Excursion Guidebook

Flint Production and Exchange in the Iberian Southeast, III millennium B.C.

by

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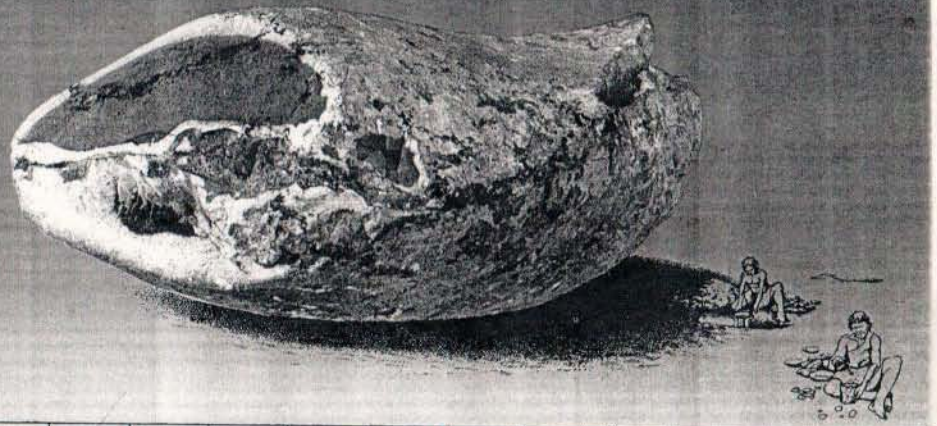

VI INTERNATIONAL FLINT SYMPOSIUM

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STOP 13. COMMENTS ON SILICEOUS ROCKS IN THE GUADIX-BAZA BASIN

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The Guadix-Baza Basin has been differentiated as such since the Upper Miocene and maintains an almost continuous sedimentary series from the Upper Miocene to Pleistocene.

This basin becomes continental from the Turolian (Cuevas *et al.*, 1984). Fluvial and lacustrine sediments, often remaining subhorizontal, can be found in the whole basin. Siliceous rocks found are associated with Pliocene materials, but in different settings.

In accordance with data offered by Soria *et al.* (1987), siliceous rocks ("flints" according to the authors) are located in the Middle Member (Pliocene), sections 2B, 2C and 2E.

Section 2C, which displays the highest flint content, corresponds to $T^{B}_{2}c$ terms on the geological map of Orce (Baena *et al.*, 1977a), defined by micritic limestones and white marls.

In Cerro de los Pedernales, many types of siliceous rocks can be found. According to data offered by the above-mentioned 1:50,000 geological map of Orce, this assemblage is located in $T^{B}_{2}c$ formation.

The sedimentary series is mainly formed of marls, limestones and very thin layers of sepiolite (fig. 38). Ostracod and gastropod remains appear but are highly localized. The most common texture is micrite with lenticular pseudpmorphs of gypsum crystals.

Three different types of siliceous rock can be defined:

1. Opal
2. Chert
3. Diatomites

1. Opals make up 90% of siliceous rocks. Their mineralogy is mainly opal-CT. Texturally, they can be defined as massive, although they display innumerable lenticular pseudomorphs of gypsum crystals. The opals vary in colour depending on their percentage of host rock relics, becoming white when pure and black when organic matter is included. The most common host rock is micrite with pseudomorphs of gypsum crystals. These opals do not display ageing to quartz, and quartz cementation processes are localized and few.

2. Cherts are very sparce. They are formed of calcedonite and microcrystalline quartz in a puzzle with undulating extinction. The opaline relics contained reveal that they are produced by ageing of bio-siliceous sediments (diatoms and silica spicules).

3. The diatomites form a very thin layer (<10 cm) in the upper part of the series (fig. 38), associated with a layer of organic matter and also forming layers of milimetres, which are randomly distributed between micritic limestones. These are continental diatomites, and detailed study of them is being carried out.

These diatomites could be part of the silica source needed for the intense silification processes of these sediments.

In accordance with compositional and textural characteristics found in the rocks of this series, opals can be interpreted as silcretes, while cherts could come solely from ageing of diatomic layers. Considering that we are dealing with Pliocene sediments, this ageing took place very rapidly.

The original sediment was probably micrites with ostracods and gastropods and sporadic thin layers of diatomite. On these sediments, formed in a shallow environment, intervals of gypsum crystal growth, carbonate substitution forming calcrete, and occasional dolomitization took place in draining stages. Subsequently, silification would seal all subaerial transformations and opaline silicretes would represent the final state of subaerial evolution.

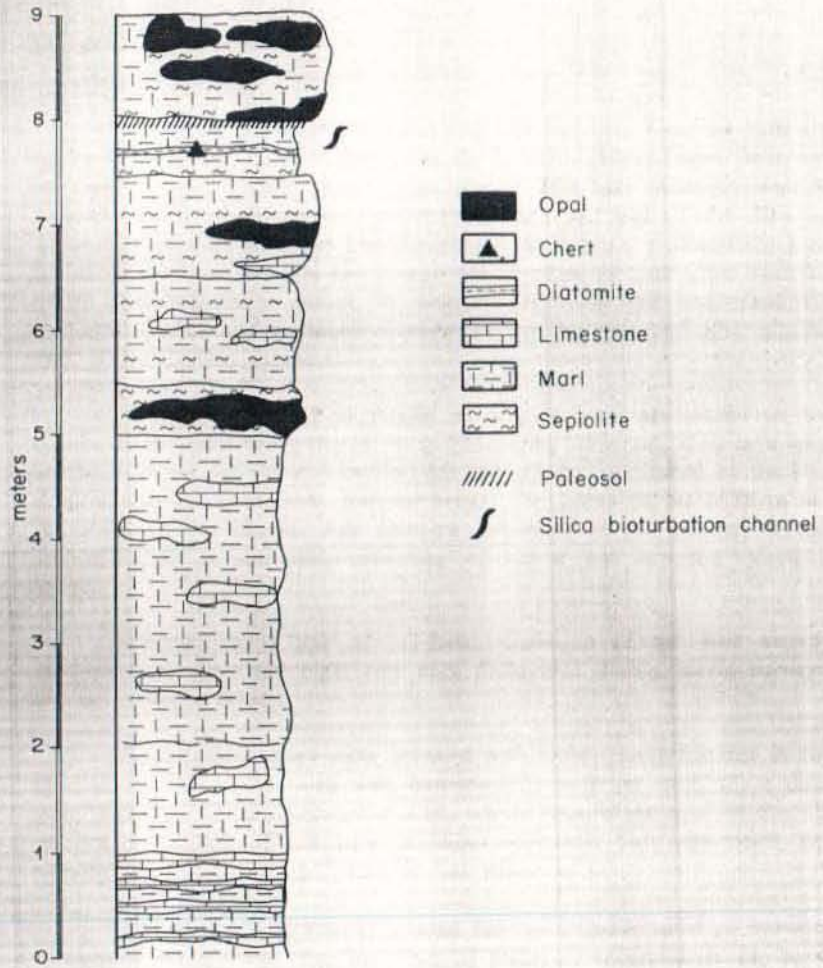

Fig. 38
Siliceous rocks in the lithological section of Los Pedernales.

stream is the watercourse that presents the best developed secondary deposits of siliceous rocks transported from Sierra de Orce y María. Its headwaters in the Periate Pass is abundant in flint and radiolarite outcrops (Morata, outcrops 18-20; La Venta outcrops 14-16; Yunco, outcrops 11-13) (fig. 8).

This stream deposits its materials at its confluence with River Cúllar. Lithological analyses of siliceous rock clasts found in stream deposits show the petrographic variety of flint provenances.

These secondary deposits had already been exploited in Paleolithic times. Only some 4 km from El Malagón, settlers collected clasts and Paleolithic artefacts of flint and radiolarite in this setting. So, it was a discontinually exploited supply source and, therefore, extensive exploitation. As in other Prehistoric and contemporary primitive contexts, we explain this exploitation as a result of an expedient economy.

