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Inhaltsverzeichnis

 ISBN 3-902086-07-6

 ISBN 3-902086-07-6

SIDGEIPA: An Archaeological Information System

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Projects CICYT-FEDER IFD97-1207-C02-01 & IFD97-1207-C02-02

ABSTRACT
In our paper we discuss the different aspects of the process we have followed to develop a completely new software to manage Archaeological Parks. The software named SIDGEIPA (Distributed System for Integral Management of Archaeological Parks) includes different modules allowing user to store archaeological data from different sources (excavation, survey, scientific literature, museum collections...) and to process them automatically in order to simplify archaeological research. The new software has been tested in the AMAPA project (Archaeology and Environment of the first agriculturalist in Mediterranean Spain) including a full implementation of it at the excavation level in the Mas D'Is case (a Neolithic Impressed-Ware site). At the conference we will show examples of how the SIDGEIPA software is able to develop a Harrix Matrix and to model 3D reconstructions. Both Technical aspects and archaeological question will be presented and discussed. Examples of the software functionality will be exposed including Geographical Information Systems, Computes Assisted Design and database management. Development of the software have been possible to financial aid from the FEDER program of the European Union being consequence of the full integration of two research projects the Rural Archaeological Park implemented in the Alcaoia-El Comtat valleys (Alacant, Spain) and the Distributed System for Integral Management of Archaeological
Parks.

RESUMEN
En el artículo se presenta un nuevo sistema de información arqueológica: SIDGEIPA -SIstema Distribuido para la GEstión Integral del Patrimonio Arqueológico- SIDGEIPA va más allá de la adaptación de un Sistema de Información Geográfica a la Gestión del Patrimonio arqueológico. Las características más destacables de SIDGEIPA son: el estar desarrollado en código Java lo que implica su capacidad multiplataforma; automatización de la matriz Harris, se trata de una aplicación única con la que se pueden realizar todos los procesos informáticos relacionados con la gestión del patrimonio arqueológico (Dibujo asistido por ordenador, base de datos, procesado de imágenes y otros. Los datos que se presentan se realizaron en la excavación de dos yacimientos arqueológicos del Holoceno Inicial en la Comunidad Valenciana: el Mas D'Is (Penàguila, Àlacant) en realidad la primera aldea neolítica localizada en el Mediterráneo peninsular; y Mangraneres (Andilla, València), pequeño yacimiento al aire libre con niveles mesolíticos y neolíticos. Ambos se encuadrar dentro del proyecto AMAPA (Agricultura y Medio Ambiente de los Primeros Agricultores).

 ISBN 3-902086-07-6

SIDGEIPA: An Archaeological Information System

This paper is a short version of a forthcoming version in Spanish (Diez-Castillo, nd). In her we are presenting a new Archaeological Information System (AIS) we've been developing in the last three years1 a Power Point presentation about it available in http://www.uv.es/~amapa/.

The Archaeological Information System SIDGEIPA

The basic reason to develop and implement these AIS was the need to have a unique tool in order to manage our archaeological data. We were a little tired of dealing with different commercial programs to cover all our needs -CAD, databases, imaging process, design, statistical software, GIS software and so on-, so we were looking for other options to manage our data. SIDGEIPA try to be more than a Geographic Information System adapted to Cultural Resource Management, we have wonderful examples of that (citations). We were trying to have an integrated system able to deal with the data from the field to publication (this papers should be the first result of that). The main features of SIDGEIPA are: It is a Multi platform software because it has been developed in Java code; it has the ability to render 3D views through the VTK library, it is able to automatically build a Harris Matrix from its own database, it can be personalized, it is highly flexible, it has the ability to integrate its data in GIS (through Grass freeware) and Statistical package (R freeware).

Sidgeipa have been developed upon the experience of other archaeologically oriented software (like Archeodate, Stratigraphics). From a theoretical standpoint we took into consideration recent developments in Landscape Archaeology.

Data supporting our arguments came from the excavation of two Early Holocene open-air sites in the Mediterranean coast of the Iberian Peninsula: Mas D'Is (Penàguila, Àlacant) being the first farming village found in the West Mediterranean, and Mangraneres (Andilla, València) a little special purpose camp with layers from both hunter-gatherers and farming groups. In the latter the field data recording was completely realized with SIDGEIPA. In both sites our results were contrasted with traditional methods of recording data.

Time and space are two of the main elements of Archaeological Data. Space can be managed successfully with Geographic Information Systems applications (GRASS, MAPINFO, IDRISI,

5. - 6. November 2001 Archäelogie und Computer Workshop 6 ISBN 3-902086-07-6

ARCINFO...). This kind applications allow archaeologists to mapping sites, but more than that GIS systems have a complete set of tools to display and to analyze Spatial Data, some examples good examples of the contribution of GIS to archaeology and anthropology can be found in the literature since 1990 (Allen, et al. 1990, Gillings, et al. 1990, Kvamme 1990, Lock and Stancic 1995, Moscati and Tagliamonte 1998, Petrie 1995, Stoll 1994) until now (Mithen 2001, Stancic, et al. 2001), in them we can find examples of using GIS for environmental analysis and from preservation and planning. The entire above can be done by SIDGEIPA, as we will see later.

SIDGEIPA ARCHITECTURE

Sidgeipa is based on a Sever/Client architecture (see figure 1). As such the application is divided in two parts: one server where all the data from the sites will be stored in several databases and an undetermined number of clients that are to solicit different views of each site.

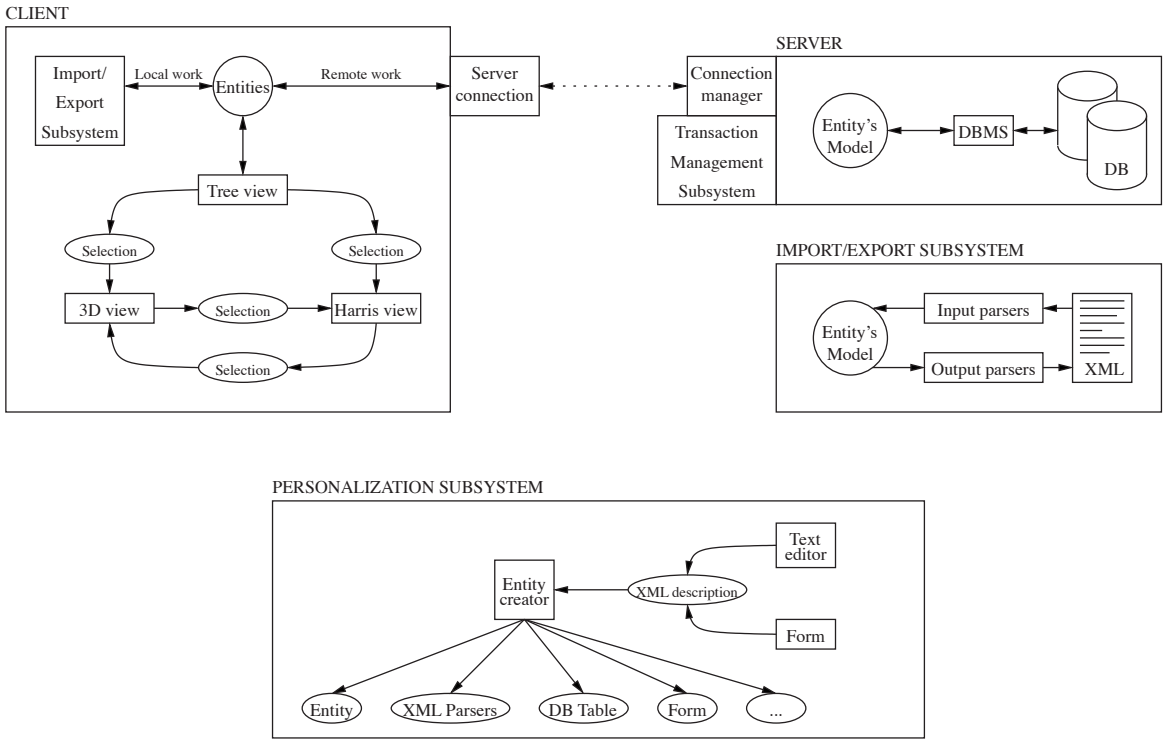

Figure 1 Sidgeipa architecture

The server

In the server resides all the infrastructure related with the management of the database, in a way that the displayed interface is independent from the database being use. This will allow the super user to change easily the Data Base Manager System (DBMS). The interface used by the clients will be adapted to the site forms with the entities included in them (figure 2 & 3).

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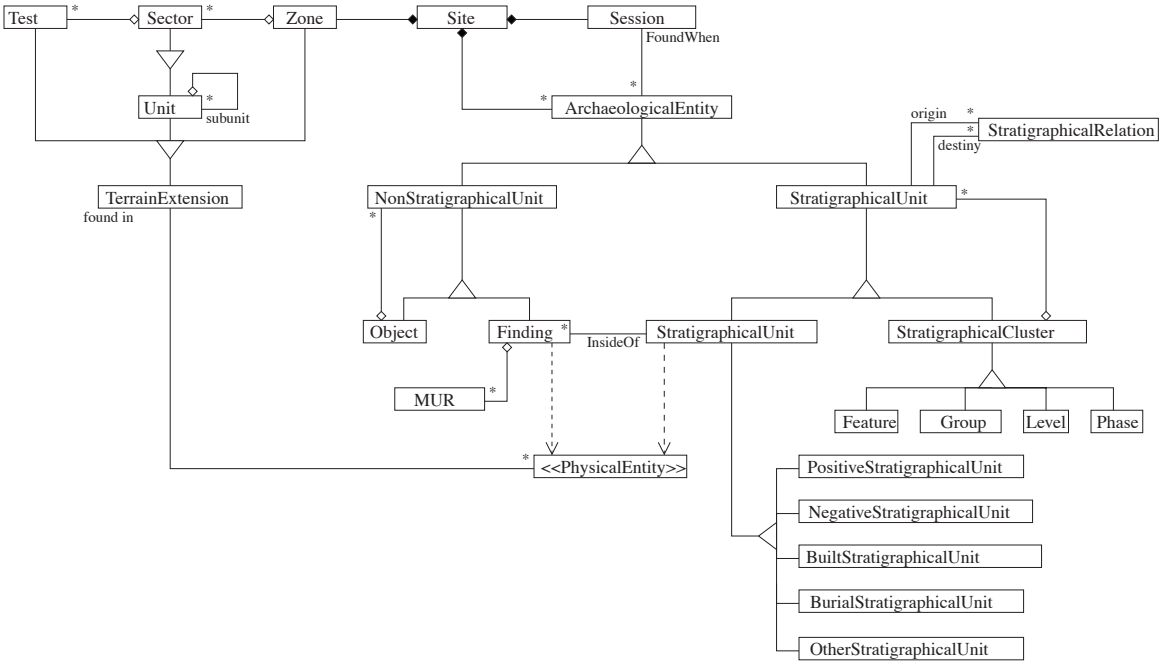

Figure 2 Sidgeipa model

Such architecture allow more than one client accessing the same data concurrently, this will be the origin of consistency conflicts storing or viewing data not updated from other clients. To avoid those conflicts SIDGEIPA has a transaction manager allowing only clients with the correct privileges in each moment to modify the server resident database; at the same time the transaction manager will send out a message to the other clients informing that data in use by them have been modified.

