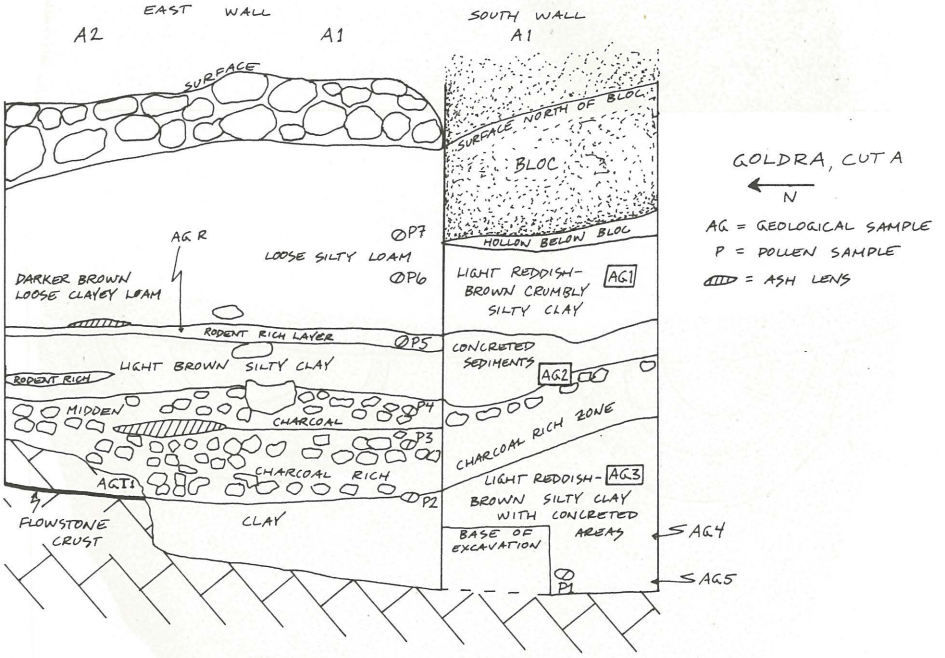
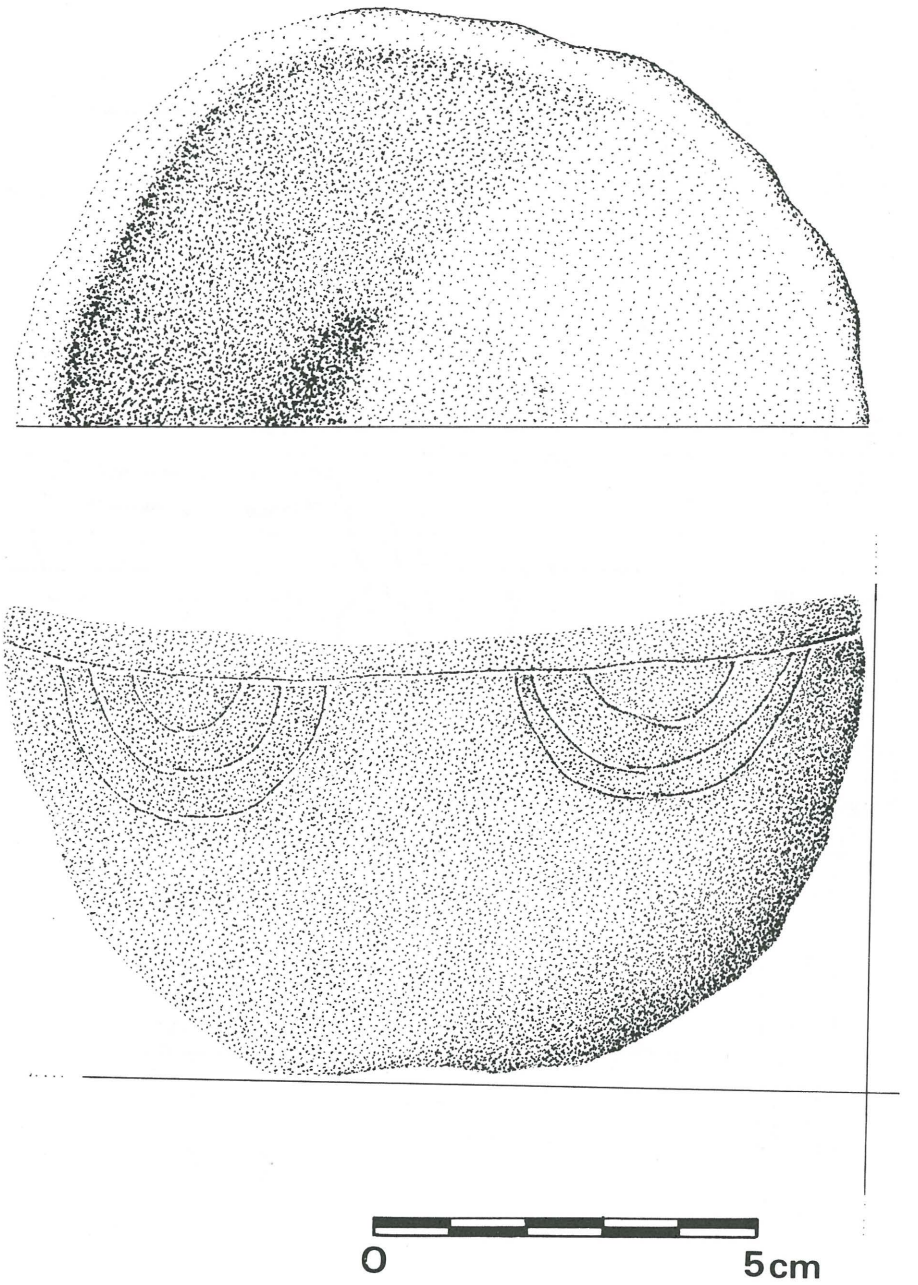
Map of Portugal showing locations of the main excavations of the University of New Mexico