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Report on existing 3D scans and metadata

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This report describes the available data relating to artefacts relevant to GRAVITATE, and documents the current level of metadata description (morphology, materials, etc.). The artefact data originates from the main participating collections: Cyprus Institute, Ashmolean Museum, Fitzwilliam Museum and British Museum.

This is a 'living document' updated internally. This public version represents a snapshot of all artefacts available to GRAVITATE researchers at this moment in time. Access to metadata and 3D scans of real-world artefacts is critical for real-world grounded evaluations of the semantic and geometric GRAVITATE technology. We also expect additional artefacts to be added to this catalogue as the GRAVITATE project progresses.

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gravitate-project.eu

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1. Executive Summary

This deliverable represents a snapshot of all artefacts available to GRAVITATE researchers at this moment in time, focussing on the target use cases selected by GRAVITATE partners. We have in GRAVITATE access to 3D scans from artefacts at some of the world's most prestigious cultural heritage institutions.

From a scientific perspective, access to metadata and 3D scans of real-world artefacts is critical for real-world grounded evaluations of the semantic and geometric GRAVITATE technology. From a business perspective, access to this data offers GRAVITATE a unique opportunity to demonstrate how techniques, extending the state of the art, can revolutionize digital search and matching within our cultural heritage institutions, riding the wave of ever cheaper and more capable 3D scanning technology to capture and share artefacts for everyone.

Scope of document

The primary use case for GRAVITATE is a set of terracotta figurative statues from the port of Salamis on the island of Cyprus. These statues are highly fragmented and are distributed across many collections, notably at the Cyprus Museum, the British Museum in London, the Ashmolean in Oxford and the Fitzwilliam in Cambridge. At the inception of the project these objects were judged as ideal as the two GRAVITATE end user consortium members, specifically the Cyprus Institute and the British Museum, were already partnered on making available 3D scans of the material from all four of these museums.

At the same time, in order to contextualise these 3D resources, and provide a basis on which first and third parties could make assertions providing further context and enriched understanding, those partners were committed to the exposure of Linked Data and, in particular, the use of the International Council of Museums' (ICOM) Documentation Committee's (CIDOC) Conceptual Reference Model (CRM).

This document describes 3D scan and metadata for artefacts from Salamis. Other available 3D and 2D data from other collections is also available to GRAVITATE, but is out of scope of this document.

Results

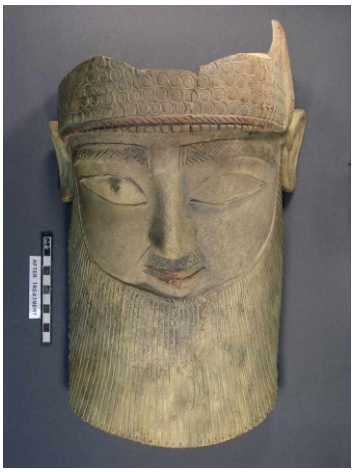
In total there are 221 3D models and over 2,000 2D scan images of the Salamis artefacts available to GRAVITATE at the time or writing. Each collection has its own metadata schema and associated controlled vocabulary, and these are all detailed within this deliverable.

The consortium also has potential access to many 100's of 3D models and 1,000's of 2D images from other collections outside the GRAVITATE target use case. These are out of scope of this deliverable but are potentially available for evaluation within GRAVITATE also.

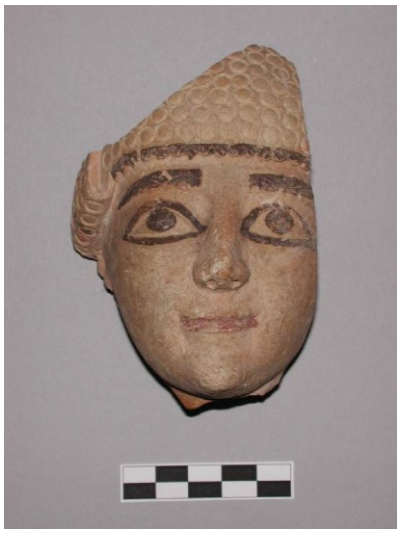
2. Introduction

The Salamis statuary, which forms the use case of GRAVIATE, exists as terracotta fragments in the collections of the Cyprus Museum, the British Museum in London, and the Ashmolean and Fitzwilliam museums, respectively in Oxford and Cambridge. Compelling examples from each collection with their identifiers are shown in Figure 1.

British Museum
1891,0806.39



Ashmolean Museum
1909.837



Fitzwilliam Museum
GR.11.1890

Cyprus Museum
C.111.1935

Figure 1: Salamis fragments showing faces

Notable among these fragments including faces are commonalities in materials, style, decoration and in the techniques used to produce these shared stylistic features: circular impressions suggesting a cap, incision to represent beard, etc.

In the case of several other fragments body part may be discerned (1968,1213.32 & 45), and may coincide with significant evidence of decorative technique (1909,0310.142), in others the body part may be rather less clear (1968,1213.41, discussed later), as shown in Figure 2.

British Museum
1968,1213.32

British Museum
1968,1213.45

British Museum
1909,0310.142

British Museum
1968,1213.41

Figure 2: Salamis fragments showing body parts

Further, there are fragments where overall morphology, by itself, leave the figurative nature of the fragment unclear, but the decorative features make clear that, for example, a beard or a cap is represented, as shown in Figure 3.

British Museum
1968,1213.19

British Museum
1909,0310.62

Figure 3: Salamis fragment showing parts identifiable by decoration

While one aim of the GRAVITATE project is re-assembly, there is limited opportunity to find directly fitting pieces; where such limited opportunities have existed in a single collection, indeed, this may have already been achieved by 'manual' archaeological means, as shown in Figure 4 where there is represented what now exists, and is 3D-scanned as, a single object but was assembled from six separately catalogued fragments.

British Museum
1891,0806.48, 49, 50, 51, 53, 55 and 56

Figure 4: Existing re-assembled Salamis statue

In order to ingest the current knowledge on the identification and understanding of these fragments, across the museums where they reside, to link with the rich geometric information available in the form of 3D scans, and to provide a backbone for encoding enrichments to the understanding and context we follow a Semantic Web-oriented approach and therefore first introduce some relevant terminology before considering the existing data institution by institution.

2.1. Definitions

CIDOC-CRM: CIDOC Conceptual Reference Model. This ISO standard (ISO 21127:2014) provides an extensible ontology for concepts and information in cultural heritage and museum documentation.

Conceptual item: Thing, ideally semantically grounded in the real-world (e.g. Artefact).

Geometric item: 3D object.

Geometric matching: Matching 3D objects based on geometric features.

Geometric semantic description: Semantic description of a geometric item (e.g. body morphology labels).

Geosemantic matching: Matching conceptual items based on a contextual descriptions around target conceptual items and/or geometric items.

Geosemantics: Contextual descriptions of geometric items (e.g. related parts in a 3D model) and semantic descriptions relating to conceptual items or geometric items (e.g. semantic URI to imaging methodology used or body morphology labels).

HR: High Resolution

Inference: Reasoning over data through rules that creates more data.

Linked Data: Semantic description(s) referenceable via realizable URI.

Linked Open Data: Semantic description(s) referenceable via a publically realizable URI.

LR: Low Resolution

PLY: Polygon File Format. This is a digital format principally designed to store three-dimensional data from 3D scanners.

Query: Database query via a language such as SQL or SPARQL.

RDF / NTriples: Resource Description Framework. This is a W3C recommendation describing an abstract model with several serialization formats (e.g. NTriples, RDF, Turtle) encoding class and entity type knowledge.

Relationship: Property associated with a conceptual item with a literal or concept value (e.g. Artefact hasOwner <person>).

Semantic description: RDF graph describing a conceptual item.

Semantic Matching: Matching conceptual items based on similarity of their semantic descriptions.

Semantic Web: Web of meaningful linked data.

Semantics: Meaning.

SKOS: Simple Knowledge Organization System. This is a W3C recommendation for an ontology that can represent concepts such as broader or closeMatch.

SPARQL: SPARQL Protocol and RDF Query Language. This is a W3C recommendation for a query language designed especially for RDF databases (e.g. triple stores).

Vocabulary: Terms used to label conceptual terms (epistemological labels) organized in a list, thesaurus or ontology.

3. State of the Art

3.1. Online artefact catalogues

The British Museum made the decision to publish the digital records from its entire catalogue in 2008. In 2011, with funding from the Andrew W. Mellon Foundation, founding the ResearchSpace project, the British Museum exposed these records as Linked Open Data, i.e. resolvable to RDF and with a public SPARQL endpoint, using the CIDOC-CRM ontology. The ResearchSpace project has since been heavily involved with advocacy for Linked Data and for the CIDOC-CRM ontology, and has provided assistance in several institutions having publish Linked Data online, notably the Yale Centre for British Art and recently the Rijksmuseum.

The British Museum has provided limited resolution of all 2D images online, via its Collection Online service to which the RDF data links, since 2009. Since the start of the GRAVITATE project the British Museum has settled on licensing both data and images according to a Creative Commons license, which permits free re-use for research and non-commercial purposes.

The Fitzwilliam Museum similarly, at the time that GRAVITATE was submitted, exposed both RDF and a SPARQL endpoint by which their records could be accessed and queried according to a CIDOC-CRM representation. Around the time of the kick-off to the project they announced that this service would be offline during Summer 2015, but following the Summer it has been communicated that, due to staff loss, there are no immediate plans for this service to be re-instated.

The Claros project of the University of Oxford exposes RDF and a SPARQL endpoint for several cultural heritage institutions, and this includes data from the Ashmolean Museum. Unfortunately this does not include the Antiquities department, under which Salamis material falls, though it does provide a prototype for expanding to include this. Since the start of the GRAVITATE project the Oxford Cultural Heritage Programme has also started to move the CLAROS data into the ResearchSpace platform and further work on this will continue during 2016. The ResearchSpace project has undertaken knowledge transfer workshops at Yale University and Oxford University during 2015, teaching knowledge representation and data mapping to non-technical cultural heritage professionals. Mappings from the Getty Institute in Los Angeles and other European data mappings are in progress. This knowledge transfer is seen as a key component for future sustainability and collaboration between cultural heritage organisations and the academy. The ResearchSpace project continues to employ specialisations of the CIDOC CRM significantly covering archaeology, scientific observation and argumentation. The process of abstracting data to different levels of specificity allows researchers from different backgrounds and working within different disciplines to effectively collaborate using the same underlying harmonised datasets. The use of argumentation as a process will allow interdisciplinary annotation that is structured to conform to recognised standards of academic discourse and provide digital provenance for both academic and more popular dissemination.

The different components are captured in a new type of system specifically designed for manging, manipulating, enriching and visualising. The Metaphacts Semantic Wiki development platform adheres to high quality semantic standards and development processes to fully support and utilise Linked Data and associated ontologies to help produce the type of applications that have been

lacking from the Linked Data world. Real world applications that are able to provide a stable and intelligent access to heterogeneous datasets in highly complex cultural heritage environments where data uses highly diverse classification systems built up separately over the last 200 years. In particular these systems do not squeeze data into fixed models but allow the full meaning of each individual dataset to be represented, yet harmonised with other knowledge graphs to provide insight through contextual relationships.

The State of the Art is not just about employing new technologies but is also about tackling the barriers to cross sector collaboration and meeting the needs of a whole range of different researchers and users. State of the Art is about recognising, and designing systems, that pull together the more practical but innovative practices emanating from the cultural heritage sector with strategies that go beyond the periods of a single research project, with the dynamic of a research project attempting to build upon previous knowledge. In a world in which the sheer amount of data makes effective knowledge building complex and difficult, often resulting in fragmentation, the GRAVITATE project is attempting to provide more coherent digital methods which can be passed to future projects.

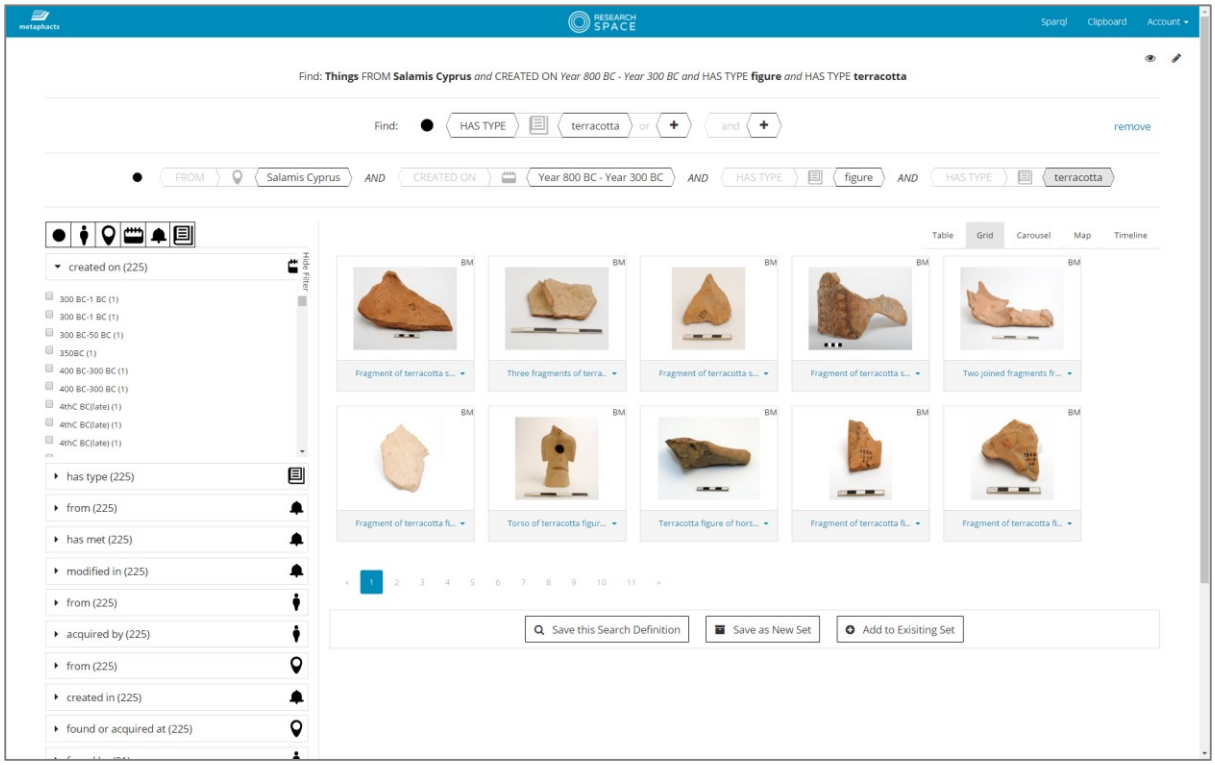


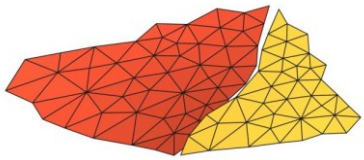
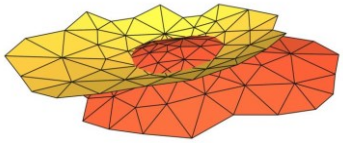
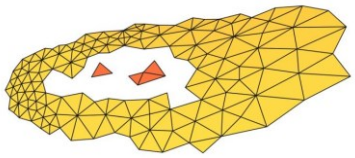
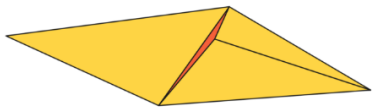
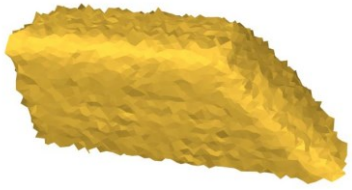
Figure 5: ResearchSpace Semantic Search System - British Museum

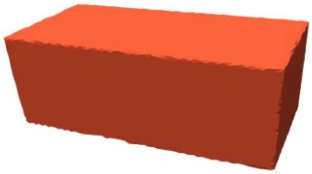
3.2. Quality of 3D data

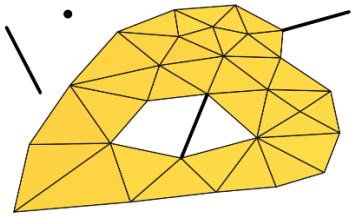
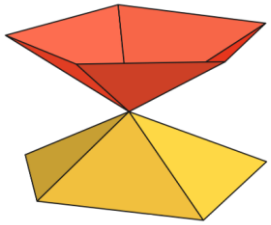
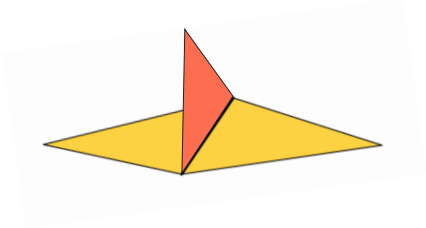
It is not sufficient to state that the project has access to a number of 3D models of artefacts. Whilst in general many 3D models are captured purely for visualisation purposes, GRAVITATE requires models that are suitable for the application of novel feature extraction and matching algorithms. We must therefore understand the quality of the 3D models and this is inextricably linked to the complexities of the scanning process itself. Here we describe some of that complexity as an aid to understanding the data quality.

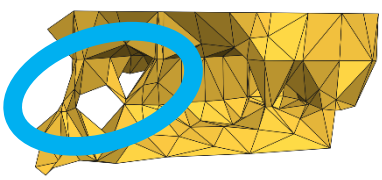
A laser scanner acquires a series of range images: each image contains the measure of the distance between the surface and the laser emitter. The scanner software, with the intervention of the user, aligns these images and processes them to reconstruct an approximation of the original surface, typically in the form of a triangle mesh.

