The earliest evidence for clay hearths: Aurignacian features in Klisoura Cave 1, southern Greece

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The authors describe clay features dating from c. 34–23 000 years ago discovered in a stratified occupation sequence in a Greek cave. The clay was brought from outside the cave, puddled with water and shaped into shallow basins. Laboratory analyses have shown that these clay features were burnt. This together with the occurrence of fragments of wood ash and phytoliths lying on their surfaces suggest that these features were hearths used for cooking, including the roasting of wild grasses.

Keywords: Upper Palaeolithic, Aurignacian, Greece, hearth, clay structures.

Introduction

Hearth structures are probably one of the first expressions of space-specific skills. Building a fireplace is a sign of permanence. Such structures are used repeatedly and can survive beyond the limits of the seasonal occupation. As Gamble (1999) has stressed, they provide a focus of performance and social life. Identifying variations in hearth structures over time is therefore fundamental for understanding the evolution of human social life. Well-built hearths are known from the Middle Palaeolithic. However, they are confined to stone constructions (Vega Toscano et al. 1994), or well delimited-accumulations of burnt remains (review by Meignen et al. 2001). A noticeable change in the manner of using fireplaces is evident in the Upper Palaeolithic. In the Gravettian of Dolni Vestonice fireplaces were used for transforming materials. They have the form of domed and banked clay kilns and they were used for the firing of clay figurines (Vandiver et al. 1989). The study of the technology of Dolni Vestonice shows an advanced mastering of the raw material possibilities (Vandiver et al. 1989), but unfortunately very little of the hearth structures survived. There is thus little information about the earlier technological steps involved in forming clay kilns and firing clay figurines (Vandiver et al. 1989). The supposed gap between stone constructions or simple delineated hearths of the middle Palaeolithic and the walled clay kilns of the Gravettian may be bridged by the hearth structures in the Klisoura cave 1 (southern Greece) which are presented in this paper.

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Figure 1. Location of Klisoura cave.

Figure 2. Plan view of Klisoura cave showing the excavation grid.

The Klisoura cave is a complex of a rockshelter and a small collapsed karstic cave located in a gorge at the northern edge of the Argive Plain in north-western Peloponnese (Figures 1 and 2). Klisoura preserves a long cultural sequence spanning the periods between the Middle Palaeolithic and the Mesolithic; part of the sequence is presented in Figure 3. The Middle Palaeolithic layers (layer VI and below), still under excavation, are overlain by an early Upper Palaeolithic industry characterised by arched backed blades (layer V). Above this lies the first well-dated sequence of Aurignacian occupation in Greece. The Aurignacian layers (IV, all of III, 7, and 6a) have a combined thickness of about 1m and are characterised by steep, carinated and nosed end-scrapers from which bladelets were removed. Special cores for bladelets also occur. A higher frequency of blades and bladelets is observed in the lower part of the sequence. Several bone points and perforated marine shells were also found. Epigravettian layers (layers II) of 0.5m maximum thickness cover the lower sequence through an unconformity and a Mesolithic sequence (layers 3-6) is found locally (Koumouzelis et al. 2001).

The lower and middle Aurignacian sequence (layers IV, IIIb, IIIC, IIIf, IIIg, 7 and 7a) in Klisoura cave 1 contained remains of about 90 well-preserved hearths. Some of them just consist of a sequential accumulation of burnt remains. However, 54 hearths have basin-like, clay-lined structures (Koumouzelis et al. 2001; Pawlikowski et al. 2000). In addition, the

Figure 3. Stratigraphic section of part of the northern wall (see figure 2). Clay hearth structures are shown in black and interstratified ash remains in gray. Spiral forms indicate the presence of large amounts of snails. Layers 1 and 2 contain mixtures of classical and Bronze age finds, 5 and 6 Mesolithic, III c and IIIe upper Aurignacian, IIIf and IV middle and lower Aurignacian, VII and below are Middle Palaeolithic. Note that some of the layers mentioned in the text do not appear on this profile.
excavations have revealed a well-preserved clay hearth structure with pronounced thickened rims and another 17 similar remains in the uppermost Aurignacian layers of the site (layers III, III' and III''), implying a long tradition of producing such structures.

