DESCRIBING AND REVEALING THE SEMANTICS OF EXCAVATION NOTEBOOKS

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Abstract. CRMarchaeo enables the integration of documentations of various aspects of archaeological excavations. It aims at sharing and formalizing knowledge that the archaeologists have achieved during their activities in the field and has been recorded in various ways. It has been created to enhance interoperability among the information systems that support the archaeological excavation processes, by revealing the semantics of the activities related to these processes. This paper exploits CRMarchaeo to describe formally the content of *excavation notebooks* that document the daily digging process and, therefore, constitute the very essence of archaeological archival material. The paper explores the possibility of the existence of a common ground for the management of archaeological records from raw excavation data recorded in the notebooks and aims at recognizing the correlations between such data. Moreover it suggests potential additions to the CRMarchaeo, as a result of its practical use on real archaeological issues extracted from the experience from the specific archival material (excavation notebooks). As a case study for this research we have used the organization system and samples of the excavation notebooks produced during the excavation of the ancient settlement located in Karabournaki on the northern coast of the Aegean, in the area of Thessaloniki, Greece. The systematic excavation on the site for over 20 years has provided an impressive amount of information that is kept in the excavation notebooks.

Keywords: Excavation Notebooks, CRMarchaeo, Information Integration

1. Introduction

Excavation research is an irreversible process. Archaeological information emerges from it but at the same time ceases to exist at its completion giving to the excavated area a constantly diversified and evolving image. The fundamental document produced during excavation is the excavation notebook. In it, the whole excavation process is recorded step by step on a daily basis, including all the basic information and material that arises in the field and embraces not only the procedures, descriptions, measurements, but also observations, assumptions, assessments and conclusions that arise at each moment of the excavation based on the excavation process itself. It often contains other kind of archival material, such as photos and drawings needed to document daily work.

Although each excavation research is unique based on the type of site or monument and the period investigated and moreover it is carried out by a different entity which often follows a different methodology and records its results in the notebooks in its own way and needs, archaeological research is characterized by common fundamental principles. Among those principles are the presentation of the excavated area in a wider geographical context, the study of stratigraphy, the recording of in situ and mobile findings and their correlation with their context. An excavation notebook is expected to contain this primary information to make the study of the excavated area feasible.

Archaeological work itself is a complex field. Diverse research groups have excavated some of the most important archaeological sites over the course of time (with even a gap of 150 years between them). These groups have often used different methodologies to conduct their investigation. New scholars at the same site need access to the archives (notebooks) of previous research groups, as they may need to review and expand issues that have emerged from them by using current methods, to use archival material as a guide, or to exclude them from their own research.

In addition, very often, archaeological sites are subjected to fragmentary examination in the framework of rescue excavations. A good example is the ancient city of Corfu and its cemetery (Spetsieri - Choremi 1987),

where more than 150 excavations (over the last 60 years) have been carried out on private plots by various archaeologists keeping different notebooks. All these excavations still refer to one ancient city and could be the subject of a study for a multitude of scholars who need to have access to a unified form of archaeological information.

Moreover, excavation research is of little value if it cannot be seen within its space-time context, that is to say, the relationship of each archaeological site with others. It would offer archaeologists a deeper insight to the revealed information by studying the excavation notebooks of neighboring or contemporary archaeological sites. Accessibility to archival material (notebooks) of an excavation should be, therefore, a key concern for the researchers as it facilitates and deepens the study of the site and its neighboring sites on multiple levels.

The necessity for archival material to diffuse and exploit the information it contains and to be accessible in an interoperable manner has promoted the development of conceptual models that allow the encoding and automated management of this information as well as they reveal, define formally, share and manage its semantics. CRMArchaeo (Doerr et al. 2018), an extension of CIDOC CRM (Ore, Doerr, Le Bœuf, Stead 2107) has been developed in an attempt to meet this need. Given the mentioned information management and diffusion needs along with the embodiment of new methods of Information Science in service of the archaeological research, this paper aims to exploit CRMarchaeo to develop a model for making explicit the main entities that exist in the excavation notebooks, their attributes and the semantic relationships that exist among them.

A representative case on which this research is based on is the excavation at the ancient settlement located on a low mound (toumba) at Karabournaki held by the Aristotle University of Thessaloniki for over 20 years[1] (Tiverios, Manakidou, Tsiafaki 1994; 2003; Manakidou, Tsiafaki 2017; Tiverios, Manakidou, Tsiafaki 2012). More than 110 trenches have been investigated so fat at the site. Excavation notebooks correspond to at least one excavation trench. These notebooks are kept at the excavation's archive and they are available for study by any specialist. They still, though, are included in what we call "*gray literature*"[2], in the sense that they remain unpublished and accessible to few.

The current Aristotle University excavations at Karabournaki, produce their own notebooks. Beyond the settlement the site includes also the cemetery – of the people living in the settlement during antiquity - an excavation conducted by the local Ephorate of Antiquities and also has produced excavation notebooks. Furthermore, a systematic university excavation, such as that at Karabournaki, is the place of training for Archaeology students in field excavations and the documentation of this process in notebooks together with the management of the finds and research results. The necessity of facilitating accessibility to this archival material for both internal and external use by the ever-expanding Karabournaki research team as well as seeking links with other organizations has led to a request for methods that will achieve this goal.

Therefore, in this paper we use a sample of the notebooks of the excavation at Karabournaki as a case study to examine the extent to which CRMarchaeo manages to fulfill our needs for (i) the conceptual description of the content of the notebooks in a standardized and reusable manner, so as to cover, if possible, the totality of the archival material, (ii) the integrated retrieval of the information included in the notebooks and also its dissemination and access by other scholars. Recognizing the specificity of the excavation notebooks regarding the heterogeneity of the information they contain (research methodology, decision making, archaeological queries based on the archaeological data, descriptions of procedures and finds, interpretations), this paper aims also at detecting and reporting the limitations and possible limitations of CRMarchaeo in modeling the semantics of the excavation notebooks.