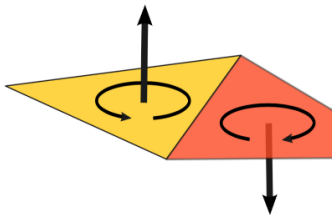
This process usually produces digital artefacts, which are mostly due to occluded areas on the object (i.e., the laser beam cannot reach the surface) or may also due to instrumental error or problematic surface finish (e.g., reflections). Here we list the most common issues that may arise [Attene 2015]. They belong to three categories: geometry, local connectivity and global topology.

Geometry	
Overlaps 	Many triangles covering the same surface patch (overlapping triangles). Possible solutions are: • removal of the overlapping parts followed by the application of the Zippering algorithm; • application of the Poisson Reconstruction algorithm, which takes as input the vertices with normal vectors, and discards completely the original triangulation.
Self-intersections 	A portion of the volume is covered twice (or more). This is an ill-posed problem, and the user should solve the ambiguity.
Missing data 	Holes, possibly with islands. It can be solved with hole-filling techniques, but user intervention is required.
Degenerate elements 	Occurs when triangles have a nearly zero area. It causes numerical issues in mesh processing algorithms. It can be solved by removing the degenerate elements or applying re-meshing techniques.
Noise 	The acquired data deviates from the real surface, due to e.g. a lack of 3D scanner resolution. It can be solved by applying de-noising techniques such as Laplacian smoothing and bilateral filtering.

Aliasing 	Sharp features are not captured correctly. These should be reconstructed in post processing, but supervision may be required.

Local connectivity	
Dangling elements 	Occurs with edges that have no incident triangles, or vertices with no incident vertices/triangles. The solution in this case is just to ignore them.
Singular vertices 	A configuration where more than one connected component is found in the neighbourhood of the vertex: in such case the vertex is called singular. The solution is to duplicate the singular vertex. Standard repairing algorithms can perform this operation automatically.
Singular Edges 	It occurs when more than two polygons share the same edge. The algorithm that solves this issue is complex, and may potentially propagate changes on the neighbours.

Global topology	
Topological noise 	The discrete model contains handles and tunnels that are not present in the real counterpart. Algorithms exist for topology simplification, but they may require user supervision.

Inconsistent orientation 	Adjacent triangles are associated with opposite orientations, so that there is no clear separation between inside and outside. The solution is to start from a seed triangle and propagate its orientation through the whole geometry (in a consistent way). However, this technique will solve the issue only if the mesh is manifold.

For 3D models in PLY format a meaningful suffix has been inserted into the filenames (see appendices for examples of these filenames):

- The suffix "**Al**" to denote Aligned file: the original scans have been aligned together, but no surface reconstruction has been applied;
- The suffix "**Im_Al**" to denote Image Alignment: the same procedure as in the aligned files has been followed, enriched by colour;
- The suffix "**Im_Al_pois**" to denote Image Alignment after Poisson reconstruction: image alignment and Poisson surface reconstruction have been applied;
- The suffix "**HDmaxW_Al**" to denote high-resolutions scans.

All the scanned artefacts in GRAVITATE bar 3 have a .ply file containing the suffix Im_Al, which is equivalent to say they exhibit texture/colour. Further, the digital objects belonging to the British Museum (and scanned in 2013) and the ones from Cyprus Museum all have .ply files with Im_Al_pois suffix, meaning that they have been produced using Poisson reconstruction.

Regarding the quality of the meshes inside the repository, 86 .ply files contain only vertices with colour. On the other hand all appear as proper meshes (with edges and triangles). The models are provided in two different resolutions, named *high resolution* (HR) and *low resolution* (LR). Some of the models are offered in both HR and LR (in particular, 38 from British Museum and 5 from Ashmolean Museum), 20 models from British museum are only available in HR, and all other models are given in LR.

Comparing the two available resolutions, HR models are certainly more accurate and possibly suitable for 3D pattern analysis, but they contain no colour information and many scans are partial (they only contain the external facet). On the other hand, LR models are always complete (they exhibit all the facets) and contain colour information, nevertheless their surface appears too smooth for 3D pattern analysis.

The production of meshes, which usually follows the scanning procedure, is performed by software which takes as input noisy point cloud data. It primarily performs the alignment of the available scans and, as a side effect, removes the noise and smooths the model's surface. Such mesh processing is classically suitable for qualitative visualization and/or non-rigid matching, but

is inappropriate for feature extraction. In fact, most feature extraction software expects certain good mesh properties, such as being watertight (i.e. the surface encloses completely a volume).

To give an example we consider the artefact with inventory number "1909 3-10 5" of the British Museum (see Figure 7). Its 3D model is available both in LR (see Figure 8) and HR (see Figure 9).

Figure 6: Fragment 1909 3-10 5, British Museum

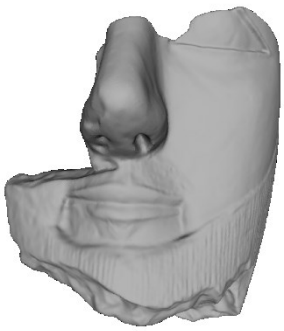


Figure 7: Model 1909 3-10 5, low resolution

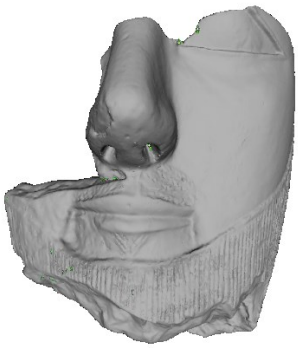


Figure 8: Model 1909 3-10 5, high resolution

Examining a detail of the surface, we notice that in the LR scan the mesh appears far from being regular and shows many degenerate triangles, probably caused by the marching cubes algorithm which is used in Poisson reconstruction (see Figure 10). The mesh of the HR model (see Figure 11) is certainly more regular but it evidently exhibits zones with different resolutions, as a result of a merge of different scans: probably a re-meshing procedure would solve this problem.

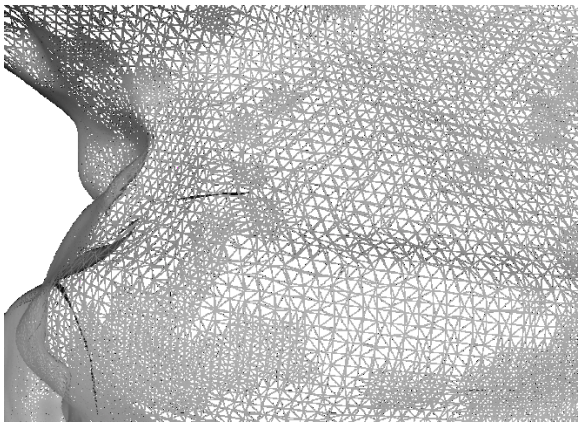


Figure 9: Zoom in the LR scan

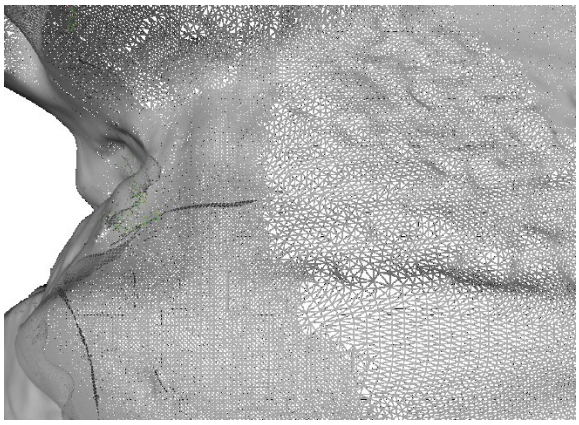


Figure 10: Zoom in the HR scan

4. British Museum Collection

4.1. Download location / details / access rights

A full RDF dump of the British Museum collection data is available as RDF/NTriples from http://collection.britishmuseum.org/dumps

The data is provided under a Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International (CC BY-NC-SA 4.0) license, as are the linked images, as described at http://collection.britishmuseum.org/licensing.html

Individual resources can be resolved via their identifiers, e.g.:
http://collection.britishmuseum.org/id/object/GAA57346

A SPARQL endpoint over the data is available at:
http://collection.britishmuseum.org/sparql

4.2. 3D and 2D objects

3D scans of the British Museum Salamis material are available on the GRAVITATE OwnCloud repository split into 169 directories. These directories are split into two years during which existing scans took place: 2013 and 2014. The directory names correspond to 175 registration numbers, plus one directory labelled 'missing parts'. The correspondence is documented in Appendix A.

Each of the 169 artefacts has a 3D scan in PLY format. There are also about 2,000 additional 2D images available as part of the scanning process. A summary of the British Museum Salamis scan data is available at Appendix C.

The uncompressed metadata dump is available in a 25Gbyte RDF file. RDF triples represent the resources using primarily CIDOC-CRM classes and properties, with SKOS being used to express British Museum terminologies. The named graphs (quad parts) are used to contain object or asset records.

4.3. Schema

An important reason for transferring data from traditional models to a semantic model is to make non-obvious information (for example, in an Entity Relationship model) intelligible by external viewers. In other words, many fields are non-obvious in a traditional format but their semantics are made explicit in a CIDOC CRM form. Further explanation is provided in the CIDOC CRM reference document available from the CIDOC CRM site[1]. The following example provides a graphical representation of the find-spot semantics. In the original database the interpretation of the original fields would be difficult without a data dictionary and looking at the internal information system. In the CIDOC CRM the semantics are, by design, much clearer. The convention used is to provide labels for entities and properties which are more fully explained in the CRM reference. Entities also start with an "E" number, e.g. "E7 Activity" and properties are given a "P" number, e.g. "P12i was present at". The "i" indicates an inverse relationship. The

[1] http://www.cidoc-crm.org/official_release_cidoc.html

inverse of P12i is, "occurred in the presence of". These labels are expanded by fuller scope notes. For example, E7 Activity is:

"*This class comprises actions intentionally carried out by instances of E39 Actor that result in changes of state in the cultural, social, or physical systems documented.*

This notion includes complex, composite and long-lasting actions such as the building of a settlement or a war, as well as simple, short-lived actions such as the opening of a door."

The property P12 is defined as:

"This property describes the active or passive presence of an E77 Persistent Item in an E5 Event without implying any specific role.

It connects the history of a thing with the E53 Place and E50 Date of an event. For example, an object may be the desk, now in a museum on which a treaty was signed. The presence of an immaterial thing implies the presence of at least one of its carriers."

A full reference is provide by the document, "Definition of the CIDOC Conceptual Reference Model", [Le Beouf 1015]

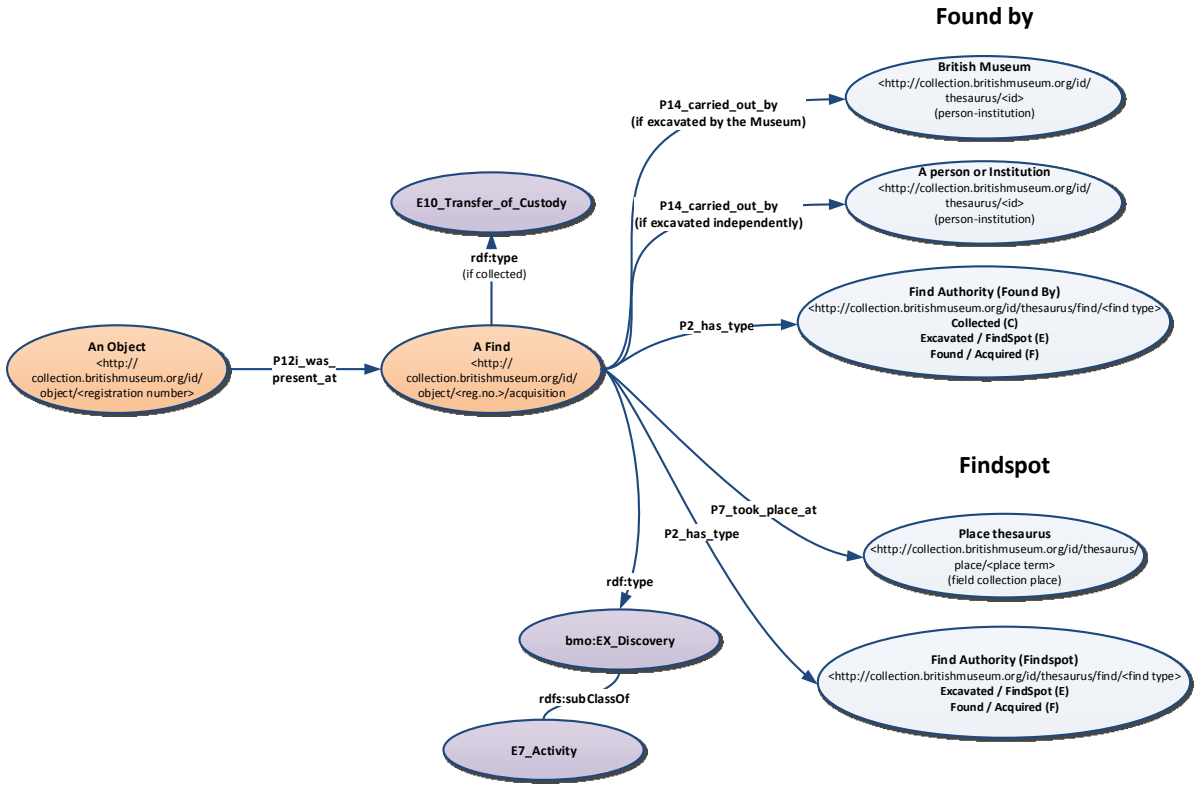


Figure 11: CIDOC-CRM example

The semantics are clear that an object was present at its own discovery (an activity in CIDOC CRM) which defined a transfer of custody to the finder. The activity itself (the discovery or find) is carried out by the British Museum (i.e. the find is recorded against the BM only), or a named individual or external group and took place at a particular location. The terminology used is denoted by CIDOC CRM "P2_has_type" which allows the recording of association codes that

denote the type of find (e.g. excavated). The British Museum publishes a full graphical schema of the British Museum model and this is produced at Appendix B.

The following narrative is taken from the British Museum's own documentation. It is a summary of the main properties and classes that make up a British Museum record. The model is generic in that it describes objects from all departments. Different departments will make use of different fields to describe different objects. For example, many ancient archaeological finds will not generally have a known maker.

Narrative	Properties	Classes
Museum's hold objects that tell the history of the world. These objects sometimes have a title and are recorded with an identifier (an accession number). Some objects form part of a sub-collection with a collection title.	**P102_has_title** **P1_is_identified_by** **P46i_forms_part_of**	**E22_Man-Made_Object** **E35_Title** **E42_Identifier** **E78_Collection**
CRM Mapping Note The domain of the property **P102_has_title** is **E71_Man-Made_Thing**. A BM object is typed as an **E22_Man-Made_Object** which is part of the **E71_Man-Made_Thing** class hierarchy. Therefore **P102_has_title** can be used with a man-made object. The range is **E35_Title**. Therefore the node that the triple uses as an object node (as in subject – predicate – object) must be of type, **E35_Title**. The domain of **P1_is_identified_by** is **E1_CRM_Entity** (so any entity in the CRM could have an identifier. The range is **E41_Appellation**. **E41_Appellation** has sub-classes that include **E42_Identifier**. Therefore to make the triple using **P1_is_identified_by** valid the object node in the triple is, and is typed as, an **E42_Identifier**. Lastly, **P46i_forms_part_of** is the inverse of the property **P46_is_composed_of,** and is used to show that the object forms part of a collection. It has a domain and a range of **E18_Physical_Thing.** This class includes the sub-class **E24_Physical_Made-Made_thing** which in turn has the sub-class **E78_Collection**. Therefore a collection is a type of **E18_Physical_Thing** and is valid for the mapping.		
Most collection catalogue databases will allow curators to write some comments or notes about the object.	**P3_has_note**	**E62_String**
CRM Mapping Note As you might expect **P3_has_note** has the domain of **E1_CRM_Entity** and can therefore apply to any triple subject (you can write notes about anything). Its range is **E62_String** and therefore the node it points to must be of type **E62_String.** Straight forward, yes? (Note: You may be starting to understand how the CRM ensures integrity of mapping. This is essential for the end product to make sense, but also ensures data harmonisation.		
Museums will record where the object came from and therefore the details of the various transfers of it from one person or organisation to another, and ultimately to the current owner. However, the current owner could be a third party if the object	**P23_transferred_title_from** **P51_has_former_or current owner.** **P52_has_current_owner**	**E22_Man_Made_object** **E8_Acquisition** **E10_Transfer of Custody**

is on loan, and the acquisition may simply be a transfer of custody rather than of ownership.	**P28_custody_surrendered_by**	

CRM Mapping Note

P23_transferred_title_from is a predicate that uses a subject node with a type of **E8_Acquisition** (domain) but must refer (range) to an **E39_Actor** (e.g. a person **E21** or a Group **E78**). This makes sense because the object must come from some sort of group or person.

For **P51_has_former_owner** we are talking about the object's **(E22_Man-Made_Object**) former owner (the domain is **E18_Physical_Thing)** and a range of **E39_Actor** again (Acquisitions work around people or organisations).

Likewise the property **P52_has_current_owner** also operates in the domain of the physical thing (**E18_Physical_Thing**) and the range of an Actor.