The frequent existence of materials from these secondary deposits in El Malagón allows us to raise questions relevant to primitive cognition. The settlers of El Malagón clearly recognised siliceous rocks with intense states of weathering.

Since Paleolithic exploitations, it is evident that primitive cultures attained understanding of the natural phenomena related to these resources. Evidence of transportation of these siliceous rock fragments along the course of Rambla del Valenciano was definitely the natural indication that led settlers of El Malagón to discover the outcrop of la Venta. La Venta is a flint supply source, abandoned since Paleolithic times, which is easily accessible through the Periate Pass along the natural route of the same El Valenciano stream.

STOP 7. LA VENTA FLINT MINE

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Regional Geoarchaeological Surveys and Locating La Venta

The location of archaeological records corresponding to flint supply sources requires geoarchaeological survey planning. It is therefore necessary to consider the geological aspects of these rocks and the archaeological aspects of their exploitation.

Through geological maps of the Subbetic, these archaeological records have been located. La Venta is an association of outcrops J_{2-3} and J_3-C_{14}, the optimum geological setting for siliceous rocks (J_2-C_{14}) (figs. 8, 12, 13 and 14). Like the majority of these outcrop areas, La Venta is positioned in relation to the faults that affect Jurassic limestones, and so in a favourable enclave for access to the Sierra.

La Venta is located in Periate Pass, the regional setting of the Sierra with the greatest presence of supply sources (fig. 23). It lies at the headwaters of the stream of the same name (subsidiary of El Valenciano stream). It is possible to distinguish evidence of a water spring next to the flint exploitation area.

The first surveys of the site (1985) localized an artefact scatter, where the general structure of two large concentration nuclei could be recognised. The samples recuperated then are fundamentally lithic (flaked flints and a millstone). The results of this work led us to consider La Venta a III millennium B.C. flint mine connected with the settlement of El Malagón (Ramos Millán, 1987a and b; 1988).

Archaeological work was recommenced last year considering:

a) Recent anthropic activities had affected the structure of the archaeological record.

- Ploughing agriculture from the beginning of the last century to the middle of the present century (Cortijo La Venta). Material culture discard from the farm appears in the archaeological site in manure components produced in the cowshed. These components clearly define the agricultural horizon of the soil stratigraphy.

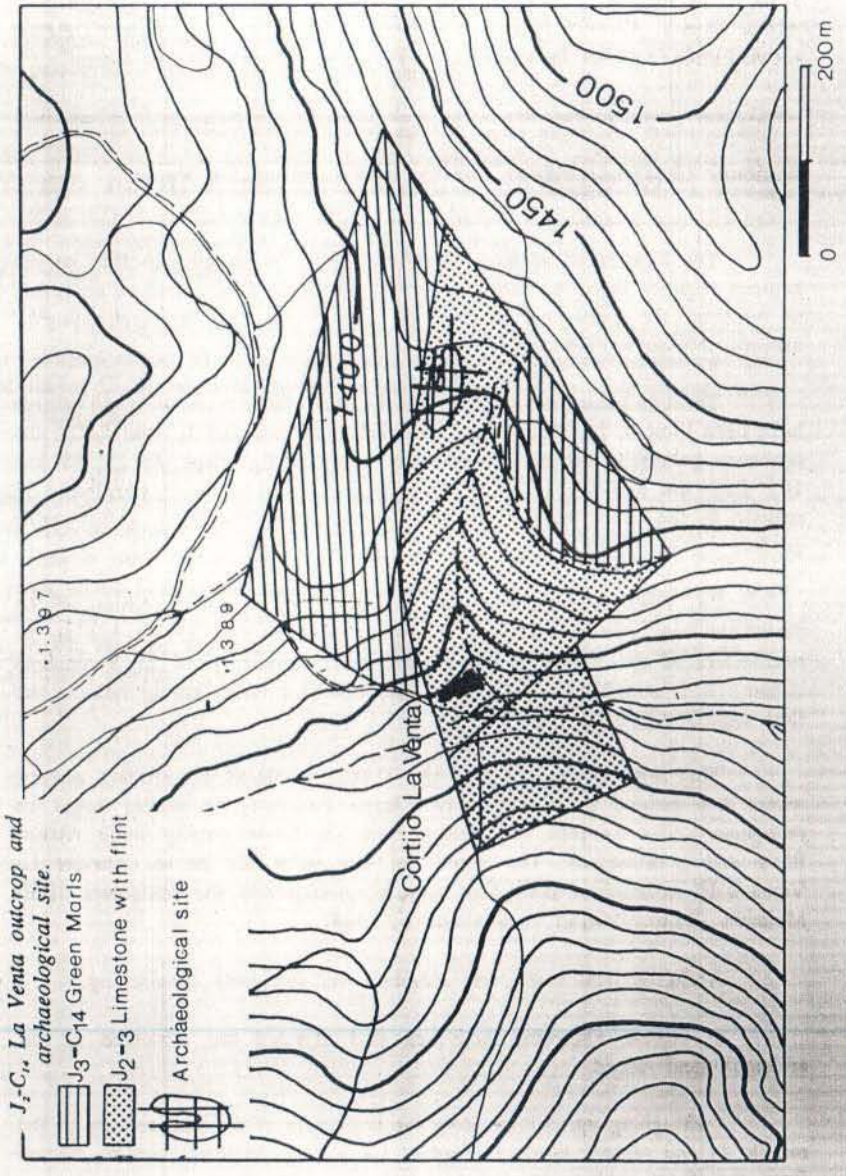


Fig. 23

-Forestry at the end of the 70's. Suitability of the terrain for pine plantation generated a topography of ridges which again affected the surface archaeological record.

b) The existence of two lithic concentration areas (A and B), detected in 1985 was, again considered and confirmed. The general structure of this lithic scatter could not be explained by recent anthropic activities. They represent, therefore, the first evidence that the present surface archaeological record maintains a close relation with ethnographic spaces where stone exploitation activities were carried out.

Interdisciplinary Research of the Archaeological Record

All archaeological research into the site has been carried out taking into consideration that the complexity of the problems presented could only be explained through turning to interdisciplinary methodology. This has been achieved through analytical liaison between archaeological, geological, geophysical and pedological readings (fig. 24).

The spatial and stratigraphic structures of the archaeological record have been researched with the following approaches:

1.- The spatial structure of lithic concentrations has been studied through selective intensive surveys. The method consisted of setting up four metre wide transects that cross the two lithic concentrations (A and B) in two directions (N-S and E-W). A total of five transects were set up in relation to the structure of these concentrations: lengthways transects running downhill in direction E-W (lengths 1 and 2) and three widthways in direction N-S (widths 1, 2 and 3). These correspond with the white strings on the ground.

2.- The basic stratigraphic structure of the archaeological record must correspond to surface lithic assemblages and filled depressions related to flint extraction structures.

a) Geophysical surveys.

- Precise magnetic surveys (7,000 m^2, area defined with blue strings on the ground) have detected a group of anomalies.