Portuguese Prehistory Project, 1987-88. No. 1= Escravelheira; No. 2= Casa da Moura; No. 3= Bocas & Buraca dos Mouros; No. 4= Goldra, Soidos & Rocha da Pena; No. 5= Vidigal.



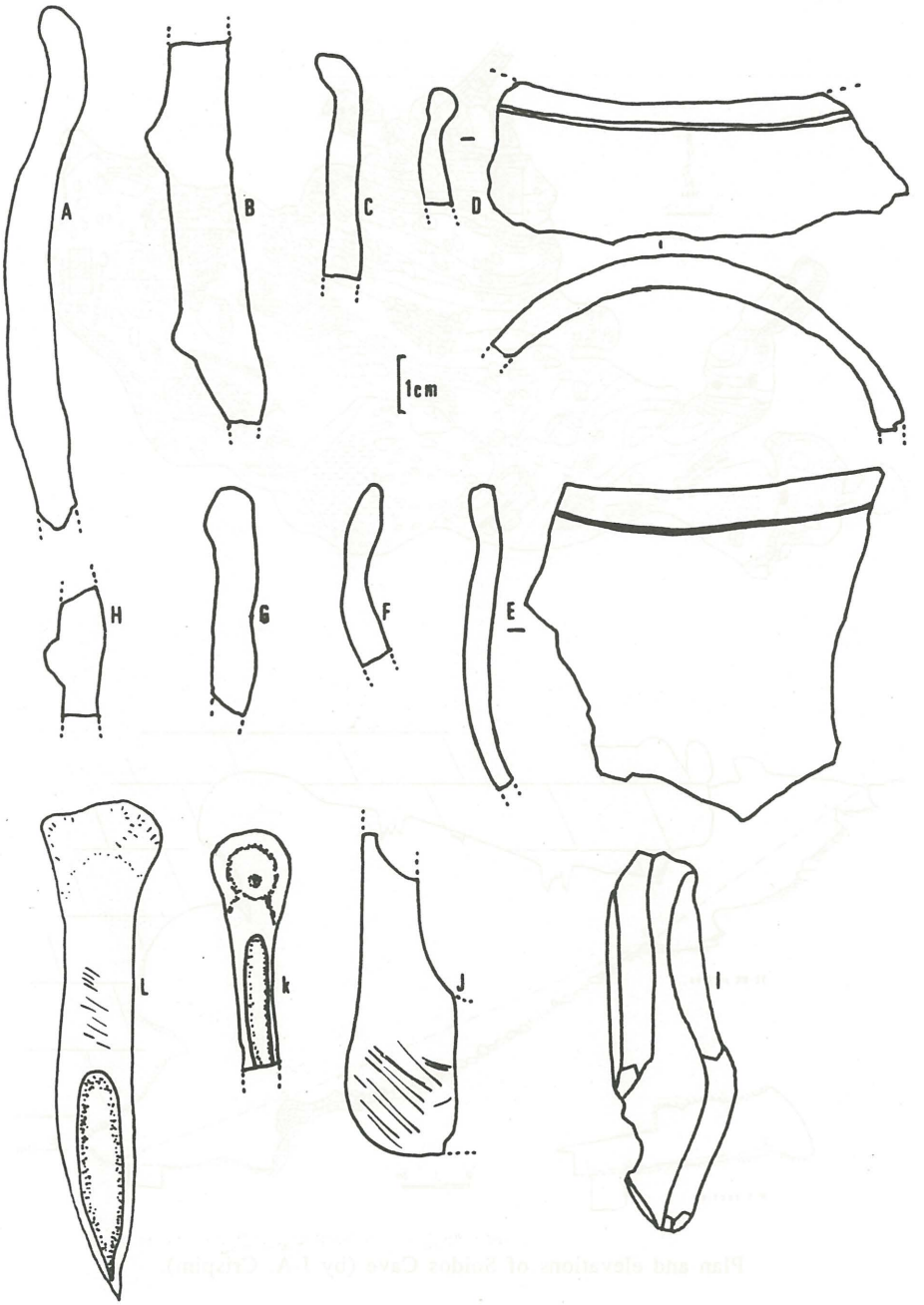
Plan and elevations of Goldra Cave (by J-A. Crispim).



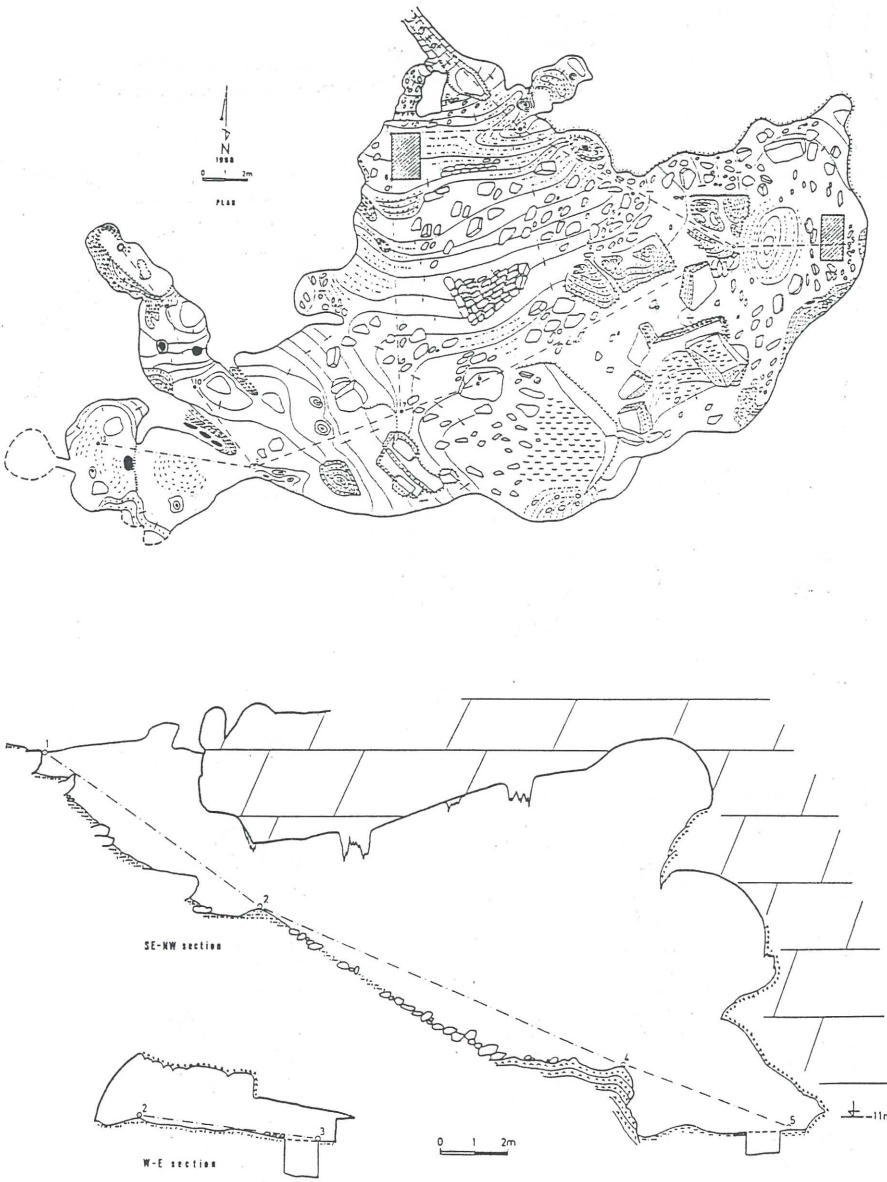
East and South stratigraphic sections of