Clay hearth structures were not identified in the Middle Palaeolithic layers, or the layers above the Aurignacian sequence. There were hearths in the Middle Palaeolithic sequence, but these consist of undisturbed sequences of superimposed thin white ash and grey and black charcoal-rich layers. Such colourful sequences are known from other caves as well, e.g., Kebara in Israel and Theopetra in Greece (Meignen et al. 2001; Karkanias 2001). The Epigravettian and Mesolithic layers are characterised by the presence of mostly dispersed burnt remains, but a few thick flat in situ accumulations of ash were also identified, particularly in the Mesolithic layers.

Three radiocarbon dates on organic fractions that have been obtained from the lowermost Aurignacian structures of Klisoura are statistically indistinguishable: Gd-10562 32 400±600, Gd-7892 34 700±1600, Gd-7983 31 400±1000. An outlier from the same layer, i.e. Gd-9688 22 500±1000 was derived from a sample with a very small amount of carbon and thus should be treated with caution (Koumouzelis et al. 2001). In the context of this work a new AMS date on charcoal from another hearth structure from the lower part of the Aurignacian layers was obtained. The date, GdA-228 31 150±480, fits very well with the previous three conventional radiocarbon dates. The uppermost Aurignacian layers in Klisoura cave were radiocarbon dated using mollusc shells. After correction for reservoir effect (i.e. 1300 years) the age ranges from c. 26 000 to 22 550 BP (Koumouzelis et al. 2001). However, other values of reservoir effect for these samples should be taken into consideration. Thus, the ages of the earliest hearth structures in Klisoura cave are certainly older than the central European Gravettian with its clay technology dated from about 28 to 26 ka BP (Vandiver et al. 1989).

In their study of the lower Aurignacian hearths of Klisoura, Pawliwowski et al. (2000) suggested that the structures were probably the oldest evidence for the emergence of ceramic technology. The aims of the present study are to demonstrate the intentional use of clay in constructing permanent hearth structures, to reveal aspects of the technology of the constructions, to identify the source of the material used and to discuss the possible use of some of these fireplaces for specific purposes.

Hearth

Macroscopic examination

In the field, the clay structures are distinguished as distinct dark red compact features with a basin-like shape (Figures 3 and 4a,b) that occasionally overlie one another (Koumouzelis et al. 2001). Where they overlie each other there is no disturbance of the lower structure, but the new hearth is built upon the truncated underlying one (Figure 4a,b). Their diameters are about 30 to 40 cm and some of them preserve a prominent thickened clay rim (Figure 4c). Some of the structures are fragile and a few of them disintegrate into fine-sized aggregates. However, some of them when moistened become soft and partially retain the clay plasticity.

The hearth structures are found beneath greyish burnt remains composed of loose ash, charcoal fragments, reddened soil lumps and large amounts of burnt bone fragments and
lithic artefacts. Sometimes thick stratified burnt remains separate a series of hearth structures (Figure 3). The boundary between the hearth structures and underlying ashes is sharp, straight and smooth (Figure 5a). However, the upper boundary is not so obvious and only a straight dark line separating the overlying burnt remains is sometimes visible (Figure 5a). In the case of Hearth 50, layer IV, the top millimetre of the upper boundary has a darker red colour as compared to the rest of the material. Hearth 41, layer IV, seems to consist of at least three distinct sub-layers of a thickness of 2 cm each (Figure 5a). Their boundaries are sharp, clear, and also delineated by a dark line. All the sub-layers contain a few visible coarse fragments of variable composition.

**Microscopic examination**

Using micromorphological techniques it was possible to examine five of the hearths (no 12: layer IIIc, no 41: layer IV, no 50: layer IV, no 63 and 63a: layer III”) and their overlying and underlying burnt remains. Under the microscope the lower boundaries of the clay structures appear straight and mostly sharp (Figure 5d). The burnt remains are loose and porous, whereas the overlying clay structure is compact and massive. There is no sign of disturbance or mixing of the two contrasting materials. The upper boundary is locally more diffuse at a microscopic scale (Figure 5b). The overlying calcitic ashes impregnate the upper millimetres of the hearth structures giving them a calcined appearance.

