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UNIVERSITETET I OSLO
FORNMINNESEKSJONEN
Postboks 6762,
St. Olavs Plass
0130 Oslo

RAPPORT

ARKEOLOGISK UTGRAVNING

Preliminary investigations of a burial mound

Rom Mellem, 113/6
Tønsberg, Vestfold

FELTLEDER: Jessica Leigh McGraw
PROSJEKTLEDER: Jan Bill

Oslo 2014

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Gårds-/ bruksnavn Rom Mellem	G.nr./ b.nr. 113/6
Kommune Tønsberg	Fylke Vestfold
Saksnavn «Prosjektbeskrivelse for forskningsundersøkelse av gravhaug Rom Vestre 113/106, lokalitet ID 140556, Tønsberg kommune, Vestfold.»	Kulturminnetype Overpløyd gravhaug
Saksnummer (MCH) 2013/8460	Prosjektkode 430289
Grunneier, adresse	Tiltakshaver
Tidsrom for utgravning 12.08 – 27.08.2013	M 711-kart/UTM-koordinater/ Kartdatum EU-89-UTM sone 32 N: 240607,5 Ø: 6584820,7
ØK-kart -	ØK-koordinater -
A-nr. 2013/269	C.nr. 59155
ID nr. (Askeladden) ID140556	Negativnr. (MCH) Cf34745
Rapport ved: Jessica Leigh McGraw	Dato: 11.03.2015
Saksbehandler: Jan Bill	Prosjektleder: Jan Bill

Summary

Between 12.08 – 27.08.2013, a grave mound at Rom Mellem was partially excavated by the means of test trenching in order to investigate its nature and character as a possible ship burial. The results of the test trenching repudiated this, in addition to confirming that the central burial had been heavily subjected to disturbance due to the later construction of a potato cellar. The potato cellar was bordered by a stone wall alignment of which undisturbed parts could belong to a central burial chamber. However, this investigation did not allow further excavations beyond the limited trench, which would have been necessary to clarify the relationship of the potato cellar and the possible intact remains of a central burial chamber.

Intact contextual phases of the burial mound were identified, such as a substantial stone layer overlying two possible cremation patches, in addition to a relict intermixed plough soil with iron concretion and a layer with ard-marks. Also, a sizable circular ring ditch containing a charcoal layer, suggest a secondary burning activity associated with the burial.

C14-analysis of the possible cremation patch in the N profile of the trench extension, have supplied a date range between 180-190 AD, 250-340 calAD (1770±30 uCal), which places the activity to the Roman Period. This is additionally confirmed by another C14-analysis of the charcoal layer in the ring ditch, which places the burning activity to 80-

240 calAD (1850±30 uCal). This was further supported by finds of coarse-grained pottery in the layer. In sum, C14-results place the mound to belong to the Roman period.

1 Contents

Preliminary results from an archaeological investigation at

ROM MELLEM, 113/106, TØNSBERG K., VESTFOLD

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2 BACKGROUND AND INITIATIVE OF THE INVESTIGATION

The investigation of the burial mound is an initiative of and a subproject concerning relevant issues of the research project «Gokstad Revitalized» (GOREV), which is managed by Professor Jan Bill at the Museum of Cultural History (hereafter MCH) and is a part of the University of Oslo. GOREV aims to utilize the untapped research-potential of the Gokstad ship burial, by exploring the landscape setting of the grave, including the possibility of undiscovered ship burials in the surrounding landscape. The main objective of GOREV is to highlight various power structures and the political development of social landscape during the Viking Age.

This subproject is purposive developed with the intention of exploring the possibilities of unknown ship burials or if these burials are in fact as rare as suggested by the archaeological material of today. An important key issue is to investigate prospected burial mounds, which are unexcavated and fulfill certain criteria of having characteristic in topography, geology and construction. As such, ID140556 has the necessary and relevant data in being a possible ship burial.

The initiative was graciously funded by the Executive Owner of Fram Shipping LDT., Per Arneberg, and made possible through the collaboration with the Department of Heritage at Vestfold Municipal County (hereafter VFK), Vienna Institute of Archaeological Science at the University of Vienna and the Ludwig Boltzmann Institute of Archaeological Prospection and Virtual Archaeology in Vienna (LBI).

It must be stressed that the current investigation is only a preliminary examination and the results from the test trenching of 2013 will act as an advisory rapport as to which action to take in regards to the preservation and cultural management of the burial mound at Rom Mellem[1].

[1] The location of the burial mound has previously been referred to as Rom Vestre 113/106 and Rom Vestre Søndre. However, the correct farmunit of which the mound belongs to is Rom Mellem 113/6. (http://www.seeiendom.no). The correct information has been updated in Askeladden (National Heritage Database).