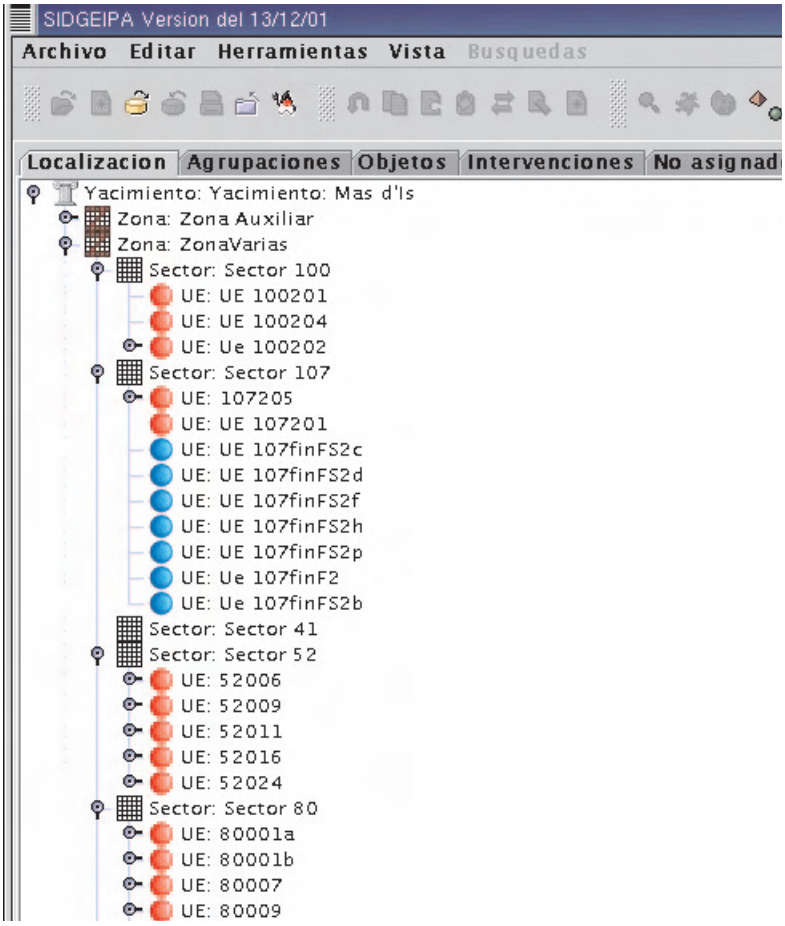

Figure 3 View of the current Mas D'Is form default

On the other hand, the server has a connection manager in charge of serving data to the clients following the established procedure. Consequently, this connection manager has information about connected clients in order

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to inform them of changes in the database when they occurred.

The client

Sometimes, archaeologists working on the field could be unable to connect their computers to an external network. When such incidence happens Sidgeipa clients are able to work without connection to any server. Clients can work both remotely and locally. When working in remote mode, it asks for the entities to a server where they actually reside, so in fact clients have only a reference to them. When working on local mode, the client get the data from a *.xml file where are stored attributes and their relations. In the same manner, clients write to the *.xml file. In local mode, clients are importing data from a file, working with them and writing modifications to either to same file or to another one. To do that there is a subsystem to import and export data at users requirements. The subsystem resides in the client and is formed by a set of parsers in command of reading and writing data from and to the *.xml file following the designed pattern. This pattern stores and gets the data from object residing in the site model.

In both modes -remote and local- clients have a set of entities (stratigraphic units, features, groups, layers, objects...) according to the site model. These entities are displayed in different site views; a

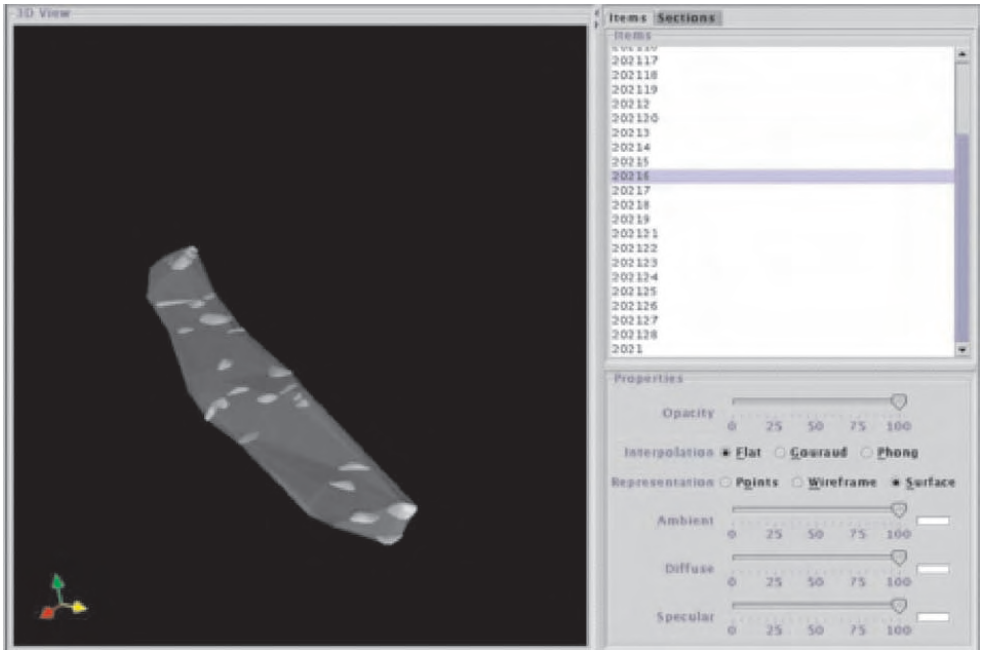

Figure 4 View of stratigraphical of Mangraneres stratigraphical units with 3D view of #2021

new view is obtained through the selection of some entities in the current view (figure 4). Among the different views users can get there is the default one where a hierarchical tree of a site is shown

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(figure 5). Different levels include: the site, the different zones of it, sectors, stratigraphical units and its components as well as features, groups, layers, seasons and so on. All this information is

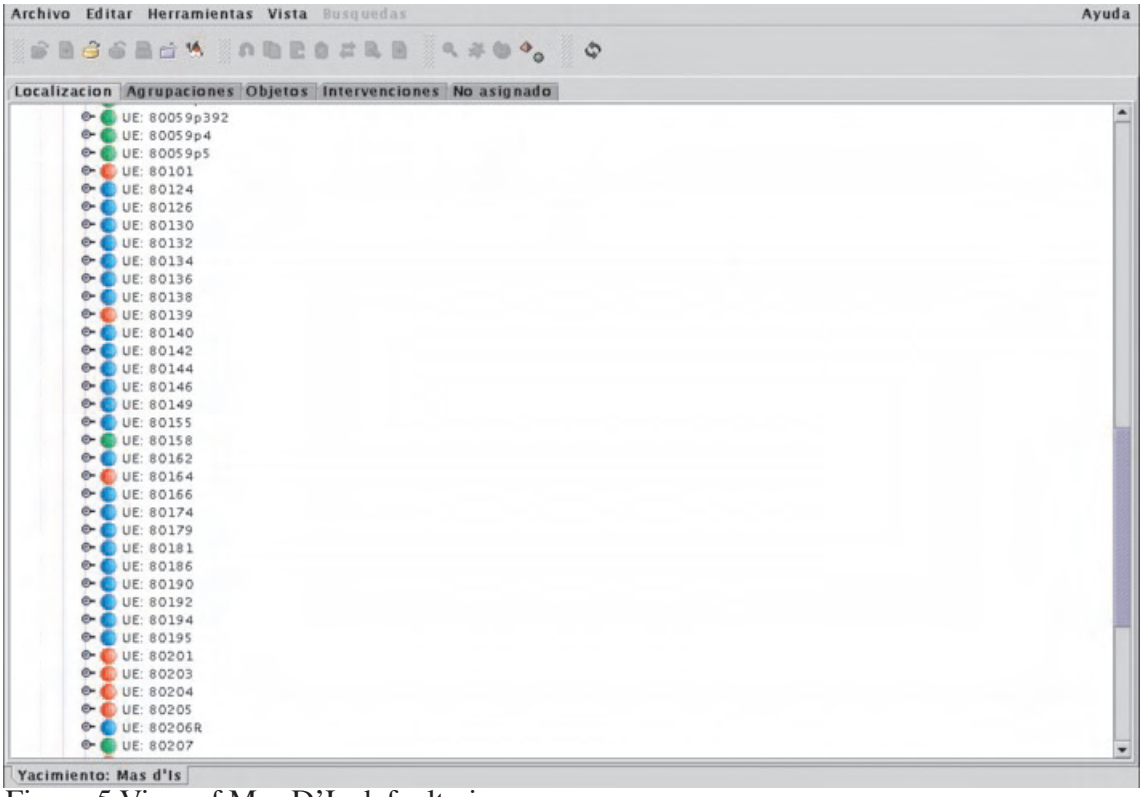

Figure 5 View of Mas D'Is default view

displayed according with its internal hierarchy (figure 6).