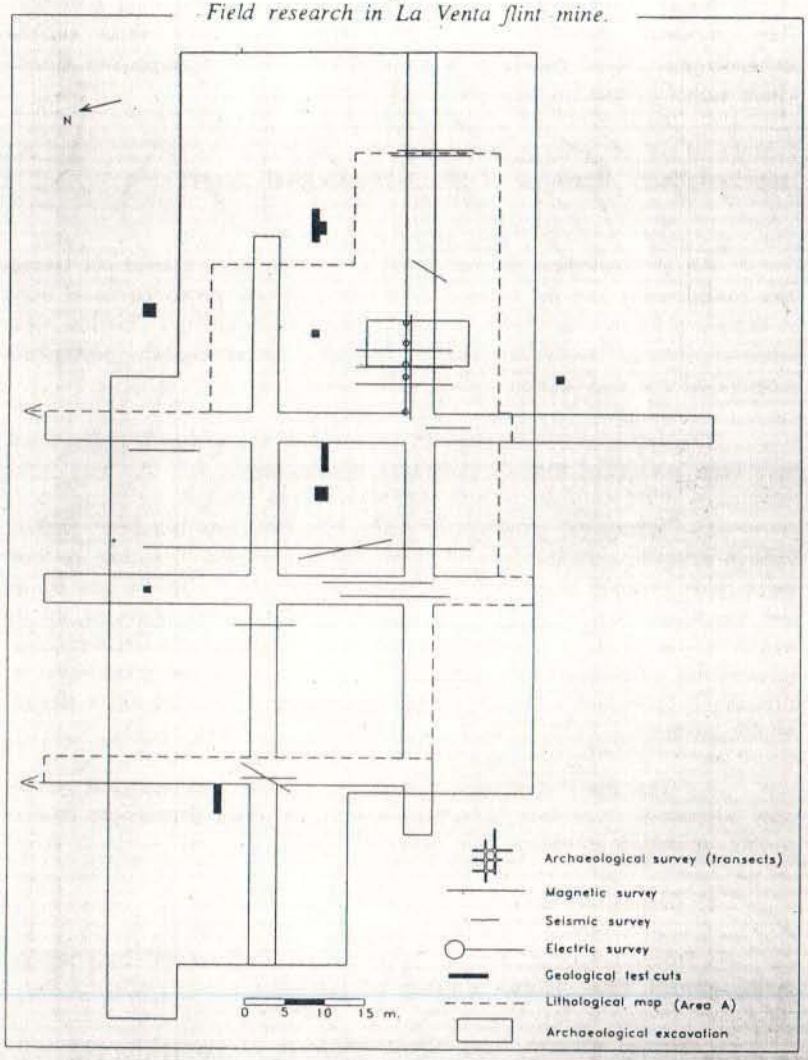
- Seismic surveys have offered readings of anomalous and non-anomalous geological settings (yellow string on the ground).

b) Geological surveys.

- Creation of a surface lithological map (1:20) whose results have led to 1:200 cartography of the site. Geological readings of the distribution

Fig. 24

Field research in La Venta flint mine.



of marl and limestone clasts and different siliceous rock lithologies led to a general geological reading similar to that offered by the 1:50,000 geological map (fig. 30) and determined the exact position of the exploited flint deposit.

- A series of geological test cuts confirmed these geological settings and validated the geological reading offered by the surface lithological map. The exploited flint deposit was located in the area foreseen by the lithological map.

c) Archaeological Research.

- The results of earlier approaches will lead to selection of an archaeological area particularly relevant for reporting on the sedimentary structure (spatial and stratigraphic) of the archaeological record. Area A presents circular magnetic anomalies, considered extraction structures, below the nucleus of lithic concentration A (fig. 33).

- The spatial and stratigraphic structure of the nucleus of lithic concentration A1 has been studied through detailed surveying and excavation of the stratigraphy of soil displaying lithic industries.

- This excavation was planned parallelly for detecting the top of the sedimentary filling of the depression and defining the circular morphology of its opening to the surface.

The Lithic Concentrations

The distribution of flaked flints displays a well-defined structure on the surface. The lithic concentration is structured in nuclei with successive peripheral strips. Fig. 25 shows the density of artefacts in each square meter in three periods. Nucleus 1 has the highest concentration and reflects the transport of fragments downhill through natural and anthropic processes (agriculture). This nucleus of the highest concentration branches off uphill to form two less concentrated nuclei which represent the source areas of nucleus 1. These two original nuclei have been considered as concentrations A and B. This whole structure displays at least two peripheral strips towards the edge, which represent the incidence of natural processes in the direction of the slope (transported by gravity), and anthropic processes perpendicular to it (ploughing and forestry agriculture).

Intensive surveys of the whole archaeological site and detailed surveying and excavations carried out on area A1 (see below) have allowed us to observe that ridges created by foresty agriculture have structured all surface archaeological features, which had already been affected by ploughing, into parallel strips of greater or lesser concentration.

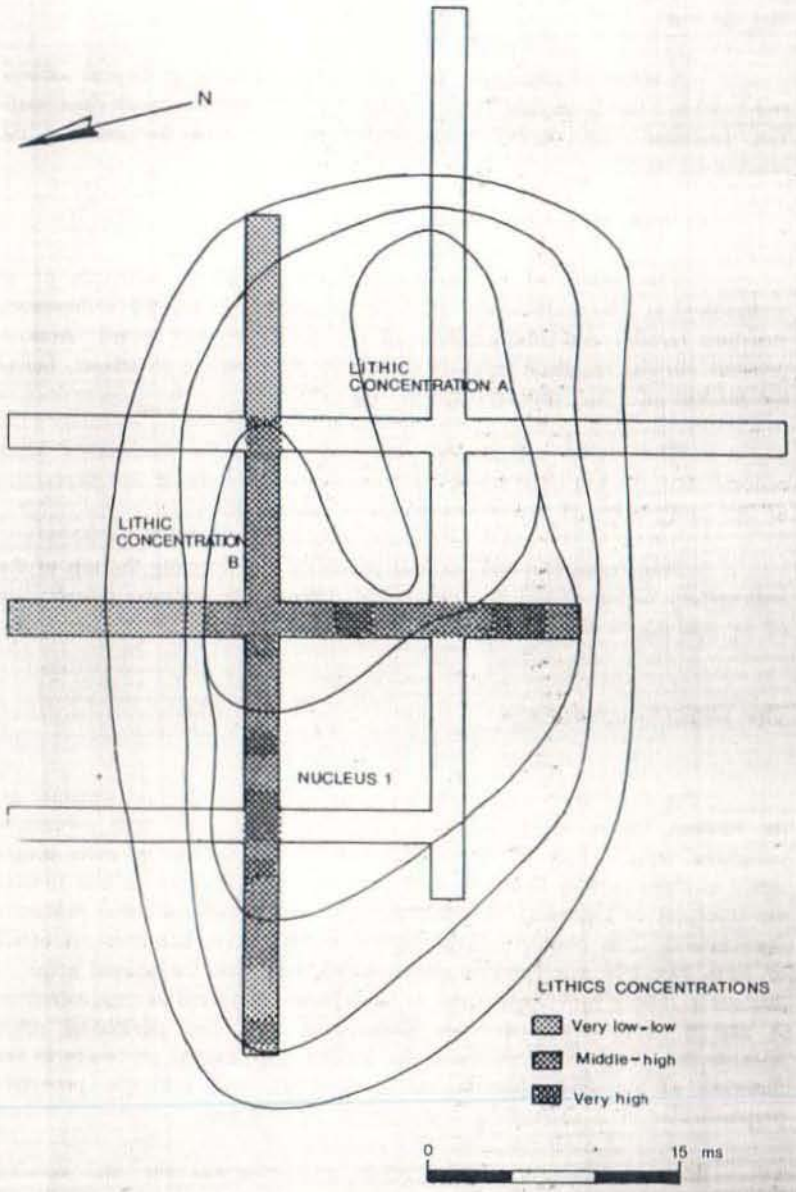


Fig. 25
Lithic concentrations in La Venta flint mine.