2.1 PRIOR INVESTIGATIONS

The burial mound (ID140556) was initially observed in an aerial photo in 1990 and repeatedly in the years of 1993-1995. Then, the burial mound protruded from the surrounding agricultural landscape in the shape of a circular crop-mark with reduced growth, enclosed by an exterior circular crop-mark of condensed growth. The circumference of the crop-mark area measured approximately 40 m.

The MCH and VFK undertook an archaeological survey of the area in 2001. The survey revealed a nucleated zone of large, sharply-edged stones directly beneath the turf horizon. The natural conditions of the surrounding soil are silty-sand/silty light clay. A 12x1 m N-S oriented testing trench was placed in the NØ part of the burial mound. The trench revealed a dense compacted core of stones in addition to the faint trace of an exterior ditch. The preliminary results confirmed that the area contained the remnants of an eroded and partly destroyed burial mound, due to the extensive cultivation in the area.

In 2003, under assignment from MCH, the AAGL Germany/Universität Kiel (Allied Associates Geophysical Ltd.) performed a geophysical prospection of the area, by the use of magnetometry and geophysical prospection. The results indicated magnetic anomalies in the subsurface in an area of 15m in diameter, which represented the nucleated core of the burial mound, running up to 30 m in diameter including the exterior ring ditch of the barrow. The geophysical survey also picked up a magnetic anomaly in the center of the mound, which appeared as an elongated oval shape in the prospection data. The interpretation of the data suggested that the mound could contain the remnants of a boat/ship and thus be a so-called ship burial. The prospection data also demonstrated that the burial mound had been exposed to recent disturbance, suggested by a possible robber-pit in the central area of the mound.

In 2004, through collaborative work by MCH and VFK, soil core samples were taken in the N, NW and S in the mound. The cores did not reveal any organic material in the form of residual wood, but the samples demonstrated that the subsoil consisted of marine clay. This type of soil retains a stable level of moisture and density, which discourages oxidation and contains good characteristics for the preservation of organic material. A fragment of Iron Age pottery was found in the topsoil-level in one of the cores.

In 2009 and 2012, extensive geophysical investigations were carried out in the area. The area was surveyed by aerial LIDAR (Light Detection and Ranging) scanning in 2009. Results suggested that the burial mound had a circumference of 40 meters in diameter. Collaborative work by the LBI, NIKU and VFK in 2012 resulted in a more intensive and detailed geophysical prospection of the burial mound and its immediate surroundings. High-resolution scans indicated that the SW part of the burial mound was damaged and partly removed, in addition to the existence of a more extensive and intrusive modern drainage system than previously thought. The data indicated that the exterior circumference of the burial mound was approximately 36 m.

2.2 The aim of the current investigation

The purpose of this initiative is to determine the character of the burial mound, in addition to collect datable material for assessing the age of its construction. Today, Vestfold Municipal County provides compensation to the landowner to uphold cultivation restrictions of the immediate area surrounding the burial mound, which is not a satisfactory permanent solution for either of the parties involved.

In addition to determining a strategic protection plan of the monument, the current survey and excavation was carried out with the intent of developing and exploring new methodological approaches to excavating large monuments, such as burial mounds.

Through conjoined efforts of exploring intrusive and non-intrusive archaeological methods, the preliminary excavation determined the character of the burial mound and its phases of construction and disturbances.

The current excavation was conducted as a partial investigation of the subsurface in a testing trench placed in a strategic location of the burial mound. The National Heritage Directorate granted the permission of the investigation of an area up towards 60 m^2 of the burial mound, which allows the objectives of the initiative to be fulfilled (cf. Bill 2013).

3 Participants, timeframe of work conducted

Name	Position	Period	No. of days
Jan Bill	Project Manager		1
Jessica Leigh McGraw	Field Supervisor	12.08-27.08	12
Petra Sneidhofer	Consultant, LBI	13.08-23.08	9
Magnar Mojaren Gran	Field Assistant	12.08-23.08	12
Julie Øhre Askjem	Vestfold Municipal County	12.08-27.08	12
Christer Tonning	Vestfold Municipal County	12.08-27.08	10
Terje Gansum	Vestfold Municipal County	13.08-26.08	10
Lars Gustavsen	NIKU	26.08-28.08	2
Jan Fredrik Pettersen	Operator, Mechanical Excavator, Fredrik Pettersen	12.08-27.08	12
Mikael A. Bjerkestrand	Vestfold Municipal County	20.08-21.08	1
In total			81