[1] The current excavations begun in 1994 by Prof. M. Tiverios who was its director until his retirement in 2013 and since then

[2] "Grey literature stands for manifold document types produced on all levels of government, academics, business and industry in print and electronic formats that are protected by intellectual property rights, of sufficient quality to be collected and preserved by library holdings or institutional repositories, but not controlled by commercial publishers i.e., where publishing is not the primary activity of the producing body" (Farace and Schöpfel 2010).

In the next Section we present an overview of CIDOC CRM and its extension CRMArchaeo, while in Section 3 we unveil the methodology of our research. In Section 4 we proceed to the core of our study, that is the representation of archaeological activities and findings based on archival material. Finally in Section 5 we discuss about expressiveness of CRMarchaeo to describe archaeological archival material and we present the conclusions of this research.

2. Overview of CIDOC CRM and its extension CRMArchaeo

The CIDOC Conceptual Reference Model (CRM) (Ore, Doerr, Le Bœuf, Stead 2107) has been created after more than 10 years of work with the intention to promote a common understanding of cultural heritage information and to serve as a mediator between different data sources of cultural heritage, such as those published by museums, libraries and archives. It aims at providing a standardized and extensible semantic framework for the description of concepts and relations in cultural heritage documentation. Since 9/12/2006 it is official standard ISO 21127:2006.

Understanding the need for expansion of this semantic framework to serve more specialized domains of cultural heritage the CIDOC CRM working team has created CRMarchaeo in order to support the process of archaeological excavation and all the activities related to that.

CRMarchaeo (Doerr et al. 2018) is intended to formalize knowledge extracted from observations made by archaeologists. Archaeological field work is often documented in various ways and excavation teams adopt different methodologies based on the conditions of the site and its special needs. It aims at managing and integrating documentations that have already occurred by providing a common language and in this way focuses on facilitating the semantic encoding, access and exchange of information in an interoperable manner. The model provides entities and properties for describing archaeological stratification processes about both archaeological stratigraphic layers and surfaces, and the wide range of human remains, stable and mobile, found within the strata and their correlations with them. It also aims at describing the interpretation of the chronological sequences of archaeological material based on the space-time analysis of a specific archaeological site. Hence it focuses on the very essence of the archaeological research, which is the understanding of past societies through the information produced during field work.

3. Methodology

The necessity of facilitating accessibility to the huge volumes of archaeological archival material (notebooks) and expressing explicitly the semantics of the activities it describes has led us to use part of the notebooks of the excavation at Karabournaki as a case study. We aim to examine the extent to which the CRMArchaeo model manages to fulfill our needs. These needs are the actual description of the content of the notebooks in a standardized manner, the expansion of the information contained in them to the totality of the archival material, the retrieval of this information through requests and also the possibility of this information to be disseminated and accessed by others.

A thorough examination of the yearly publications of the excavation at Karabournaki and other publications concerning specific studies of archaeological material from the site was first conducted to choose the most representative excavation trenches that would better serve our purpose. Then, from the trenches we moved on to the corresponding notebooks. The aim was to select excavation trenches that yielded a range of information recorded in the notebooks that could be exploited and to examine or trigger the descriptive capabilities of the CRMarchaeo model.

From the archaeological notebooks produced during the excavation research at Karabournaki, during the time frame 1995 - 2012, we selected specific ones that correspond to the trenches 22/84β, 27/100δ and

27/79δ (Tiverios, Manakidou, Tsiafaki 1999; 2002; 2005; 2012; Tiverios et al. 2013). This choice was made taking into consideration (a) the content of the trenches, meaning the findings and also the publications that emerged in the aftermath of specialized studies of the above findings and (b) the content of the notebook and how this content will be represented by CRMarchaeo.

For the trenches 27/100δ and 27/79δ we modeled the actions described in the notebook and correspond to the plan of a working day in the excavation. Thus we focus on issues such as definition of elevation point, excavation of fixed layers, measurements, stratigraphy, recording of stable and mobile findings, documentation through images and drawings.

Regarding the trench 22/84β we decided to model the ordinary excavation process, the rich set of archaeological findings (Piles of stone, Pits, Beehive shaped semi-subterranean structures), as well as the publications that have emerged following the specialized studies on the finds that arose from the excavation research in this trench (pottery, archaeobotanical and archaeozoological material). These publications recognize activities related to a kitchen in the area of the Beehive shaped semi-subterranean structure.

It should be noted that this paper is based on the definitions of the entities and properties of CRMarchaeo 1.4.5. and CIDOC CRM 6.2.1. Moreover the first step for modeling the excavation notebooks in terms of CIDOC CRM is to define the concept of a CIDOC CRM path. Thus a CIDOC CRM path as a chain of the form entity-property-entity (e-p-e), such that the entities associated by a property correspond to the property's domain and range (Lourdi, Papatheodorou, Doerr 2009). The instances of the entities are given after the name of the entity in parentheses e.g. *A9 Archaeological excavation* (=Karabournaki excavation). In the figures the paths of a graph that models a particular exaction process are presented. The upper boxes show the CRM entities that take part in the excavation process, while the lower boxes present the corresponding instances of them.

4. Representation of archaeological activities and findings

4.1. Timespan of the works on a trench

The excavation of a trench is an activity having duration and therefore is represented by the class A9 Archaeological Excavation of CRMarchaeo. The activities that take place in the trenches are parts of the excavation and therefore they are instances of the class *A1 Excavation Process Unit*. Hence the trench 27/100δ could be represented by the path:
A9 Archaeological excavation (=Karabournaki excavation) - *P9 consists of* - *A1 Excavation Process Unit* (=trench 27/100δ).