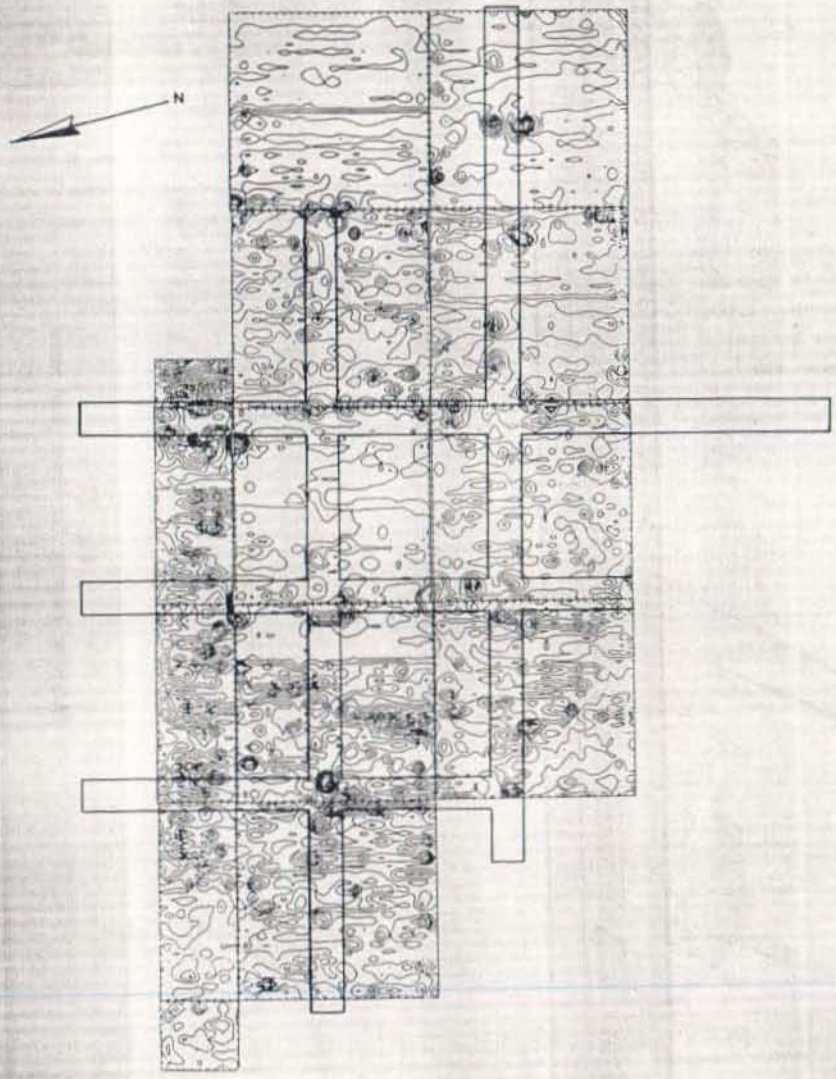


Fig. 26
Magnetic map of La Venta flint mine.

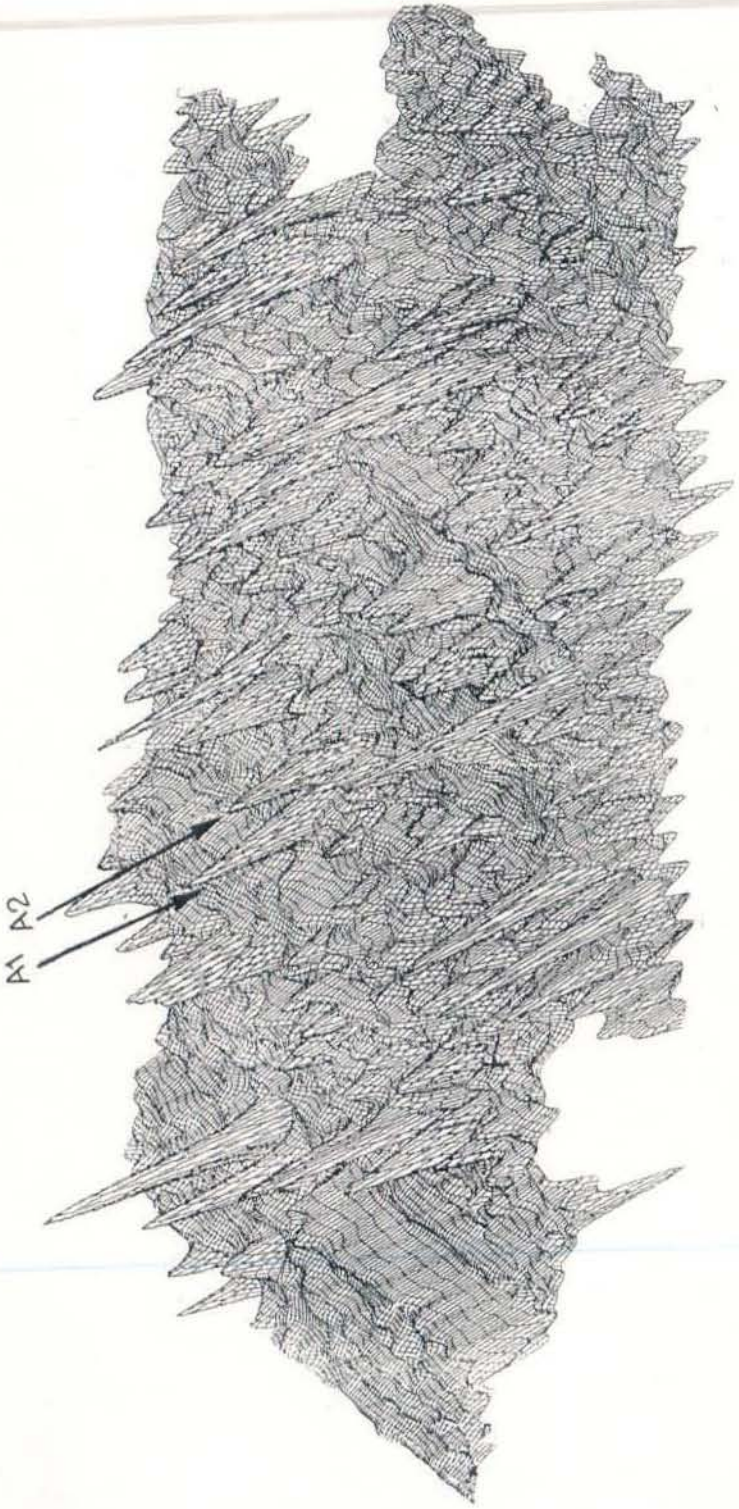


Fig. 27
Magnetic map of La Venta flint mine.

Lithic concentrations A and B could not be explained by the incidence of these natural or anthropic processes and therefore indicate the most relevant archaeological spaces for researching ethnographic contexts of Prehistoric exploitation. These industries have offered accurate information about the whole geoarchaeological structure of mining exploitation. They were the records that permitted intensive archaeology from the surface.

Geophysics in Subsoil Research

1. Magnetic surveys were carried out with a proton magnetometre, model Geometrics G-856, which measures the intensity of the magnetic field with an accuracy of a tenth of a gamma. The density of the wire netting is four meassures per square metre (detailed magnetometry). Magnetic surveys (area defined by blue string) have indicated subsoil topography where, in a general setting of depressions predicatably connected with regular circular morphology and are well defined in these isoanomalous contexts. The morphology was typical of extraction structures, with a pair of wide circular openings. These studies have led to different image analyses, which allowed data interpretation.

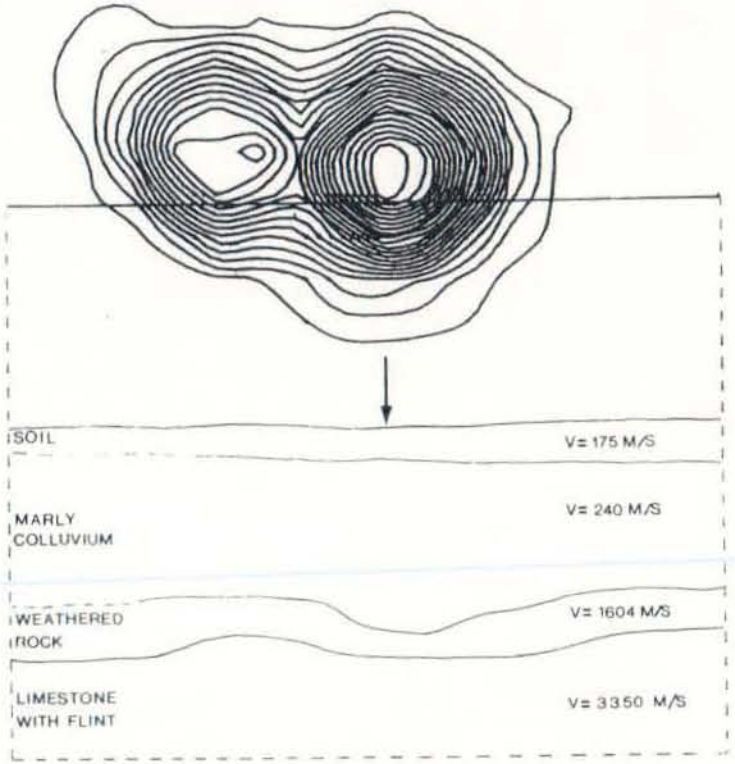


Fig. 28.
Seismic profile of the magnetic anomaly.