4 Public Engagement and Visitors

The initiative received substantial media coverage, through the local newspaper Tønsberg Blad, publicity on the Internet and tv-broadcasts by local NRK-crew of Tønsberg, under the following headlines:

http://www.nrk.no/vestfold/ligger-det-et-skip-under-steinene_-1.11179490

http://www.nrk.no/vestfold/fant-gull-i-gravhaug-1.11186588 http://www.tb.no/kultur/dette-er-en-del-av-gamet-1.8039889

http://www.vfk.no/Aktuelt/Arkiv-2013/Apner-gravhaug/

http://www.vfk.no/Aktuelt/Arkiv-2013/Gullfunn-pa-Rom/

5 SURROUNDING ARCHAEOLOGICAL LANDSCAPE

The burial mound at Rom Mellem is located approximately 150 meters S of the main building at the farmstead. It is also situated c. 1700 meters N of the Oseberg ship burial (ID61845), which is located within the same valley. The burial mound is situated on the western side of and close to the river Slagenbekken, which runs through the valley, past the Oseberg mound, which is to be found on its eastern side.

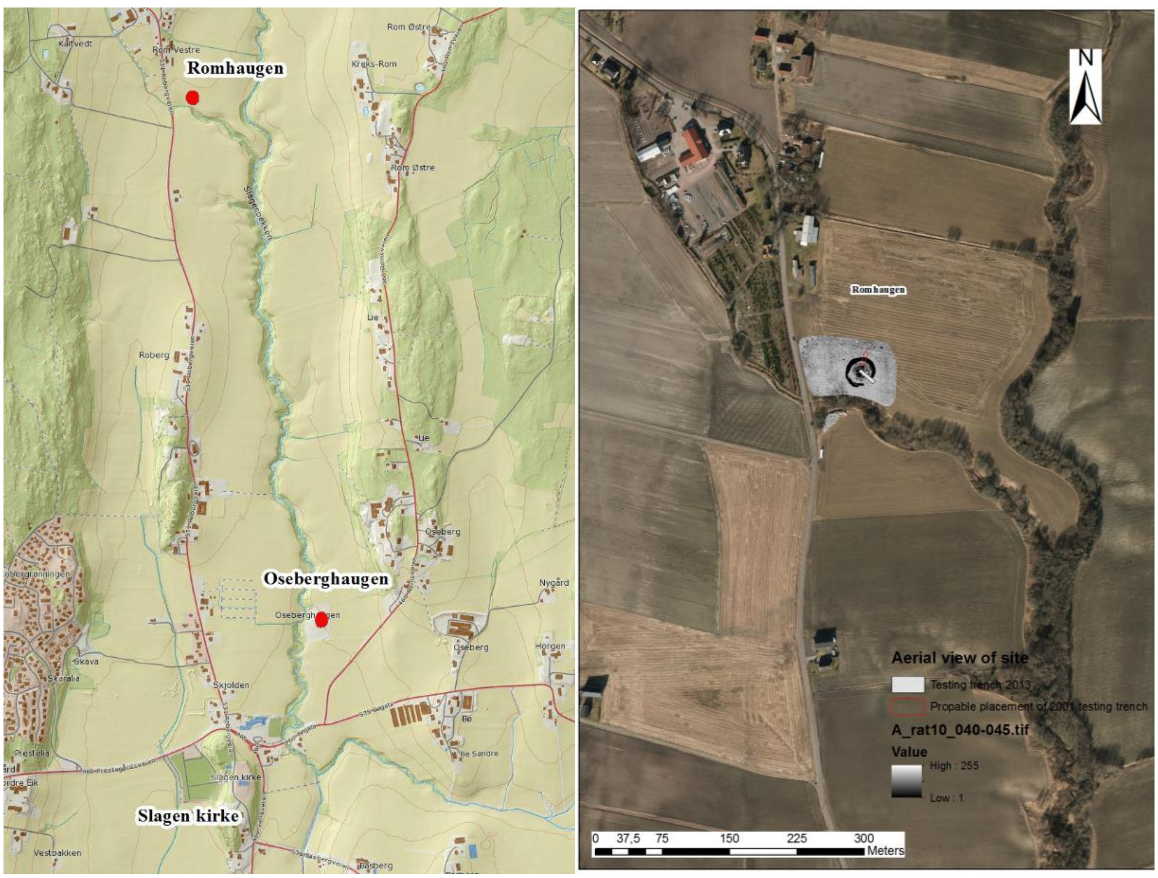

Fig. 1: *Extracts of map (t.l) showing the location of the Rom mound in relation to the Oseberg ship burial. Aerial view (t.r.) of the Rom mound, superimposed with a depth-slice (40-45 cm) of the prospection data, its location in the surrounding landscape and the placement of the testing trenches of 2001 and 2013.*

Several important and relevant archaeological sites dominate the landscape of Slagen. At Kaltvet (ID76844), directly 433 m to the SW, there is one certain burial mound and multiple possible ones. The burial mound at Kaltvet was excavated in 1914, but there is no record of any findings.