The works in a trench were conducted through a specific timeframe. We describe that as follows:
A1 Excavation Process Unit (=trench 27/100δ) - P4 has timespan - *E52 Timespan* (= 08 July 1997 – 18 July 1997).

4.2. Definition of elevation point and the final depth of the works on a trench

The activities of a trench took place in a particular area (in the trench) of the excavation, which is represented as an instance of the class *E53 Place* that has particular coordinates. Thus the initial path used for the definition of a trench is expanded as follows: *A9 Archaeological excavation* (=Karabournaki excavation) - *P9 consists of* - *A1 Excavation Process Unit* (=trench 22/84β) - *P7 took place at* - *E53 Place* (=place of the trench 22/84β) - *P87 is identified by* - *E47 Spatial Coordinate*s (= the spatial coordinates of the trench 22/84β).

Additionally at the place of the trench an *elevation point* was defined. We model the definition of the elevation point as follows (Figure 1):

E53 Place (=the place of the elevation point) - *P89 falls within* - *E53 Place* (=place of the trench 22/84β). Alternatively we could use the entity *S20 Physical feature* could be used for the conceptualization of the place of the *elevation point* instead the entity *E53 Place*. The characterization of a place as *elevation point* is a feature attribution process and hence it could be modeled by the path:
E53 Place (=the place of the elevation point) - *P140 assigned attribute to* - *E13 Attribute assignment* - *P141 assigned* - *E46 Section definition* (=elevation point of the trench 22/84β).
Thus we consider the elevation point of the trench (=elevation point of the trench 22/84β) as an instance of the entity *E46 Section definition*.

In the case the *elevation point* is a particular object in that space, then the representation is more complex:
E53 Place (=the place of the elevation point) - *P140 assigned attribute to* - *E13 Attribute assignment* - *P141 assigned* - *E46 Section definition* (=elevation point of the trench 22/84β) - *P58 has section definition* - *S20 Physical feature* (=the object defined as elevation point).

The works in the trench reached a final depth, which is measured from the *elevation point*. The measurement of the final depth of the works in the trench is a typical measurement process and could be modeled by the following two paths starting from the object defined as *elevation point* that is an instance of the entity *S20 Physical feature*:
(a) *S20 Physical feature* - *P39 measured* - *E16 Measurement* - *P40 observed dimension* - *E54 Dimension** - *P90 has value* - *E60 Number* (=2.48) - *P2 has type* - *E55 Type* (from the surface of the northern side of the trench)
(b) *E54 Dimension** - *P91 has unit* - *E58 Measurement unit* (=*meters*).
The symbol (*) denotes a branching point of a path.

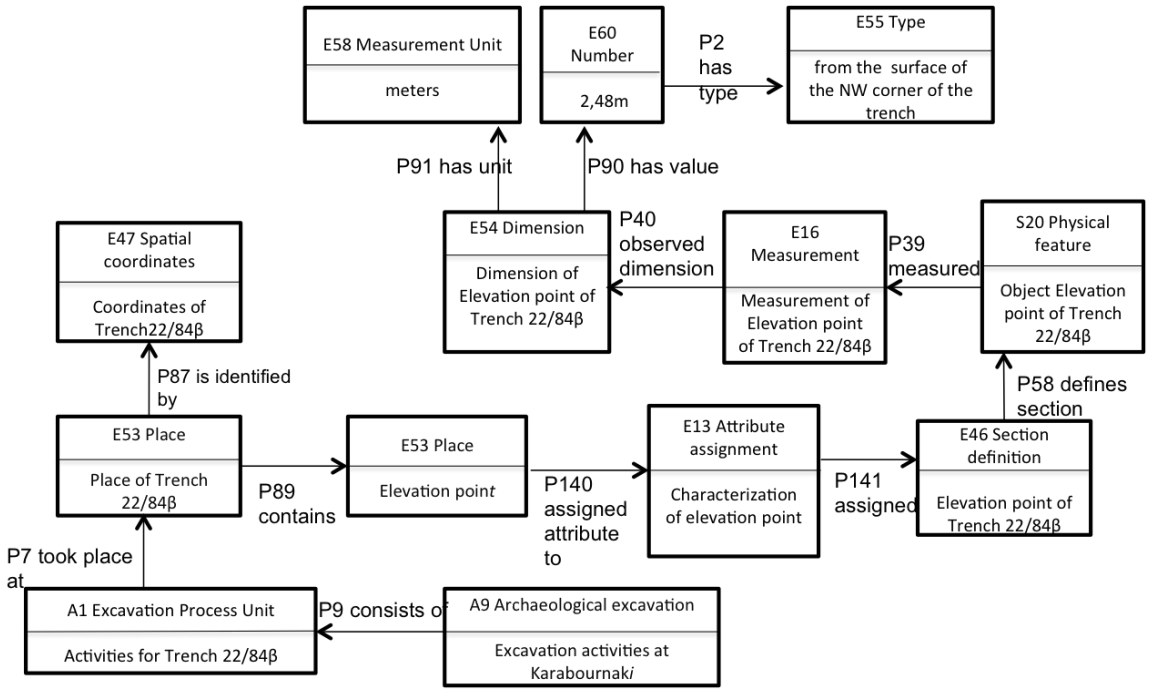

Fig. 1. Definition of Elevation Point, Karabournaki, Trench 22/84β

4.3. Stratigraphy

CRMarchaeo describes deeply and clarifies the semantics of the archaeological stratification processes, the stratigraphic layers and their correlation. Thus the representation of the definition of strata in a trench could be represented taking into consideration that: (i) an object or a structure (e.g. a Pit or a Beehive shaped semi-subterranean structure that was unearthed by the trench 22/84β) is considered an instance of the entity *E26 Physical feature*, (b) this *E26 Physical feature* instance was dug in a *A8 Stratigraphic Unit* through an *A5*