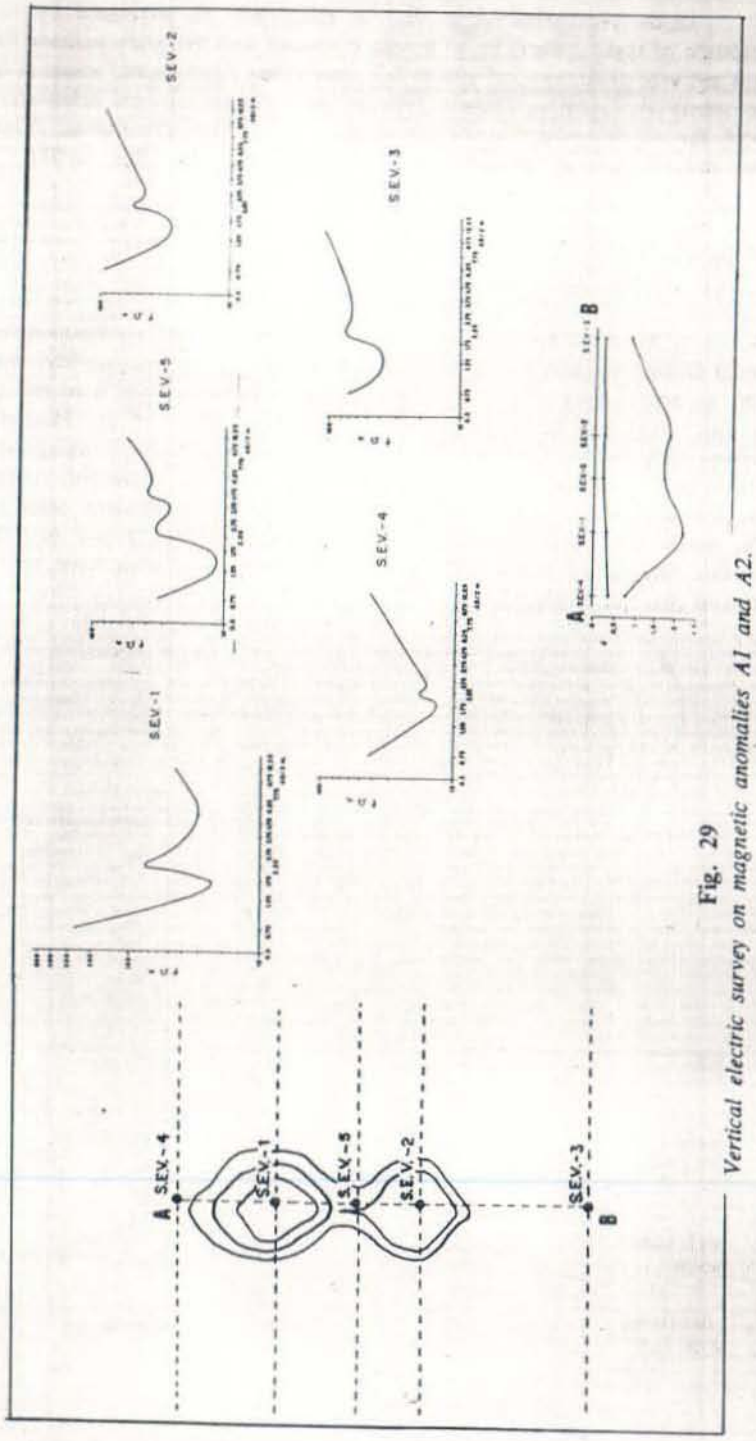


Fig. 29
Vertical electric survey on magnetic anomalies A1 and A2.

a) Contour maps through analysis of squares, with output in black (morphology of anomalies) (fig. 26), and in colour (intensity of anomalies), and through analysis of gradients to rectify and define the morphology of the anomalies to the greatest possible accuracy.

b) Isometric maps to persue the structural definition of subsoil topography (fig. 27).

2. Seismic surveys were carried out with a single channel seismograph, mark PASI s.r.l. model LCM-4, with 100 microsecond resolution; system of generating waves through shock by means of a 9 kg. hammer. On an aluminium plaque and on the magnetic anomalies, 15 seismic profiles were taken with direct and inverse approaches, in subhorizontal straight lines and span of between 9 and 15 m, allowing surveying to a depth of 3 to 5 m. The profiles obtained (yellow strings on the ground) offered a seismic stratigraphy whose lithostratigraphic readings were totally corroborated by the earlier geological drillings. Fig. 28 shows one of these readings on a magnetic anomaly,

3. Vertical electrical surveys was carried out after the explanations of magnetic data of the anomaly under research (area A1). These surveys consisted of precise vertical electrical surveys in points inside and outside the anomaly. For this reason, non-comercial equipment was used, developed by the Laboratory of Geophysics and Instrumentation of the Museo Nacional de Ciencias Naturales (CSIC) for specific archaeological survey work. Vertical electrical surveys carried out have Schlumberger configuration, calculated to reach an apparent theoretic penetration of three metres. Results have confirmed the anomalous state, offering readings of the depths of the depressions that represent these anomalies (fig. 29)

Flint Deposit Geological Research

Geological research has attempted to solve problems presented by the lithic assemblages. The raw materials could not have come from any surface deposit, and therefore could only be considered a mining resource.

The close relation that the lithic concentrations seemed to maintain with the space where Prehistoric exploitation took place, allowed it to be assumed that, as in other mines researched, La Venta displays a tripartite structure: lithic concentrations were positioned on top of the exploited flint deposit and, between these two phenomena, the flint extraction structures appeared. Therefore, the geoarchaeological structure in La Venta was considered to be due to the flint mine. The first confirmation of this structure was provided by magnetometric readings: as in other flint mines, geophysical research, a series of anomalies, presumably of anthropic origin, appeared under the transects set up on the surface in accordance with lithic