An additional large burial site is situated at Rom Søndre (ID61689), located 710 m SE of the burial mound at Rom Mellem. This burial site consists of 26 small burial mounds, where ten of the burial mounds contain traces of robber-pits, suggested by depressions in the center of each one of them. Another small burial mound can be found 848 m to the south, at Rom Østre (ID22248). This burial mound also contains a central depression, which could indicate that the mound has been subjected to robbery.

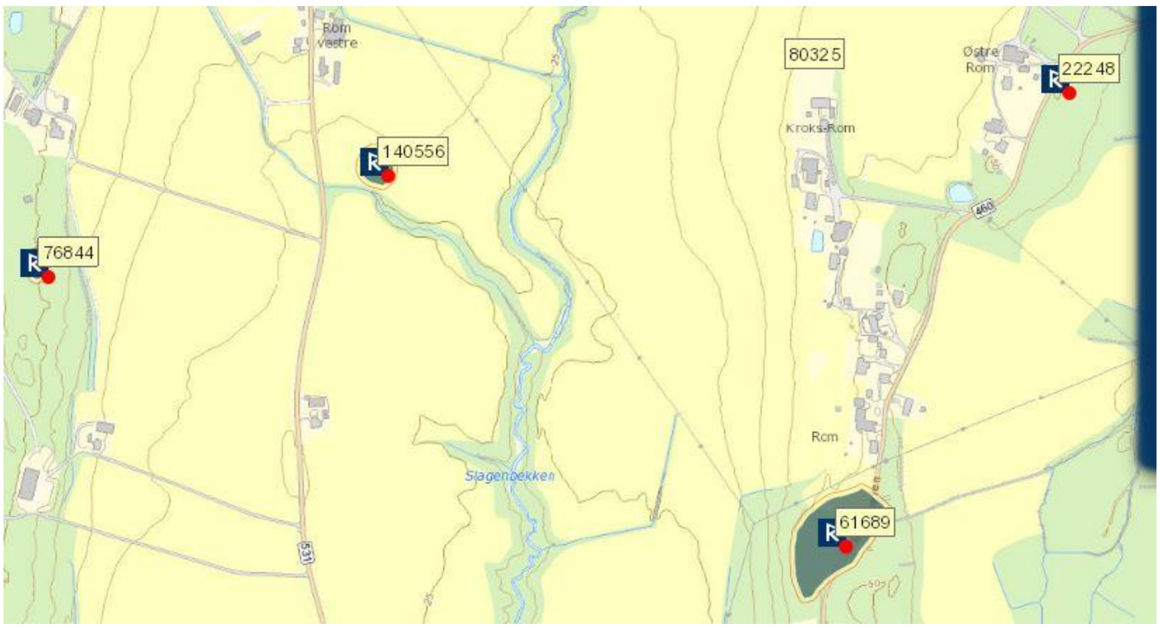

Fig. 2: *Extract of map illustrating the immediate burial sites in relation to the burial mound id140556. Source: https://askeladden.ra.no/askeladden/*

In sum, the surrounding landscape of the burial mound at Rom Mellem suggests the presence of a nucleated area of various burial sites, with the famous Oseberg ship burial as the most prominently known of in its archaeological landscape.

6 PRACTICAL IMPLEMENTATION OF THE PROJECT

6.1 RELEVANT ISSUES – PRIORITIES

The primary objective of the excavation was to find out if the burial mound of Rom Mellem was indeed a ship burial. According to the geophysical prospection, the data suggested an elongated oval anomaly situated in the middle of the mound. The anomaly was observed most prominently at a depth-slice of 40-45 cm below the surface of the topsoil. The GPR data indicated a disturbance of the burial mound. This disturbance initially was interpreted as a robber pit and can be seen on depth slice 40-50cm below surface, where a seemingly denser, triangular area consisting of very strong reflections is visible from the south-western part towards the center of the burial mound (fig…). As such, in addition to the main objective, it was also relevant to investigate the nature of the disturbance as well as understand and record its relation to the remaining intact mound.