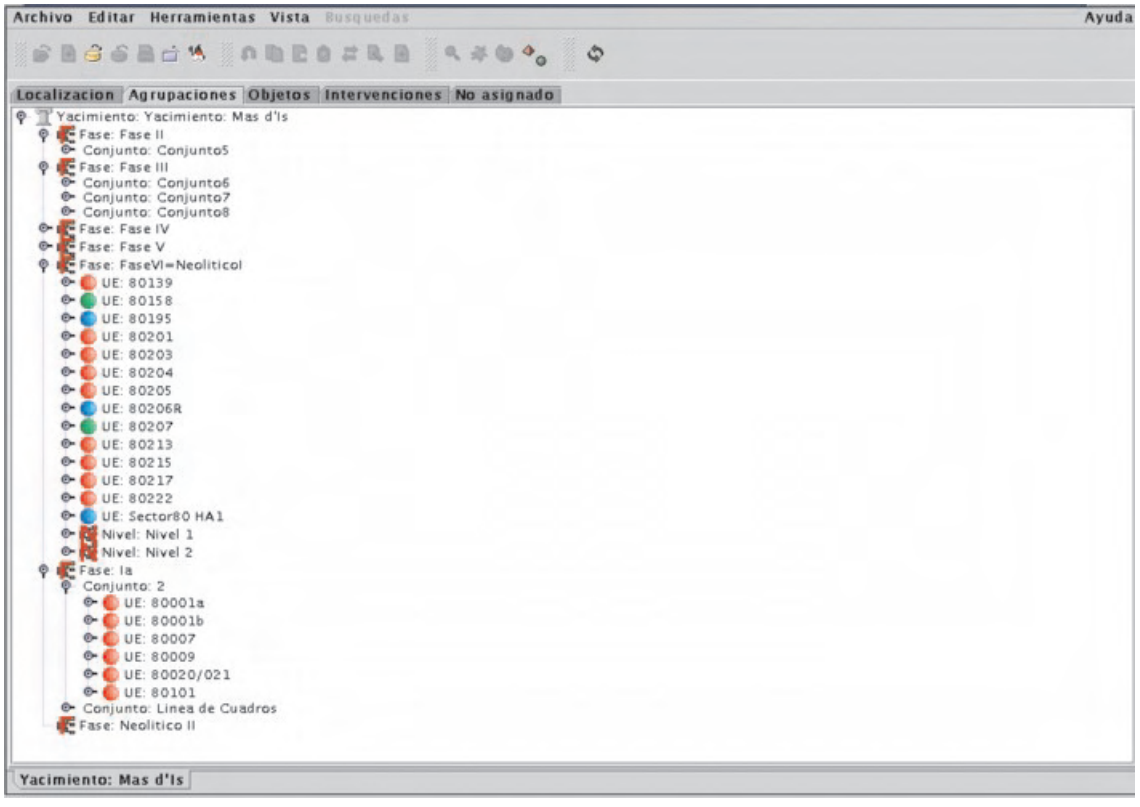

Figure 6 View of Mas D'Is groups Tag

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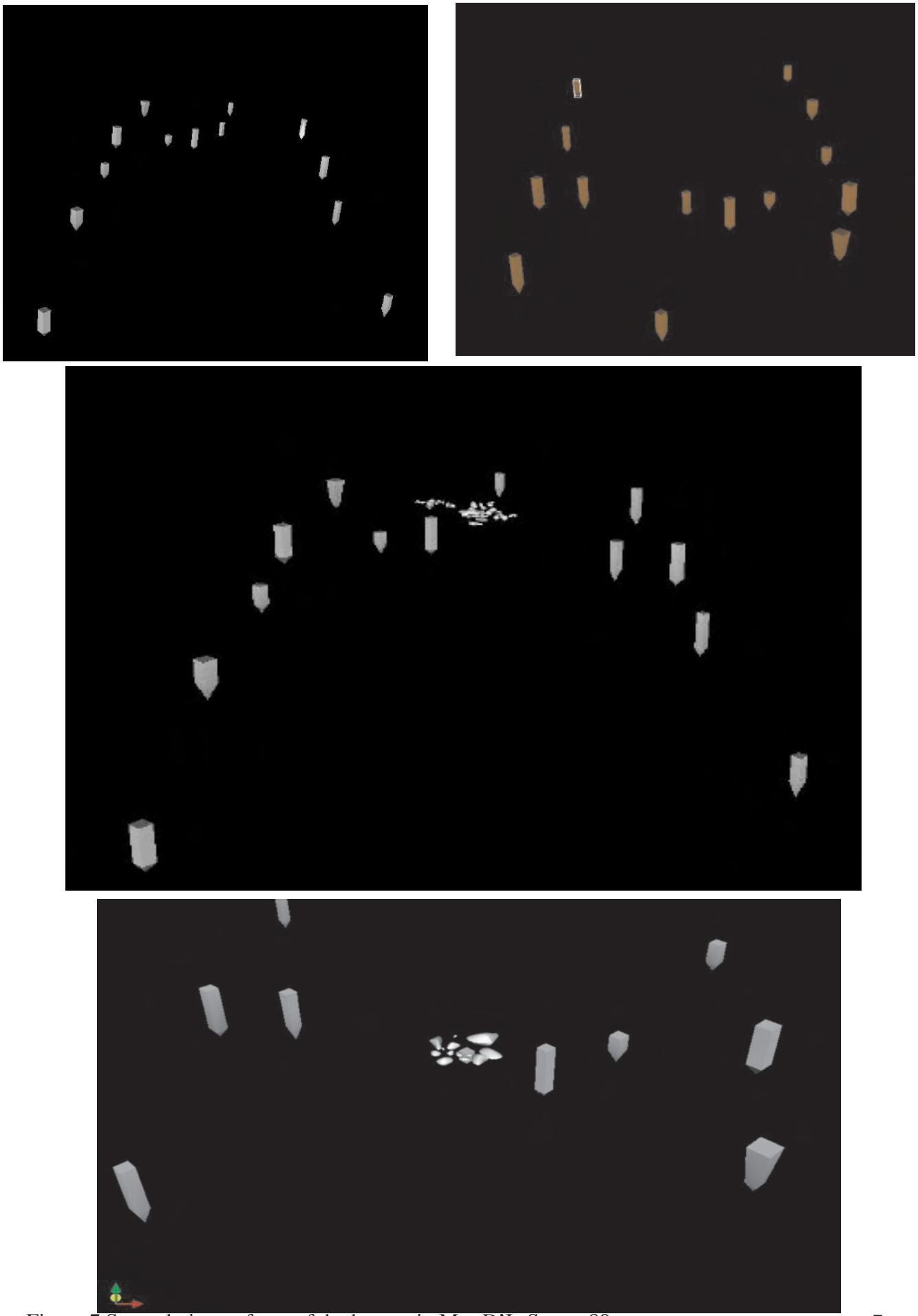

Figure 7 Several views of one of the houses in Mas D'Is Sector 80

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Other view is the 3D reconstruction of previously selected entities. In this view, users can navigate through the scene, cut the entities, and change the visual properties of each or a set of entities (figure 7).

The last view mode is the one where the Harris Matrix is built; the matrix can be displayed in different levels, groups, features and Stratigraphical Units (figure 8). This tag allows users to automatically draw and sort the selected entities, in addition an editor is provided to edit the final view.

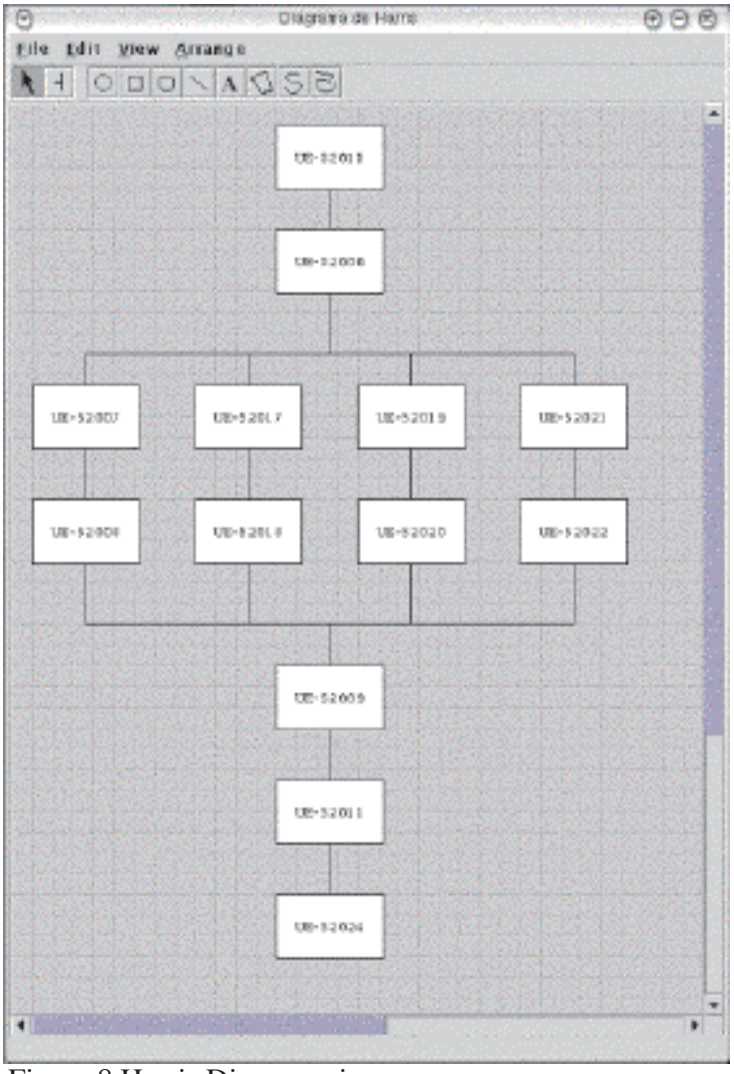

Figure 8 Harris Diagram view

In any of the view modes described entities can be selected and from them new displays can be created. In the hierarchical tree all the entities are included, it is not possible to create new trees from a selected tree. One of the most important features in SIDGEIPA is that from any of the views an entity can be selected and from there get information about its characteristics through a form that allows user to modify it -in case they have the privileges to do so- (figure 9).

Personalization in SIDGEIPA

In SIDGEIPA there is a part of the application independent of both the client and the server. It is a module to edit and personalize new entities forms from an basic one, for instance if the user wan to create a new type of findings that share essential attributes the new entity (i. e. lithic tools) can be created from the basic one (i. e. lithics) (figure 10).