Stratigraphic Modification process and has an *A3 Stratigraphic Interface* and (c) this *E26 Physical feature* instance might be filled with an *A2 Stratigraphic Volume Unit* through an *A4 Stratigraphic Genesis* process. This process is represented by the path:

A5 Stratigraphic Modification (=digging to create the Pit that disturbed the preexisting strata) – *AP8 disturbed – A8 Stratigraphic Unit* (=soft brown soil mixed with black soil and charcoal; it is the pre-existing strata) - *AP15 is or contains remains of - E26 Physical feature* (=Pit) (Figure 2).

Additionally the unearthed structure - instance of the entity *E26 Physical feature* (=Pit) – has an interfaces that is considered instance of the entity *A3 Stratigraphic interface*. This interface confines a different part of soil, represented by an instance of the entity *A2 Stratigraphic Volume Unit* that was created by an instance of the entity *A4 Stratigraphic genesis process*. Thus the following paths are created:

*A3 Stratigraphic interface - AP12 confines - A2 Stratigraphic Volume Unit**

*A4 Stratigraphic genesis - AP7 produced - A2 Stratigraphic Volume Unit**) (Figure 2).

The symbol (*) denotes a branching point of two paths.

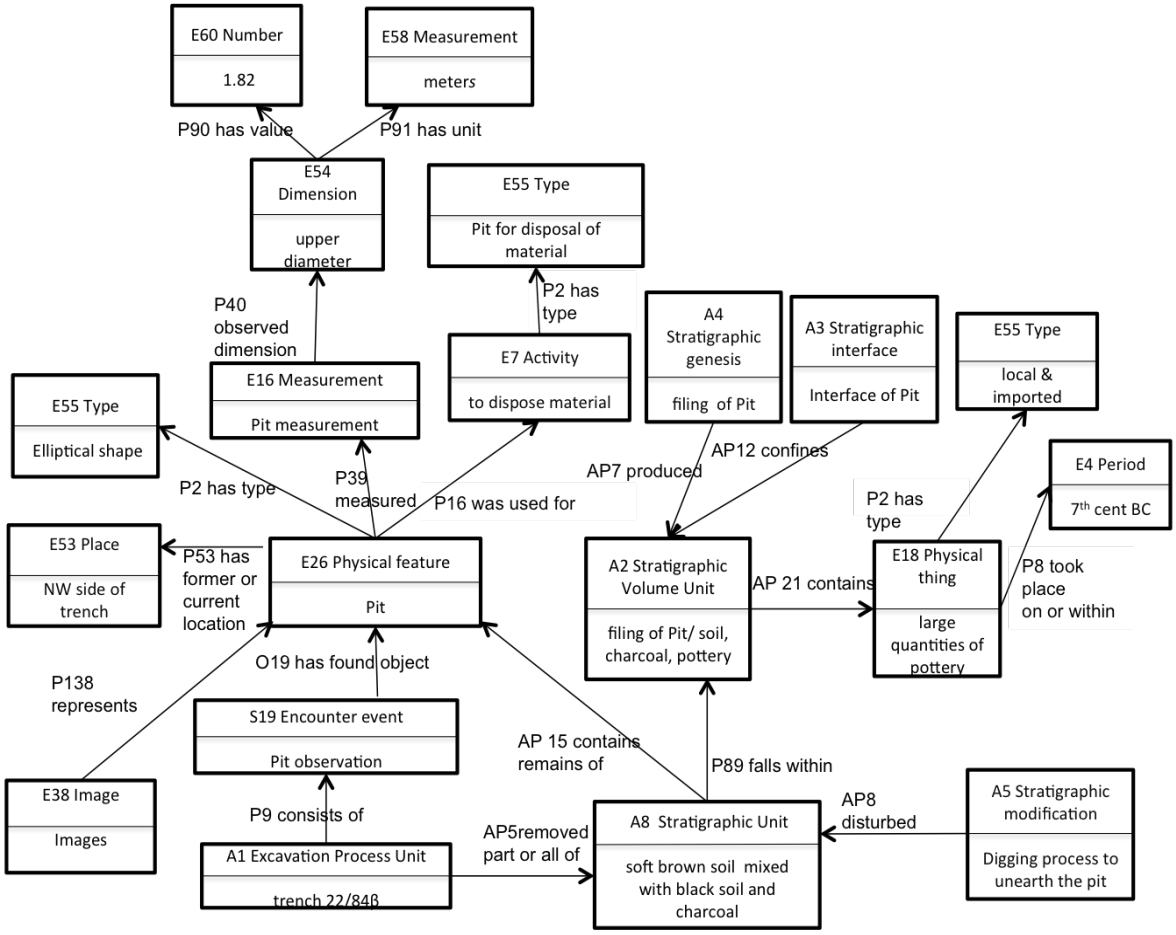

Fig. 2. Pit, Karabournaki, Trench 22/84β

4.4. Findings in a trench

The aim of this paragraph to model the stable and movable finds of a trench. Therefore a variety of findings, stable and movable that have been discovered in a trench are described.

Findings

A Pit of elliptical shape was unearthed during the excavation of trench 22/84β on the northwestern side of the trench. Measurements were taken and it was photographed. The filing of the Pit was excavated and the mobile

finds were collected and dated. After studying the finds, the excavators concluded that it was used for disposal of material that was no longer in use.