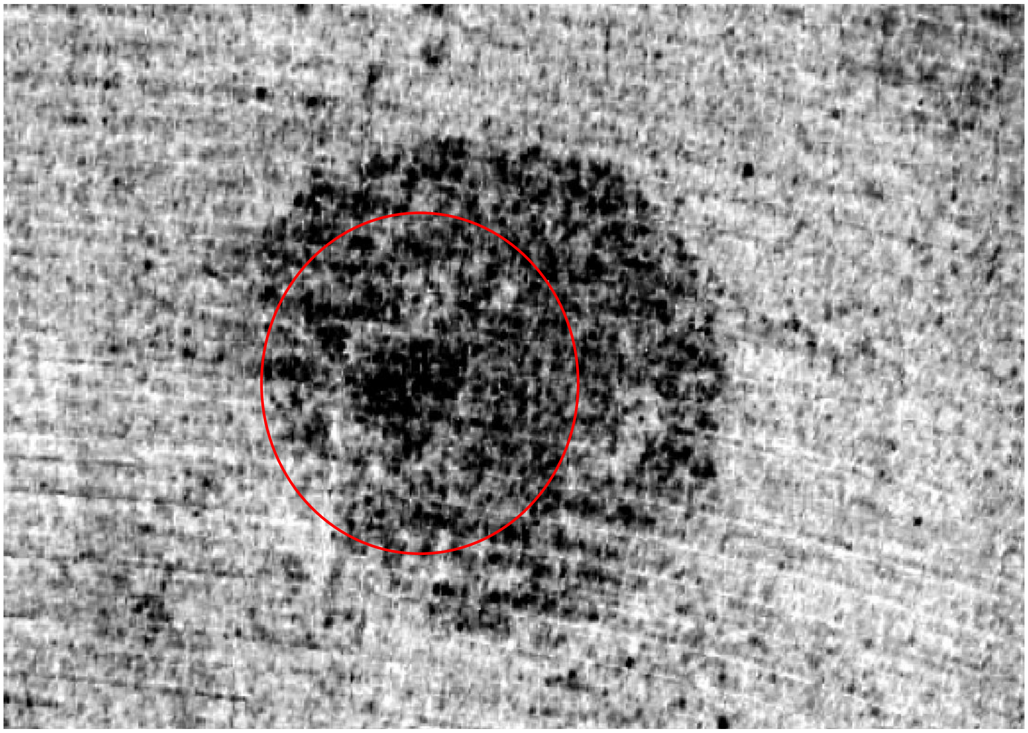

Fig. 3: *GPR data at a depth slice of 40-45 cm below topsoil surface. Dark areas indicate strong reflections and white areas stand for absorption of the electromagnetic wave, while it is travelling through the subsurface. The red circle highlights a triangular-shaped strongly reflecting area, which was interpreted as a possible ship-burial.*