The boundaries of the sub-layers in Hearths 41 and 50 are very sharp and smooth at a microscopic scale. In addition, a ferruginous line separates the sub-layers, together with several large polyconcaive voids on their lower boundaries. In some cases the voids are also impregnated with ferruginous material (Figure 5c). All these features imply certain conditions of manufacture, discussed later in the text.

The body of the hearths is composed mainly of reddish clay with a dense and very homogeneous appearance and with very little porosity except for a few dispersed vesicles and large voids (Figure 6a). In most cases prominent horizontal fissuring is present that also bears
Figure 5. Polished resin-impregnated slab of a section of a clay structure and the enclosing sediment a) and microphotographs of their contacts: b) Upper contact showing light grey ash crystals impregnating the underlying clay structure. Note the dark appearance of the clay aggregates due to burning (crossed polarised light). c) Contact between two sublayers of the clay structure marked with ferrous oxide coatings (black) and large polyconcave voids (white) (plane polarised light). d) Lower contact between the dense clay structure and the underlying porous burnt remains (plane polarised light).

Figure 6. Microphotographs in crossed polarised light of a) clay structure showing chert (white-dotted crystals) and quartz fragments of sand and silt sizes (white crystals) in a stratified clay matrix, b) terra rossa soil with silt-size quartz (white crystals) and c) red palaeosol with sand-size chert fragments (grey dotted crystals) in a stipple-speckled clay matrix.
signs of ferruginous coatings. Such a feature cannot be attributed to artificial cracking during the excavation, or be due to the preparation of the thin sections, but should be related to the manufacture, or heating procedure (see below).

The coarse component of the hearths consists of large amounts of evenly distributed fine sand- and silt-size chert fragments, quartz and, more rarely, exotic materials (schist, basalt, etc.) (Figure 6a). Note that no burnt remains, such as charcoal fragments or ash crystals, were found inside the clay layers. The clay itself has relict oriented fabrics that are attributed to soil-forming processes, i.e. granostratified and random striated fabric and fragmented layered clay coatings (Figure 6a). Some iron nodules cementing chert fragments are also attributed to relict soil features. The most interesting characteristic is that both sub-layers are completely decalcified. The above features strongly indicate that the material comes from a relatively mature red soil developed most likely on a schist-chert formation, or from an area very close to such a formation.

The upper sub-layer of Hearth 41 differs from the lower sub-layer in that it is less decalcified, less clayey and contains less exotic materials. Many very fine plant imprints and some altered bone fragments are also observed in the matrix of this sub-layer. The material could be derived from a more immature soil or from an area that is closer to the limestone bedrock.

The burnt remains above and below the studied structures consist mainly of lozenge-shaped calcitic crystals attributed to wood ash crystals (Figure 5b). The presence of some plant pseudomorphs of calcitic ash suggest minimum disturbance of the burnt remains. Burned soil lumps, charcoals and a large amount of bone fragments showing varying degrees of burning are important attributes of the burnt remains.

**Mudflow**

It was obviously important to establish that the clay-pan was not formed *in situ* as a result of natural formation processes. A sample of a recent mudflow on the floor of the cave was studied as reference material with regard to the process of natural accumulation of clay inside the cave. The mudflow layer covers part of the floor of the cave without creating a particular shape. It has a thickness of about 3 cm and a brownish colour. It is quite coherent but less compact than the hearth structures. It also contains a higher amount of coarse fragments.

Although the mudflow layer appears in the field as having a sharp lower boundary, in the microscope there is a mixed horizon about a centimetre thick. This horizon consists of loose fragments both from the underlying ash-rich sediments and the overlying clay-rich sediments. In addition, the sediment of the mudflow consists of a mixture of soil aggregates from different sources in addition to several fragments of burnt bones. The different components reflect the process of formation and deposition of the mudflow. A slurry of brownish immature soil from above the cave has incorporated limestone fragments from the bedrock and from the cave walls and was mixed with cave sediment during its deposition on the cave floor. Several of the so-called exotic materials also occur in the mudflow matrix. Part of this material should be air-born sand and dust, in addition to an admixture of previously deposited material. In addition, fabrics that characterise mature soils are not observed. All the above features are normal for natural processes occurring in the environment of Klisoura cave. Nevertheless, none of them characterise the hearth structures, as described above.
Locating the source of the raw material used for the hearths.