To create these new entities, user can use a form where the new attributes are defined forming

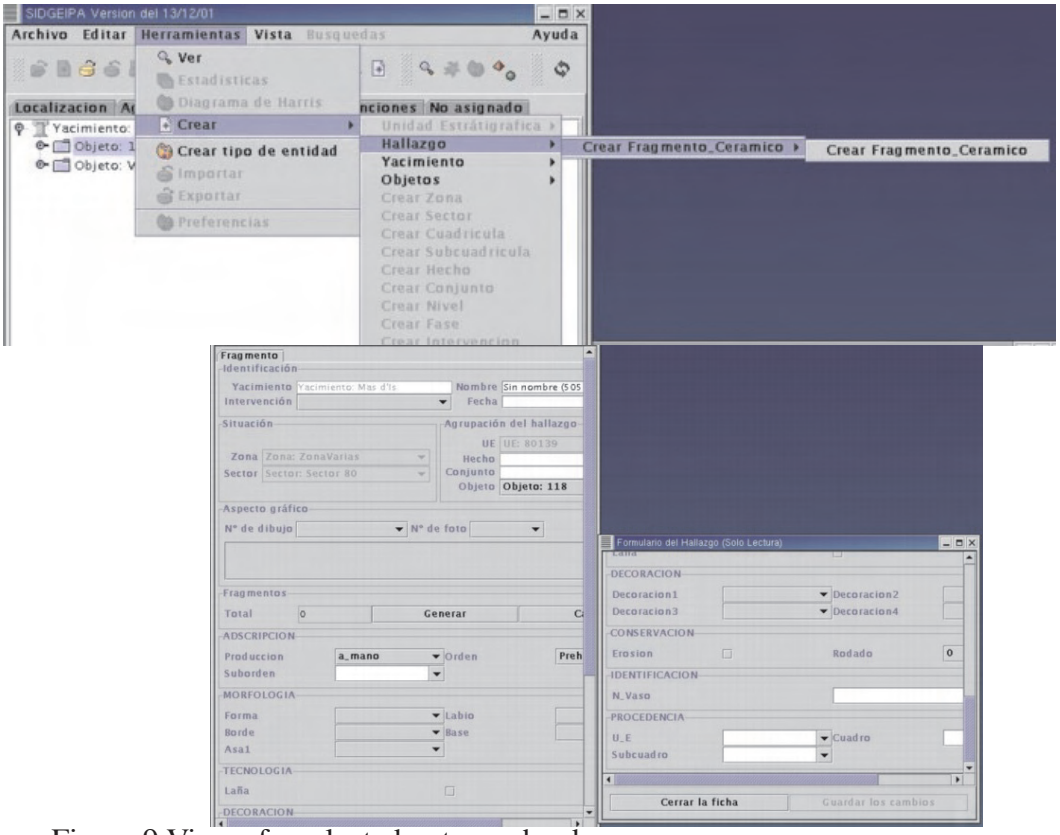

Figure 9 View of a selected poterry sherd

groups (figure 11). This form will generate a xml file describing the new entity, those files go into a compiler where the new kind of entity will be generated with all the attributes needed to be incorporated to the application -the new kind of entity to be included in the sites, parsers in and out

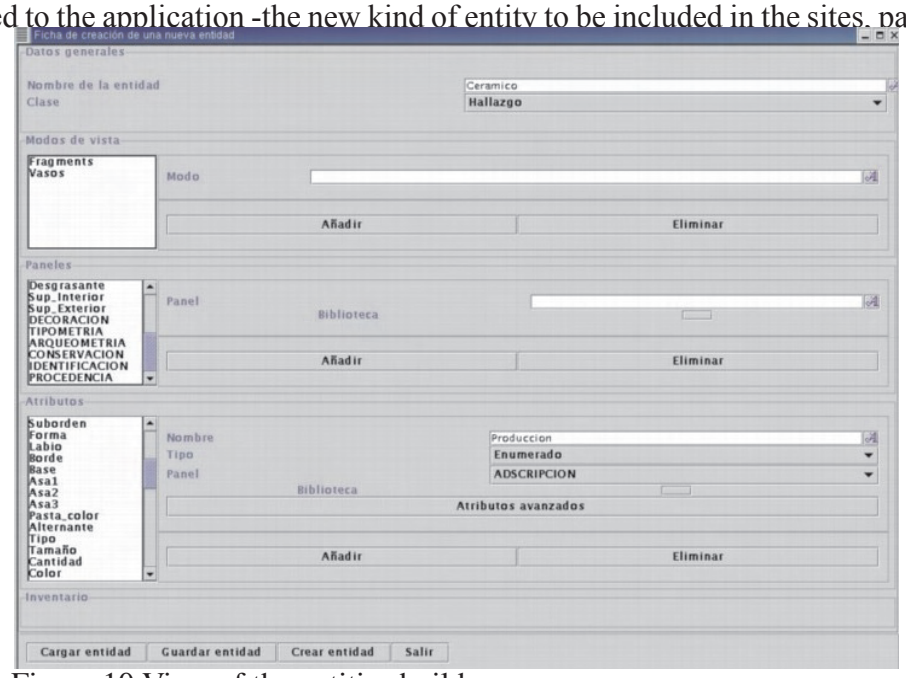

Figure 10 View of the entities builder

to be imported, tables to be incorporated in the DBMS, edition form, ...- Finally the new created entities and objects will be introduced in its location, either in the server, the clients or both.

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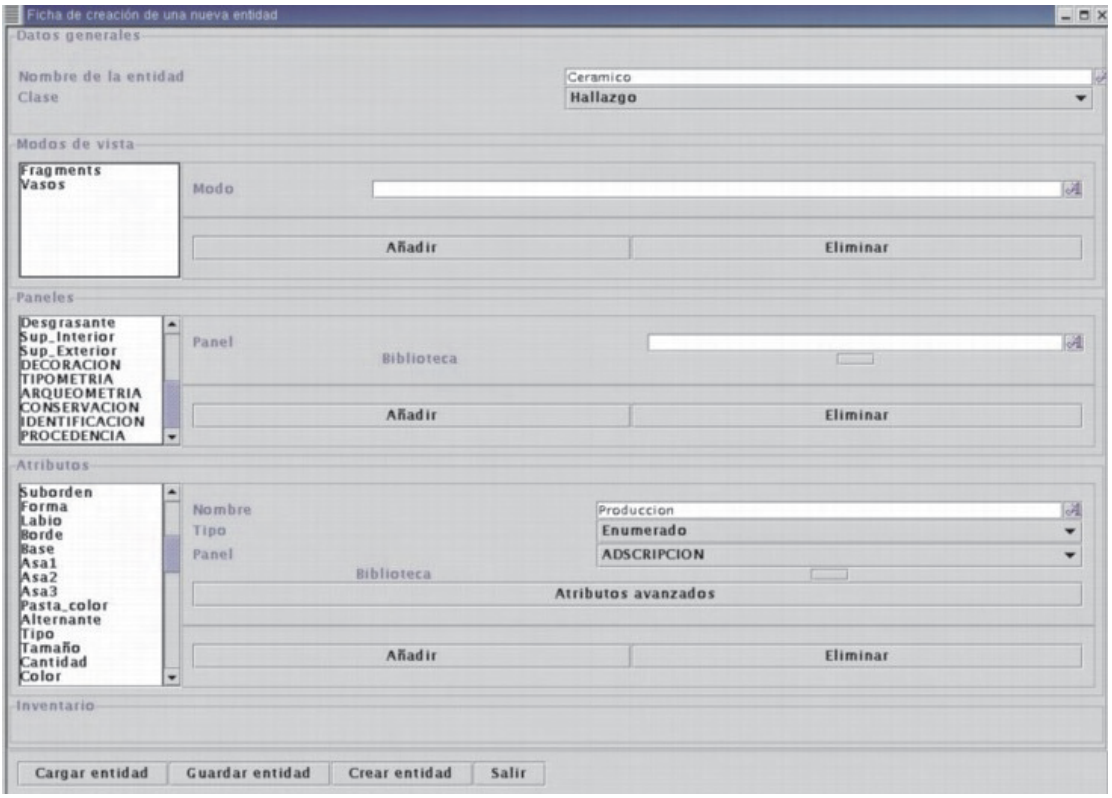

Figure 11 View of the entities builder

All the programming has been done is Java language, using Swing to develop graphic interfaces, because it allows launching the application in any computer where a Virtual Java Machine is implemented. This allows easily to use SIDGEIPA in a multi platform environment.

To implement 3D views on the clients, it has been used a visualization library call VTK and to implement the Harris Diagram a Java graphs library call GEF (Graph Editing Framework) it being used.

Lastly, files to store entities and the ones allowing user to personalize the application have been created using XML language. To parse those files we are using Xerces, a Java library. Currently, we are using Linux like development platform, because its distribution is open source code, it is powerful, and have a great variety of development software available in Linux. To cite some example the freely distributed Postgres DBMS is being using in this stage of the application. Nevertheless, as far as clients and server are isolated machines SIDGEIPA is open to the use of commercial DBMS.

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Briefly, we are to present some practical examples of excavation management through SIDGEIPA with some comparative results. In order to manage data in Sidgeipa we need to create the spatial setting of at the site. As we said before, SIDGEIPA has been tested in two Early Holocene open-air sites in Eastern Iberia. Mas D'Is (Penàguila, Àlacant) is a huge site being excavated since