P28_custody_surrendered_by has a range of **E39_Actor** but the domain is **E10_Transfer_of _Custody.** This triple operates between the acquisition node (typed as a transfer of custody as well as an acquisition) and the actor from which the object was transferred. Other forms of transfer exist like **P24_transferred_ownership_through** (rather than 'from'). The semantics are different and therefore there will be different forms of acquisition mapping. We call this different constructs

In some cases details of where an object was originally found are known and recorded. The find itself is an event at which the object was present.	**P12i_was_present_at**	**EX_Discovery (BM specialisation)**

CRM Mapping Note

P12i_was_present_at is the inverse of the property **P12_occurred_in_the_presence_of** which is used in the domain of **E5_Event**. The Museum has created a sub-class of **E5_Event** called **EX_Discovery** to describe the event of discovery of an object. If the CRM doesn't have a class that describes your entity fully then you can usually create a sub-class of an existing CRM class. The BM has limited the number of class specialisations to the absolute minimum and instead made use of typing by vocabularies.

Further investigation of the object will often provide more information about how the object was created or produced in the first place. Like an acquisition or a find, a production is an event with a range of useful information. For example, the technique used to produce the object. The BM records the broad production types to support precise searching.	**P108i_was_produced_by** **P32_used_general_technique**	**E12_Production** **E55_Type**

CRM Mapping Note

P108i_was_produced_by provides the initial relationship between the collection item and the production event node. Therefore the domain must be the classes that describe an object, in this case **E24_Physical_Man-Made_Thing** which clearly denotes that this is an artificial thing that has been produced (and encompasses **E22_Man_Made_object). P32_used_general_technique** works with activities (**E7_Activity** being the domain) and production is indeed an activity because it is a sub-class of **E11_Modification** which is, in turn, a sub-class of **E7_Activity**. The British Museum then uses a thesaurus of technique terms in a SKOS format - the term itself is typed as **E55_Type –** which is the range of **P32_used_general_technique**.

The period in which production falls within is a key piece of information and may be accompanied by a date or specific time period.	**P10_falls_within** **P4_has_time_span**	**E52_Time_Span**
CRM Mapping Note **P10_falls_within** has both a domain and a range of **E4_Period.** An example of a period is an **E7_Event** and all activities are therefore within the sub-classes of **E4_Period**, including say, an **E8_Acquisition.** Therefore in the mapping we can use **P10_falls_within** with any event object but must ensure that the triple subject comes within the realms of **E4_Period** node before defining the details of the period. This is done by creating an appropriate date URI, typed as a time span, to hold the date information.		
People and places are commonly associated with production information. The people, groups or artistic schools who carried out the production of the object and the locations where production took place (which might be various) are important material aspects of the object.	**P14_carried_out_by** **P7_took_place_at**	**E21_Person** **E39_Actor** **E74_Group** **E53_Place**
CRM Mapping Note The most frequent use of the generalisation **P14_carried_out_by** in the Museum's mapping is in production, and in particular, the relationship with people and places (using **P7_took_place_at)**. Unsurprisingly **P14_carried_out_by** has a domain of **E7_Activity** (as production is also an event) and a range of **E39_Actor**. **P7 P14_carried_out_by** has the same domain but the range is, of course, **E53_Place**.		

4.4. Controlled vocabulary and/or ontologies used

Most cultural heritage organisations use controlled authorities and vocabularies. Authorities are the controlled names and concepts that must be used when inputting data into the system. This is a practice common in all database systems but particularly important in cultural heritage. These authorities fit into two categories. They can either be instances of real entities, like people and places, or they can be conceptual descriptions, like object type, subject, material and so on. These are also known as terminologies and sometime, in some types of institution, taxonomies.

The British Museum does not use third party authorities such as Getty, Viaf or ISMI.

Like most cataloguing systems, Museum data entry is controlled using a combination of thesauri (a hierarchical list of related terms or entities usually organised as broader to narrower (specialised) concepts) or with other hierarchical relationships such a places exiting within a larger geographical space, and flat formats. Often additional descriptive information is also added, such as scope notes or additional properties. The records (terms, places and people) have a unique identifier – a system number. A single object record may use these authorised terms or names many times, for example, where the record refers to a location (a production place, a find spot and so on).

The British Museum's current authorities (i.e. controlled terms) are:

- Object type (e.g. pin, cup)
- Material (e.g. paper, stone)
- Technique of production (e.g. carved, incised)
- Material Culture/Period (e.g. 13th dynasty, Late Minoan)
- Ware (specialised thesaurus for pottery, e.g. Black Glaze Ware, Samian)
- School (used for artworks, e.g. Italian, Aesthetic Movement)
- Escapement type (specialist thesaurus for clocks and watches)
- Subject (e.g. animal, acupuncture)
- Ethnic Name (e.g. Aztec, Yoruba)
- Place
- People
- Bibliography
- Dimensions
- State
- Location (internal)

Terminologies (or concepts) will have the following properties:

- term (preferred label)
- term discriminator
- broader term(s)
- related term(s)
- use-for terms (alternative labels)
- scope note (description)
- whether the term has been authorised

The place name thesaurus (authority) states whether a place name is modern or archaic (place name type) and a code for distinguishing different parts of a place hierarchy, e.g. continents, countries, villages etc. (place type). There are two significant flat authorities (not hierarchical) and these are biographical and bibliographic.

Real world entities that are recorded as authorities such as places and people should use the CIDOC ontology. Conceptual terminologies are mapped to "E55 Type" and use SKOS (Simple Knowledge Organisation System).

While most authority terms are assigned a system identifier a small proportion do not and the term itself is used for the URI. For example, a URI for a person is http://collection.britishmuseum.org/id/person-institution/57074

An example URI for a material is http://collection.britishmuseum.org/id/thesauri/x10411 (concept terms have an 'x' prefix).

However, some simple ad hoc system terminology will not have a system identifier but will be a unique term (and therefore a unique URI). For example,
http://collection.britishmuseum.org/id/thesauri/gender/male
http://collection.britishmuseum.org/id/thesauri/nationality/Roman

The following diagram, taken from the British Museum's own documentation, provides an overview of the authorities.

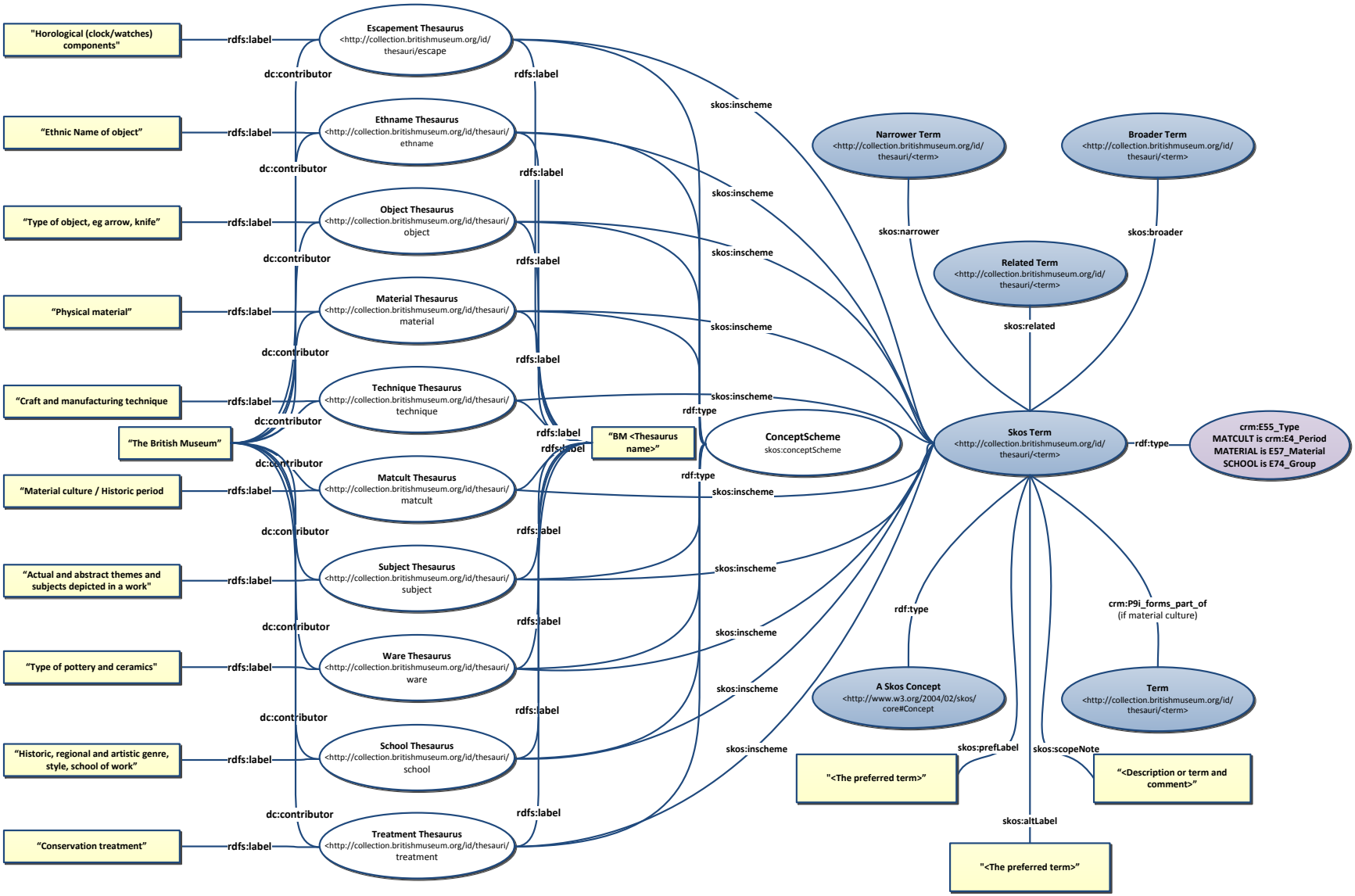


Figure 12: CIDOC-CRM example

4.5. Examples

Photographs of three of the Salamis artefacts held at the British Museum are shown below.

Figure 13: AN01249931

Figure 14: AN01250172

Figure 15: AN01358389

5. Fitzwilliam Collection

The Fitzwilliam museum has already attempted a publication of data in CIDOC CRM format providing an Endpoint in 2015. This is currently not operational and a data export has been obtained directly from their collection management section. This has been re-mapped to CIDOC CRM and will be available to the GRAVITATE project. However, the records are not highly detailed and will need enrichment from the project with additional information added.

We expect the full Fitzwilliam RDF CIDOC-CRM metadata will be available to GRAVITATE in 2016. Currently the British Museum is liaising with the Fitzwilliam to achieve this full access. Whilst the number of 3D scanned objects is small the full 2D image archive involves many artefacts so could have a lot of value to GRAVITATE for testing semantic matching algorithms.

Further scans of artefacts held at the Fitzwilliam will become available from the Cyprus Institute during the project.

5.1. Download location / details / access rights

Web access

The Fitz Explorer provides web pages presenting artefact records. This service is provided using Adlib Museum software and is SPECTRUM compliant. The Adlib Museum software provides some thesaurus support to constrain free text fields. The project does not have a direct export of the thesauri/vocabulary data. However, given the small dataset these have been reconstructed and put into SKOS format.

Fitz Explorer Endpoint:
http://webapps.fitzmuseum.cam.ac.uk/explorer

RDF access

The Fitzwilliam provide an RDF model using CIDOC-CRM. Note: the service is experimental and not always available.

Fitz SPARQL Endpoint:
http://data.fitzmuseum.cam.ac.uk/beta/sparqlhtml/

Licenses

Fitz: Creative Commons:

http://data.fitzmuseum.cam.ac.uk/id/licence/cc-0
http://data.fitzmuseum.cam.ac.uk/id/licence/cc-by-nc
http://data.fitzmuseum.cam.ac.uk/id/licence/cc-by-sa
http://data.fitzmuseum.cam.ac.uk/id/licence/cc-by-nc-nd

The Fitzwilliam have shared XML schema information behind their explorer search interface with the GRAVITATE project. There is also the beta RDF endpoint where CIDOC-CRM RDF metadata can be searched.

5.2. 3D and 2D objects

There are 13 artefacts from Salamis Cyprus, each with a PLY formatted scan. In addition 40 2D images in JPG format are available as a result of the scanning process.

5.3. Schema

The Fitzwilliam record is not as detailed at the British Museum record and therefore the data connections between the British Museum and Fitzwilliam are sparse. The Fitzwilliam record is more oriented towards an internal inventory record but could be further enriched along the lines of the British Museum record and beyond.

The schema is reproduced in Appendix E.

5.4. Controlled vocabulary and/or ontologies used

The controlled vocabulary examples are returned by the online portal based on the terms that exist within the catalogue. A few terms (e.g. 'Korea,') are clearly the result of data entry mistakes. In GRAVITATE we take the approach of not asking for the data sources to be 'perfect' but rather taking them as they are and building strategies to handle these real-world errors (e.g. pre-processing steps with stoplists or spell checking prior to text analysis).

object.category

Vocabulary for artefact types. Currently there is no standard export from the system of vocabulary terms and the samples below have been reconstructed from web site resources and object records themselves. Further work is required to liaise with the Fitzwilliam which will be done during 2016.

```
print, coin, drawing, album, letter, token, vessel, jewellery, tin-glazed earthenware,
stoneware, scarab, figure, book, lead-glazed earthenware, paper money, painting, glass,
weapons, seal, hard-paste porcelain, accounts, miniature (painting), engraved gems, soft-
paste porcelain, medal, funerary equipment, receipts, textiles, sculpture, porcelain,
architectural element, toy coins, fans, maiolica, English delftware, sword fitting,
equipment, illuminated manuscript, sketchbook, embroidery, snuff bottles, tool/implement,
netsuke, silver, cosmetic equipment, fritware (stonepaste), fan, mould, armour, notes
```


object_name

Vocabulary for artefact name which consists of a combination of places, object usage and object type. The terms used appear to be largely unconstrained and a result of curator preference.

```
print, drawing, Roman Imperial, Indian, Far Eastern, Greek, denarius, British Isles, 17th-century Tokens, Medieval, China, Roman Republic, Islamic, halfpenny, farthing, Italy, cash (Chinese money), Sultanate, Princely States, amulet, scarab, penny, sestertius, tokens, bowl, 18th-century Tokens, ‘Korea,’, jar, Germany, painting, Roman Provincial, paper money, As, Jital, United Kingdom, bead, France, toy coins, Northern Song (960-1127), 1 Mun, Qing, Iberian Peninsula, fragment, figure, jug, dish, medals, intaglio, statuette
```

field_col1.place

Vocabulary for location names (e.g. London) and cultural names (e.g. English) for the collection that this artefact is part of. This list can include historical names that are no longer modern day place names and question marks where the location is uncertain.

```
Egypt, Rome, England, China, English, London, Korea, Italy, Chinese, Staffordshire, Japan, London?, Germany, France, Japanese, Cambridge (Cambs.), Delhi, Cyprus, Greece, French, ‘Colmar, Paris’, Vietnam, Iran, Dutch, Athens Attica Greece, United Provinces of the Netherlands, Lyons, Crete Greek Islands, Bihar, East Anglia, United Kingdom, Birmingham, Holland, Delft, Cambridgeshire, Spain, Kent, German, Umbria, Peking, Tell Kuyunjik (Nineveh) Iraq, ‘France,’, Nüremberg, Alexandria, India, Venice, Netherlands, Syria, Iranian, Europe
```

production.place

Vocabulary for location names (e.g. London) and cultural names (e.g. English) for where the artefact was manufactured originally. This list can include historical names that are no longer modern day place names and question marks where the location is uncertain.

```
Egypt, Rome, England, China, English, London, Korea, Italy, Chinese, Staffordshire, Japan, London?, Germany, France, Japanese, Cambridge (Cambs.), Delhi, Cyprus, Greece, French, ‘Colmar, Paris’, Vietnam, Iran, Dutch, Athens Attica Greece, United Provinces of the Netherlands, Lyons, Crete Greek Islands, Bihar, East Anglia, United Kingdom, Birmingham, Holland, Delft, Cambridgeshire, Spain, Kent, German, Umbria, Peking, Tell Kuyunjik (Nineveh) Iraq, ‘France,’, Nüremberg, Alexandria, India, Venice, Netherlands, Syria, Iranian, Europe
```

material

Vocabulary for artefact material types. The terms used appear to be largely unconstrained and a result of curator preference, especially when sub-types or notes are applied.


```
paper, silver, ink, copper, copper alloy, black carbon ink, graphite, bronze, watercolour,
clay, gold, laid paper, billon, earthenware, bodycolour, glaze, brown ink, black chalk,
printing ink, stoneware, lead-glaze, black ink, tin-glaze, oil paint, grey wash, ivory,
enamels (note: multiple enamels used), enamel, vellum (skin), white bodycolour, steel,
high-temperature colours, wood, brown wash, lead-glass, glass, hard-paste porcelain,
canvas, red chalk, soft-paste porcelain, card, silk, iron, brass (alloy), white chalk, wove
paper, linen, limestone, parchment, slip
```

techniques

Vocabulary for production techniques. The terms used appear to be largely unconstrained and a result of curator preference, especially when sub-types or notes are applied.

```
etching, engraving, handwriting, struck, struck (metalworking), watercolour, drawing, cast
(process), milled (metal), mezzotint, drawing (image-making), painting, wood engraving,
printing, glazing (coating), woodcut, throwing, moulding, lithography, hand colouring, tin-
glazing, painting (image-making), gilding, colour printing, drypoint, carving, lead-
glazing, pen and ink, blowing, glazing, intaglio cutting, stipple, painting underglaze,
aquatint, weaving, incising, painting overglaze, carved, printed, press-moulding, casting
(process), illumination, punchwork, embroidering, piercing, moulded, typewriting, hammered,
screenprint, chiaroscuro woodcut
```

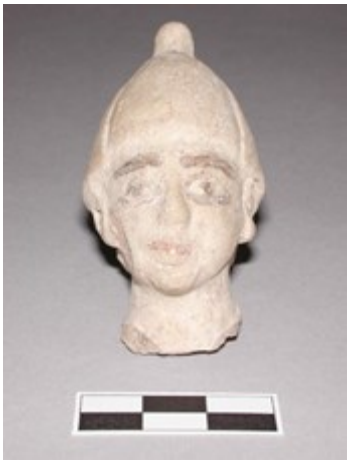
comments on free text descriptions

The 'description' element is usually a one line description of the artefact (e.g. "head of charioteer"). Information is therefore very limited in this element.