As mentioned in the Section 4.3 we consider the Pit as an instance of the CRM Entity *E26 Physical Feature* (or *S20 Rigid Physical Feature*) with a specific shape and measurements that was found at a specific part of trench 22/84β. The Pit was excavated from its filling which is considered an instance of the entity *A2 Stratigraphic Volume Unit*. Hence a new strata is generated by a process which is an instance of the entity *A4 Stratigraphic Genesis*. Between the Pit and its filling an interface exists which is considered an instance of the entity *A3 Stratigraphic Interface*. Finally the process of unearthing the Pit by disturbing the already existing strata (A8 soft brown soil mixed with black soil and charcoal) is an instance of the entity *A5 Stratigraphic Modification*. These activities that concern the definition and excavation of pre-existing strata have been represented by the paths of the section 4.3 (Figure 2).

The location and the shape of the Pit are given by the paths (Figure 2):
Location: *E26 Physical feature*** (=Pit) - *P53 has former or current location* - *E53 Place* (=NW part of the trench)
Shape: *E26 Physical feature*** (=Pit) - *P2 has type E55 Type* (=elliptical shape).
Furthermore the measurements for determining the dimensions of the Pit are similar to the measurements made for the elevation point and are briefly presented with the instances of the intermediate entities:
Upper diameter: *E26 Physical feature*** (=Pit) - *P39 measured* - *E16 Measurement* - *P40 observed dimension* - *E54 Dimension*$_2$ (=upper diameter) - *P90 has value* - *E60 Number* (=1.82), while *E54 Dimension*$_2$ - *P91 has unit* - *E58 Measurement unit* (=meters) and *E54 Dimension*$_2$ *– P2 has type – E55 Type* (=upper diameter)
Lower diameter: *E26 Physical feature*** (=Pit) - *P39 measured* - *E16 Measurement* - *P40 observed dimension* - *E54 Dimension*$_3$ (=lower diameter) - *P90 has value* - *E60 Number* (=1.42), while *E54 Dimension*$_3$ - *P91 has unit* - *E58 Measurement unit* (=meters) and *E54 Dimension*$_3$ *– P2 has type – E55 Type* (=lower diameter). Similar paths represent the internal depth of the Pit and the distance from the surface to the mouth of the Pit.

According to the excavation notebook the Pit was used to dispose material. This statement is represented by the path:
E26 Physical feature (=Pit) - P16 used specific object (was used for) - E7 Activity (= to dispose material) - P2 has type - E55 Type (=Pit for disposal of material).

Finally the instance of the *A2 Stratigraphic Volume Unit* contained mobile finds, which are instances of the entity *E18 Physical thing* such as soil, charcoal and pottery. Thus we define the following paths (Figure 2):
*A2 Stratigraphic Volume Unit** (=filling of the Pit, soil, charcoal, pottery) - *AP21 contains* - *E18 Physical Thing* (=charcoal) and
*A2 Stratigraphic Volume Unit** (=filling of the Pit, soil, charcoal, pottery) - *AP21 contains* - *E18 Physical Thing (*=soil*) – P2 has type - E55 Type (=very soft, sandy)* and
*A2 Stratigraphic Volume Unit** (=filling of the Pit, soil, charcoal, pottery) - *AP21 contains* - *E18 Physical Thing**** (=pottery) *– P2 has type - E55 Type* (=local and imported) and finally
*E18 Physical Thing**** (=pottery) - *P8 took place* - *E4 Period* (=7th century B.C.).
The symbols (*), (**), (***) denote branching points of a path.

Similar models we could develop for other constructs that need stratigraphic processing in the trench. For example a Beehive shaped, semi-subterranean structure of circular shape with an interface with a few holes was unearthed during the excavation of trench 22/84β on the northeastern side of the trench. Measurements were taken and it was photographed. The filing of the Pit was excavated and the mobile finds were collected and dated. Taking into consideration the mobile finds (types of pottery and other finds, archaeo-zoological and archaeobotanical material) the excavators concluded that it was used for the preparation of food. In this case the Beehive shaped, semi-subterranean structure is considered an instance of the entity *E26 Physical Feature*. It was dug in an *A8 Stratigraphic Unit* through an *A5 Stratigraphic Modification* process, has an *A3 Stratigraphic Interface* and was filled with a *A2 Stratigraphic Volume Unit* through a *A4 Stratigraphic Genesis process*. This

A2 Stratigraphic Volume Unit contained as *E18 Physical things* as soil, pottery and archaeo-zoological material (animal bones and shells).

Piles of Stone

Three Piles of stone were unearthed during the excavation of trench 22/84β. Piles of stone 1, 2 and partially 3 were destroyed after being recognized as modern interventions to facilitate the continuation of excavation to a deeper level. We consider the "*Pile of stone 1*" as in instance of the CRM Entity *E18 Physical Thing* that was embedded in an instance of the entity *A2 Stratigraphic Volume Unit* and was destroyed with the specific purpose to continue research to a deeper level in the trench:

A1 Excavation Process Unit (= trench 22/84β) - *AP5 removed part or all of* - *A2 Stratigraphic Volume Uni*t - *AP19 is embedding in* - *A7 Embedding* - *AP18 is embedding* of - *E18 Physical Thing** (=Pile of stone 1) - P13 *destroyed* - *E6 Destruction* - *P20 has specific purpose* - *E7 Activity** (=research of the trench to a deeper level).
Alternatively we could use the shortcut:
A2 Stratigraphic Volume Unit - *AP21 contains* - *E18 Physical Thing* to shorten the path:
AP19 is embedding in - *A7 Embedding* - *AP18 is embedding* - *E18 Physical Thing*.