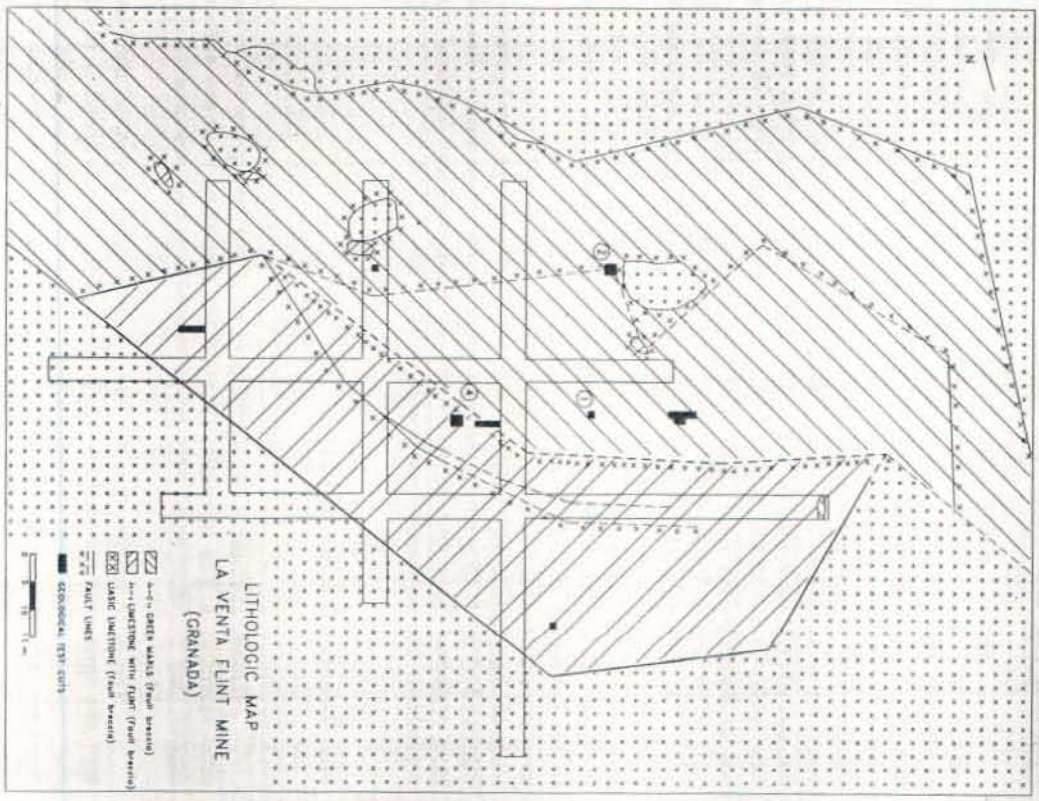
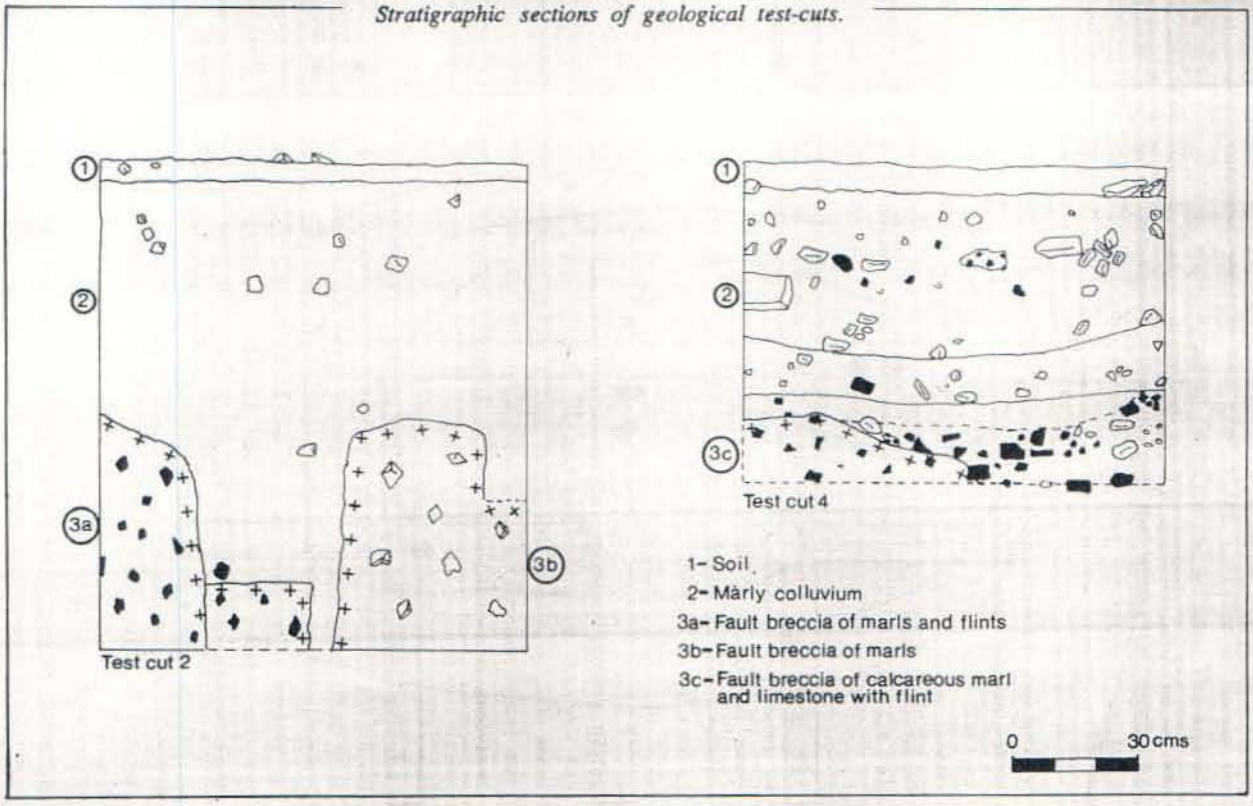


Fig. 30

Fig. 31

Stratigraphic sections of geological test-cuts.



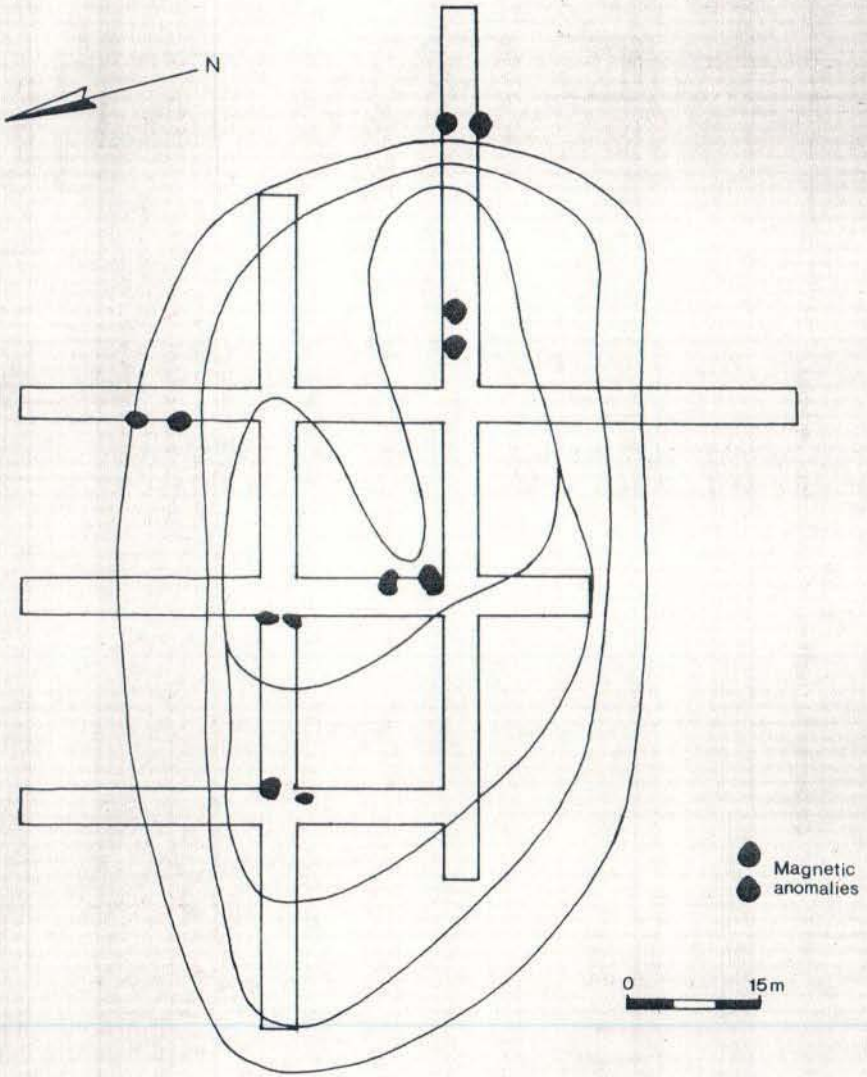


Fig. 32
Principal features of the archaeological structure of La Venta flint mine.

concentration distribution. This is how the exploited flint deposit was expected to be underground, below the lithic concentrations.

All geological research was carried out in order to locate the exploited flint deposit, which appeared flaked on the surface. The location of the flint deposit was a geological mining problem, and so it was approachable in archaeological terms through the waste that represented flaked industries. The artefacts discarded in flint exploitation displayed important lithological and structural characteristics of the deposit:

1.- Petrography of the artefacts indicated that tabular and nodular flints of three facies were exploited: Radiolarian and filament flints (jasperoid), filament flints and oolithic flints. In La Venta only this last lithology is represented in surface deposits of the western slope (lowest slope of the site). For this reason, exploitation of the great majority of flaked siliceous lithologies could only be explained by extraction of a rich underground flint deposit.