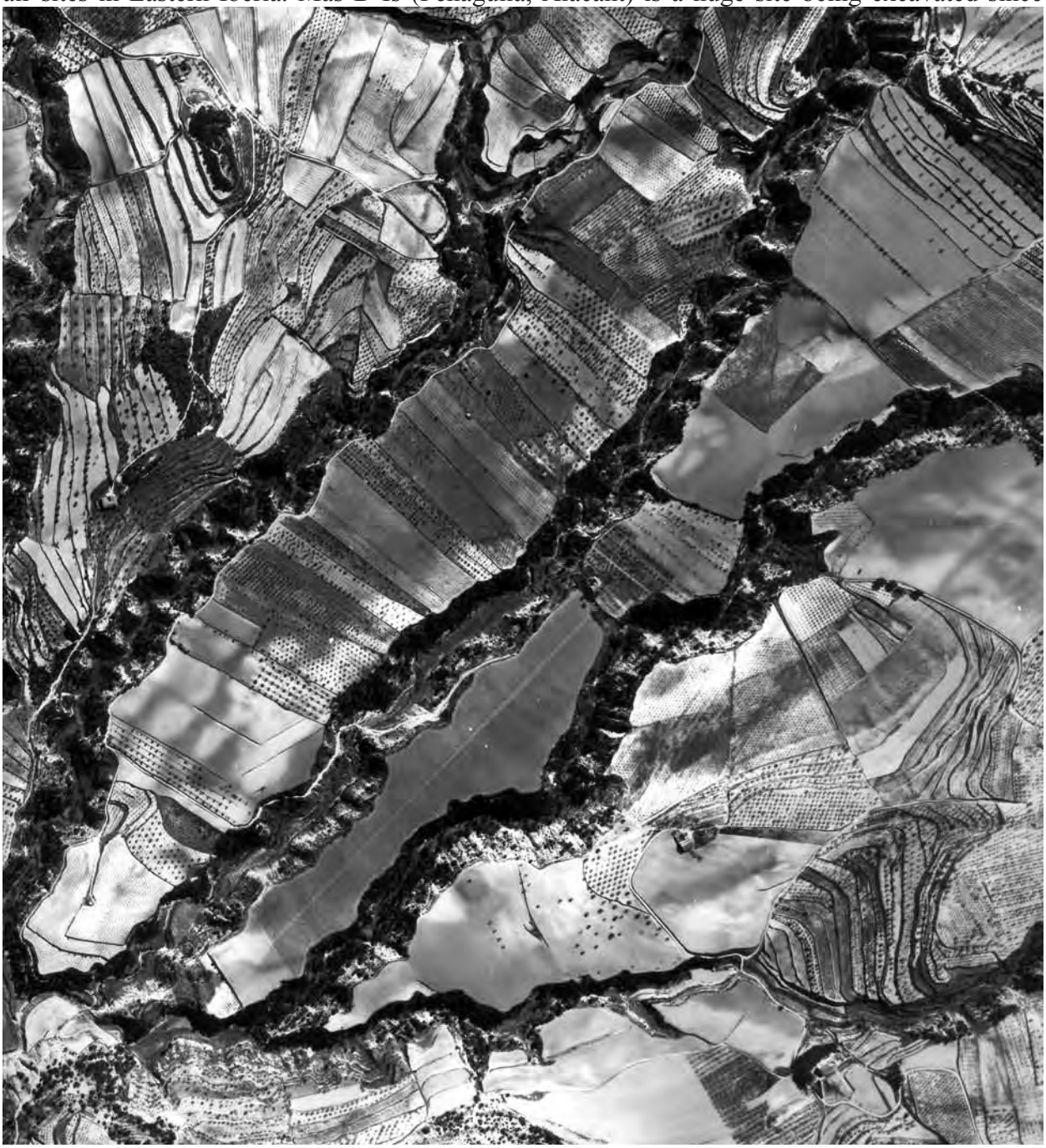


Figure 12 Mas D'Is aerial view

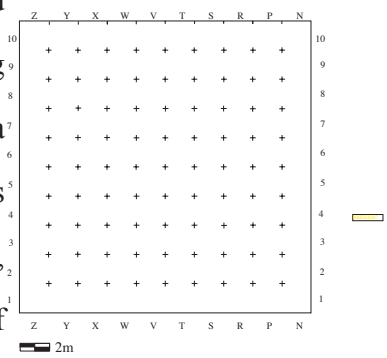
1998 under the direction of Professors Joan Bernabeu and Teresa Orozco (figure 12). Mangraneres (Andilla, València) is a small special purpose camp being excavated continuously since

5. - 6. November 2001 Archäelogie und Computer Workshop 6 ISBN 3-902086-07-6

1998, after a CRM intervention in 1991 under the direction of professors Joan Bernabeu and Josep Lluis Pasqual (figure 13).

Figure13 General view of Mangraneres during 2001 field season

Mas D'Is is a whole Neolithic farming hamlet where several main features have been found -houses, storage pits, ditches, furnaces, public buildings-. SIDGEIPA is being developed to fulfill the needs of recording such amount of data. In Sidgeipa once a new site is created users need to define Zones, Areas, Sectors and grids -at least one of them- in a hierarchical mode. To date, in Mas D'Is there is one Zone divided in almost 100 sectors of 40 by 40 mts -0.4 acres-, the default excavation unit is 2x2 mts (figure 14). Only a few of them have been excavated, being sector 80 where the SIDGEIPA team have tested the potentialities of the Beta version (figure 15).



In the 2001 season both the traditional way of recording data and the SIDGEIPA beta version were in use at Mas D'Is. One of the most important archaeological features found at the site is a series of concentric ditches.

SIDGEIPA was used concurrently with a Total Station to do the measurements in the field. In this case we use

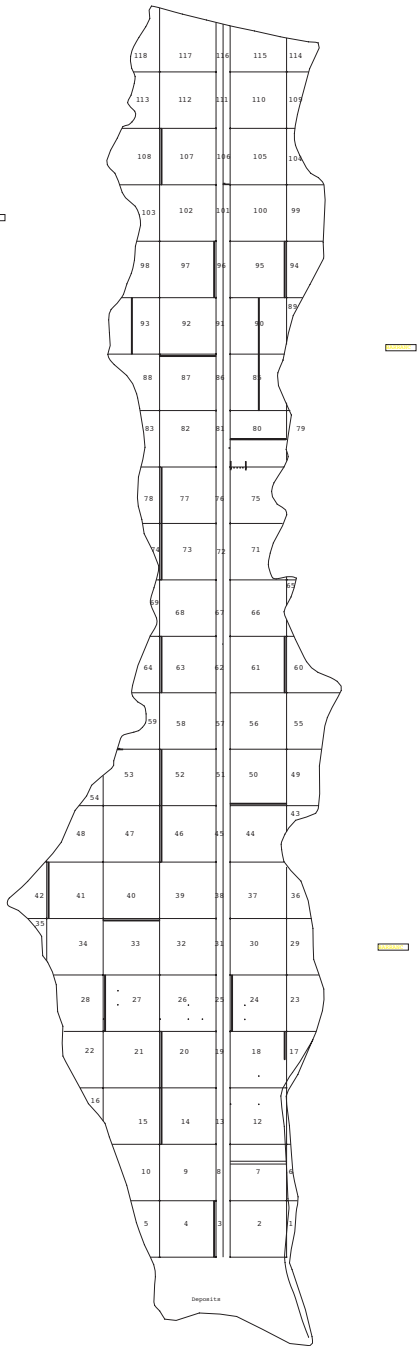


Figure 14 Plan of Mas D'Is with 40x40m sectors --->

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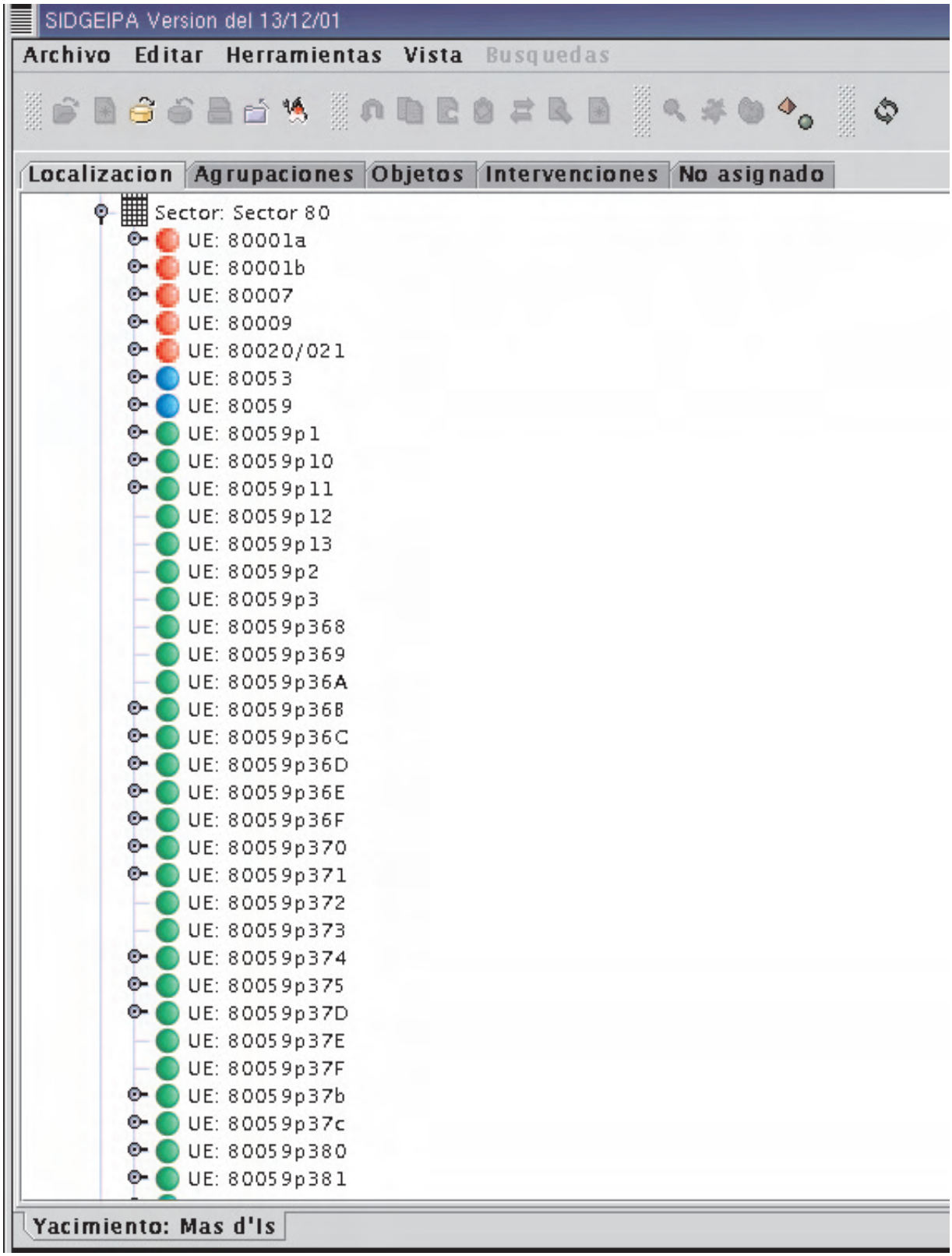

Figure 15 View of Mas D'Is sector 80 tree in SIDGEIPA

a Sokkia 3100 (figure 16), the setting up of the equipment was easy because thoroughly topographical work including several stations had been done at the site. After that, a systematically data recording process was implemented in the field where strict codes (stratigraphical unit, kind

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Figure 16 Total station Sokkia 3100

of point and the like) were enclosed to each of the measurements.

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Figure 17 View of a SDR file

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Data from the total station can be download directly to Sidgeipa using a SDR file (figure 17). In the season this SDR file was transformed in two different kind of files a X, Y, Z ASCII and a DXF file to import the data to some commercial CAD application2.