The 'documentation.title' element in the schema is often used to describe the collection this artefact belongs to (i.e. not the artefact itself). The 'documentation.source_title' element contains free text to a catalogue or report/paper that itself describes the artefact in more detail. It is unlikely references to such documentation could be downloaded automatically as the free text citations are not structured sufficiently well.

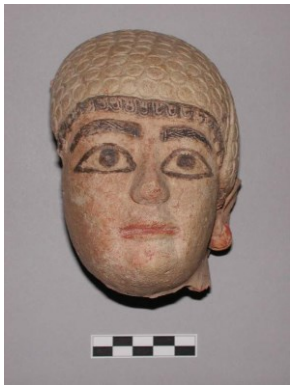
5.5. Examples

Some examples of the Salamis artefacts held at the Fitzwilliam are shown below.



Fitz: http://webapps.fitzmuseum.cam.ac.uk/explorer/index.php?oid=66498

Figure 16: Head of a terracotta statue (GR.10.1890) - Salamis Cyprus



Fitz: http://webapps.fitzmuseum.cam.ac.uk/explorer/index.php?oid=66669

Figure 17: Head of youth (GR.22.1891) - Salamis Cyprus

6. Ashmolean Collection

The Ashmolean Museum manage a SPECTRUM compliant collection management system with limited data exporting capability. The records are also minimal and similar to those received from the Fitzwilliam museum. The Ashmolean is interested in developing open data further and, like the Fitzwilliam, further communication and collaboration with the Ashmolean is likely throughout the duration of the project.

6.1. Download location / details / access rights

The Ashmolean dataset was obtained by way of an export to Microsoft Access (database) format. There is currently no other way of obtaining the required data, except through the data management group at the Ashmolean itself. However, there are plans to provide more accessible records in the future. The Ashmolean currently have a long term project for improving internal records for external publication processes. The British Museum are in contact with the Ashmolean on related matters and will engage with the Ashmolean throughout the project.

6.2. 3D and 2D objects

There are 20 artefacts from Salamis Cyprus, each with a PLY formatted scan. In addition about 400 2D images are available as a result of the scanning process.

A summary of the 3D images files is available in Appendix D. Additional metadata from the Cyprus Institute, for Ashmolean objects, is available in Appendix H.

6.3. Schema

The Ashmolean Schema (extracted from XML serialized record) is available at Appendix F.

6.4. Controlled vocabulary and/or ontologies used

Full vocabulary information is not currently available for the Ashmolean dataset.

6.5. Examples

Some examples of artefacts held at the Ashmolean are shown below.

Figure 18: 1891.471; 1909.840

Figure 19: 551.1926

Figure 20: 469.1891

7. Cyprus Museum Collection

The Cyprus Museum made available their objects for the GRAVITATE project purposes. Nineteen objects were scanned and their inventory numbers have been mapped into CIDOC CRM. In cases of some objects an additional description derived from related publications is provided. This too, along with the bibliographic information, was mapped into CIDOC CRM.

7.1. Download location / details / access rights

The Cyprus Museum's dataset was obtained especially for the GRAVITATE project and it is not currently available online. Metadata was handed over in an MS Excel spreadsheet and from there converted into XML format.

The Cyprus Institute has through various other projects curated a dataset made publically available in the STARC Repository[2]. This includes the scans of Salamis terracotta fragments from both the Cyprus Museum and the other museum collections described previously.

The full list of links to the Cyprus Museum objects in the STARC repository is provided at Appendix I.

7.2. 3D and 2D objects

There are 19 artefacts from the Cyprus Museum collection, each with a PLY formatted scan. A summary of the 3D images files is available in Appendix J.

7.3. Schema

The STARC repository uses a variation on the CARARE schema[3] from Europeana. The Cyprus Schema (extracted from XML serialized record) is available in Appendix H.

7.4. Controlled vocabulary used and/or ontologies used

The metadata provided by the Cyprus Museum comprises excerpts from publications related to the particular objects. The majority of them comes from the Vassos Karageorghis texts, but there are some citations from Tubbs, H.A. and Munro, J.A.R and A. Hermary. The metadata is available in Appendix K.

There is no controlled vocabulary (e.g. central thesaurus) used in these collections. Location names (e.g. London) and period types (e.g. Cypro-Archaic period) are consistent between collections. Each collection's use of vocabulary is self-consistent, so statistical analysis of terms might be able to extract dictionaries from the metadata records without problems caused by spelling mistakes, synonyms etc.

7.5. Examples

Some examples of the Salamis artefacts held at the Cyprus Institute are shown below.

[2] http://public.cyi.ac.cy/starcRepo/

[3] http://www.carare.eu/slk/Support/CARARE-2.0-schema

Figure 21: C 111 1935

Figure 22: C 113 1935

Figure 23: C 114 1935

8. Recommendations

There is a large disparity between the British Museum schema and those contained within the Fitzwilliam, Cyprus and Ashmolean datasets. However, information from the 3D scanning process is available and is being mapped also to the CIDOC CRM so we consider this data as sufficient for the needs of GRAVITATE.

There are in addition to the Salamis collections many other collections available to GRAVITATE from the British Museum and Cyprus Institute. For example we have access to the large Naukratis online collection[4]. These additional collections could prove useful when we look at evaluating how specific GRAVITATE technology performs when applied at an institutional collection scale involving 1,000's of artefacts.

The data recorded by the museums is generic (i.e. not specific to the terracotta statues) and applied to a wide range of different objects so there is little specialisation except in free text fields. Since data is crucial to the success of the project the following specific GRAVITATE recommendations are proposed to further enrichment the core data already collected:

1) The records from Fitzwilliam should be enriched using the British Museum record as a benchmark.
2) Any additional information that can be obtained, either through other materials or available project experts, should be added to all records.
3) The British Museum should continue to engage with the Fitzwilliam, Cyprus Institute and Ashmolean to identify further improvements in the data. Additional time should be provided to reinstate the Fitzwilliam CIDOC CRM dataset and improve that system.
4) Additional specialist terminologies should be developed that provide a structured way of improving the data that is specific to the terracotta figures and added to the data graph. For example, specific information about the body parts and their decoration.
5) Information derived from the process of digitisation at the Cyprus Institute should be merged with the museum data.
6) There should be more collaboration between the Cyprus Institute and the British Museum to improve the integration of information from its different sources.

[4] http://www.britishmuseum.org/research/online_research_catalogues/ng/naukratis_greeks_in_egypt.aspx

9. References

SKOS Simple Knowledge Organization System - https://www.w3.org/2004/02/skos/

CIDOC CRM (Conceptual Reference Model) Home page - http://www.cidoc-crm.org/

Le Beouf et al, February 2015, Definition of the CIDOC Conceptual Reference Model Version 6.1, available at http://www.cidoc-crm.org/official_release_cidoc.html

M. Attene, M. Campen and L. Kobbelt, "Polygon mesh repairing: An application perspective," ACM Computing Surveys (CSUR), vol. 45, no. 2, p. 15, 2013

Appendix A. British Museum Identifiers and Scans

The following table lists the currently scanned British Museum terracotta objects provides a key to link the scan directory to the normalised human-readable, and the machine-resolvable, identifiers.

3D Scan Directory	Display Identifier (Reg. number)	URI at collection.britishmuseum.org
1909 3-10 100	1909,0310.100	http://.../id/object/GAA58780
1909 3-10 101	1909,0310.101	http://.../id/object/GAA58782
1909 3-10 102	1909,0310.102	http://.../id/object/GAA58783
1909 3-10 103	1909,0310.103	http://.../id/object/GAA58789
1909 3-10 104	1909,0310.104	http://.../id/object/GAA58795
1909 3-10 105	1909,0310.105	http://.../id/object/GAA58790
1909 3-10 106	1909,0310.106	http://.../id/object/GAA58794
1909 3-10 107	1909,0310.107	http://.../id/object/GAA58791
1909 3-10 108	1909,0310.108	http://.../id/object/GAA58792
1909 3-10 109	1909,0310.109	http://.../id/object/GAA58793
1909 3-10 11	1909,0310.11	http://.../id/object/GAA58718
1909 3-10 110	1909,0310.110	http://.../id/object/GAA58712
1909 3-10 111	1909,0310.111	http://.../id/object/GAA58800
1909 3-10 112	1909,0310.112	http://.../id/object/GAA58799
1909 3-10 113	1909,0310.113	http://.../id/object/GAA58701
1909 3-10 114	1909,0310.114	http://.../id/object/GAA58788
1909 3-10 119	1909,0310.119	http://.../id/object/GAA58730
1909 3-10 12	1909,0310.12	http://.../id/object/GAA58804
1909 3-10 126	1909,0310.126	http://.../id/object/GAA58723
1909 3-10 127	1909,0310.127	http://.../id/object/GAA58724
1909 3-10 129	1909,0310.129	http://.../id/object/GAA58699
1909 3-10 13	1909,0310.13	http://.../id/object/GAA58802
1909 3-10 134	1909,0310.134	http://.../id/object/GAA58703
1909 3-10 136	1909,0310.136	http://.../id/object/GAA58760
1909 3-10 139	1909,0310.139	http://.../id/object/GAA58761
1909 3-10 14	1909,0310.14	http://.../id/object/GAA58805
1909 3-10 140	1909,0310.140	http://.../id/object/GAA58714

1909 3-10 141	1909,0310.141	http://.../id/object/GAA58803
1909 3-10 142	1909,0310.142	http://.../id/object/GAA58762
1909 3-10 143	1909,0310.143	http://.../id/object/GAA58758
1909 3-10 146	1909,0310.146	http://.../id/object/GAA58692
1909 3-10 147A	1909,0310.147	http://.../id/object/GAA58711
1909 3-10 147B	1909,0310.147	http://.../id/object/GAA58711
1909 3-10 147C	1909,0310.147	http://.../id/object/GAA58711
1909 3-10 148	1909,0310.148	http://.../id/object/GAA58693
1909 3-10 15	1909,0310.15	http://.../id/object/GAA58812
1909 3-10 16	1909,0310.16	http://.../id/object/GAA58813
1909 3-10 17	1909,0310.17	http://.../id/object/GAA58720
1909 3-10 18	1909,0310.18	http://.../id/object/GAA58810
1909 3-10 19	1909,0310.19	http://.../id/object/GAA58811
1909 3-10 20	1909,0310.20	http://.../id/object/GAA58808
1909 3-10 21	1909,0310.21	http://.../id/object/GAA58809
1909 3-10 22	1909,0310.22	http://.../id/object/GAA58807
1909 3-10 23	1909,0310.23	http://.../id/object/GAA58741
1909 3-10 24	1909,0310.24	http://.../id/object/GAA58737
1909 3-10 25	1909,0310.25	http://.../id/object/GAA58740
1909 3-10 26	1909,0310.26	http://.../id/object/GAA58738
1909 3-10 27	1909,0310.27	http://.../id/object/GAA58744
1909 3-10 3	1909,0310.3	http://.../id/object/GAA58721
1909 3-10 32	1909,0310.32	http://.../id/object/GAA58691
1909 3-10 33	1909,0310.33	http://.../id/object/GAA58690
1909 3-10 34A	1909,0310.34	http://.../id/object/GAA58752
1909 3-10 34B	1909,0310.34	http://.../id/object/GAA58752
1909 3-10 48	1909,0310.48	http://.../id/object/GAA58742
1909 3-10 5	1909,0310.5	http://.../id/object/GAA58814
1909 3-10 58	1909,0310.58	http://.../id/object/GAA58765
1909 3-10 59	1909,0310.59	http://.../id/object/GAA58775
1909 3-10 61	1909,0310.61	http://.../id/object/GAA58774
1909 3-10 62	1909,0310.62	http://.../id/object/GAA58764
1909 3-10 63	1909,0310.63	http://.../id/object/GAA58773
1909 3-10 66	1909,0310.66	http://.../id/object/GAA58726

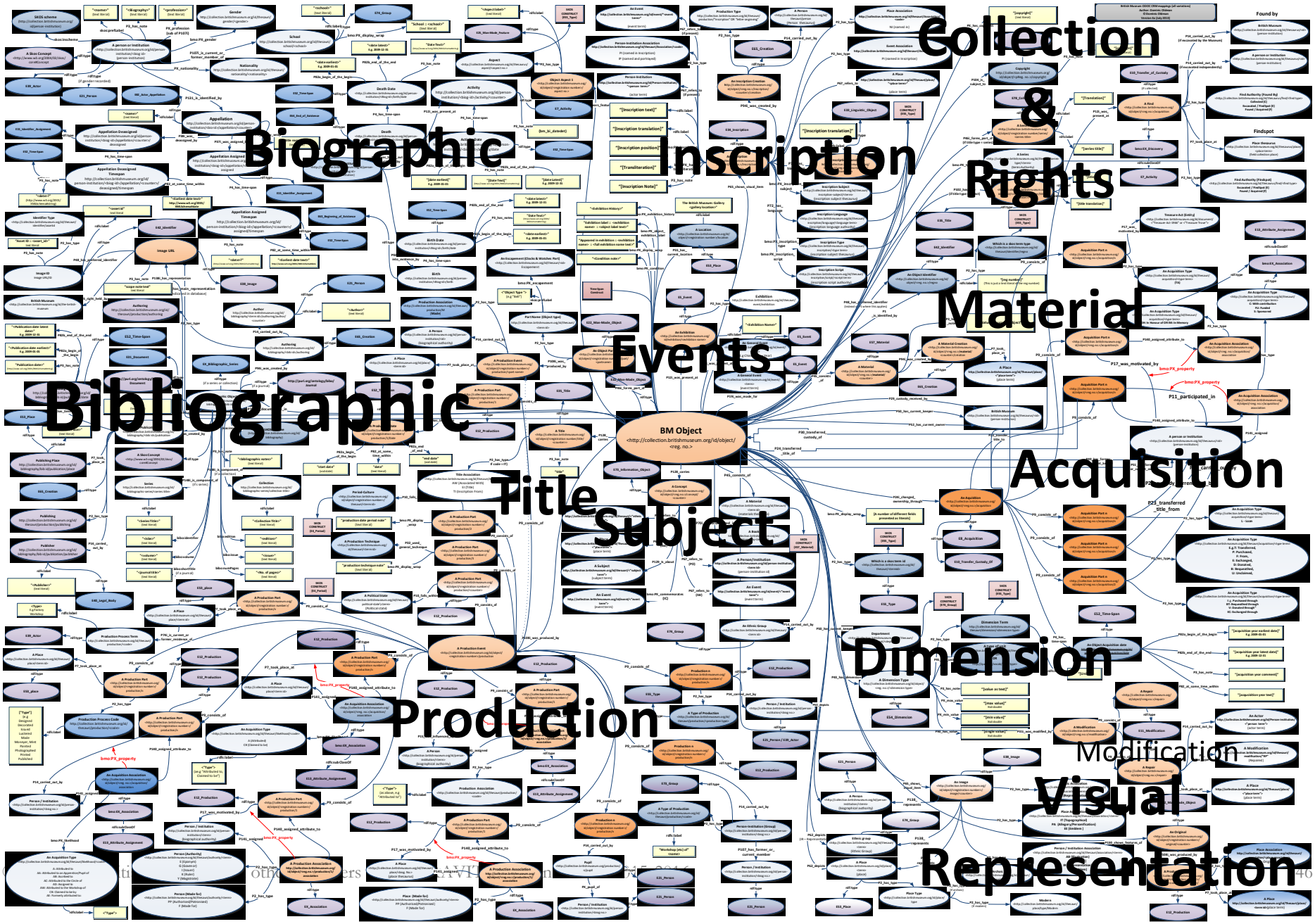
1909 3-10 67	1909,0310.67	http://.../id/object/GAA58779
1909 3-10 68	1909,0310.68	http://.../id/object/GAA58772
1909 3-10 69	1909,0310.69	http://.../id/object/GAA58766
1909 3-10 7	1909,0310.7	http://.../id/object/GAA58801
1909 3-10 70	1909,0310.70	http://.../id/object/GAA58681
1909 3-10 71	1909,0310.71	http://.../id/object/GAA58676
1909 3-10 72	1909,0310.72	http://.../id/object/GAA58673
1909 3-10 73	1909,0310.73	http://.../id/object/GAA58674
1909 3-10 74	1909,0310.74	http://.../id/object/GAA58679
1909 3-10 76	1909,0310.76	http://.../id/object/GAA58748
1909 3-10 77	1909,0310.77	http://.../id/object/GAA58747
1909 3-10 78	1909,0310.78	http://.../id/object/GAA58682
1909 3-10 79	1909,0310.79	http://.../id/object/GAA58749
1909 3-10 8	1909,0310.8	http://.../id/object/GAA58806
1909 3-10 80	1909,0310.80	http://.../id/object/GAA58731
1909 3-10 81	1909,0310.81	http://.../id/object/GAA58675
1909 3-10 82	1909,0310.82	http://.../id/object/GAA58680
1909 3-10 83	1909,0310.83	http://.../id/object/GAA58683
1909 3-10 84	1909,0310.84	http://.../id/object/GAA58677
1909 3-10 85	1909,0310.85	http://.../id/object/GAA58732
1909 3-10 86	1909,0310.86	http://.../id/object/GAA58688
1909 3-10 87	1909,0310.87	http://.../id/object/GAA58684
1909 3-10 88	1909,0310.88	http://.../id/object/GAA58686
1909 3-10 89	1909,0310.89	http://.../id/object/GAA58787
1909 3-10 9	1909,0310.9	http://.../id/object/GAA58759
1909 3-10 90A	1909,0310.90	http://.../id/object/GAA58685
1909 3-10 90B	1909,0310.90	http://.../id/object/GAA58685
1909 3-10 91	1909,0310.91	http://.../id/object/GAA58707
1909 3-10 92	1909,0310.92	http://.../id/object/GAA58713
1909 3-10 93	1909,0310.93	http://.../id/object/GAA58785
1909 3-10 94	1909,0310.94	
1909 3-10 95	1909,0310.95	
1909 3-10 96	1909,0310.96	http://.../id/object/GAA58786
1909 3-10 97	1909,0310.97	http://.../id/object/GAA58784