the test trench in Goldra, showing locations of pollen («p») and geological («AG») samples.



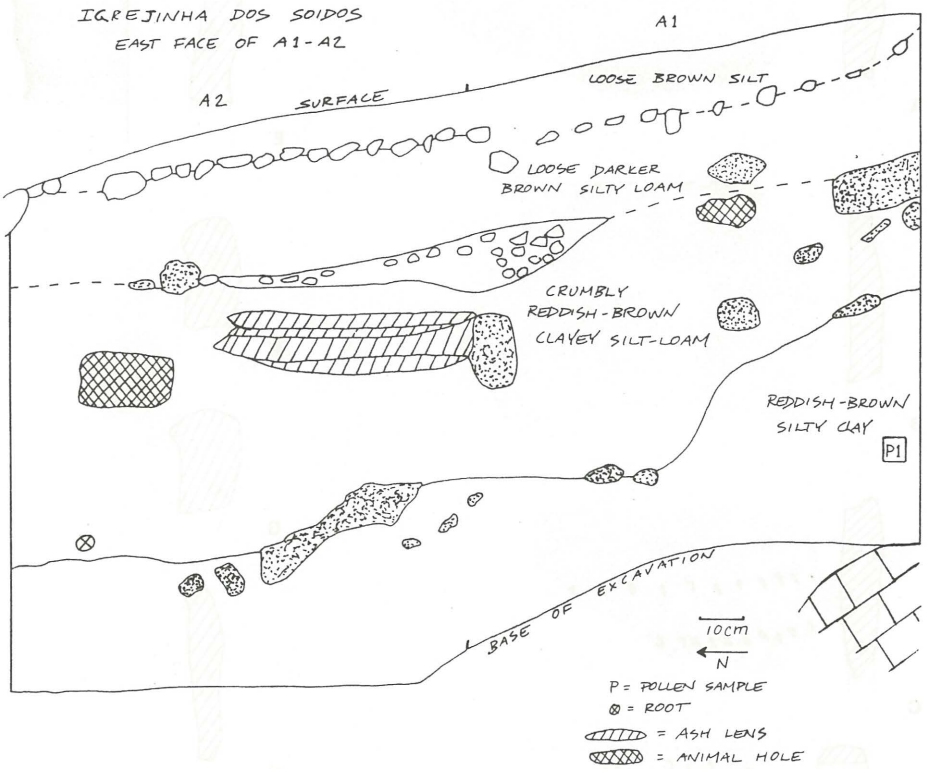
Whole bowl from the Goldra midden layer.