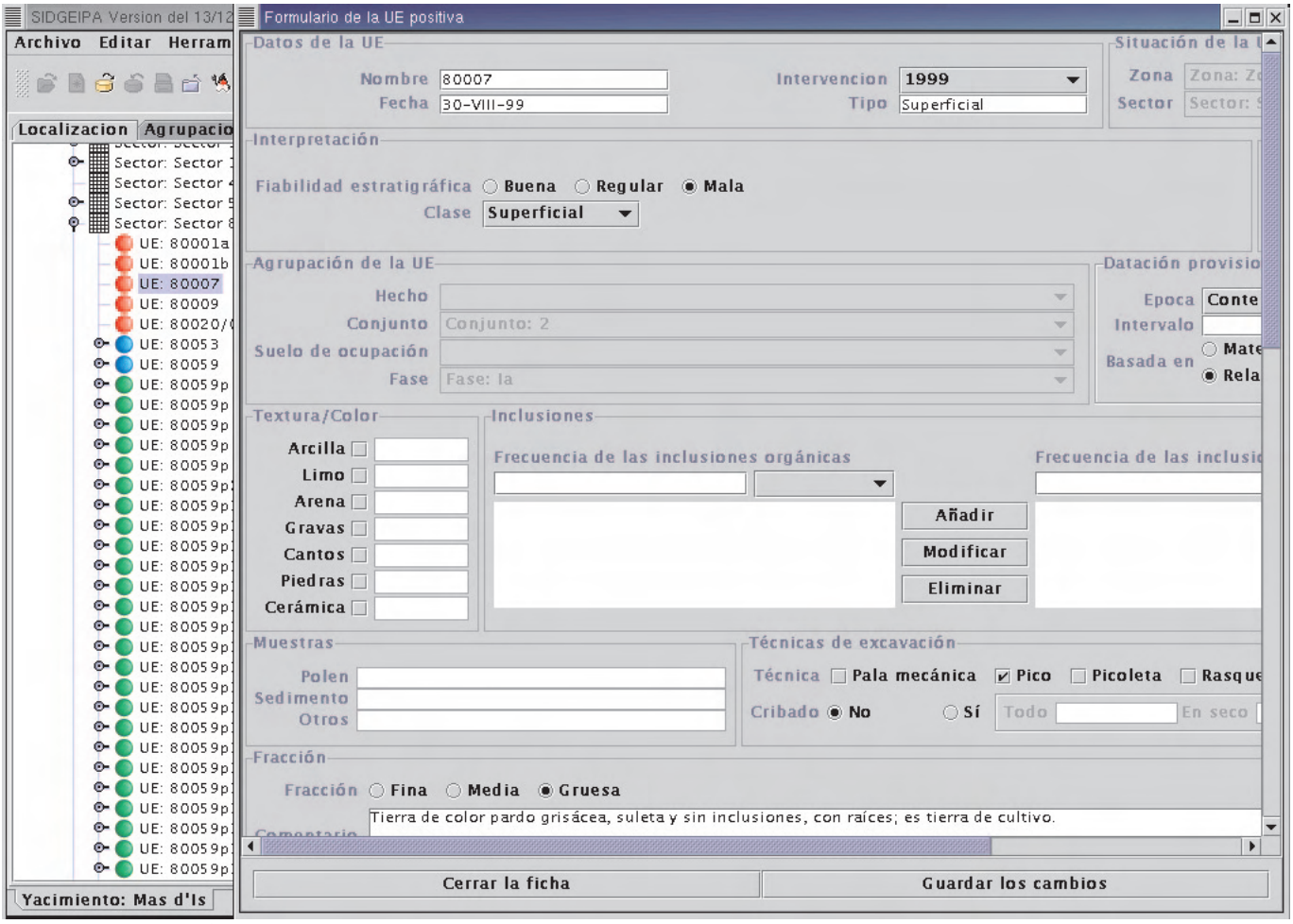

Figure 18 Stratigraphical Unit form (Top)

In order to download data into SIDGEIPA the Stratigraphic Unit should be created first (figure

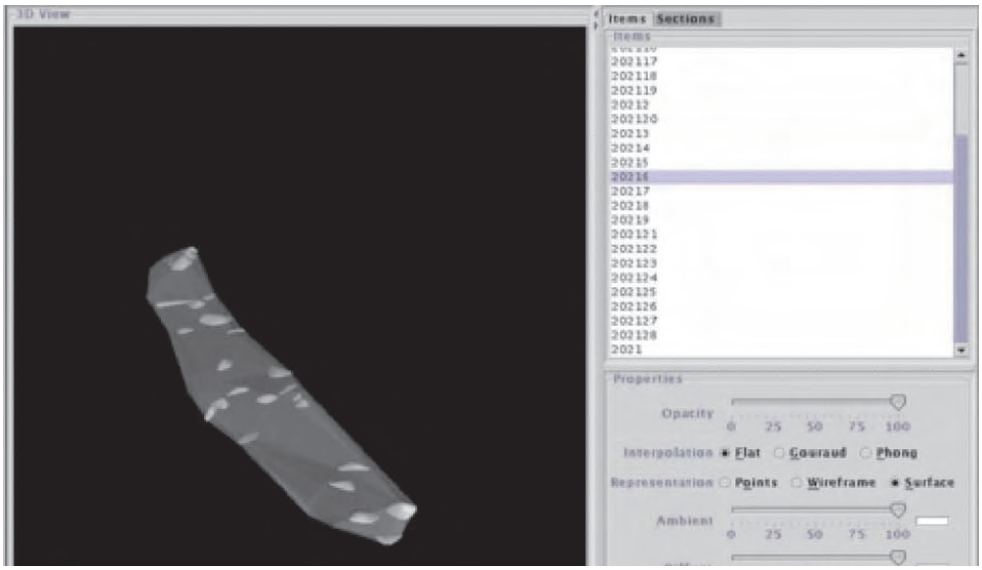

Figure 19 3D view of Stratigraphical Unit # 2021 at Mangraneres

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18). From the Stratigraphical Unit form the SDR file defining its volume, once this is done we can see its 3D view (figure 19).

SIDGEIPA potential was clearly state went data from the ditches (figure 20) were download into the application. Ditches were detected in several trenches cut at the site; for the first moment

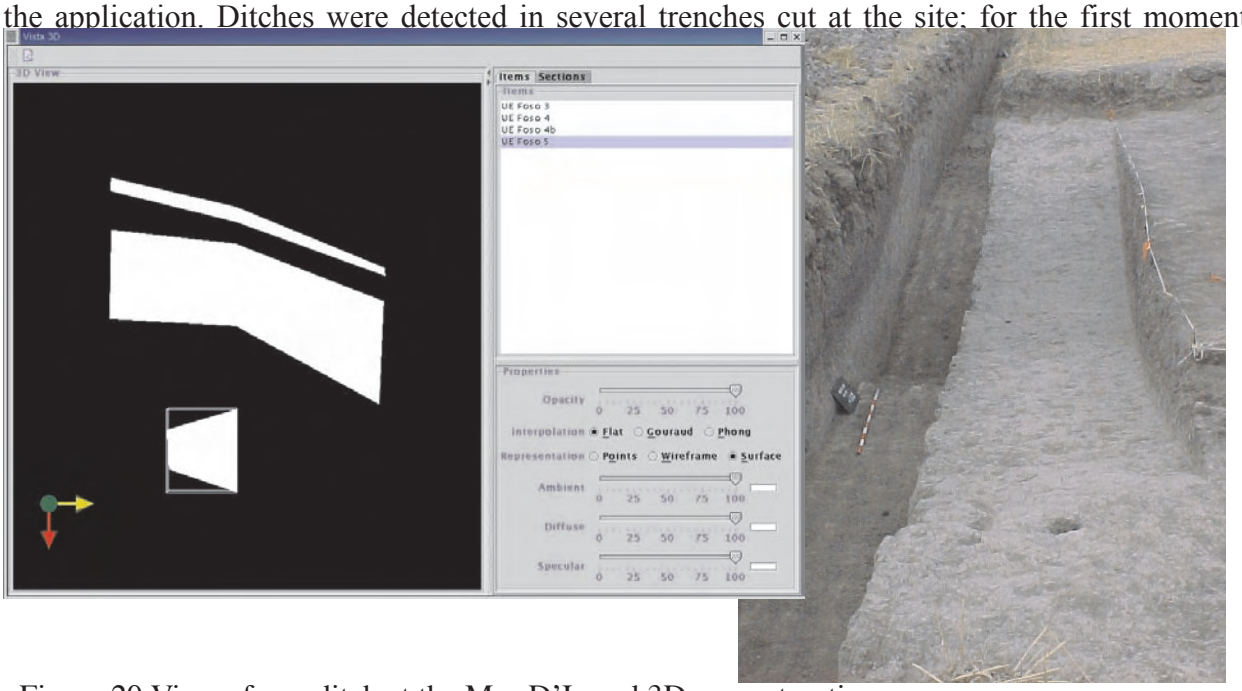

Figure 20 View of one ditch at the Mas D'Is and 3D reconstruction

SIDGEIPA show that there was a concentric succession of ditches at the site (figure 21).

Maybe SIDGEIPA potential is more clearly stated when reconstructing the house 1 in the sector

Figure 21 Reconstruction of ditches in Sidgeipa

80 (figure 22). The reconstruction of house 1 combining data from the total station, hand drawings

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from the field and pictures is amazing in his zoom in and navigation features (figure 23).