1909 3-10 98	1909,0310.98	http://.../id/object/GAA58781
1909 3-10 99	1909,0310.99	http://.../id/object/GAA58798
1968 12-13 1	1968,1213.1	http://.../id/object/GAA58899
1968 12-13 10	1968,1213.10	http://.../id/object/GAA58903
1968 12-13 11	1968,1213.11	http://.../id/object/GAA58902
1968 12-13 12	1968,1213.12	http://.../id/object/GAA58904
1968 12-13 13	1968,1213.13	http://.../id/object/GAA58916
1968 12-13 2	1968,1213.2	http://.../id/object/GAA58898
1968 12-13 28	1968,1213.28	http://.../id/object/GAA58933
1968 12-13 29	1968,1213.29	http://.../id/object/GAA58932
1968 12-13 32	1968,1213.32	http://.../id/object/GAA58926
1968 12-13 36	1968,1213.36	http://.../id/object/GAA58919
1968 12-13 46	1968,1213.46	http://.../id/object/GAA58943
1968 12-13 47	1968,1213.47	http://.../id/object/GAA58942
1968 12-13 5	1968,1213.5	http://.../id/object/GAA58894
1968 12-13 54	1968,1213.54	http://.../id/object/GAA58951
1968 12-13 9	1968,1213.9	http://.../id/object/GAA58901
91 8-6 37	1891,0806.37	http://.../id/object/GAA57396
1909 3-10 115	1909,0310.115	http://.../id/object/GAA58797
1909 3-10 123	1909,0310.123	http://.../id/object/GAA58716
1909 3-10 124	1909,0310.124	http://.../id/object/GAA58717
1909 3-10 125	1909,0310.125	http://.../id/object/GAA58735
1909 3-10 128	1909,0310.128	http://.../id/object/GAA58697
1909 3-10 130	1909,0310.130	http://.../id/object/GAA58700
1909 3-10 131	1909,0310.131	http://.../id/object/GAA58695
1909 3-10 132	1909,0310.132	http://.../id/object/GAA58696
1909 3-10 133	1909,0310.133	http://.../id/object/GAA58757
1909 3-10 135	1909,0310.135	http://.../id/object/GAA58698
1909 3-10 143	1909,0310.143	http://.../id/object/GAA58758
1909 3-10 4	1909,0310.4	http://.../id/object/GAA58706
1909 3-10 47	1909,0310.47	http://.../id/object/GAA58727
1909 3-10 48	1909,0310.48	http://.../id/object/GAA58742
1909 3-10 49	1909,0310.49	http://.../id/object/GAA58745
1909 3-10 50	1909,0310.50	http://.../id/object/GAA58750

1909 3-10 51	1909,0310.51	http://.../id/object/GAA58769
1909 3-10 52	1909,0310.52	http://.../id/object/GAA58776
1909 3-10 57	1909,0310.57	http://.../id/object/GAA58770
1968 12-13 14	1968,1213.14	http://.../id/object/GAA58912
1968 12-13 15	1968,1213.15	http://.../id/object/GAA58908
1968 12-13 16	1968,1213.16	http://.../id/object/GAA58907
1968 12-13 17	1968,1213.17	http://.../id/object/GAA58914
1968 12-13 18	1968,1213.18	http://.../id/object/GAA58910
1968 12-13 19	1968,1213.19	http://.../id/object/GAA58906
1968 12-13 20	1968,1213.20	http://.../id/object/GAA58905
1968 12-13 21	1968,1213.21	http://.../id/object/GAA58909
1968 12-13 22	1968,1213.22	http://.../id/object/GAA58915
1968 12-13 23	1968,1213.23	http://.../id/object/GAA58913
1968 12-13 24	1968,1213.24	http://.../id/object/GAA58911
1968 12-13 25	1968,1213.25	http://.../id/object/GAA58922
1968 12-13 26	1968,1213.26	http://.../id/object/GAA58930
1968 12-13 3	1968,1213.3	http://.../id/object/GAA58897
1968 12-13 30	1968,1213.30	http://.../id/object/GAA58927
1968 12-13 31	1968,1213.31	http://.../id/object/GAA58931
1968 12-13 33	1968,1213.33	http://.../id/object/GAA58925
1968 12-13 34	1968,1213.34	http://.../id/object/GAA58924
1968 12-13 35	1968,1213.35	http://.../id/object/GAA58923
1968 12-13 37	1968,1213.37	http://.../id/object/GAA58918
1968 12-13 38	1968,1213.38	http://.../id/object/GAA58917
1968 12-13 39	1968,1213.39	http://.../id/object/GAA58920
1968 12-13 4	1968,1213.4	http://.../id/object/GAA58895
1968 12-13 40	1968,1213.40	http://.../id/object/GAA58928
1968 12-13 45	1968,1213.45	http://.../id/object/GAA58948
1968 12-13 48	1968,1213.48	http://.../id/object/GAA58946
1968 12-13 49	1968,1213.49	http://.../id/object/GAA58956
1968 12-13 50	1968,1213.50	http://.../id/object/GAA58955
1968 12-13 51	1968,1213.51	http://.../id/object/GAA58952
1968 12-13 56	1968,1213.56	http://.../id/object/GAA58949
1968 12-13 6	1968,1213.6	http://.../id/object/GAA58893

1968 12-13 7	1968,1213.7	http://.../id/object/GAA58896
1968 12-13 8	1968,1213.8	http://.../id/object/GAA58900
91 8-6 39	1891,0806.39	http://.../id/object/GAA57346
91 8-6 48 and 49 and 50 and 51 and 53 and 55 and 56	1891,0806.48	
	1891,0806.49	
	1891,0806.50	
	1891,0806.51	
	1891,0806.53	http://.../id/object/GAA57405
	1891,0806.55	
	1891,0806.56	
91 8-6 60	1891,0806.60	
91 8-6 61	1891,0806.61	

Appendix B. British Museum CIDOC CRM Schema


Biographic
Inscription
Collection
&
Rights
Material
Events
Bibliographic
Title
Subject
Acquisition
Dimension
Production
Modification
Visual
Representation
BM Object
<http://collection.britishmuseum.org/id/object/
<reg. no.>
bmo:PX_property
P11_participated_in

Appendix C. British Museum 3D image files – Summary

	PLY	SCN
Average size	38,367,404	849,329,073
Minimum size	3247219	19942970
Maximum size	97001095	1940690166

3D Images – Full dataset results

PLY: polygon file format
SCN: file format primarily associated with Steam Source SDK Model Source File

Scan directory	PLY (AI) size / bytes	Has Im PLY	SCN size / bytes
1909 3-10 100	5,275,701	y	0
1909 3-10 101	3,660,166	y	1,932,875,310
	4,646,975	y	0
1909 3-10 103	4,206,022	y	1,934,352,879
1909 3-10 104	5,032,918	y	0
1909 3-10 105	2,383,721	y	1,931,447,646
1909 3-10 106	2,552,936	y	0
1909 3-10 107	1,037,975	y	0
1909 3-10 108	1,920,245	y	0
1909 3-10 109	1,585,414	y	0
1909 3-10 11	44,076,941	y	1,599,572,445
1909 3-10 110	38,568,683	y	4,493,869,703
1909 3-10 111	13,050,421	y	0
1909 3-10 112	6,648,289	y	0
1909 3-10 113	3,968,511	y	2,367,988,877
1909 3-10 114	2,624,710	y	0
1909 3-10 119	6,849,394	y	685,706,878
1909 3-10 12	49,234,049	y	0
1909 3-10 126	7,887,546	y	216,708,599
1909 3-10 127	6,776,137	y	1,941,068,699
1909 3-10 129	9,193,433	y	0

Scan directory	PLY (AI) size / bytes	Has Im PLY	SCN size / bytes
1909 3-10 13	44,745,493	y	2,069,551,058
1909 3-10 134	24,598,715	y	425,082,571
1909 3-10 136	7,675,783	y	1,938,030,318
1909 3-10 139	10,243,799	y	1,942,989,717
1909 3-10 14	3,084,446	y	2,669,931,704
1909 3-10 140	27,264,402	y	0
1909 3-10 141	9,657,059	y	1,940,690,166
1909 3-10 142	14,493,417	y	1,952,870,051
1909 3-10 143	7,229,133	y	0
1909 3-10 146	12,913,889	y	1,944,527,389
1909 3-10 147A	6,353,301	y	0
1909 3-10 147B	22,403,156	y	2,587,087,400
1909 3-10 147C	9,825,147	y	0
1909 3-10 148	10,618,208	y	0
1909 3-10 15	8,043,093	y	0
1909 3-10 16	5,453,971	y	0
1909 3-10 17	147,870,598	y	2,164,818,621
1909 3-10 18	134,480,723	y	867,735,647
1909 3-10 19	63,930,281	y	2,096,601,658
1909 3-10 20	62,236,586	y	2,718,810,851
1909 3-10 21	60,798,613	y	0
1909 3-10 22	249,356,153	y	13,467,294,507
1909 3-10 23	84,828,197	y	0
1909 3-10 24	156,520,126	y	0
1909 3-10 25	32,677,524	y	0
1909 3-10 26	6,593,678	y	0
1909 3-10 27	61,733,592	y	4,555,916,374
1909 3-10 3	23,645,325	y	3,986,751,884
1909 3-10 32	5,943,376	y	1,939,885,817
1909 3-10 33	8,390,960	y	0
1909 3-10 34A	5,328,138	y	1,937,720,477
1909 3-10 34B	3,875,392	y	0

Scan directory	PLY (AI) size / bytes	Has Im PLY	SCN size / bytes
1909 3-10 48	2,194,993	y	1,931,820,036
1909 3-10 5	2,383,721	y	1,931,447,646
1909 3-10 58	3,153,134	y	1,935,582,804
1909 3-10 59	4,157,938	y	0
1909 3-10 61	4,335,254	y	1,928,934,690
1909 3-10 62	1,849,201	y	424,292,162
1909 3-10 63	1,700,768	y	968,067,135
1909 3-10 66	10,804,983	y	1,938,571,785
1909 3-10 67	5,559,316	y	0
1909 3-10 68	2,380,733	y	2,141,450,109
1909 3-10 69	12,618,235	y	0
1909 3-10 7	11,736,925	y	427,305,861
1909 3-10 70	7,937,008	y	2,281,381,022
1909 3-10 71	6,888,685	y	0
1909 3-10 72	7,626,908	y	1,936,548,269
1909 3-10 73	2,410,308	y	0
1909 3-10 74	3,996,741	y	0
1909 3-10 76	2,431,757	y	2,043,062,749
1909 3-10 77	11,537,930	y	2,063,999,103
1909 3-10 78	5,434,245	y	0
1909 3-10 79	6,057,565	y	1,936,785,784
1909 3-10 8	6,299,394	y	2,952,429,343
1909 3-10 80	24,688,580	y	0
1909 3-10 81	4,120,180	y	0
1909 3-10 82	4,004,436	y	1,931,599,179
1909 3-10 83	26,118,235	y	0
1909 3-10 84	2,655,141	y	1,929,037,103
1909 3-10 85	2,550,296	y	0
1909 3-10 86	2,738,724	y	1,927,721,357
1909 3-10 87	1,002,085	y	0
1909 3-10 88	11,712,027	y	1,824,837,004
1909 3-10 89	13,433,290	y	426,296,964

Scan directory	PLY (AI) size / bytes	Has Im PLY	SCN size / bytes
1909 3-10 9	4,223,197	y	1,955,816,298
1909 3-10 90A	9,487,023	y	0
1909 3-10 90B	53,318,067	y	425,548,569
1909 3-10 91	13,744,561	y	427,390,272
1909 3-10 92	17,819,738	y	426,243,201
1909 3-10 93	10,959,407	y	1,941,638,320
1909 3-10 94	7,895,976	y	1,941,844,947
1909 3-10 95	8,175,256	y	0
1909 3-10 96	7,663,736	y	1,939,967,834
1909 3-10 97	5,548,008	y	0
1909 3-10 98	6,964,767	y	0
1909 3-10 99	4,479,660	y	0
1968 12-13 1	3,809,987	y	2,061,307,122
1968 12-13 10	1,217,449	y	443,724,909
1968 12-13 11	1,256,444	y	968,782,795
1968 12-13 12	1,519,747	y	0
1968 12-13 13	5,822,002	y	0
1968 12-13 2	1,217,449	y	443,724,909
1968 12-13 28	67,872,860	y	0
1968 12-13 29	6,637,471	y	0
1968 12-13 32	3,247,219	y	0
1968 12-13 36	28,149,566	y	0
1968 12-13 46	8,684,864	y	0
1968 12-13 47	8,653,803	y	1,943,644,817
1968 12-13 5	5,341,660	y	0
1968 12-13 54	2,499,872	y	2,048,879,868
1968 12-13 9	5,106,099	y	0
91 8-6 37	17,853,275	y	1,940,043,556
1909 3-10 115	35,116,170	y	480,625,927
1909 3-10 123	204,394,731	y	555,850,419
1909 3-10 124	136,048,023	y	953,710,338
1909 3-10 125	21,223,998	y	447,779,479

Scan directory	PLY (AI) size / bytes	Has Im PLY	SCN size / bytes
1909 3-10 128	35,064,203	y	0
1909 3-10 130	27,964,942	y	0
1909 3-10 131	33,424,943	y	0
1909 3-10 132	51,189,571	y	683,157,994
1909 3-10 133	110,059,655	y	808,667,980
1909 3-10 135	15,909,654	y	0
1909 3-10 143	78,292,451	y	0
1909 3-10 4	111,444,031	y	510,525,068
1909 3-10 47	92,459,223	y	176,255,658
1909 3-10 48	19,035,309	y	515,266,580
1909 3-10 49	44,217,915	y	389,104,280
1909 3-10 50	97,001,095	y	358,341,896
1909 3-10 51	67,085,770	y	129,127,843
1909 3-10 52	52,164,644	y	530,492,243
1909 3-10 57	100,859,621	y	764,472,521
1968 12-13 14	44,882,375	y	0
1968 12-13 15	27,280,118	y	0
1968 12-13 16	30,740,779	y	0
1968 12-13 17	23,403,490	y	677,373,606
1968 12-13 18	39,795,503	y	0
1968 12-13 19	27,119,415	y	19,942,970
1968 12-13 20	19,942,970	y	0
1968 12-13 21	8,708,362	y	654,002,314
1968 12-13 22	74,354,279	y	0
1968 12-13 23	28,851,398	y	583,619,215
1968 12-13 24	43,767,947	y	316,880,443
1968 12-13 25	36,967,195	y	590,349,383
1968 12-13 26	10,982,466	y	369,999,367
1968 12-13 3	15,819,914	y	354,265,141
1968 12-13 30	16,515,910	y	0
1968 12-13 31	5,989,114	y	0
1968 12-13 33	21,727,410	y	0

Scan directory	PLY (AI) size / bytes	Has Im PLY	SCN size / bytes
1968 12-13 34	11,819,526	y	547,618,499
1968 12-13 35	18,100,542	y	462,447,786
1968 12-13 37	10,305,202	y	0
1968 12-13 38	5,591,150	y	0
1968 12-13 39	16,098,878	y	0
1968 12-13 4	30,106,187	y	0
1968 12-13 40	16,718,182	y	0
1968 12-13 45	105,640,051	y	2,348,920,001
1968 12-13 48	214,146,963	y	0
1968 12-13 49	59,844,203	y	579,463,274
1968 12-13 50	42,187,263	y	0
1968 12-13 51	78,529,723	y	0
1968 12-13 56	35,520,239	y	490,774,319
1968 12-13 6	76,661,395	y	947,347,456
1968 12-13 7	47,466,103	y	0
1968 12-13 8	14,891,798	y	0
91 8-6 39	571,777,396	n	2,273,670,453
91 8-6 48 and 49 and 50 and 51 and 53 and 55 and 56	424,347,322	n	1,132,462,080
91 8-6 60	146,770,707	y	0
91 8-6 61	142,456,718	y	950,805,718
BRITISH MUSEUM missing parts	553,994,200	n	833,678,398
Average size	**38,367,404**		**849,329,073**
Minimum size	**3247219**		**19942970**
Maximum size	**97001095**		**1940690166**

Primary Images – Summary

The following data describes 2D photos taken concurrently with the 3D scans. There are used as a source of colorimetric information for the 3D models.