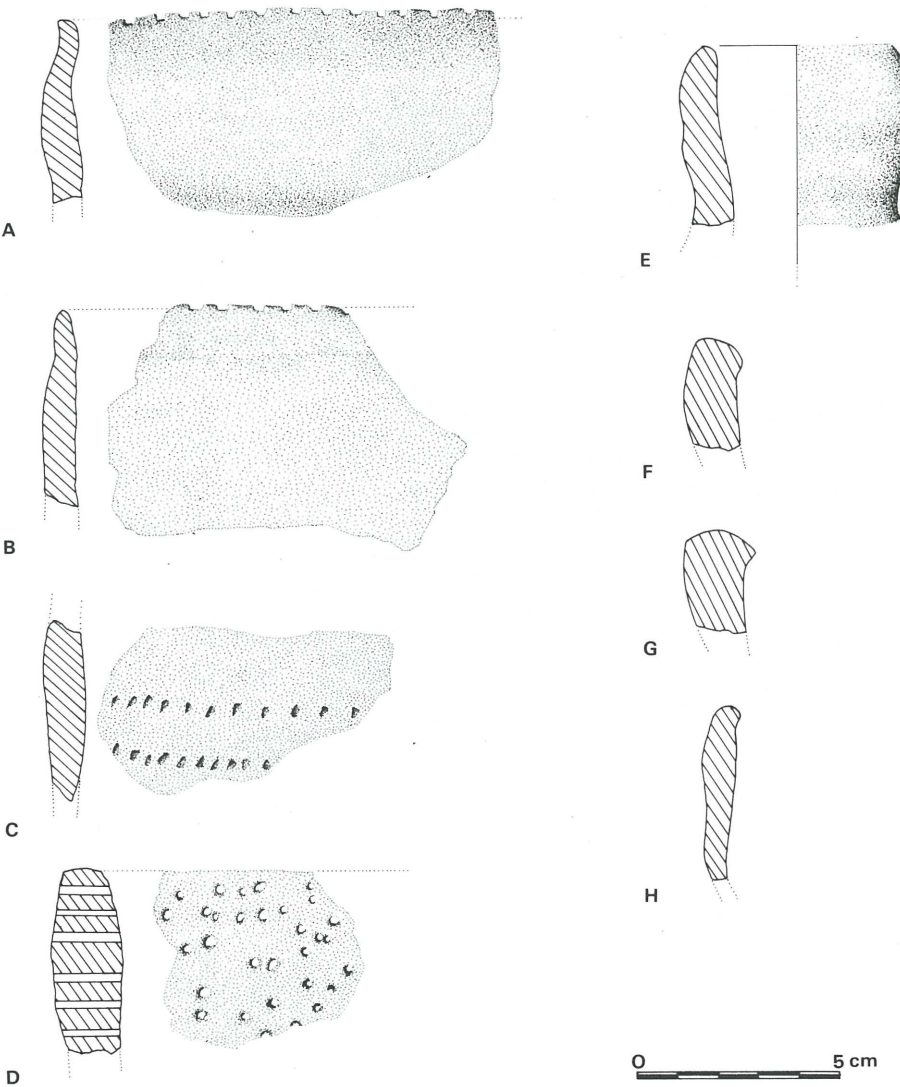
Ceramic, bone and lithic artifacts from the Goldra midden layer.