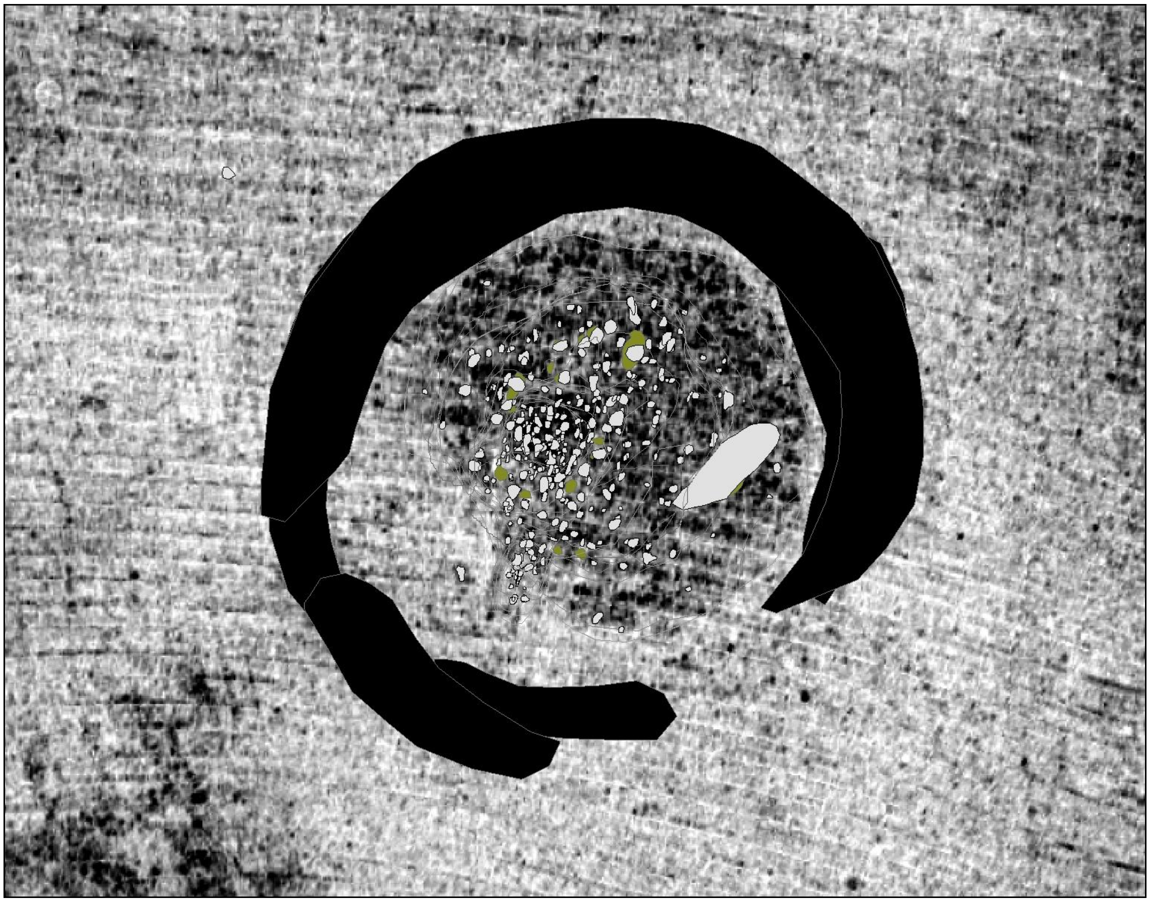

Fig. 4: *GPR data superimposed with the interpretations by LBI.*

Today, the burial mound is visually protruding as a slight elevation from the surrounding terrain. From the flat surface of the topsoil to the south, the elevation measures approximately 1 m in height. To the north, the terrain has a gradual inclination towards a riverbed. The visibility of the remnants of the burial mound was better when facing north, as the gradual inclination enhanced the geometry of the elevated surface.

As previously mentioned, the mound and its surrounding area had been subjected to extensive cultivation prior to 2001, which consequently had resulted in the periodical removal of a large number of stones belonging to the mound. The stones had been secondary deposited at a sharp inclination of an old riverbed 162 meters further east.

Fig. 5: *Cf34745_158.JPG. Photo of the stones removed from continuously ploughing. Facing E.*

The slope contained a large number of stones. The exact number and weight of these was difficult to assess for mass-calculations, as the steepness of the incline was regarded as to unsafe for inspection.

By consulting the results from the trench of 2001, in addition to assessing the GPR data and the interpretation of possible archaeological and topographic features in the subsoil, a strategic area for placing the test trench was chosen. The trench was placed as to include a section of the supposed robber pit and the elongated oval-shaped anomaly. The length of the trench was 25 meters and included the boundary of the circular ring ditch.