2.- The raw materials flaked were slabs and nodules of flint fractured to the size of large and small cobbles. Natural fragments of calcareous and siliceous lithologies of the western slope showed many microbreccias of techtonic origin. The geological setting of the exploited siliceous lithology displays nodular and tabular flint cobbles in the state of a fault breccia.

These archaeological proposals about the geological setting of the exploited flint deposit have directed all geological research. Analysis has integrated different readings of this setting: 1:200 topography, 1:2,000 aerial photography, petrographic analysis of siliceous rocks, surface lithological map scale 1:20, maps of magnetic intensities, seismic stratigraphy and geological test cuts (fig. 30).

The geological reading, expressed in scale 1:50,000 cartography (fig. 23), allowed us to observe that the archaeological site was located on an outcrop area J_2-C_{14} where the lower part of the column (limestones with flints mapped as J_{2-3}) displayed mechanical contact with the upper part (green marls mapped as J_3-C_{14}). The layout of this fault line seemed to fracture an apparent lithological continuity between one part of the column and the other. The limestone with flint outcrop (J_{2-3}) displayed clasts and artefacts on the surface corresponding to three lithologies.

- Radiolarian and filament calcareous marls with jasperoid flint in tabular structures.

- Filament limestones with flint in tabular structures. In Sierra de Orce y María, these correspond to the Dogger-Malm transit (Callovian-Oxfordian). They represent the upper flint deposit in La Venta.

- Crystalline and oolithic silicified limestone with nodular and tabular flint structures. These correspond to the Dogger (Bathonian-Bajonian) and represent the lower flint deposit.

It therefore seemed that in outcrop J_{2-3} of La Venta a continuous series of lithological facies was represented from the Upper Dogger to Lower Malm of Sierra de Orce y María.

In the Periate Pass faults in the Jurasic limestones are common and it is in these areas that outcrops J_2-C_{14} appear. All of this outcrop area of La Venta displays a mechanical contact with the cream and pink linestones of Lias (see below). These limestones, a tabular breccia zone oblique to the stratification of green marls (J_3-C_{14}) and limestones with flint (J_{2-3}), seems to be the base of all the outcrop that concerns us. Presence of a fault between the two outcrops, and in their contacts with the Lias limestones, makes the area a fault zone and the techtonic microbreccia phenomena, which siliceous rock fragments on the surface demonstrated, could therefore acquire some meaning. Geological documentation also predicted that limestones with exploited flint would be displayed in the form of a fault breccia.

The contrasts between geological settings of this fault zone were recorded in magnetic surveys. Through image analysis, the existence of three areas with greater or lesser magnetic intensity could be observed, separated by lineal layouts of clear structural character. So, in the archaeological site area, outcrops J_{2-3} and J_3-C_{14}, as different geological settings are present as techtonic blocks individualized through mechanical contact.

These structural readings of the geological setting gave way to an initial evaluation of the importance of faults in mining surveys. The different dispositions presented by the flint deposit, and therefore its differential availability towards one or other side of the mechanical contact between the two outcrops, would have to be considered.

Through work carried out, it can be observed that outcrop J_{2-3} displays the two flint deposits at an angle to the slope of the hill. The upper and lower flint deposits are exposed at the bottom of the slope in two successive zonal strips.

Geological test cuts show that under a marly colluvium formation, exploited limestones with flint appear in the state of a fault breccia (large and small blocks or pebbles of flint slabs). Weathering of the top of these breccias has generated a rich residual deposit where the flint slabs are free from the breccia (fig. 31, test cut 4). The top of the breccia offers itself, therefore, as an optimum geological setting for Prehistoric exploitation. Seismic stratigraphy of the magnetic anomalies could be considered like this: the top of the limestones with flint appeared eroded, hollowed out, displaying the absence of mining yield (fig. 28). As in other Prehistoric flint mines, the lithic industries were on the surface above the exploited flint deposit and, between one (archaeological) and the other (geological) phenomenon, are the magnetic anomalies which represent the filling of the extraction (fig. 32).

Siliceous Rocks

Geoarchaeological interest in this outcrop involved intensive petrographic studies combined with thin-section analysis and some hundreds of reflection and immersion exoscopic observations. Samples were recovered from surface residual deposits of natural and anthropic (Prehistoric exploitation) origin.

The Sierra de Orce shows three general types of siliceous rocks fig. 7): oolithic flint, filament flint and calcareous radiolarites, but only the two types of flint appear in La Venta outcrop. No geological section is visible on the site. However, geological test cuts have allowed us to deduce the existence of three parts: Malm green marls at the top, filament flints (upper flint deposit) and Dogger oolithic silicified limestone with flint (lower deposit).

The flint, included in oolitic limestones as nodules or beds, have between 5 and 30 per cent of host rock relics. The main allochems (oolites and echinoderm fragments) are replaced by microcrystalline and criptocrystalline quartz (<30 micras). The largest crystals of the microcrystalline mosaic show irregular form, and sometimes presents undulatary extinction. The calcite cement of the host rock is replaced by megaquartz (>30 micras) and calcedonite which show spherites up to 200 micras in radius. Silicification is selective and the latest replaced are the echinoderm fragments.

There are many kinds of flint with filaments because the textures of the filament limestone replaced are diferent. These limestones are biomicrites. The association of pellets and filaments is frequent, and sometimes radiolarian and echinoderm fragments may appear. The size and form of filaments are variable and are usually oriented forming laminae. Host rock relics in these flints range between 10 and 60 per cent. Pellets and micrite were replaced by criptocrystalline quartz and filaments and echinoderm fragments by microcrystalline quartz and calcedonite (spherulites up to 30 micras in radius). Calcedonite or greater size is also found in former cements. Locally there exist isotropic zones that can be interpreted as opal, although by XR diffration, quartz is the only mineral detected.

The Structure of the Archaeological Record. The First Archaeological Excavations (Area A1)

In the geological setting of the exploited flint deposit, the nucleus of lithic concentration A is found above a pair of magnetic anomalies, very probably of anthropic origin (A1 and A2). In this situation of great archaeological relevance, more intensive research of the problem raised was planned:

1. The influence of natural and recent anthropic processes to explain the nucleus of the lithic concentration.

2. Confirming the sedimentary nature of the depression filling top and its relation with flaked artefacts.

Approaches (fig. 33)

1. Geophysical

Magnetic, seismic and electrical surveys determined an oval based depression with two circular openings and some four meters in diameter each. The oval base of these structures displays the form of an irregular hollow, representing exploitation of the upper flint deposit top. Their depths are calculated between 2.5 m (vertical electrical surveys) (fig. 29) and 3.5 m (seismic surveys).

The extraction structures opened at the edge of the through which seems to separate this geological context ($J_{2\text{-}3}$) from block $J_{2\text{-}3}$-C_{14}.

2. Soil Stratigraphy

Excavation of the flaked lithic surface deposit required precise references to soil stratigraphy (horizons). At a point of high soil development in the marly colluvium, six pedologic horizons were defined. Only the first horizon is of archaeological interest. Horizon 1 (Ah_1, 0-11cms) displays flaked lithics. This is the horizon earlier affected by agriculture (ancient Ap) and that which has been systematically moved by forestry agriculture (ridges). It is a horizon rich in humus, of a dark brown colour and displaying a clear boundary with horizon 2. This horizon (2 Ah_2) displays a reddish-brown colour and greater compaction which makes it easily detectable in archaeological excavation. The boundary separating the two horizons (2-3 cm) is a compact transitional horizon, like horizon 2, but of a darker colour (humus), in horizon 1. Given that horizon 2 has not been affected by recent anthropic processes, it was predictable that the sedimentary filling of the depression would be in lateral contact with this horizon.