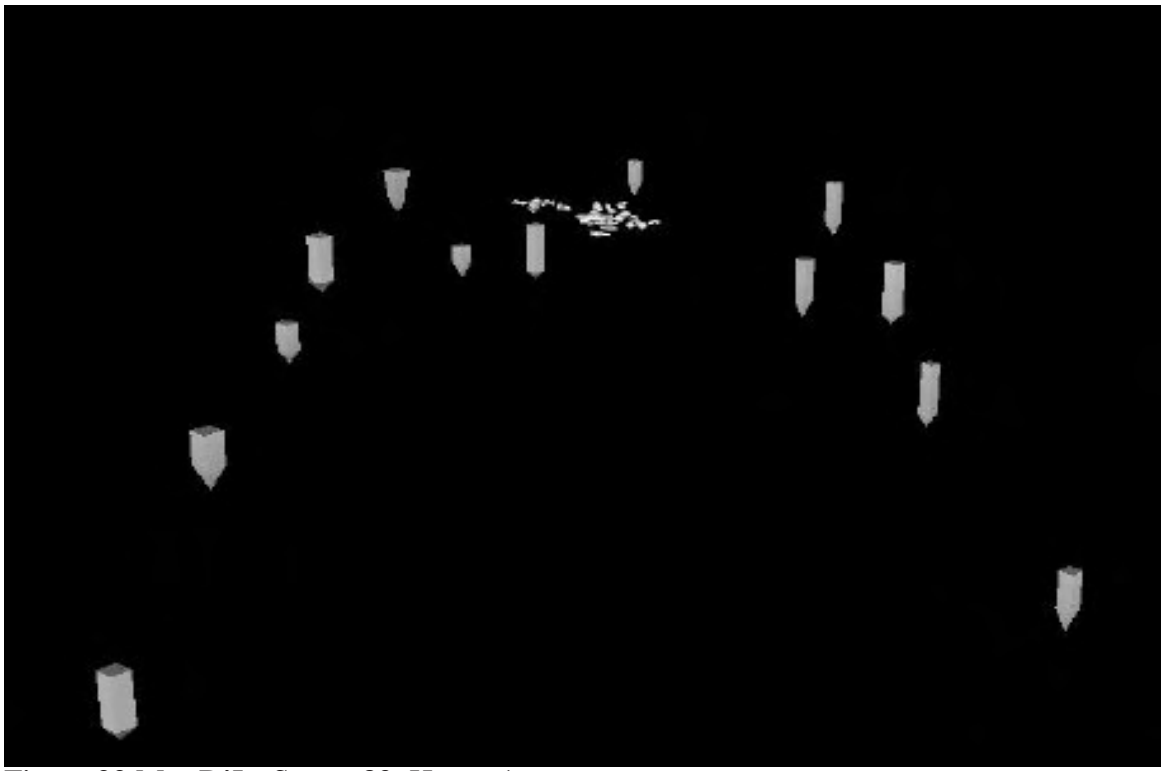

Figure 22 Mas D'Is, Sector 80, House 1

The best way to see a group of stratigraphical units and features is through the

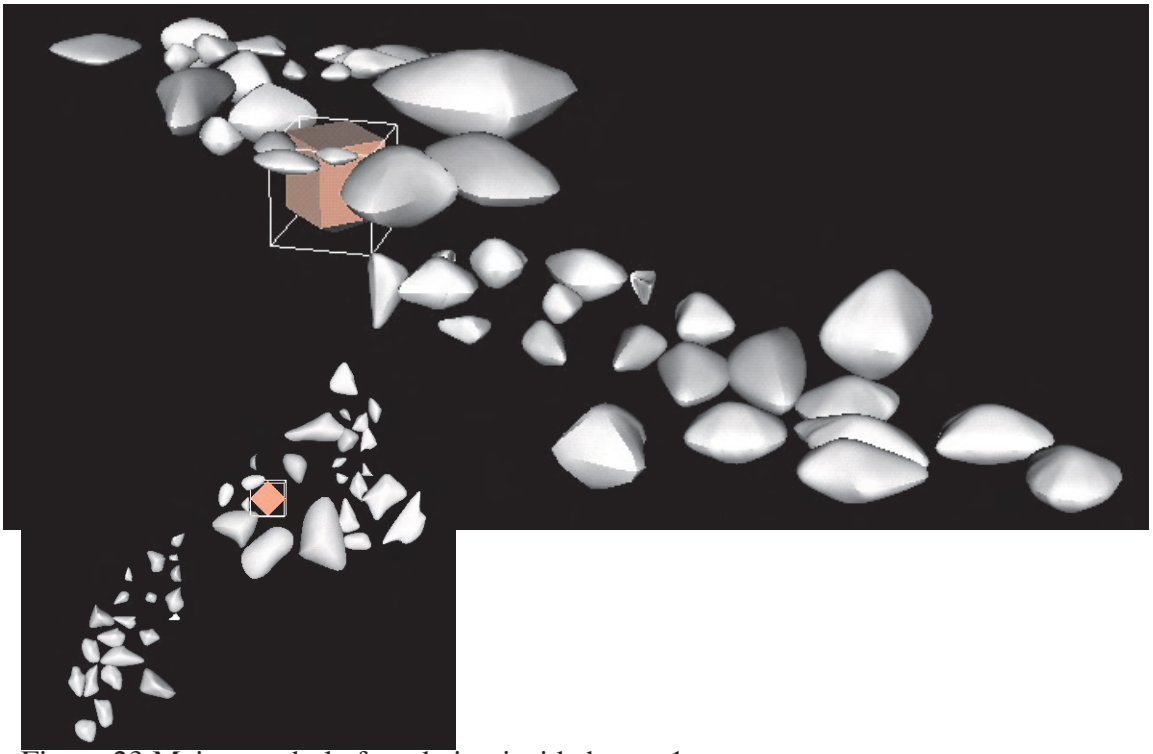

Figure 23 Main post-hole foundation inside house 1

5. - 6. November 2001 Archäelogie und Computer Workshop 6 ISBN 3-902086-07-6

groups tag where users can create new groups of features (figure 24).

In the default view users can create new objects inside of a stratigraphical unit. In

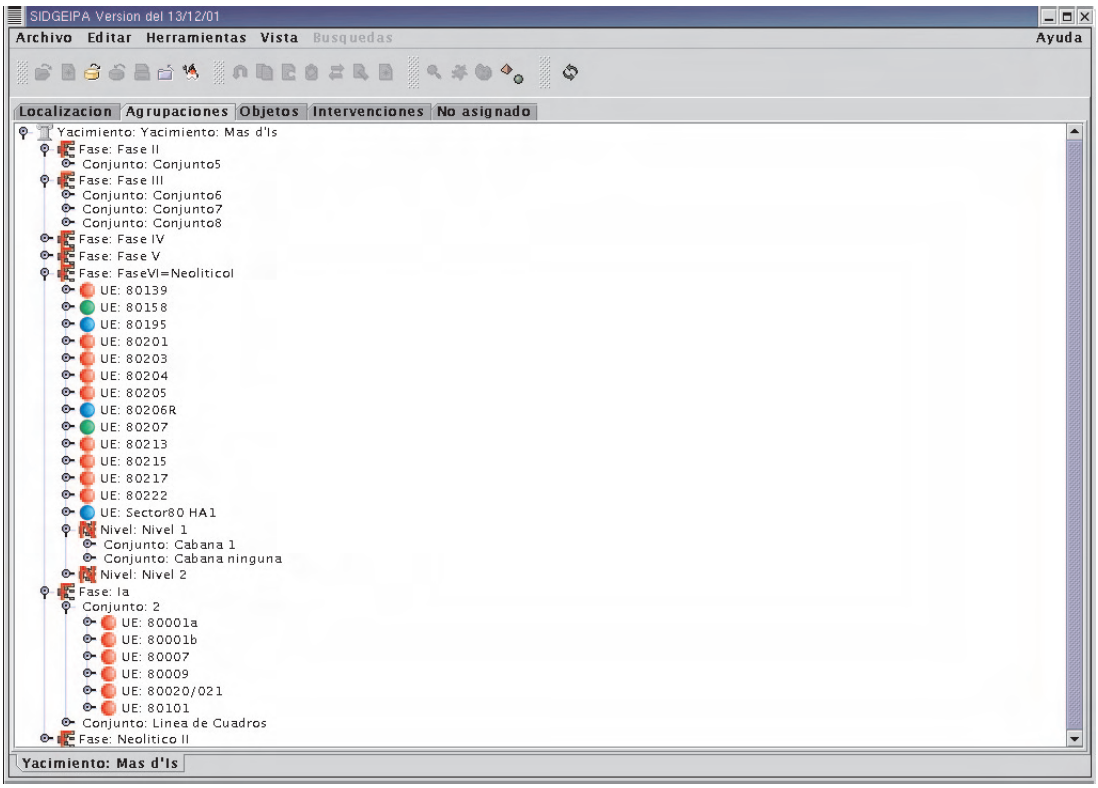

Figure 24 Groups tag in Mas D'Is

this step users can add new findings to a Unit (pottery, lithics, metal and so on). Currently, we have in Mas D'Is more than 9000 pottery pieces catalogued (figure 25). Artifacts can be managed in the objects tag and, of course, users can move, delete,

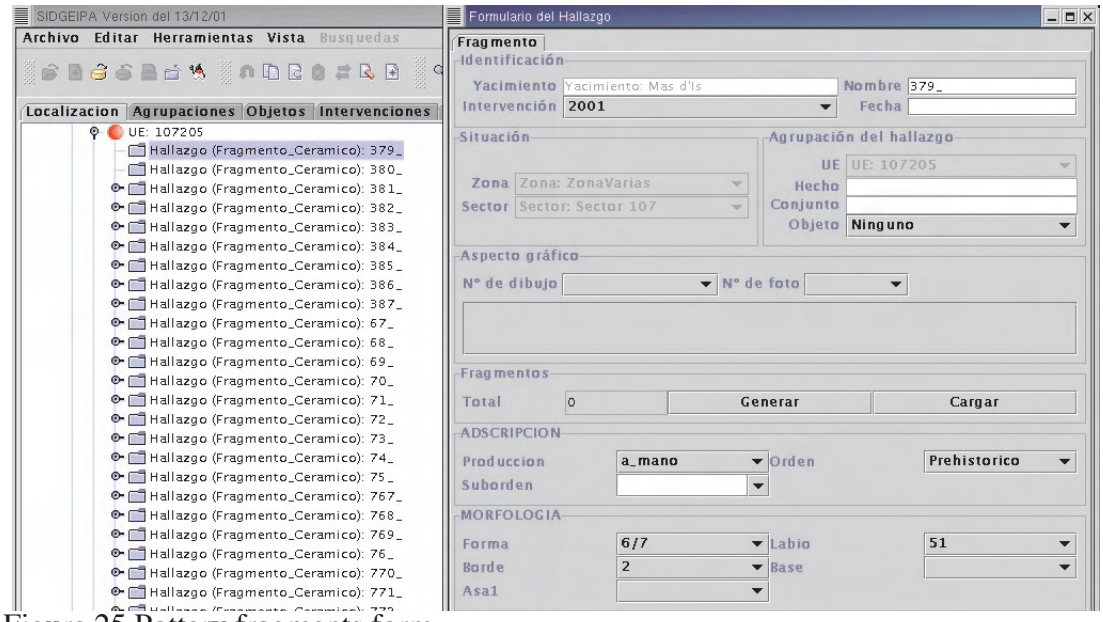

Figure 25 Pottery fragments form

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copy and paste those elements from tag to tag (figure 26). In the artifact form users can include pictures and drawings of the objects.