	File size / bytes	Horizontal resolution	Vertical resolution	No. of images
Average	78233	750	781.975	13.7869
Minimum	37840	750	493	5
Maximum	9782788	4928	3264	292

Primary Images – Full Dataset

Primary Image located at www.britishmuseum.org/collectionimages unless otherwise indicated	File size / bytes	Horizontal resolution	Vertical resolution	2d images from 3d scanning process per object
http://.../AN01249/AN01249867_001_l.jpg	46897	750	506	10
http://.../AN01249/AN01249873_001_l.jpg	54184	750	563	9
http://.../AN01249/AN01249877_001_l.jpg	62255	750	546	7
http://.../AN01249/AN01249884_001_l.jpg	57450	750	562	11
http://.../AN01249/AN01249886_001_l.jpg	68649	750	593	11
http://.../AN01249/AN01249887_001_l.jpg	44005	750	533	8
http://.../AN01250/AN01250014_001_l.jpg	82651	750	679	6
http://.../AN01250/AN01250018_001_l.jpg	73462	750	541	9
http://.../AN01362/AN01362425_001_l.jpg	82819	750	1064	7
http://.../AN01250/AN01250020_001_l.jpg	64063	750	507	7
http://.../AN01358/AN01358370_001_l.jpg	52669	750	661	13
http://.../AN01362/AN01362427_001_l.jpg	54565	750	1064	8
http://.../AN01362/AN01362429_001_l.jpg	51052	750	772	9
http://.../AN01362/AN01362431_001_l.jpg	53181	750	625	8
http://.../AN01362/AN01362434_001_l.jpg	54608	750	704	10
http://.../AN01362/AN01362435_001_l.jpg	100770	750	778	13
http://.../AN01362/AN01362445_001_l.jpg	78031	750	742	9
http://.../AN01250/AN01250021_001_l.jpg	65827	750	588	8

Primary Image located at www.britishmuseum.org/collectionimages unless otherwise indicated	**File size / bytes**	**Horizontal resolution**	**Vertical resolution**	**2d images from 3d scanning process per object**
http://.../AN01362/AN01362459_001_l.jpg	74931	750	1037	7
http://.../AN01362/AN01362461_001_l.jpg	65109	750	943	7
http://.../AN01250/AN01250026_001_l.jpg	128515	750	1494	10
http://.../AN01250/AN01250039_001_l.jpg	70477	750	578	9
http://.../AN01362/AN01362483_001_l.jpg	126352	750	769	8
http://.../AN01362/AN01362487_001_l.jpg	78719	750	625	16
http://.../AN00257/AN00257233_001_l.jpg	69552	750	633	14
http://.../AN01250/AN01250045_001_l.jpg	58892	750	573	9
http://.../AN01362/AN01362495_001_l.jpg	68584	750	682	12
http://.../AN00257/AN00257234_001_l.jpg	96494	750	931	11
http://.../AN00257/AN00257235_001_l.jpg	123237	750	1128	11
http://.../AN01362/AN01362498_001_l.jpg	67424	750	1128	10
http://.../AN01362/AN01362510_001_l.jpg	101521	750	858	10
http://.../AN01369/AN01369686_001_l.jpg	43933	750	567	12
http://.../AN01369/AN01369686_001_l.jpg	43933	750	567	12
http://.../AN01369/AN01369686_001_l.jpg	43933	750	567	10
http://.../AN01362/AN01362424_001_l.jpg	51409	750	592	10
http://.../AN01249/AN01249800_001_l.jpg	57273	750	588	9
http://.../AN01250/AN01250051_001_l.jpg	51660	750	588	7
http://.../AN01362/AN01362515_001_l.jpg	66477	750	757	14
http://.../AN01250/AN01250059_001_l.jpg	109683	750	677	12
http://.../AN01250/AN01250063_001_l.jpg	70166	750	551	8
http://.../AN01249/AN01249805_001_l.jpg	72593	750	653	15
http://.../AN01251/AN01251367_001_l.jpg	74267	750	644	11
http://.../AN01250/AN01250073_001_l.jpg	115375	750	1057	8
http://.../AN01250/AN01250074_001_l.jpg	106309	750	1074	7
http://.../AN01250/AN01250080_001_l.jpg	78158	750	1006	8
http://.../AN01250/AN01250081_001_l.jpg	47793	750	557	10
http://.../AN01250/AN01250090_001_l.jpg	59143	750	516	6
http://.../AN01250/AN01250095_001_l.jpg	54040	750	532	7

Primary Image located at www.britishmuseum.org/collectionimages unless otherwise indicated	**File size / bytes**	**Horizontal resolution**	**Vertical resolution**	**2d images from 3d scanning process per object**
http://.../AN01358/AN01358371_001_l.jpg	50909	750	505	7
http://.../AN01250/AN01250118_001_l.jpg	113646	750	541	9
http://.../AN01250/AN01250120_001_l.jpg	59456	750	507	8
http://.../AN01250/AN01250131_001_l.jpg	52263	750	534	8
http://.../AN01250/AN01250131_001_l.jpg	52263	750	534	8
http://.../AN01250/AN01250144_001_l.jpg	52321	750	532	10
http://.../AN01358/AN01358389_001_l.jpg	72725	750	802	11
http://.../AN01250/AN01250172_001_l.jpg	125694	750	1120	11
http://.../AN01249/AN01249896_001_l.jpg	119607	750	1086	9
http://.../AN01249/AN01249905_001_l.jpg	54000	750	596	9
http://.../AN01369/AN01369708_001_l.jpg	49582	750	845	10
http://.../AN01249/AN01249931_001_l.jpg	72383	750	562	7
http://.../AN01250/AN01250179_001_l.jpg	110459	750	1058	9
http://.../AN01250/AN01250184_001_l.jpg	124494	750	1115	15
http://.../AN01250/AN01250189_001_l.jpg	63410	750	1119	7
http://.../AN01250/AN01250192_001_l.jpg	44972	750	498	7
http://.../AN01355/AN01355622_001_l.jpg	130963	750	1037	13
http://.../AN01250/AN01250193_001_l.jpg	49085	750	493	10
http://.../AN01250/AN01250194_001_l.jpg	162480	750	1159	7
http://.../AN01250/AN01250202_001_l.jpg	136326	750	1111	7
http://.../AN01250/AN01250205_001_l.jpg	65490	750	512	7
http://.../AN01250/AN01250209_001_l.jpg	92403	750	1079	8
http://.../AN01249/AN01249939_001_l.jpg	63111	750	507	8
http://.../AN01249/AN01249942_001_l.jpg	107890	750	1056	7
http://.../AN01249/AN01249945_001_l.jpg	55786	750	509	5
http://.../AN01249/AN01249948_001_l.jpg	111024	750	1041	8
http://.../AN01358/AN01358390_001_l.jpg	55421	750	832	11
http://.../AN01249/AN01249953_001_l.jpg	99858	750	1093	5
http://.../AN01249/AN01249956_001_l.jpg	108742	750	1122	13
http://.../AN01249/AN01249959_001_l.jpg	121214	750	1123	7

Primary Image located at www.britishmuseum.org/collectionimages unless otherwise indicated	**File size / bytes**	**Horizontal resolution**	**Vertical resolution**	**2d images from 3d scanning process per object**
http://.../AN01249/AN01249961_001_l.jpg	108120	750	1054	10
http://.../AN01249/AN01249963_001_l.jpg	60418	750	525	7
http://.../AN01249/AN01249965_001_l.jpg	49708	750	498	9
http://.../AN01249/AN01249967_001_l.jpg	60071	750	505	8
http://.../AN01249/AN01249968_001_l.jpg	60112	750	521	6
http://.../AN01362/AN01362539_001_l.jpg	60680	750	757	9
http://.../AN01362/AN01362576_001_l.jpg	46023	750	683	12
http://.../AN01355/AN01355627_001_l.jpg	122955	750	982	13
http://.../AN01249/AN01249972_001_l.jpg	130600	750	1122	11
http://.../AN01249/AN01249972_001_l.jpg	130600	750	1122	6
http://.../AN01362/AN01362622_001_l.jpg	65461	750	708	9
http://.../AN01362/AN01362629_001_l.jpg	76620	750	855	10
http://.../AN01249/AN01249983_001_l.jpg	113741	750	1099	6
Updated entry, no image available in SPARQL endpoint, owncloud link: http://oc.cytera.cyi.ac.cy/index.php/apps/files?dir=%2FBritish%20Museum%2F2013%2F1909%203-10%2094%2FImages%2FJPG	14731	750	947	6
Updated entry, no image available in SPARQL endpoint, owncloud link: http://oc.cytera.cyi.ac.cy/index.php/apps/files?dir=/British%20Museum/2013/1909%203-10%2095	14039	750	989	11
http://.../AN01249/AN01249997_001_l.jpg	54736	750	572	12
http://.../AN01250/AN01250002_001_l.jpg	46504	750	533	10
http://.../AN01250/AN01250009_001_l.jpg	59238	750	519	14
http://.../AN01250/AN01250010_001_l.jpg	53557	750	500	11
http://.../AN01355/AN01355655_001_l.jpg	144708	750	1076	21
http://.../AN01355/AN01355634_001_l.jpg	86550	750	640	15
http://.../AN01362/AN01362635_001_l.jpg	113407	750	818	6
http://.../AN01355/AN01355637_001_l.jpg	63434	750	597	7
http://.../AN01355/AN01355639_001_l.jpg	118122	750	1120	11
http://.../AN01362/AN01362638_001_l.jpg	52969	750	721	7

Primary Image located at www.britishmuseum.org/collectionimages unless otherwise indicated	**File size / bytes**	**Horizontal resolution**	**Vertical resolution**	**2d images from 3d scanning process per object**
http://.../AN01364/AN01364089_001_l.jpg	131674	750	1347	8
http://.../AN01364/AN01364092_001_l.jpg	71105	750	1181	12
http://.../AN01364/AN01364349_001_l.jpg	59913	750	558	10
http://.../AN01364/AN01364359_001_l.jpg	78908	750	487	8
http://.../AN01364/AN01364387_001_l.jpg	64174	750	923	8
http://.../AN01251/AN01251373_001_l.jpg	60448	750	977	12
http://.../AN01355/AN01355675_001_l.jpg	97297	750	768	12
http://.../AN01364/AN01364394_001_l.jpg	66184	750	723	6
http://.../AN01364/AN01364098_001_l.jpg	56478	750	582	7
http://.../AN01369/AN01369671_001_l.jpg	46114	750	878	8
http://.../AN01362/AN01362437_001_l.jpg	110742	750	904	7
http://.../AN00362/AN00362618_001_l.jpg	139413	750	1359	24
http://.../AN01362/AN01362454_001_l.jpg	70007	750	1116	22
http://.../AN01362/AN01362457_001_l.jpg	59133	750	749	17
http://.../AN01362/AN01362477_001_l.jpg	53130	750	820	16
http://.../AN01362/AN01362479_001_l.jpg	57632	750	966	14
http://.../AN01355/AN01355619_001_l.jpg	80006	750	868	16
http://.../AN01362/AN01362481_001_l.jpg	74425	750	958	23
http://.../AN01369/AN01369682_001_l.jpg	37840	750	762	13
http://.../AN01362/AN01362498_001_l.jpg	67424	750	912	43
http://.../AN01358/AN01358374_001_l.jpg	64769	750	524	23
http://.../AN01250/AN01250139_001_l.jpg	92734	750	1107	13
http://.../AN01250/AN01250144_001_l.jpg	52321	750	532	8
http://.../AN01250/AN01250147_001_l.jpg	49016	750	529	8
http://.../AN01250/AN01250148_001_l.jpg	97194	750	1068	6
http://.../AN01250/AN01250154_001_l.jpg	84765	750	1040	15
http://.../AN01250/AN01250156_001_l.jpg	97356	750	1103	8
http://.../AN01250/AN01250169_001_l.jpg	143139	750	1106	12
http://.../AN01355/AN01355643_001_l.jpg	107977	750	1120	19
http://.../AN01355/AN01355645_001_l.jpg	129312	750	1052	12

Primary Image located at www.britishmuseum.org/collectionimages unless otherwise indicated	**File size / bytes**	**Horizontal resolution**	**Vertical resolution**	**2d images from 3d scanning process per object**
http://.../AN01355/AN01355649_001_l.jpg	90351	750	668	18
http://.../AN01355/AN01355652_001_l.jpg	93780	750	902	24
http://.../AN01363/AN01363207_001_l.jpg	60474	750	645	23
http://.../AN01363/AN01363216_001_l.jpg	70124	750	708	19
http://.../AN01369/AN01369695_001_l.jpg	76970	750	800	18
http://.../AN01363/AN01363237_001_l.jpg	79305	750	683	14
http://.../AN01363/AN01363240_001_l.jpg	52996	750	608	25
http://.../AN01363/AN01363247_001_l.jpg	96173	750	993	12
http://.../AN01251/AN01251377_001_l.jpg	111364	750	989	10
http://.../AN01363/AN01363257_001_l.jpg	89354	750	686	14
http://.../AN01363/AN01363260_001_l.jpg	54086	750	796	21
http://.../AN01355/AN01355658_001_l.jpg	77201	750	915	20
http://.../AN01364/AN01364094_001_l.jpg	65521	750	833	19
http://.../AN01364/AN01364096_001_l.jpg	40037	750	540	19
http://.../AN01364/AN01364351_001_l.jpg	63150	750	559	20
http://.../AN01364/AN01364353_001_l.jpg	59086	750	522	19
http://.../AN01364/AN01364357_001_l.jpg	48106	750	497	19
http://.../AN01364/AN01364360_001_l.jpg	68865	750	709	14
http://.../AN01364/AN01364362_001_l.jpg	71306	750	780	14
http://.../AN01364/AN01364365_001_l.jpg	52437	750	499	7
http://.../AN01355/AN01355663_001_l.jpg	81446	750	869	18
http://.../AN01364/AN01364368_001_l.jpg	52153	750	491	11
http://.../AN01364/AN01364385_001_l.jpg	53484	750	594	24
http://.../AN01364/AN01364390_001_l.jpg	61181	750	627	21
Updated entry, no image available in SPARQL endpoint, owncloud link: http://oc.cytera.cyi.ac.cy/index.php/apps/files/?dir=%2FBritish%20Museum%2F2014%2F1968%2012-13%2049%2FImages%2FJPG	14196	750	899	17
http://.../AN01362/AN01362644_001_l.jpg	106090	750	796	16
http://.../AN01362/AN01362652_001_l.jpg	87507	750	714	29

Primary Image located at www.britishmuseum.org/collectionimages unless otherwise indicated	**File size / bytes**	**Horizontal resolution**	**Vertical resolution**	**2d images from 3d scanning process per object**
http://.../AN01364/AN01364399_001_l.jpg	62538	750	838	16
http://.../AN01355/AN01355684_001_l.jpg	166877	750	1014	21
http://.../AN01355/AN01355686_001_l.jpg	94299	750	913	28
http://.../AN01355/AN01355688_001_l.jpg	69465	750	636	19
http://.../AN00342/AN00342501_001_l.jpg	138006			22
fragments of cuirass photographed together (91 8-6 48, 49, 50, 51, 53, 55, 56 owncloud link: http://oc.cytera.cyi.ac.cy/index.php/apps/files/?dir=%2FBritish%20Museum%2F2014%2F91%208-6%2048and49and50and51and53and55and56	9782788	4928	3264	292

Appendix D. Ashmolean Image Files - Summary

3D images – full data set

Scan directory	PLY (AI) size	Has Im PLY	SCN size
09_840_ [= 1909.840 and same as 1891.471	98,368,675	y	0
1891_471 [= 1909.840]	64,142,539	y	0
1912 147	12,832,846	y	1,647,292,573
1930_392	8,591,966	y	0
462_1891_[large body fragment]	423,262,437	n	1,903,613,747
464_1891_	102,308,023	y	600,160,016
465_1891	42,417,675	y	718,545,237
466_1891	51,561,859	y	0
467_1891	15,009,902	y	0
469_1891_	158,342,631	y	708,053,020
470 1891_	152,025,299	y	0
472_1891	25,614,902	y	553,369,582
473 1891_	95,825,687	y	360,547,799
474_1891_	23,808,146	y	689,477,782
480_1891_	3,224,758	y	0
481_1891_	42,908,235	y	0
551_1926_	69,088,431	y	0
AN1909_837 [[Large head]	451,339,651	n	5,107,633,055
C_601	92,213,183	y	0
C_603	20,908,970	y	362,785,475
MISSING PARTS_Ashmolean_Museum	104,576,139	n	162,962,970
Average PLY Size	**98017712.1**	**y = 18**	**610211488.4**
Minimum PLY Size	**3,224,758**	**n = 3**	**0**
Maximum PLY size	**451339651**		**5107633055**