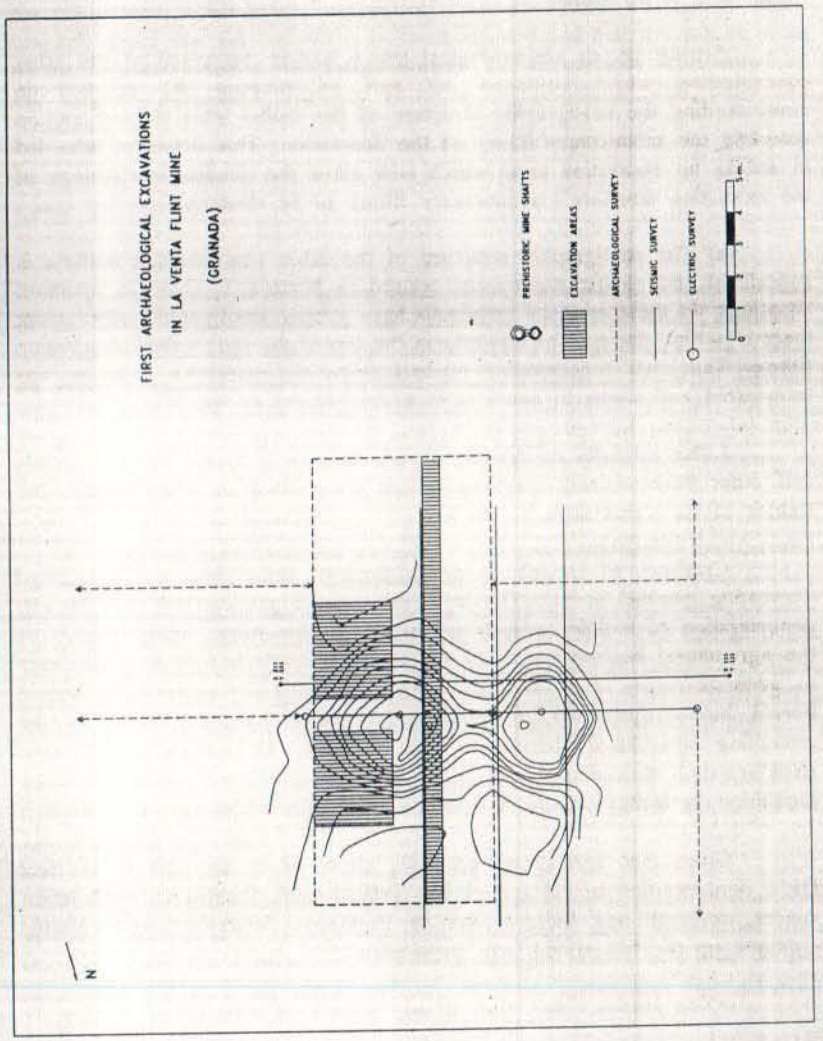


Fig. 33
Geophysical and archaeological field research on the anomaly A.

3. Archaeological Research

All of area A1 was the object of detailed surface surveys. This consisted of recording all material in 0.5 m^2 cells. The resulting distribution map referred to the surface topography of the ridges (microtopography, scale 1:10). The impact of this ridge topography on the surface lithic distributions could then be established.

Setting up an archaeological trench across the space of the lithic concentration which sectioned off half of anomaly A1 resulted in understanding the stratigraphic structure of the flaked lithic deposit and in detecting the sedimentary filling of the depression. This detection later led to setting up excavation areas which now allow the circular morphology of the extraction structure's sedimentary filling to be observed.

a) The stratigraphic structure of the lithic concentration nucleus is superficial and almost exclusively centred in horizon 1. Only in optimum situations do these artefacts appear to have greater stratigraphic importance; there is a high presence of artefacts in the top of the sedimentary depression filling. The lithic concentration nucleus above the extraction structure was transferred and seems to come from a few metres up the hill.

Lithic artefacts are concentrated in horizon 1, associated with sherds and other contemporary material culture transported in manure from the stables of La Venta farm to the site.

Creation of ridges through foresty agriculture has generated alternating parallel strips. The strip between ridges displays the highest concentration of mobile artefacts in the dip of the ridge, while the top of the agricultural horizon has been cut off (earth collection with a bulldozer to generate ridges at its side). The ridges display the agricultural surface buried below them. So, forestry agriculture had only affected to the ploughing agricultural horizon in parallel strips. All interest in anthropic transformation processes was centred on transformations brought about by ploughing agriculture in the subsurface archaeological record of artefacts.

Given that agricultural activities allow us to see that the surface lithic concentration nuclei are closely related with Prehistoric exploitation spaces, research into these nuclei as Prehistoric workshop areas should continue up the hill taking into consideration:

- The spatial distribution of the density of artefacts in horizon 1.

- The existence of more reliable stratigraphic contexts with presence of flaked lithics.

b) The top of the sedimentary filling of the magnetic anomaly displays a zonal structure predominantly of marly colluvium with some artefacts. This lithological matrix of the filling is obvious if we consider

that this colluvium represents sediment extracted to reach the flint deposit. Accumulated around the shaft openings, it would be the first and basic source area for their filling.

The colluvium displays flaked lithics and other calcareous and siliceous clasts related with prehistoric exploitation waste. These components are not present in the natural lithological context of marly colluvium. These are indications that the colluvium is re-sedimented and that the source areas of the depression filling had flaked lithics. The depressions represented by the magnetic anomalies therefore seem to be prehistoric flint extraction structures.

Lithic Industries

Long before III millennium B.C. mining exploitation, siliceous rocks of La Venta were exploited in the Paleolithic (fig. 34). Their industries were scattered on both sides of the headwaters of La Rambla de La Venta, on outcrop $J_{2,3}$. The artefact frequency on the surface is scarce in relation with the abundance displayed by other nearby Paleolithic sources, such as Periate and El Yunco (outcrops 17 and 12-13) (fig. 8). Artefacts show high development of white patina and indicate the same technological features as most paleolithic sources in the Sierra (Stop 8).

Raw materials extracted were large and small pebbles of nodular and tabular flint. Nodules (ovoid, spherical with or without ramifications) display two types of natural surfaces: surfaces of natural fracture and cortical surfaces. Blocks are rectangular, generally with 6 faces. The lateral facets are natural fracture surfaces of sedimentary-diagenetic or techtonic origin. These facets have surfaces streaked with calcite, quartz and manganese dendrites and sometimes with flinty microbreccias of techtonic origin.

The first flaking activities consisted of selection of raw materials. Some nodular or tabular blocks with large calcareous relics or with techtonic features were discarded.

All lithic production is by flaking. Preparation of precores consisted of first fracturing large pebbles into more manageable sizes. Preparation then continues with the elimination of natural surfaces. These activities do not necessarily eliminate all these surfaces, so core preparation finishes with progressive adaptation of fracture surfaces might function well as striking platforms and flaking surfaces.

Cores can display one or several striking platforms. Amongst cores discarded in the mine, it can be seen that the concept of exhausted core is strictly dependent on resource quality and on its constant adaptation for flake removal. The rupture of geometric relations that is required between

the flaking surface and striking platform is often a reason for discarding cores of great size.

Along with these cores, the presence of all waste resulting from flaking is abundant: cortical flakes, flakes of other natural facets, flakes resulting from striking platform rejuvenation. The only products which are absent are flakes blanks produced. As far as core flaking surfaces indicate. these flakes are wide and of large and medium size. They are the flakes found in the settlement of El Malagón.

The certain diversity of raw materials and interests in a not totally formal standardized lithic production led to a more irregular production of cores or precores, above all in relation to jasperoid flint slabs.

Flaking activities were carried out with flint hammers, reutilizing exhausted cores. These hammers are of different weights, with the aim of being usable for various flaking activities.

Amongst concentrations of lithic waste, only some chipped tools are found. These are, together with pottery sherds and the cereal millstone, a material culture related to subsistence activities for maintaining the expeditionary group in flint exploitation.

Evaluations of technological structures in the two lithic concentrations (A and B) do not exist yet. Both concentrations seem to reflect a clear spatial structure and therefore could be the result of two successive flint exploitation periods during the III millennium B.C. The different compositions they reflect, with regard to exploited resources and their different positions in outcrop area J_2-C_{14} of La Venta, indicate that the extraction structures of one and the other exploitation period gave access to different petrographic facies. It is proposed that the industrial groups of the two lithic concentrations correspond with the two phases of inhabitation of El Malagón.