On June 2001 at Mangraneres (Andilla, València), under the direction of Professor

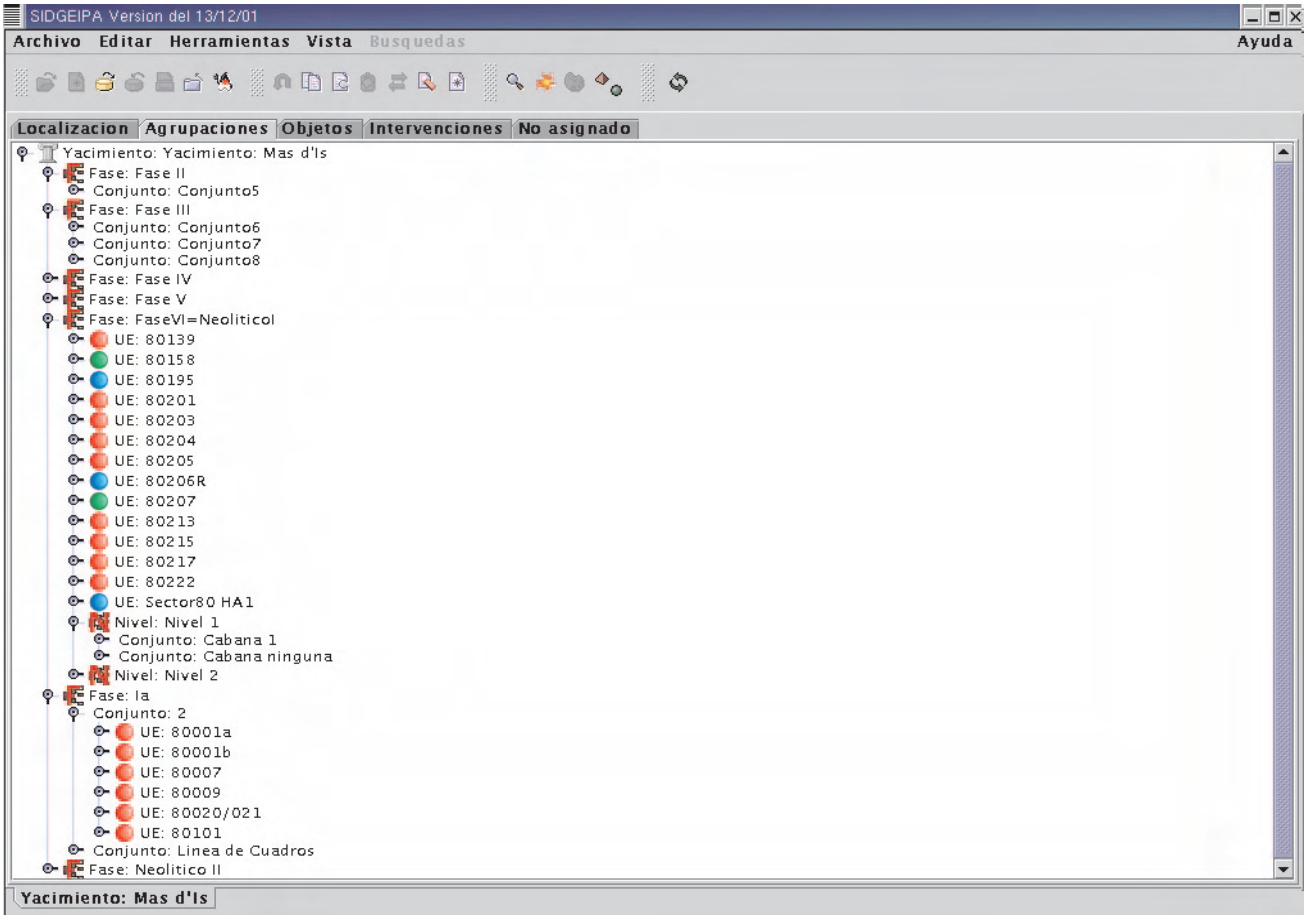

Figure 26 Objects tag

J. Bernabeu, SIDGEIPA was tested for the first time on the field. Mangraneres was chosen because is a small open-air site where setting up the Total Station and conducting a SIDGEIPA assisted excavation was easy because the logistics of the excavation is more than simple that in Mas D'Is. Mangraneres, like Mas D'Is, is an Early Holocene open-air site but in here our team had found in previous years layers that were ascribed to both the Mesolithic -absence of pottery and presence of characteristic microliths- and Neolithic (pottery and a different lithic technology)

Figure 27 General view of Mangraneres

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layers. The extension of exposed area in Mangraneres is small (figure 27).

The process to deal with archaeological data in the field was essentially the same that in Mas D'Is. First a topographical base was set up in this case no previous topographical work had been done at the site. The extension of Mangraneres allows us to set a single base for the total station simplifying data acquirement (figure 28).

Figure 28 Total Station

In Mangraneres, as later at the Mas D'Is, we were comparing SIDGEIPA results with CAD drawings. So when

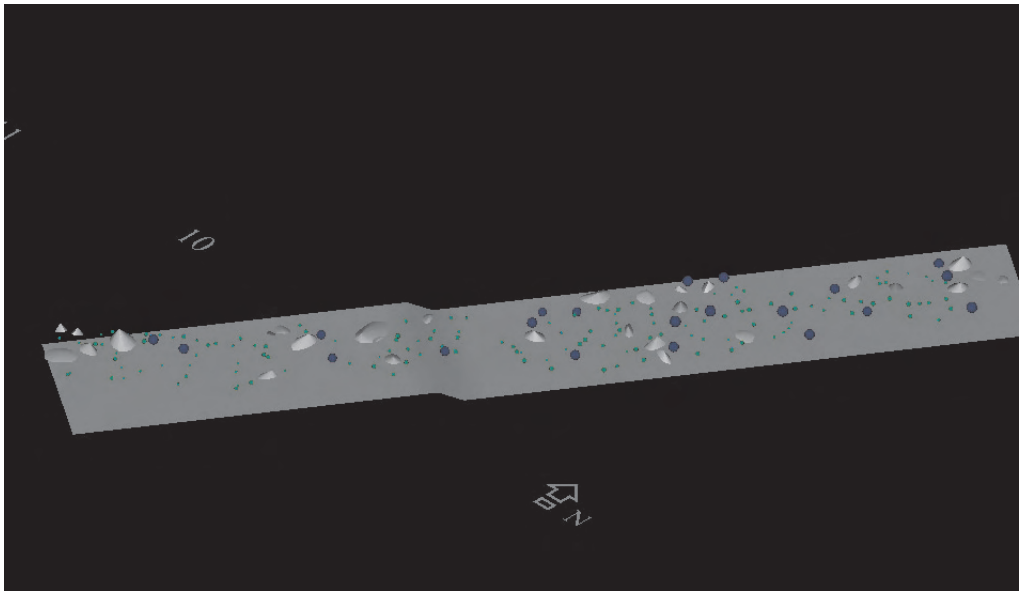

Figure 29 Stratigraphical Unit 2021 in CAD

Figure 30 Stratigraphical Unit 2021 drawn by SIDGEIPA

downloading data from the total station to the computer -in this case, a PC running

 ISBN 3-902086-07-6

windows- we convert data to both DXF format and X, Y, Z coordinates1. Comparative results of both procedures can be seen in figures 29 -CAD- and 30 -SIDGEIPA-. On our view results are comparable being the main advantage of SIDGEIPA that the application will reconstruct by itself saving a lot of time.

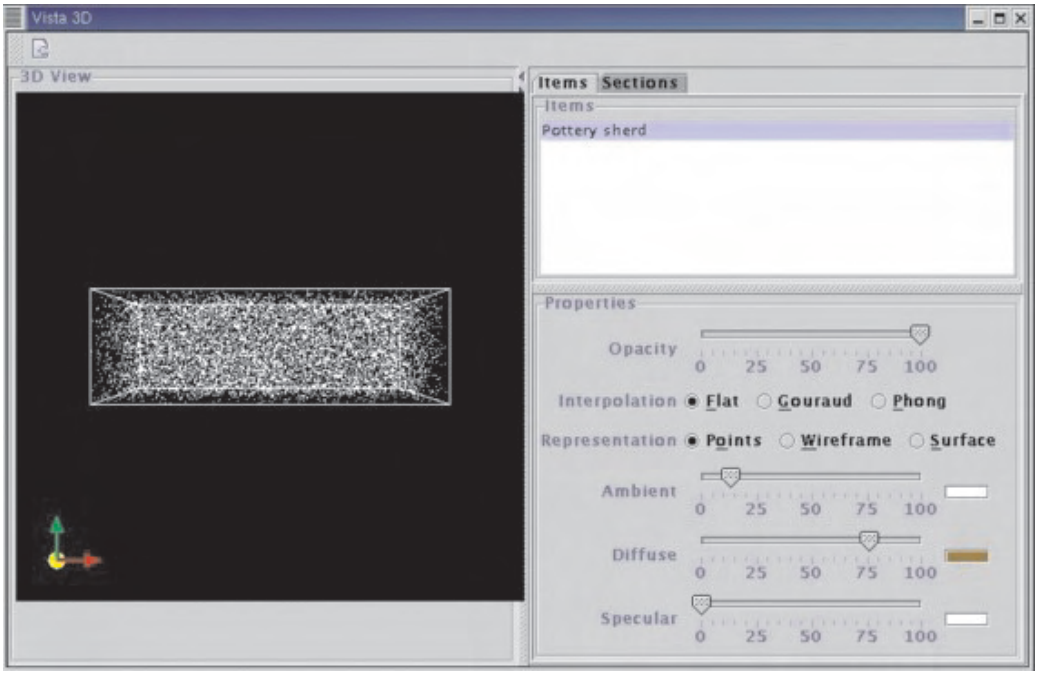

Figure 31 Random distribrution of lithics in a Mangraneres unit

At the artifact management level one of the main contributions of SIDGEIPA is the ability to randomly generate coordinates for a given number of artifacts found inside of a unit (figure 31).

To sum up:

SIDGEIPA is a wholly integrated Archaeological Information System. Main features in Sidgeipa are:

- Ability to manage from planning to artifact inventories
- It has been developed with open source code software
- 3D displays of all the data contained in the database

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