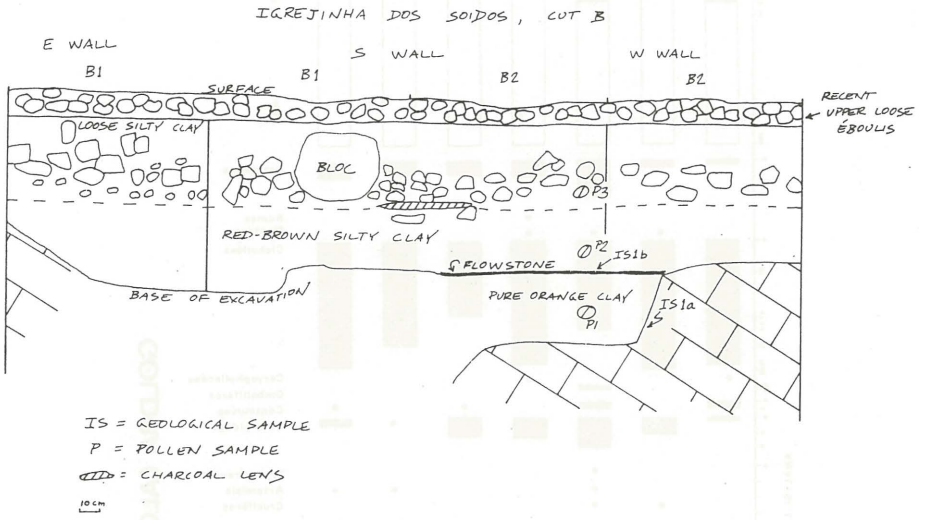
Plan and elevations of Soidos Cave (by J-A. Crispim).



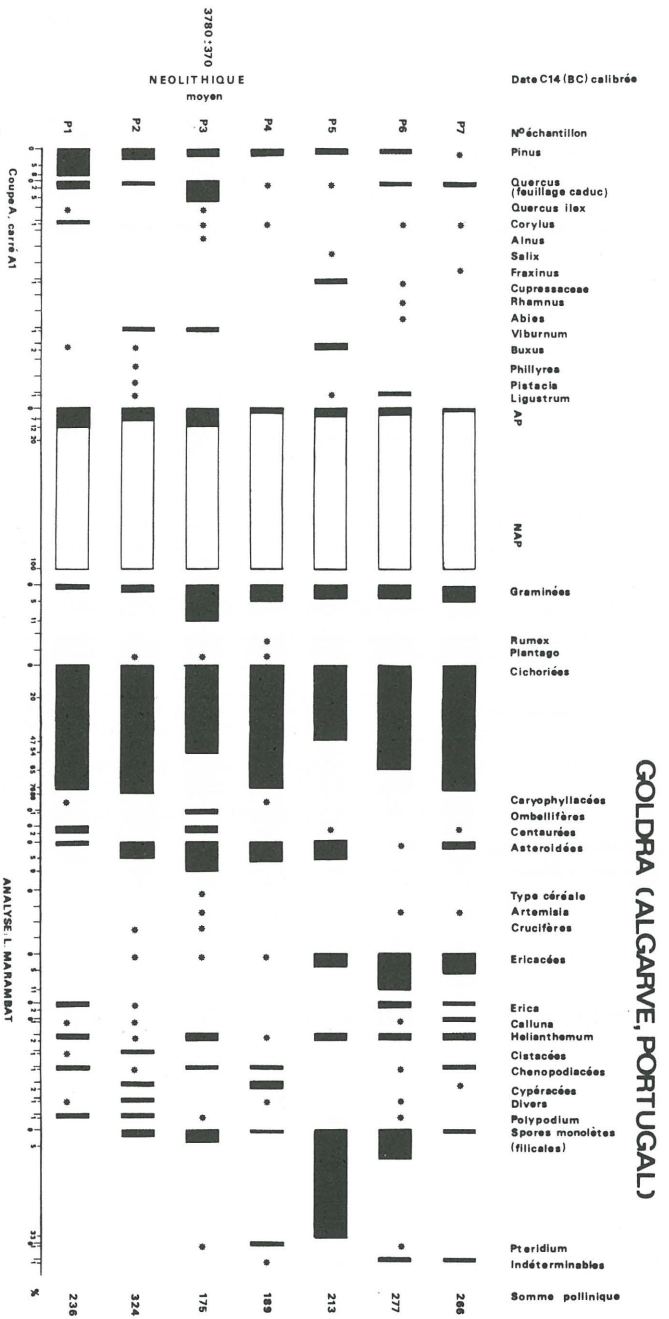
East stratigraphic section of Cut A in Soidos.



Ceramics from Cuts A & B in Soidos.



East, South and west stratigraphic sections of the Cut B in Soidos.



Pollen diagram for Goldra (by L. Marambat).