The limestone hills above the cave are highly karstic. They are characterised by deep solution runnels and flutes that are due to runoff on bare rock surfaces. Most of the soils are immature, rich in fine limestone fragments, but some dark red mature terra rossa pockets do rarely occur. Under the microscope the fine mass of these terra rossa soils is composed of clay with a weak stippled-speckled appearance. Most interestingly, the coarser content consists of quartz and chert fragments with sizes below 20-30 microns (Figure 6b). It is obvious that the coarse component has typical dust sizes attributed to long term aeolian transport (Nickling 1994: 309) and thus should be air-borne material. It is interesting to note that, based on particle-size distribution, Macleod (1980) has proposed that several of the terra rossa soils of the Eastern Mediterranean have developed on blown dust. The terra rossa soil of the hills above the cave contains a high amount of air-borne fine silty material. Wherever it is less mature, it contains in addition a range of limestone fragments. Neither of these features was observed in the clay of the hearth structures. However, the soils on the plain eventually incorporate a terra rossa component from the erosion of the surrounding hills. This process is more prominent near the foothills where the cave is located.

The floodplain in front of the Klisoura gorge is an extended and heavily cultivated alluvial plain. Its drainage basin includes a variety of rock types i.e. limestones, slates, schist-chert formations, and basic igneous rocks. Down towards the plain, about 1 kilometre away from the cave along the banks of Berbatio River, two remnant alluvial paleosols were identified, about 1 and 2.5 m respectively below the present ground surface. These paleosols are immature reddish soils and the oldest one is locally quite decalcified. They contain an appreciable amount of coarse fraction of all the rock components found in the area and resemble in that respect, the clay of the hearth structures. The groundmass of the red paleosols is composed mostly of microcrystalline calcite, but there are also areas with stippled-speckled clay and partial granostriated fabric (Figure 6c). These features were also observed in the clay hearth structures. We conclude that a rather mature red alluvial soil from the floodplain, resembling the red paleosol, must be the source of the raw material used in the clay hearth structures.

Heating temperature

The temperature of use of the hearths was studied by heating samples of the raw red paleosol from which they were thought to have been made. Fourier transform infra-red spectrometry (FTIR) was used to identify changes in the fired clay as a function of the firing temperature (Shoval, 1994). FTIR spectra of the pre-fired red paleosol samples and samples of the clay hearth structures no 112 and 68 are shown in Figure 7. When the soil samples are heated to 600°C the characteristic double peak of the clay mineral kaolinite at 3700 and 3620 cm⁻¹ (Russel & Fraser 1994) disappears. In addition, the intensity of the major clay peak at 1034 cm⁻¹ decreases, whereas the peaks of quartz at 1084 cm⁻¹ and the doublet at about 800 cm⁻¹ are relatively enhanced. The 914 and 536 cm⁻¹ peaks of the clays also disappear (see also Freund 1974). The clay hearth structures of Klisoura had not been heated above 600°C as the kaolinite is still present (3700, 3620 cm⁻¹ doublet), as well as the clay peaks at 914 and 536 cm⁻¹ (Figure 7). It is worth noting that FTIR is very sensitive to the presence of even small amounts of kaolinite (Farmer 1974: 355). The complex peak series at 1700 to
Figure 7. FTIR spectra of hearth samples and red paleosols heated at different temperatures.

Figure 8. DTA curves (30 to 1000 °C) of hearth samples and paleosols pre-heated at different temperatures.
1200 cm\(^{-1}\) is ascribed to the presence of organic material in the raw soil sample and is not observed in the hearth samples.

Differential thermal analysis (DTA) curves from preheated soil samples and hearth structures confirm the results obtained by the FTIR analyses (Figure 8). The sharp exothermic peaks at 350 to 400°C of the raw soil samples are not observed in the hearth samples. They are related to the presence of organic matter and are destroyed when the samples are heated to 400°C. Decomposition endotherms in the range of 500 to 700°C are attributed to the dehydroxylation of different clay admixtures (Cole & Hoskins 1957). It is observed that the clay endotherms shift to lower temperatures as the firing temperature increases (Figure 8). Prior heating had caused partial dehydroxylation of the clays (c.f. Vandiver et al. 1989). The hearth curves when compared to the soil standards suggest that the firing temperatures were certainly above 400°C and below 600°C. Pawlikowski et al. (2000) reported a hearth without kaolinite suggesting that the firing temperature was above 600°C. It is possible that some of the hearths were heated marginally above the decomposition of kaolinite at about 600°C. It should be also noted that experimental partial rehydration of the fired raw material by soaking it in water and drying it in the open air did not produce any change in the FTIR spectra and DTA curves.