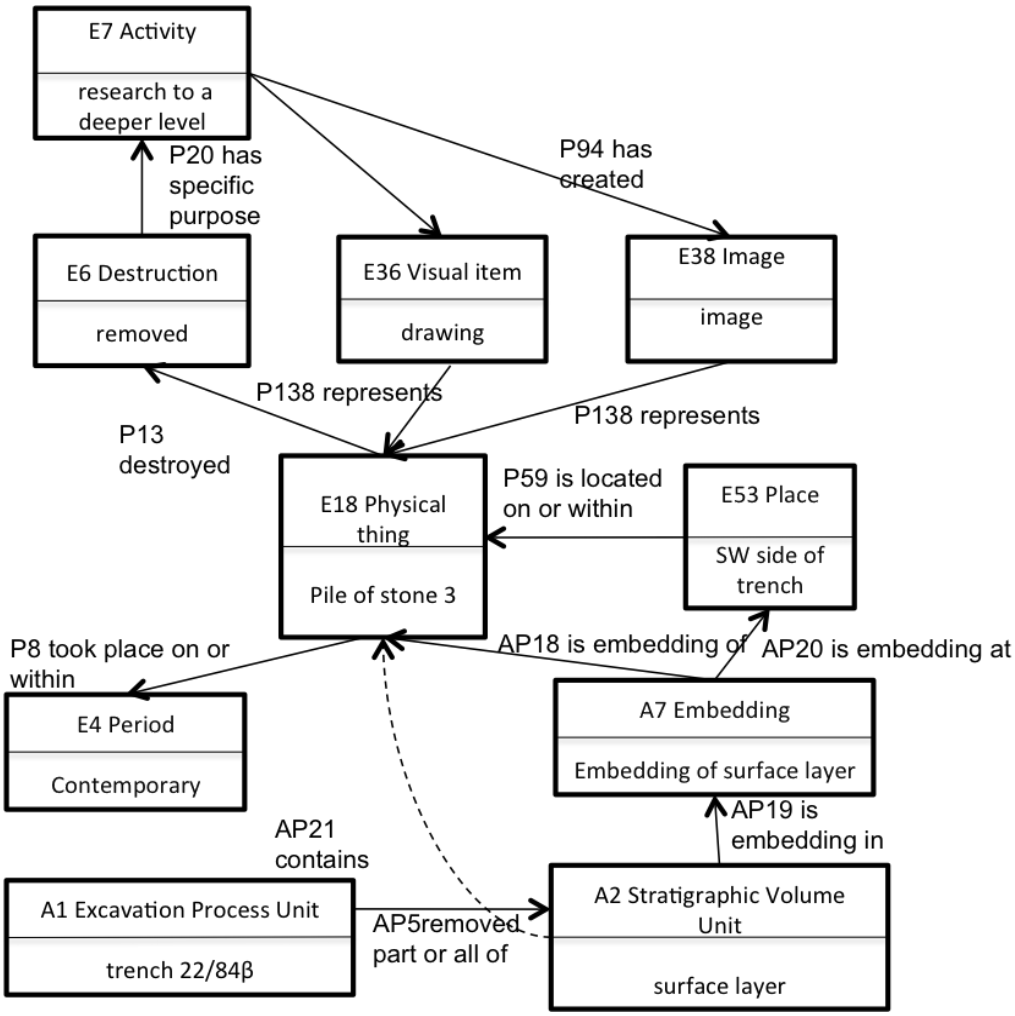

Fig. 3. Piles of stones, Karabournaki, Trench 22/84β

The creation of images and drawings that are exhibited in the excavation notebook is represented as follows:
*E7 Activity** (=research of the trench to a deeper level) - *P94 has created* - *E36 Visual item* (=Drawing of Pile of stone 1) - *P138 represents (is represented by)* - *E18 Physical thing** (=Pile of stone 1)

*E7 Activity** (=research of the trench to a deeper level) - *P94 has created* - *E38 Image* (=Image of Pile of stone 1) - *P138 represents (is represented by)* - *E18 Physical thing** (=Pile of stone 1)
The symbol (*) denotes a branching point of a path.

The same representation we use for instances of CRM Entity: E18 Physical thing "*Pile of stone 2*" and E18 Physical thing "*Pile of stone 3*" (Figure 3).

4.5. Publications

The results of excavations and/or the respective trenches are usually published in journals or conference proceedings. In the case of the trench 22/84β its results has been published as part of the proceedings of the conference. A publication in the terms of CIDOC CRM is represented as an instance of the entity *E33 Linguistic object*. The publication has a specific title, an ISSN Number and was published in a specific language. It has been created by and carried out by people (the research team) at a specific period in time. These attributes are expressed as follows:
Title: *E33 Linguistic object** - *P102 has title* - *E35 Title* (= Ανασκαφικές έρευνες στο Καραμπουρνάκι κατά το 2009. Ο αρχαίος οικισμός).
ISSN: *E33 Linguistic object** – *P1 is identified by* - *E42 Identifier* (=ISSN 1106-5311)
Language: *E33 Linguistic object** - *P72 has language* - *E56 Language* (=Greek)
Author(s): *E21 Person* (=Tiverios, M., Manakidou, E., Tsiafaki, D.) - *P14 carried out by* - *E65 Creation*** - *P94 has created* - *E33 Linguistic object** (Note that this path should be repeated for each one of the instances of *E21 Person* Tiverios, M., Manakidou E. and Tsiafaki, D.)
Publication date: *E65 Creation*** - *P4 has timespan* - *E52 Timespan* (=2009).
The symbols (*) and (**) denote branching points of paths.
The Entity E33 Linguistic object has been about the following:
E53 Place (=Karabournaki) - *P129 is about* - *E33 Linguistic object*.
E53 Place (= place of the trench 22/84β) - *P129 is about* - *E33 Linguistic object*.
A1 Excavation Process Unit (=trench 22/84β) - *P129 is about* - *E33 Linguistic object*.