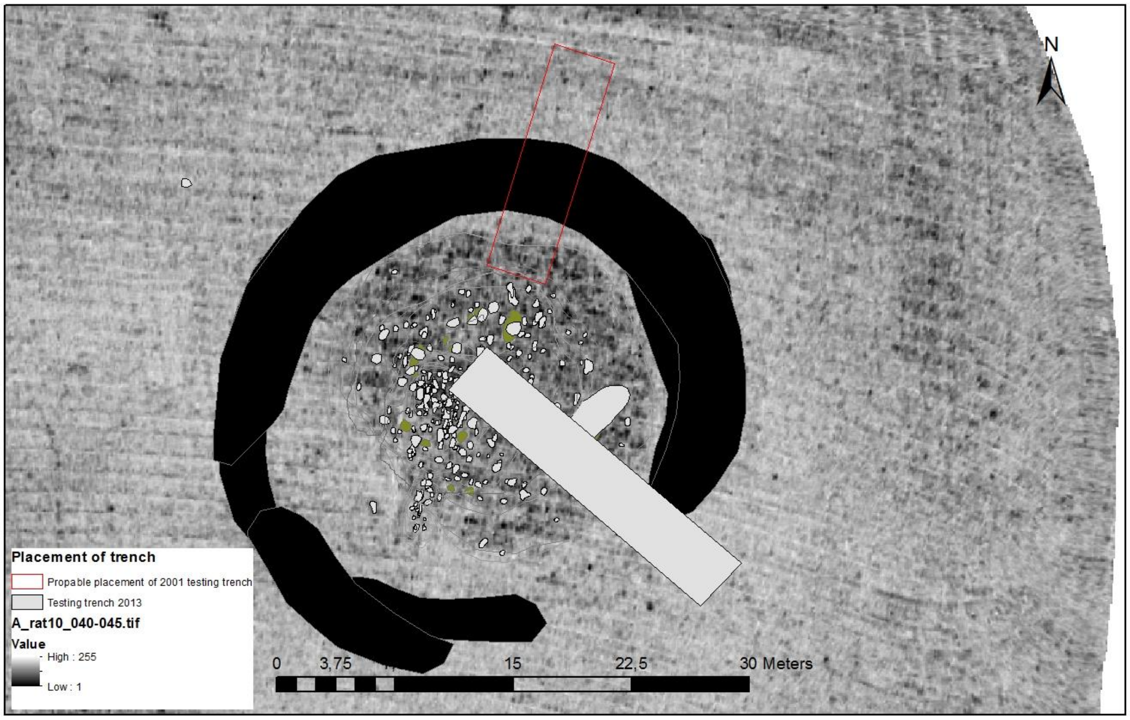

Fig 6: *Map showing the proposed location of the trench in relation to the GPR data and the trench from 2001outlined in red.*

6.2 INVESTIGATIVE METHODS

The excavation was conducted single-context recording in accord with according to stratigraphic principals (Harris: 1979). All archaeological units, such as interfaces and deposits, were excavated in relation to their correct stratigraphic sequence. The result of the recording is presented in a matrix in Ch. 7.

The excavation was photo-documented with a digital SLR camera, NIKON D60, and photos are stored in the digital photo-archive at MCH, under the assigned negative-number Cf.34745. Finds and scientific samples have been stored digitally under C59155/1-… in the Object Database at MCH.

A 15-tonn excavator with a tilt-rotator, claw and grading bucket was used during the excavation.

Additionally, all archaeological surfaces were scanned by using a RIEGL LMS VZ- 400 terrestrial laser scanner. The resulting 3D point clouds were stored at the LBI for further data processing[2].

For topographic surveying and GIS-recording, a Trimble R6 RTK GPS with a CPOS subscription was used. The recorded units were then transferred and imported into the

[2] The surveyed GIS data and the scanned units do not have an exact correlation. There is an offset in data appr. 0,5 SE.

documentation system Intrasis (Explorer 2.1/Analysis 1.2) for subsequent processing and analysis. ESRI ArcMap 10 was used for further data processing, analysis and publication to meet the standards required. The data-stream from GPS to Intrasis software occurs when the measured points are stored as Trimble RAW files on the controller, version Trimble TSC3. During the transfer of data, they are converted to an Intrasis RAW format before being exported into the respective Intrasis project database on the PC.

The export takes place via cable from the controller to the PC. Further processing and analysis of the Intrasis data is conducted by using ESRI ArcMap 10. The map data is placed according to an actual coordinate system UTM/WGS84 zone 32N, and stored in an ESRI geodatabase format for delivery and storage at the Documentation Unit (DigDok) at MCH. In addition, the respective Intrasis project is delivered to the same authority for storage and potential re-distribution.

6.3 Excavation – progress and procedures

A NW-SE oriented test trench was placed in the SE area of the burial mound. The trench measured 25 x 3 meters. Additionally, a small extension was placed to the N and E of the main trench, which measured c. 4 x 2 meters.The trench was situated to include a section of the elongated anomaly and the possible robber-pit, running to the exterior ring ditch.

All units were excavated stratigraphically in the reversed order of their deposition. The greatest dimension of every unit – the boundary polygon – was recorded using a total station, while top and bottom surface was documented with a 3D Laserscanner. The resulting three-dimensional volumes of every unit will enable a virtual reconstruction of the entire excavated – and thereby destroyed – investigation area. In order to give a more realistic appearance, all units will be textured using georeferenced photographs taken from every unit's top surface.

Large boulders were removed by the excavator with a claw and each layer with a grading bucket. All the profiles were cleaned and documented, either by scanning or photography. A selection of these were drawn technically and digitalized. These are included in the appendix (Ch. 11.9).

7 Results of preliminary investigations

7.1 Contexts and Units

Three main archaeological contexts were observed during the excavation of the trench. These are the recent disturbance, original burial mound and the ring ditch. Several units were identified belonging to these contexts. These are presented in a table in the appendix (Ch. 12.1)

7.1.1 Burial mound

Upon initial removal of the topsoil, a dense and very compact stone layer was exposed.