**Discussion**

The main evidence that supports an intentional preparation of the clay hearth structures is:

- The shape and dimensions of the clay structures are more or less constant. In particular the clay rims of the structures strongly suggest an intentional construction.
- The geometry and characteristics of the boundaries of the structure are straight and smooth and there is no evidence of erosional contacts, despite the juxtapositioning of very different materials.
- Some structures consist of homogeneous, distinct, and unique sub-layers, each one implying a different and homogeneous natural source of material.
- The source of the material of some of the sub-layers that make up the structures is derived from an area away from the cave.
- No evidence for any kind of natural process that can account for the formation of the hearth structures was found. In particular, there is no sign of incorporation of any burnt component inside the clay structures that would imply colluvial or rain-wash processes.

The obscure horizontally layered structures in parts of the hearths and the vesicular porosity are characteristic puddling effects from wet conditions of manufacture (Courty et al. 1989: 125). The ferruginous boundaries between the different sub-layers of the structures, as well as the large polyconcave voids also lined with ferruginous material close to the boundaries, imply iron movement under conditions of water saturation (c.f. Courty et al. 1989: 151-153; Bullock & Thompson 1985: 41). However, cave moisture absorbed by the clay after being heated may have also played a role in the movement of iron (Macphail 2004, personal communication). The clay material was brought to the site and after wetting it was carefully puddled and shaped in place. It is not sure if the plant material in some of the sub-layers was deliberately added as a stabilising material. The plant imprints are generally shorter than a few millimetres, something that is normally not found in more recent analogues. From the hearth structures studied it seems that there were no: more than two or three reconstructions
or repairs. In most cases the hearth was filled with ashes and a new hearth was built above the old one.

There are no signs of intense heating of the hearth structures. Microstructural changes, such as the formation of a glassy phase, or a loss of most of the original clay characteristics, have not been observed and the inherited pedogenic features seem to be intact. FTIR and DTA experiments suggest that the clay structures were heated to between 400 and 600°C, which are typical surface sediment temperatures generated by campfires (Bellomo 1993). Moreover, the clay hearth structures are quite friable and cannot be moved without breaking into small pieces. Actually, there are clay structures that still retain some of their original clay properties after being wetted. It is therefore reasonable to assume that the clay was not pre-fired. Burning of the fuel material above the hearth structure could have enhanced the reddish coloration, the horizontal fissuring and the desegregation of the material of some of the hearth structures into small grains (Ulery & Graham 1993).

The undisturbed burnt material associated with the hearth structures suggests that the primary and probably the only use of these structures was as firing or cooking places. Indeed, the calcined appearance of the top of some of the structures and the associated large amount of wood ashes, burnt bones, burnt plant remains and seeds (Koumouzelis et al. 2001) support this interpretation. However, we were usually not able to precisely differentiate in the field the boundary between the contents of the clay structured hearths from the rest of the interstratified ash remains. In contrast, under the microscope it was possible to define the undisturbed part of the ashes that are associated with the structures and confirm the existence of burnt bones and charred material inside them. In addition, one of the few samples that were collected from the content of the clay hearth structures yielded phytoliths of starches of seed grasses (Hearth 18), probably of Graminac, which suggests that the structure was used for roasting grains of wild grasses. Hearth 13 contained silica phytoliths from inflorescence parts indicating that the fire was made in the spring or autumn (Koumouzelis et al. 2001). The majority of the identifiable bone fragments was not found inside the clay structures, but in the surroundings around the hearths area. The study of the faunal and plant remains of the upper part of the Aurignacian sequence did not reveal any differences between the clay hearth structures and the rest of the ash remains. However, we should take in account that the burnt remains in the hearths probably record only the last few burning episodes in an occupational season since frequent cleaning of the structures could have taken place. Actually, only a few centimetres of mostly undisturbed burnt remains separate some of the superimposed structures. In general, most of the bones associated with the hearths are of fallow deer and hare and of the birds Rock Partridge and Great Bustard. Burnt seeds of edible plants like Chenopodium sp. (goosefoot) and fruits of Polygonum sp. (knotgrass) were identified in the upper Aurignacian layers (Koumouzelis et al. 2001), but it is not possible to determine if they were being cooked.