Primary images - summary

Average file size	**717315.0526**	**450**	**300**	**21.65 (average no images)**
Minimum file size	**520899**	(Horizontal av)	(vertical av)	**14 (minimum no images)**
Maximum file size	**784741**			**48 (maximum no images)**

Primary images – full data set

Primary Image	File size	Horizontal	Vertical	2d images from 3d scanning process no per object
ODS3-7087_1	549615	450	300	21 images
ODS3-7087_1	520899	450	300	27 images
ODS6-3125_1	724260	450	300	13 images
ODS3-6718_1	737456	450	300	13 images
ODS3-7227_1	726704			24 images
ODS3-7269_1	751150	450	300	35 images
ODS3-7254_1	734369	450	300	33 images
ODS3-7260_2	768813	450	300	15 images
ODS3-7257_1	776636	450	300	29 images
ODS3-7138_1	731623	450	300	19 images
ODS3-7058_1	761801	450	300	24 images
ODS3-7149_1	784741	450	300	14 images
ODS3-7031_1	764248	450	300	16 images
ODS3-5624_1	704531	450	300	15 images
ODS6-5821_1	740598	450	300	12 images
ODS3-7326_1	757464	450	300	21 images
[No digital image in Ashmolean folder]		450	300	18 images
AN_1909_837_a-RAT; ODS5-6415_1	714739			48 images
ODS6-3167_1	670569	450	300	16 images
ODS6-3300_1	708770	450	300	20 images
Average file size	**717315.0526**	**450**	**300**	**21.65 (average no images)**
Minimum file size	**520899**	(Horizontal av)	(vertical av)	**14 (minimum no images)**
Maximum file size	**784741**			**48 (maximum no images)**

Appendix E. Fitzwilliam Museum Data Schema

Fitz Artefact Schema (extracted from XML serialized record)

Concept (1st)	Concept (2nd)	Concept (3rd)	Value (example)	Notes
priref			66498	identifier
acquisition	date		1890	acquisition method and date
acquisition	method		given	
acquisition	method	lref	106203	
description			male head, wearing cap	free text description
dimension	type		height	
dimension	type	lref	3997	
dimension	unit		m	
dimension	unit	lref	115004	
dimension	value		0.063	
documentation	author		Karageorghis, Vassos	References to full text documentation about the artefact
documentation	notes		p 67, cat no. 119	
documentation	title		Art of Ancient Cyprus in the Fitzwilliam Museum, Cambridge	
documentation	title	lref	7478	
documentation	source_title		Cypriote Terracottas, Proceedings of Conference, ed. Vandenbeele and Laffineur	
field_coll	place		Salamis Cyprus	
field_coll	place	lref	111299	
material			clay	
material	lref		32002	
object_name			head	Object CI-DOC CRM ID, name and category
object_name	lref		107683	
object_category			figure	

Concept (1st)	Concept (2nd)	Concept (3rd)	Value (example)	Notes
object_category	lref		107454	
object_number			GR.10.1890	
production	notes		Moulded	Production method, period, date, place
production	period		Archaic	
production	period	lref	111220	
production	date	start	-600	
production	date	end	-501	
production	place	continent_country	Cyprus	

note: shortened to focus on fields that best represent the type of metadata available

Appendix F. Ashmolean Data Schema

Concept (1st)	Concept (2nd)	Concept (3rd)	Value (example)	Notes
ObjDaten	ObjId		304893	Object ID
ObjDaten	ObjTypS		general	Record type
ObjDaten	ObjAufId		153	Responsible Person Id
ObjDaten	ObjInventarNrS		AN1912.147	String version of accession number constructed from components according to type.
ObjDaten	ObjInventarNrSortiertS		AN1912.0147	Constructed string version of acc. no. with padding.
ObjDaten	ObjInv01S		AN	1st part of acc. no.
ObjDaten	ObjInv02S		1912	2nd part of acc. no.
ObjDaten	ObjInv03S		.	3rd part of acc. no.
ObjDaten	ObjInv04S		147	4th part of acc. no.
ObjDaten	ObjInv05S			5th part of acc. no.
ObjDaten	ObjInv06S			6th part of acc. no.
ObjDaten	ObjDinId		33	Accession number type
ObjDaten	ObjGeografieS			Object name
ObjDaten	ObjAnzahlS		1	No. of items
ObjDaten	ObjFeld01M		Property	Acquis. Inventory
ObjDaten	ObjFeld02M		Gift	Acquis. Method
ObjDaten	ObjFeld03M		Bowen, L.	Acquis. Source
ObjDaten	ObjFeld05M			Acquis. Fund src
ObjDaten	ObjFeld01S			Acquis. Date
ObjDaten	ObjMulId		144114	Main image
ObjDaten	ObjInvStatusS			Data quality
ObjDaten	ObjInternetS			Internet ready
ObjDatierung	OdaObjId		304894	Object Id
ObjDatierung	OdaId		69961	Date Id
ObjDatierung	OdaArtS		Display	Dating type
ObjDatierung	OdaJahrVonL		-750	Year from

Concept (1st)	Concept (2nd)	Concept (3rd)	Value (example)	Notes
ObjDatierung	OdaJahrBisL		-480	Year to
ObjDatierung	ObjDatierungS		Cypro-Archaic Period (c. 750 - c. 480 BC)	Period
ObjDatierung	OdaBemerkungM		CG-CAI	Remarks
ObjMass	ObmId		279531	Dimension Id
ObjMass	ObmObjId		305401	Object Id
ObjMass	ObmTypMasseS		Width	Type
ObjMass	ObmMasseHF			Size_1 value
ObjMass	ObmMasseBF		3.3	Size_2 value
ObjMass	ObmMasseTF			Size_3 value
ObjMass	ObmMasseMS		Cm	Unit
ObjMass	ObmMasseBemVorS			Extent
ObjMass	ObmMasseBemNachS			Qualifier
ObjMass	ObmSortL		1	Sort
ObjMass	ObmMasseS			Composite: Extent Size_1 x Size_2 x Size_3 Unit Qualifier
ObjMass	ObmInvPersonS			Inv. Person
ObjMass	ObmInvDatumD			Inv. Date
ObjMultiple	OmuInhalt01M			Acc. No.
ObjMultiple	OmuGenFeldS			Type: Associated place
ObjMultiple	OmuId		662219	Multiple Id
ObjMultiple	OmuGenFeldS		ObjBeschriftungM	Type: Keyword
ObjMultiple	OmuGenFeldS			Type: Acc. No.
ObjMultiple	OmuGenFeldS			Type: Inscription/mark
ObjMultiple	OmuGenFeldS			Type: Mat/Tech
ObjMultiple	OmuGenFeldS			Type: Title
ObjMultiple	OmuInhalt01M		Cyprus	Associated place
ObjMultiple	OmuInhalt01M			Keyword
ObjMultiple	OmuInhalt01M			Inscription/Mark
ObjMultiple	OmuInhalt01M			Title
ObjMultiple	OmuObjId			Reference Id

Concept (1st)	Concept (2nd)	Concept (3rd)	Value (example)	Notes
ObjMultiple	OmuInhalt01M			Mat/Tech
ObjMultiple	OmuTypS			Type
ObjMultiple	OmuBemerkungM			Remark
ObjMultiple	OmuInhalt01S			Details
ObjMultiple	OmuSortL			Sorting
ObjMultiple	OmuTypS			Inscription type
ObjMultiple	OmuInhalt01S			Inscription detail
ObjMultiple	OmuInhalt01M			Inscription
ObjObj	OobID			Object-Object Id
ObjObj	OobObj1ID			Related object 1
ObjObj	OobObj2ID			Related object 2
ObjObj	OobBeziehungS			Relation
ObjObj	OobBemerkungS			Relation remark

Appendix G. Cyprus Institute Data Schemas

General information across collections

Field	Example
Collection	Collection of Digital Resources of Salamis Terracotta Fragments, Cyprus
Creation Date	2015-01-08
End Date	480 B.C.
Language	EN
Location	Cyprus
Period Name	Cypro-Archaic
Rights	The Fitzwilliam Museum, The Cyprus Institute - STARC
Source	The Cyprus Institute - STARC
Start Date	750 B.C.

Cultural heritage asset (Salamis Terracotta Fragments, Tombs of the Kings etc.)

Field	Example
Collection	Collection of Digital Resources of Salamis Terracotta Fragments, Cyprus
Country	Cyprus
Creation Date	2015-01-08
Data Format	JPG
Data Weight	830 KB
Description	Head of a male beardless terracotta statue wearing a helmet
End Date	480 B.C.
Geopolitical Area	Europe,Cyprus,Famagusta District,Salamis
Language	EN
Location Name	Salamis
Name	Fragment of a terracotta statue (GR.10.1890)
Period Name	Cypro-Archaic
Rights	The Fitzwilliam Museum, The Cyprus Institute - STARC
Software	Adobe Photoshop Lightroom 5
Source	The Cyprus Institute - STARC
Spatial	Nicosia, Cyprus

Field	Example
Start Date	750 B.C.
Subject	Head of a terracotta statue
Type	Image
Unit	cm
Value	4.3
X	35.1833
Y	33.9000

Inscription (Grammateia)

Field	Example
Title	Simalos' epigram - Modern Greek text (E1 in Voskos, 1997)
Country	Cyprus
Description	Stolos the Athenean honours his Cypriot friend Simalos by dedicating a statue to the Delian Apollo. Ὁ Στόλος Θέωνος ὁ Ἀθηναῖος ὁ μέγας ἀξιωματοῦχος τοῦ βασιλιᾶ Πτολεμαίου τοῦ δευτέρου Σωτῆρος (τὸ ἄγαλμα ποὺ παριστάνει) τὸν Σίμαλο Τιμάρχου τὸν Σαλαμίνιο, τὸν δικό του φίλο, (ἀφιερώνει) στὸν Ἀπόλλωνα. Μὲ τοῦ Ἀλκίνοου τ' ἀνάκτορα παρόμοια μέγαρα σὺ ποὺ κατοικεῖς, Σίμαλε, τῆς ἀπροσποίητης δεῖγμα φιλοξενίας, ἁπλὲ καὶ στοὺς λόγους καὶ στὸν βίο τὸν περικαλλῆ, προσφιλὲς στῆς Αἰγύπτου τοὺς βασιλιάδες καταφύγιο καὶ στῆς Ρώμης τοὺς ὑπάτους καὶ στὴν Ἀττικὴ τοῦ Κέκροπα τὴ γῆ καὶ στῆς Δήλου τοὺς κατοίκους πολυσέβαστε, εἴθε στοὺς χρόνους κείνους νὰ σὲ γεννοῦσε ἡ πατρίδα ἡ ποθητή, τῶν Τρώων καὶ τῶν Δαναῶν ὅταν τραγούδαγε τὶς μάχες ὁ Μαιονίδης, τὴ δική σου εὐφροσύνη νὰ ἀτενίσει χρυσὸ μέσ' στὰ βιβλία μνημεῖο λόγου ἀνεγείροντας· τῶν Φαιάκων ἔτσι ὁ βασιλιὰς τόση δὲν θά 'παιρνε τὴ δόξα ὅπως σύ, ποὺ σπιτικὸ φιλόξενο στοὺς πάντες πρόσφερες. τοῦ Ἀντισθένη ἀπὸ τὴν Πάφο
Link	
Language	Ancient Greek
Translator	Voskos, A.
Translation language	Modern Greek
Translation date	1997
Translation publication	Αρχαία Κυπριακή Γραμματεία, τόμ. 2: Επίγραμμα
Translation rights	The A.G. Leventis Foundation

Book (Ancient Books)

Field	Example
Title	Επίσημη Κυβερνητική Εφημερίδα της Κύπρου, 1η Ιανουαρίου 1879 - The Cyprus Official Government Gazette, 1st of January 1879
Work Type	Εφημερίδα - Gazette
Description	Επίσημη συλλογή των γκαζέττων της χρονολογίας 1879 της Κυβερνητική Εφημερίδα της Κύπρου. Στη φωτογραφία απεικονίζεται το χειροποίητο εξώφυλλο. Η αριστερή πλευρά του εξώφυλλου είναι διακοσμημένη με καρδιές σε διάφορους χρωματισμούς (κόκκινο, κίτρινο και πράσινο) και μέσα στις καρδιές υπάρχουν μικρές διακοσμήσεις από λουλούδια. Στη δεξιά πλευρά του εξωφύλλου υπάρχει μια πλούσια διακόσμηση από λουλούδια και τριαντάφυλλα. Τέλος, οι δύο άκριες (δεξιά) του εξωφύλλου είναι ντυμένες με υφασμάτινα κρόσσια. – The Official collection of 1879 Gazettes of the Government of Cyprus. The image shows the handmade cover. At the left side of the cover there is a decoration of hearts in various colours (red, yellow and green) and inside the hearts there are smaller decorations of flowers. At the right part of the cover there is a rich decoration of several types of flowers and roses. Finally, the two edges (right side) of the cover are decorated with small fringed fabric.
Production	Δημοσιεύθηκε απο την Κυβέρνηση - Authority of Cyprus
Object Date	1879 -
Material	Χαρτί - Paper -
Dimension	30 x 20 cm

Art (Byzantine Museum)

Field	Example
Image title	Saints Cosmas and Damian
Copyrights	The Cyprus Institute - STARC / Βυζαντινό Μουσείο Ιδρύματος Αρχιεπισκόπου Μακαρίου Γ
Locations	From the Church of Virgin Chrisaliniotissa, Nicosia.
Dimension	78 x 33 cm
Artist	Unknown
Date	11th century with later over-paintings
Technique	Egg tempera on wood
Show at the Byzantine Museum	http://makariosfoundation.org.cy/bm002.html
Conservation status	Good

Cyprus 2D Provenance Schema (screen scraped from STARC)

Field	Example
Copyright	The Cyprus Insitute - STARC
Country	Cyprus
Exposure_time	1/15 sec
Focal_length	105 mm
Institution Author	Eleni Athanasiou, Alexia Kolosova
Model	AF-S MICRO NIKKOR 1:2.8G ED
Rights	The Cyprus Institute - STARC
Serial Number	352524
Software	Camera Control Pro 2
Source	The Cyprus Institute - STARC

Cyprus 3D Provenance Schema (screen scraped from STARC)

Field	Example
Accuracy	0.038 cm
Acquisition_Range	34.29 x 25.65 cm
Camera_Resolution	3 Mpx
Copyright	The Cyprus Insitute - STARC
Country	Cyprus
Data_Input_Format	SCN
Data_Output_Format	PLY
Exposure_Time	1/20 sec
Focal_Length	105 mm
Institution Author	Nicola Amico
Integrated_Camera	Y
Integrated_GPS	N
Model	NextEngine Desktop 3D Scanner
Name	ScanStudio
Number_Of_Scans	14
Number_Of_Targets	N
Physical_Characteristics	22x28x9 cm

Field	Example
Points_Second	50000 p/s
Rights	The Cyprus Institute - STARC
Serial Number	5008907
Software	Camera Control Pro 2
Source	The Cyprus Institute - STARC
Target_Model	N
Technology	Multi-stripe laser triangulation (MLT)
Time_Acquisition	2 min each scan

Appendix H. Additional Metadata for Ashmolean Objects (Cyprus Institute)