Regarding the subjects of the publication the statement *E33 Linguistic object** - *P129 is about – E?* could be used with a variety of entities in the place of the object of the statement *E?*. In particular:
*E33 Linguistic object** - *P129 is about* - *E7 Activity* (=cooking activities) and
*E33 Linguistic object** - *P129 is about* - *E18 Physical thing*** (=big quantity of pottery) - *P8 took place* - E4 Period (=6th century B.C.)
*E18 Physical thing*** (=big quantity of pottery) – *P2 has type* - *E55 Type* (=handmade coarse cooking vessels, cooking vessels, chytrae, weelmade oinochoe, cups, olpae, storage pithoi, clay mortaria, imported amphorae) (Note that the path *E18 Physical thing*** (=big quantity of pottery) – *P2 has type* - *E55 Type* should be repeated for each one of the instances of *E55 Type* of finds).
The symbols (*) and (**) denote branching points of paths.

Similarly the results of the trench 22/84β has been published in the proceedings of an international conference and they concern the findings that have been the subject of specialized research by scientists - collaborators of the excavation, such as Beehive shaped semi-subterranean construction/ Pit 1, pottery, archaeozoological and archaeobotanical material, etc. According to the mentioned conceptualization we construct the following paths (Figure 4):
Title: *E33 Linguistic object** - *P102 has title* - *E35 Title* (=Cooking in an Iron Age Pit at Karabournaki)
ISSN: ISSN: *E33 Linguistic object** – *P1 is identified by* - *E42 Identifier* (=ISBN 978-90-429-2724-7)
Language: *E33 Linguistic object** - *P72 has language* - *E56 Language* (=English)
Author(s): *E21 Person* (=Tiverios, M., Manakidou, E., Tsiafaki, D., Valamoti, S., Theodoropoulou, T., Gatzogia, E.) - *P14 carried out by* - *E65 Creation*** - *P94 has created* - *E33 Linguistic object** (Note that this path should be repeated for each one of the instances of *E21 Person* Tiverios, M., Manakidou E., Tsiafaki, D., Valamoti, S., Theodoropoulou, T., Gatzogia, E.)
Publication date: *E65 Creation*** - *P4 has timespan* - *E52 Timespan* (=2010).

Spatial coverage: *E33 Linguistic object* - P129 is about - E53 Place* (=Karabournaki, trench 22/84β),
while the subjects of the publication are the findings in trench 22/84β:
E33 Linguistic object - P129 is about - E26 Physical feature* (=Beehive shaped semisubterranean construction/ Pit)
E33 Linguistic object - P129 is about - A2 Stratigraphic Volume Unit* (soil that has filled the Pit)
E33 Linguistic object - P129 is about - E20 Biological object* (=zooarchaeological remain)
E33 Linguistic object - P129 is about - E20 Biological object* (=archaeobotanical remains)
E33 Linguistic object - P129 is about – E53 Place* (=optanion)
E33 Linguistic object - P129 is about – E7 Activity* (=symposium activities)