On the basis of ethnographic as well as archaeological observations it has been suggested that some small fireplaces with repeated accumulations of burnt remains could have been used as special hearths for cooking purposes (Meignen et al. 2001). In these hearths the fire would be used in the incandescent stage and not during the flaming stage. These fireplaces were probably satellite fireplaces with their burning fuel actually brought from principal fireplaces located elsewhere in the site (Meignen et al. 2001). The above interpretation fits
well with the relatively small size and constant shape of the clay hearths in the Klisoura cave, the low firing temperature of the underlying clay structures, and the associated burnt food remains. Indeed, the intercalation of burnt remains related to the clay hearth structures with other more expanded and thickly stratified burnt remains supports the scenario of principal vs. satellite hearths. It is estimated that about four to six clay hearth structures might surround an unstructured one (Figure 9 for an example), but it is not always possible to definitively relate each clay structure to a particular unstructured hearth. This is the case of the unstructured

![Figure 9. Clay hearth structures filled with ash surrounding a thick and relatively more expanded accumulation of burnt remains. The whole configuration was revealed after careful excavation of a single occupational level (layer IV, lowermost Aurignacian). Note: H.# = number of hearths.](image-url)
hearth 14a, layer IIIg (not shown here) which is actually a complex of unstructured hearths that represents repeated accumulations of burnt remains of a thickness of more than 20 cm. This complex is located in squares A1-A2 (Figure 3) and it covers an area of about 1 m². The hearth is surrounded by several clay hearth structures that certainly are not found in the same level and some of them may be associated with other neighbouring unstructured hearths.

As mentioned above, the picture of the Aurignacian hearths differs substantially from those of the Middle Palaeolithic. The Middle Palaeolithic hearths are unstructured and composed of colourful sequences of altering thin white ash layers and black charcoal-rich layers that represent discrete repeated episodes of burning (cf. Courty et al. 1989). The preservation of these discrete intact features can be attributed to the absence of trampling and probably the intermittent use of fire. One possible explanation would be that visits to the site were infrequent or spasmodic. In contrast, the thick accumulations of ash in the Aurignacian layers might imply more intense occupation and more continuous use of the fires. The associated large number of clay hearth structures is consistent with this possibility. Interestingly, clay structured hearths were not found in any of the layers overlying the Aurignacian.

Vaquero & Pasto (2001) and Meignen et al. (2001) considered that Upper Palaeolithic hearth-related activities differed little from those of the Middle Palaeolithic. However, the data from the Klisoura cave show that new aspects of fire-making activities are introduced at the beginning of the Upper Palaeolithic. Building permanent hearth structures with a certain style, repairing and reconstructing them, is probably part of setting up a memorable place (cf. Gamble 1999: 400-402).

Conclusions

The Aurignacian layers of Klisoura cave 1 contain several basin-like clay-lined structures. Consistent shape and dimensions, straight, smooth boundaries and lack of erosional contacts, internal microstructure, a homogeneous extraneous source of the construction material and lack of cave sediment admixtures, all indicate an intentional use of clay for the preparation of the structures. The study of the microstructure of the clay material suggests that the clay was brought to the site and after wetting was puddled and shaped in place. The source of the material used for the clay structures was most likely clay-enriched soils from the floodplain in front of the Klisoura cave. Application of micromorphological, thermoanalytical and spectrophotometric techniques suggest that the clay structures were heated to temperatures of 400 to 600°C. In addition to the low temperature of heating, the association of the clay structures with undisturbed, microscopically intact wood ashes and food remains implies that they were used as hearth structures for cooking purposes. The use of clay in the beginning of the Aurignacian in the Klisoura cave 1, Greece, at about 32-34 kyr BP, precedes the manufacture of clay figurines and kilns in Dolni Vestonice and the Middle Danube Gravettian (Pavlovian) dated to 26 kyr BP.

The hearth skills that are revealed in Klisoura cave 1 provide new information on social life at the beginning of the Upper Palaeolithic.
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References