URI	Collection	Rights	Source	Language	Location	Start Date	End date	Period name	Creation date	country	name	description	location name	geopolitical area	x	y
http://public.cyi.ac.cy/starcRepo/details/show/7b9a2e201002c9b4df61a9346bbcce58	Collection of Digital Resources of Salamis Terracotta Fragments, Cyprus	The Ashmolean Museum, The Cyprus Institute - STARC	The Cyprus Institute - STARC	EN	Cyprus	750 BC	480 BC	Cypro-Archaic	08/01/2015	Cyprus	Fragment of a terracotta statue	Left foot of a terracotta statue	Salamis	Europe,Cyprus,Famagusta District,Salamis	35.1833	33.9
http://public.cyi.ac.cy/starcRepo/details/show/e403b845f57aa9f80dbad8a7edaf5067	Collection of Digital Resources of Salamis Terracotta Fragments, Cyprus	The Ashmolean Museum, The Cyprus Institute - STARC	The Cyprus Institute - STARC	EN	Cyprus	750 BC	480 BC	Cypro-Archaic	08/01/2015	Cyprus	Fragment of a terracotta statue	Head of a terracotta statue	Salamis	Europe,Cyprus,Famagusta District,Salamis	35.1833	33.9
http://public.cyi.ac.cy/starcRepo/details/show/652200c4c384a1132de976404ff34deb	Collection of Digital Resources of Salamis Terracotta Fragments, Cyprus	The Ashmolean Museum, The Cyprus Institute - STARC	The Cyprus Institute - STARC	EN	Cyprus	750 BC	480 BC	Cypro-Archaic	08/01/2015	Cyprus	Fragment of a terracotta statue	Fragment of a calf bearer figurine, animal feet and human hand of a terracotta statue	Salamis	Europe,Cyprus,Famagusta District,Salamis	35.1833	33.9
http://public.cyi.ac.cy/starcRepo/details/show/38093b53ab44d59a6665183292d9b7cb	Collection of Digital Resources of Salamis Terracotta Fragments, Cyprus	The Ashmolean Museum, The Cyprus Institute - STARC	The Cyprus Institute - STARC	EN	Cyprus	750 BC	480 BC	Cypro-Archaic	08/01/2015	Cyprus	Fragment of a terracotta statue	Fragment of a terracotta statue	Salamis	Europe,Cyprus,Famagusta District,Salamis	35.1833	33.9
Sorin notified												Fragment of a terracotta statue				
http://public.cyi.ac.cy/starcRepo/details/show/cd91c026bfd61d8d7b88c6cba7a16c74	Collection of Digital Resources of Salamis Terracotta Fragments, Cyprus	The Ashmolean Museum, The Cyprus Institute - STARC	The Cyprus Institute - STARC	EN	Cyprus	750 BC	480 BC	Cypro-Archaic	08/01/2015	Cyprus	Fragment of a terracotta statue	Decorated fragment of a terracotta statue	Salamis	Europe,Cyprus,Famagusta District,Salamis	35.1833	33.9
http://public.cyi.ac.cy/starcRepo/details/show/ad8a945e51ffbe42265829d525ac976b	Collection of Digital Resources of Salamis Terracotta Fragments, Cyprus	The Ashmolean Museum, The Cyprus Institute - STARC	The Cyprus Institute - STARC	EN	Cyprus	750 BC	480 BC	Cypro-Archaic	08/01/2015	Cyprus	Fragment of a terracotta statue	Decorated fragment of a terracotta statue	Salamis	Europe,Cyprus,Famagusta District,Salamis	35.1833	33.9
http://public.cyi.ac.cy/starcRepo/details/show/ca2bf28dd2ead302ffb5d9a9b02a633b	Collection of Digital Resources of Salamis Terracotta Fragments, Cyprus	The Ashmolean Museum, The Cyprus Institute - STARC	The Cyprus Institute - STARC	EN	Cyprus	750 BC	480 BC	Cypro-Archaic	08/01/2015	Cyprus	Fragment of a terracotta statue	Decorated fragment of a terracotta statue	Salamis	Europe,Cyprus,Famagusta District,Salamis	35.1833	33.9
http://public.cyi.ac.cy/starcRepo/details/show/f29f19b2dde182dd4fe83654c87d24bf	Collection of Digital Resources of Salamis Terracotta Fragments, Cyprus	The Ashmolean Museum, The Cyprus Institute - STARC	The Cyprus Institute - STARC	EN	Cyprus	750 BC	480 BC	Cypro-Archaic	08/01/2015	Cyprus	Fragment of a terracotta statue	Decorated fragment of a terracotta statue	Salamis	Europe,Cyprus,Famagusta District,Salamis	35.1833	33.9
http://public.cyi.ac.cy/starcRepo/details/show/c30a67edeec72fcef6e053acd843789c	Collection of Digital Resources of Salamis Terracotta Fragments, Cyprus	The Ashmolean Museum, The Cyprus Institute - STARC	The Cyprus Institute - STARC	EN	Cyprus	750 BC	480 BC	Cypro-Archaic	08/01/2015	Cyprus	Torso of a terracotta statue (469.1891.)	Torso of a terracotta statue	Salamis	Europe,Cyprus,Famagusta District,Salamis	35.1833	33.9
http://public.cyi.ac.cy/starcRepo/details/show/def1688ff161a5d3733d77781edb93bc	Collection of Digital Resources of Salamis Terracotta Fragments, Cyprus	The Ashmolean Museum, The Cyprus Institute - STARC	The Cyprus Institute - STARC	EN	Cyprus	750 BC	480 BC	Cypro-Archaic	08/01/2015	Cyprus	Terracotta statuette (470 1891.)	Terracotta Statuette	Salamis	Europe,Cyprus,Famagusta District,Salamis	35.1833	33.9
http://public.cyi.ac.cy/starcRepo/details/show/dc5e27c04e159ca02d9ff83bde1d2988	Collection of Digital Resources of Salamis Terracotta Fragments, Cyprus	The Ashmolean Museum, The Cyprus Institute - STARC	The Cyprus Institute - STARC	EN	Cyprus	750 BC	480 BC	Cypro-Archaic	08/01/2015	Cyprus	Fragment of a terracotta statue (472.1891)	Upper part of the torso of a terracotta statue	Salamis	Europe,Cyprus,Famagusta District,Salamis	35.1833	33.9
http://public.cyi.ac.cy/starcRepo/details/show/23beba2a4a0cc934cf30f5c93fd463ce	Collection of Digital Resources of Salamis Terracotta Fragments, Cyprus	The Ashmolean Museum, The Cyprus Institute - STARC	The Cyprus Institute - STARC	EN	Cyprus	750 BC	480 BC	Cypro-Archaic	08/01/2015	Cyprus	Fragment of a terracotta statue (473 1891.)	Front part of a terracotta statue	Salamis	Europe,Cyprus,Famagusta District,Salamis	35.1833	33.9
http://public.cyi.ac.cy/starcRepo/details/show/0f7949abaebe707469254003a6efb50e	Collection of Digital Resources of Salamis Terracotta Fragments, Cyprus	The Ashmolean Museum, The Cyprus Institute - STARC	The Cyprus Institute - STARC	EN	Cyprus	750 BC	480 BC	Cypro-Archaic	08/01/2015	Cyprus	Torso of a terracotta statue (474.1891.)	Torso of a terracotta statue	Salamis	Europe,Cyprus,Famagusta District,Salamis	35.1833	33.9
http://public.cyi.ac.cy/starcRepo/details/show/0767d21e555510dc118d223e31ae50b2	Collection of Digital Resources of Salamis Terracotta Fragments, Cyprus	The Ashmolean Museum, The Cyprus Institute - STARC	The Cyprus Institute - STARC	EN	Cyprus	750 BC	480 BC	Cypro-Archaic	08/01/2015	Cyprus	Fragment of a terracotta statue (480.1891.)	Fragment of a terracotta statue	Salamis	Europe,Cyprus,Famagusta District,Salamis	35.1833	33.9
http://public.cyi.ac.cy/starcRepo/details/show/464abd7d3d646db951e0860d33991a76	Collection of Digital Resources of Salamis Terracotta Fragments, Cyprus	The Ashmolean Museum, The Cyprus Institute - STARC	The Cyprus Institute - STARC	EN	Cyprus	750 BC	480 BC	Cypro-Archaic	08/01/2015	Cyprus	Fragment of a terracotta statue (481.1891.)	Decorated fragment of a terracotta statue	Salamis	Europe,Cyprus,Famagusta District,Salamis	35.1833	33.9
http://public.cyi.ac.cy/starcRepo/details/show/535cf5dd9f8d2a09c6ac37f6a55586f3	Collection of Digital Resources of Salamis Terracotta Fragments, Cyprus	The Ashmolean Museum, The Cyprus Institute - STARC	The Cyprus Institute - STARC	EN	Cyprus	750 BC	480 BC	Cypro-Archaic	08/01/2015	Cyprus	Fragment of a terracotta statue (551.1926.)	Head of a terracotta statue	Salamis	Europe,Cyprus,Famagusta District,Salamis	35.1833	33.9
Sorin notified																
http://public.cyi.ac.cy/starcRepo/details/show/0e89762f9e723082f5f98bafd11c1e47	Collection of Digital Resources of Salamis Terracotta Fragments, Cyprus	The Ashmolean Museum, The Cyprus Institute - STARC	The Cyprus Institute - STARC	EN	Cyprus	750 BC	480 BC	Cypro-Archaic	08/01/2015	Cyprus	Torso of a terracotta statue (C.601)	Upper part of the torso of a terracotta statue	Salamis	Europe,Cyprus,Famagusta District,Salamis	35.1833	33.9
http://public.cyi.ac.cy/starcRepo/details/show/97c3af5ae79cfe95a05fbf818223faae	Collection of Digital Resources of Salamis Terracotta Fragments, Cyprus	The Ashmolean Museum, The Cyprus Institute - STARC	The Cyprus Institute - STARC	EN	Cyprus	750 BC	480 BC	Cypro-Archaic	08/01/2015	Cyprus	Fragment of a terracotta statue (C.603)	Lower part of the torso of a terracotta statue	Salamis	Europe,Cyprus,Famagusta District,Salamis	35.1833	33.9

Appendix I. Links to Cyprus Museum's objects in STARC Repository

http://public.cyi.ac.cy/starcRepo/details/show/2dbf63ad93dfe120c8f37c53c9086254
http://public.cyi.ac.cy/starcRepo/details/show/d9622260729e5ba00e255aef7b815aa3
http://public.cyi.ac.cy/starcRepo/details/show/8cfd7f2078a49c82151b5968450cad51
http://public.cyi.ac.cy/starcRepo/details/show/161f90fb7524911d8dca285b4f740e11
http://public.cyi.ac.cy/starcRepo/details/show/dbcbfa459ea0541d34dac7708be44ff1
http://public.cyi.ac.cy/starcRepo/details/show/9e804bbeee7c73a997be079d115c3cd7
http://public.cyi.ac.cy/starcRepo/details/show/b36b720f2a365ff2251131eca542cadf
http://public.cyi.ac.cy/starcRepo/details/show/f22eb4ce9c99fa9b399fe0ff01b6d886
http://public.cyi.ac.cy/starcRepo/details/show/e9047eb2062958bfbecf4dc6371eae61
http://public.cyi.ac.cy/starcRepo/details/show/6f0affee0fd0f3f74bca372902c5dc71
http://public.cyi.ac.cy/starcRepo/details/show/9da743a31850245a87996928d80d67b8
http://public.cyi.ac.cy/starcRepo/details/show/cf4eb708d4749b6dfbba729dd8822135
http://public.cyi.ac.cy/starcRepo/details/show/71fa03dc33bec6edd6f5a468d268538e
http://public.cyi.ac.cy/starcRepo/details/show/bdb9926e3888cfffc167e63c1933bb6c
http://public.cyi.ac.cy/starcRepo/details/show/d0c2ed15f0fa553d77c51dc755ce4e8f
http://public.cyi.ac.cy/starcRepo/details/show/4b3a0dd0363c0d9f4ba9e8a904660d7f
http://public.cyi.ac.cy/starcRepo/details/show/880d61d9c4cd894f6e2e9297ed65f2b2
http://public.cyi.ac.cy/starcRepo/details/show/e61dcf45be06ceb5a2ce4454d56df65e

Appendix J. Cyprus Museum 3D images summary

Scan directory	PLY (AI) size / bytes	Has Im PLY	SCN size / bytes
C 111 1935	39,284,168	y	1,357,122,001
C 113 1935	23,807,684	y	1,312,903,028
C 114 1935	28,984,671	y	1,096,312,193
C 115 1935	36,541,305	y	1,164,091,118
C 2405	29,786,780	y	1,081,211,250
C 2412	44,294,545	y	579,246,608
C 2599	78,371,674	y	1,131,990,989
C 2600	23,155,682	y	571,665,208
C_1070	50,818,354	y	1,118,374,044
C_2167	12,761,425	y	1,094,319,979
C_2224	47,473,078	y	564,077,077
C_2235	19,253,120	y	1,443,051,258
C_2246	63,965,315	y	1,164,091,118
C_2255	58,084,966	y	585,153,761
C_2267	31,343,761	y	1,793,175,388
C_2378	18,473,912	y	1,128,047,207
C_2404	49,767,096	y	579,246,608
C_2434	19,621,693	y	1,096,312,193
D_292	21,010,832	y	538,057,790

Appendix K. Cyprus Museum Bibliography

Inv. Nr.	Other Inv. Nr.	Description of object	Bibliography
C 111 1935	C 111 1935	All the large statues apparently were painted. The features reproduce in the main those of the example described. There are, however, two main differences in the heads (cf. Figs. 7, 8). The first is in the treatment of the hair and beard. The hair is sometimes stamped with circular, sometimes with horse-sloe marks ; occasionally it is rendered by sweeping incised lines, as though combed. The back hair is now divided in tiers, now in a single ridge. In one or two instances there seems to have been a bristly wave or roll of hair over the forehead. The beards are long or short and close, full and broad or comparatively narrow, stepped in tiers or plain. The vertical ribs are now close and fine, now broad and large, and the ends may or may not be curled (Tubbs and Munro 1891, 149, FIG. 8)	Tubbs, H.A., and Munro, J.A.R., 1891, "Excavation in Cyprus, 1890" *JHS* XII, 59-198.
		Dans le rapport publié immédiatement après les fouilles, Tubbs et Munro mentionnent “an extraordinary number of fragments” de personnages barbus tenant une fleur, dont la taille varie de la statuette au colosse d’environ 15 pieds, soit près de 4, 60 ! De ces grandes statues modelées en pièces détachées seuls sont connus quelques fragments de têtes, de pieds, de mains, de cuirasses peintes ; les coroplathes ont rendu la coiffure et les traits du visage avec une extrême minutie à l’aide de fines incisions et de rehauts de couleurs, des mèches de cheveux sont parfois rapportées : je reproduis ici une tête d’Oxford (pl. XXXIX, a) et un fragment de visage du Cyprus Museum (pl. XXXIX, b) (Hermary 1991, 143).	Hermary, A., 1991, "Les débuts de la grande plastique chypriote en terre cuite" in F. Vandenabeele and R. Laffineur (eds.) *Cypriote Terracottas. Proceedings of the First International Conference of Cypriot Studies, Brussels-Liège-Amsterdam, 29 May-1 June, 1989*. Brussels and Liège: 139-47.
		Fragmentary head from *Toumba*, Cyprus Museum, Inv. no. C111. (Tubbs and Munro 1891, 149, fig. 8; Hermary 1991, pl. XXXIX:b). Preserved height: 13,2 cm. The beard is very similar to that of Cat. no. 75. Black paint on ridged eyelids and irises, moustache and beard. Painted triangle below	Karageorghis, V., 1993, *The Coroplastic Art of Ancient Cyprus III. The Cypro-Archaic Period Large and Medium Size Sculpture*. Nicosia: A. G. Leventis Foundation.

Inv. Nr.	Other Inv. Nr.	Description of object	Bibliography
		lower lip. Well-defined nostrils (Karageorghis 1993, 32, Cat. no. 76).	
C 113 1935	C 113 1935	Unprovenanced head in the Cyprus Museum may come from Salamis-Toumba. Cyprus Museum, Inv. no. C113. Preserved height: 9,8 cm. This head is similar to head with Inv. no. C115 and they may have been made in the same mould. The paint is well preserved on the hair, 'feathered' eyebrows, eyelids, irises and lips. The hair forms a wavy line across the forehead, the extra clay below the outer edge of the impressed spirals having been trimmed away. Double ear-ring on the right ear-lobe (Karageorghis 1993, 50, Cat. no. 146).	Karageorghis, V., 1993, *The Coroplastic Art of Ancient Cyprus III. The Cypro-Archaic Period Large and Medium Size Sculpture*. Nicosia: A. G. Leventis Foundation.
C 114 1935	C 114 1935	Unprovenanced head in the Cyprus Museum may come from Salamis-Toumba. Cyprus Museum, Inv. no. C114. Preserved height: 9,8 cm. Earrings preserved on both earlobes, and short grooves incised on the lower edge of the hair border. This head is smaller and differs slightly from the heads with Inv. no. C113 and C115 in the treatment of the hair and eyes (Karageorghis 1993, 50, Cat. no. 147).	Karageorghis, V., 1993, *The Coroplastic Art of Ancient Cyprus III. The Cypro-Archaic Period Large and Medium Size Sculpture*. Nicosia: A. G. Leventis Foundation.
C 115 1935	C 115 1935	Unprovenanced head in the Cyprus Museum may come from Salamis-Toumba. Cyprus Museum, Inv. no. C115. Preserved height: 13,2 cm. This head is similar to head with Inv. no. C113 and may have been made in the same mould. The paint is well preserved on the hair, 'feathered' eyebrows, eyelids, irises and lips. The hair forms a plain straight border on the forehead (Karageorghis 1993, 50, Cat. no. 148).	Karageorghis, V., 1993, *The Coroplastic Art of Ancient Cyprus III. The Cypro-Archaic Period Large and Medium Size Sculpture*. Nicosia: A. G. Leventis Foundation.
C 2405	C 2405	Not published	
C 2412	C 2412	Not published	
C 2599	C 2599	Not published	
C 2600	C 2600	Not published	
C.1070	C_1070	Fragmentary head of unknown provenance, Cyprus Museum, Inv. no. C1070. Preserved height: 14,2 cm. Ridged eyebrows, ridged eyelids, black paint on irises. Prominent rounded chin (Karageorghis 1993, 51, Cat. no. 157).	Karageorghis, V., 1993, *The Coroplastic Art of Ancient Cyprus III. The Cypro-Archaic Period Large and Medium Size Sculpture*. Nicosia: A. G. Leventis Foundation.

Inv. Nr.	Other Inv. Nr.	Description of object	Bibliography
C.2167	C_2167	Not published	
C.2224	C_2224	Not published	
C.2235	C_2235	Not published	
C.2246	C_2246	Not published	
C.2255	C_2255	Not published	
C.2267	C_2267	Not published	
C.2378	C_2378	Not published	
C.2404	C_2404	Not published	
C.2434	C_2434	Not published	
D.292	D_292	Unprovenanced head in the Cyprus Museum may come from Salamis-Toumba. Cyprus Museum, Inv. no. D292. Preserved height: 9,3 cm (Karageorghis 1993, 50, Cat. no. 149).	Karageorghis, V., 1993, *The Coroplastic Art of Ancient Cyprus III. The Cypro-Archaic Period Large and Medium Size Sculpture*. Nicosia: A. G. Leventis Foundation.
		Not Available	Karageorghis 1970m pl. XL VII:608. Excavations in the necropolis of Salamis II