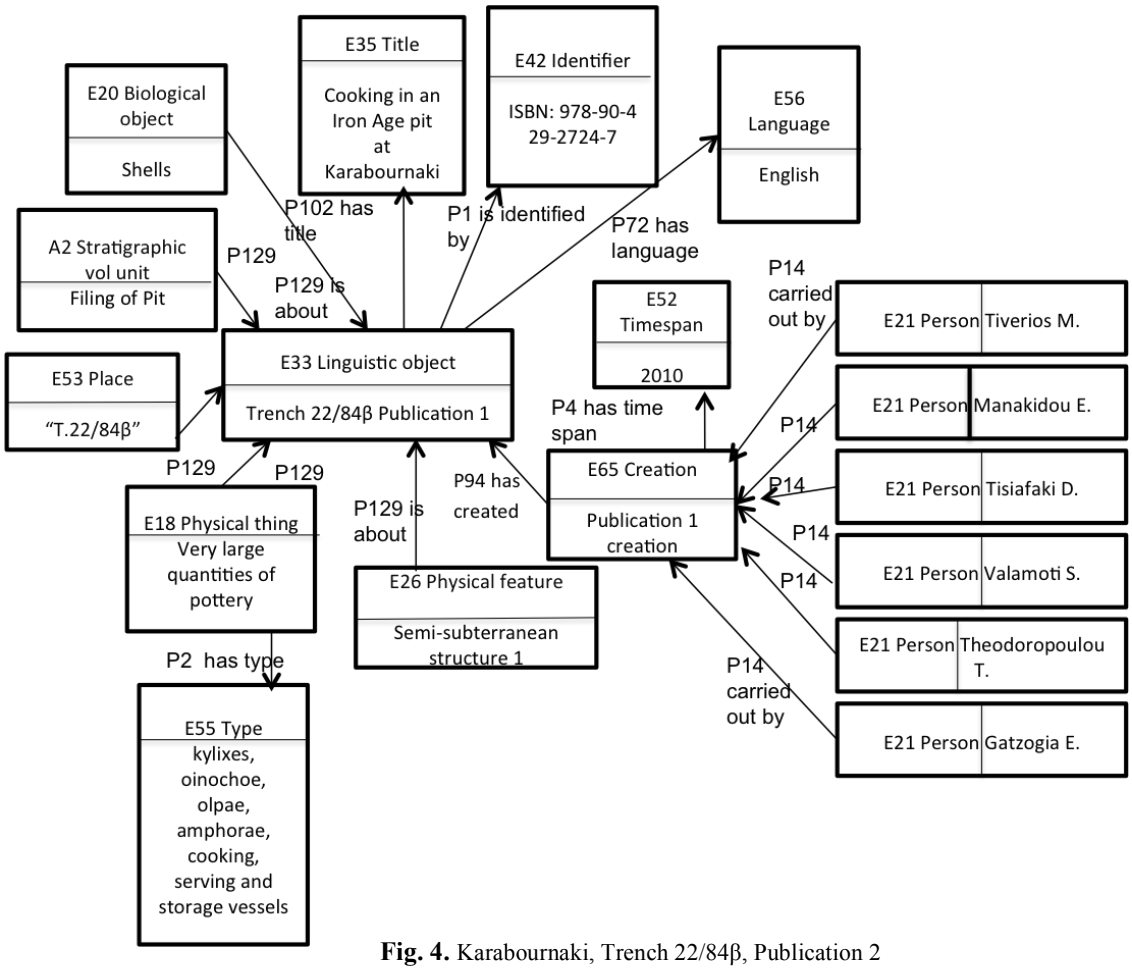

Fig. 4. Karabournaki, Trench 22/84β, Publication 2

5. Discussion and Conclusions

Concluding our efforts to explore the descriptive capabilities of CRMArcheo using archival material from the excavation at Karabournaki as a case study, we would highlight that the model covers the descriptive needs of the archival material regarding the key issues of excavation works at the level of everyday activities such as the definition of the archaeological layers and fixed layers, the description of the process of encountering in situ and mobile findings, the chronology and timeframe of field works. We find adequate modeling capabilities also concerning more focused excavation activities such as: the definition of the timeframe of research, the description of stratigraphy, interpretive approaches to the use of in situ and mobile findings and also publications.

Additionally we would point out where the model did not respond adequately or did not facilitate the handling of our archival material in a user-friendly, clear and efficient manner. These issues are the following:

Definition of elevation point

Definition of the elevation point from where the measurement of the depth of the location of each find is taken during the excavation is a key aspect for the excavation process. In most archaeological excavations the elevation point is defined taking into consideration a basic predefined point of the field of excavation (elevation point 0) the altitude of which is measured in correlation to the level of the sea. Elevation point 0 is considered as the basis for each depth measurement it the excavation field. For the measurements to be taken in an easy and close to each trench manner, elevation point is very often relocated close to each trench. As differences in altitude may occur in different parts of the excavation field, it is fundamental that in the notebook the difference in altitude of the elevation point of each trench in comparison to elevation point 0 is noted. In the notebooks of Karabournaki the first activity that we encounter with in all excavation notebooks prior to the description of daily works is the definition of elevation point from which the measurements (depth) of finds will be taken (present in all three trenches 22/84β, 27/100δ, 27/79δ under study). This is defined in comparison to elevation point 0 but it is common that it is also defined in comparison to elevation point of neighboring trenches (which has already been defined in comparison to elevation point 0).

We presented already a proposal of modeling the definition of elevation point for trench 22/84β in Figure 1, but the path we presented only focuses on the description of the elevation point of the trench where is has been located. The part of the definition that correlated to its connection and comparison to elevation point 0 and other neighboring trenches, we can propose as follows:
Definition of the elevation point of the excavation: *A9 Archaeological excavation* (=Karabournaki excavation*) - P9 consists of - A1 Excavation Process Unit** - *P7 took place at - E53 Place** (=top of excavation hill, Trench 23/15a) - *P87 is identified by – E44 Place Appellation*** (=elevation point 0) and
*E53 Place** (=top of excavation hill, Trench 23/15a) – *P39 measured – E16 Measurement – P40 observed dimension – E54 Dimension** (=Altitude) – P90 has value – E60 Number* (= 25.909) and
*E54 Dimension*** (=Altitude) – *P2 has type – E55 Type* (=from the sea level)
The definition of the elevation point of the trench has already given:
A9 Archaeological excavation (=Karabournaki excavation) - *P9 consists of - A1 Excavation Process Unit* (=trench 22/84β) - *P7 took place at - E53 Place* (=place of the trench 22/84β) and *E53 Place* (=the place of the elevation point of the trench 22/84β) - *P89 falls within - E53 Place* (=place of the trench 22/84β).
Thus the two elevation points are correlated by the path:
*E53 Place** (=top of excavation hill, Trench 23/15a) - *P122 borders with - E53 Place* (= south of place of the trench 22/84β) and
*E53 Place** (=top of excavation hill, Trench 23/15a) - *P122 borders with - E53 Place* (= east of place of the trench 22/85α).

Although this is a fundamental activity in the excavation process and expected to be encountered with as information of major importance in most excavation notebooks, CRMArchaeo does not provide a clear statement (path) that would make such an important and very often repeated activity to be modeled in an short, simple and comprehensive way.

Stratigraphic interfaces

Usually stratigraphic interfaces have specific physical characteristics. For instance, the interface of the Beehive shaped semi-subterranean construction in trench 22/84β contains intentional or unintentional holes of different dimensions. However no CIDOC - CRM property covers meaningfully or helps to describe the interface in greater detail and clarity. The properties that have similar semantics are indicatively *P56 bears feature*, *P46 is composed of (forms part of)*, *P130 shows features of.* Therefore there is need for a property for connecting the entity *A3 Stratigraphic Interface* with the entities *E19 Physical object*, or *E18 Physical Thing* or *E26 Physical Feature*.

Description of shapes

Regarding the shape description we propose the establishment of terminology as well as more formal and clear definitions than terms of vocabularies – instances of *E55 Type* (eg. elliptical, circular). Shape descriptions occur often in notebooks and therefore there is a need of common archaeological descriptions found on notebooks.

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