This layer was disturbed in the western part of the trench and thus confirmed the prospection data as being a possible robber-pit. This area was characterized by loose soil intermixed with angular stones. It thus contrasted with the very dense stone-layer. Surface cleaning of this area also produced small pieces of modern tile and iron nails, which confirmed that the area was disturbed fairly recently. The supposed area of disturbance was easily visible, yet the extent of it was greater than anticipated.

Fig. 7: *Cf34745_012.JPG (t.l). Stone-layer as seen facing east. Cf34745_49.JPG (t.r). Overview of the stone layer and the exterior ring ditch of the mound upon removal of topsoil. The enclosure is clearly visible in both photos.*

The stone layer seemed to be more compact between the disturbed area and the exterior stones. It is possible that this area represents the nucleated core of the mound.

Subsequently, following single-context procedures, the removal of the stone-layer revealed that only the first constructional phase of the mound was intact. The stones seemed to be uniform and consisted of larger, round-edged boulders in contrast to the smaller angular ones in the disturbed area. In addition, the soil surrounding the stone layer was very compressed and dense, making troweling and cleaning the surfaces more time-consuming.

Through further investigation, it became evident that the stones had sealed the initial surface upon which the burial mound had been constructed. In addition, it also sealed two areas of a patchy charcoal-layer, where one was exposed in the central area of the trench (AL939) and the other was observed in the N-profile of the N-E extension of the main trench. The latter was closer to the central core of the burial mound.

Fig. 8: *Cf34745_087.JPG. Overview of patchy charcoal layer (AL939) to the right.*

However, documentation and removal of this charcoal patch did not reveal any finds such as burned bones or ceramics. It was characterized as patchy and inconsistent, but covered an area which ran across the width of the trench and measured approximately 3 meters at its widest point. The boundaries of AL939 narrowed quite sharply towards the N of the trench and its widest point was at the southern profile of the trench. It is therefore likely that the layer was not exposed in total and extends further south.

The additional charcoal patch had the same characteristics as AL939, was observed in the N profile of the extended trench. The additional charcoal-layer was only observed in the profile in this area and did not extend in towards the exposed surface of the trench. The trenching thus seemed to only have exposed the exterior boundary of the patchy charcoal layer in this area and it is likely that the layer has a further extension towards the north and east.

The similar charcoal patches had the same stratigraphical sequence, both being sealed by the stone packing. Also, the charcoal patches were situated directly on top of the iron panning layer, which represents the preserved surface of the old topsoil pre-dating the construction of the burial mound.

Fig 9: *Cf34745_222.JPG. Section of the NE profile of the trench. The same patchy charcoal layer is observed. Micromorphology sample (PX1667) is taken of the layers in the profile.*

This layer (A1052) was characterized by the presence of significant iron panning, visible on the surface upon the removal of stones, in addition to being observed in sections of the profile of the trench.

Interestingly, there were iron concretions surrounding the stones in the stone packing, both visible on the surface of AL1052 and through AL1059 to AL1235. Upon the removal of each stone, the iron concretion was seen as imprints after these in the layer. The occurrence of the iron pan is a result of natural conditions between the topsoil and drainage properties of the subsoil. The creation of such iron concretions is a slow process and is the result of a build-up of dissolved calcium carbonate and iron sulfide, which are soluable and deoxidized in water, then becomes oxidized when drained and precipitate into concretions (pers.com. Cannell & Sneidhofer). It occurs in areas where the build-up of water becomes trapped or the soil is temporarily saturated, and then drains or evaporates. Over time this results in a build-up of iron-rich concretion, which is present in this layer.

The geological circumstances indicate that the stones were in an original position of deposition and the concretion, which can be seen as the outline of the stones, has accumulated over some time.

Fig.10: *Cf34745_108.JPG (t.l). Photo of AL1052. Greyish cultivation layer with a high content of iron concretions. Cf34745_140.JPG. (t.r) after removal of AL1052. The iron panning is seen following the outline of the removed stones. Photo of AL1235, layer with ard marks suggest cultivation activity prior to the construction of the burial mound.*

According to the principals of single-context recording, the last phase of occurrences to the burial mound was the possible robber-pit located in the center of the mound. As previously mentioned, this was identified early and characterized as loosely compacted, having small angular stones and modern inclusions, such as pieces of roof tile and iron nails. The supposed area of the disturbance was therefore partly excavated prior to the remaining undisturbed area of the mound.

By using the N and W profiles of the main trench, the backfill of the disturbance was subsequently removed as the excavation progressed. When emptying the pit for disturbed material, it became clear that the modern disturbance was more intrusive to the stratigraphy of the mound than previously thought. The area of disturbance covered the entire width of the trench. The intrusive cut of the disturbance was visible in the S- and W profiles of the trench.

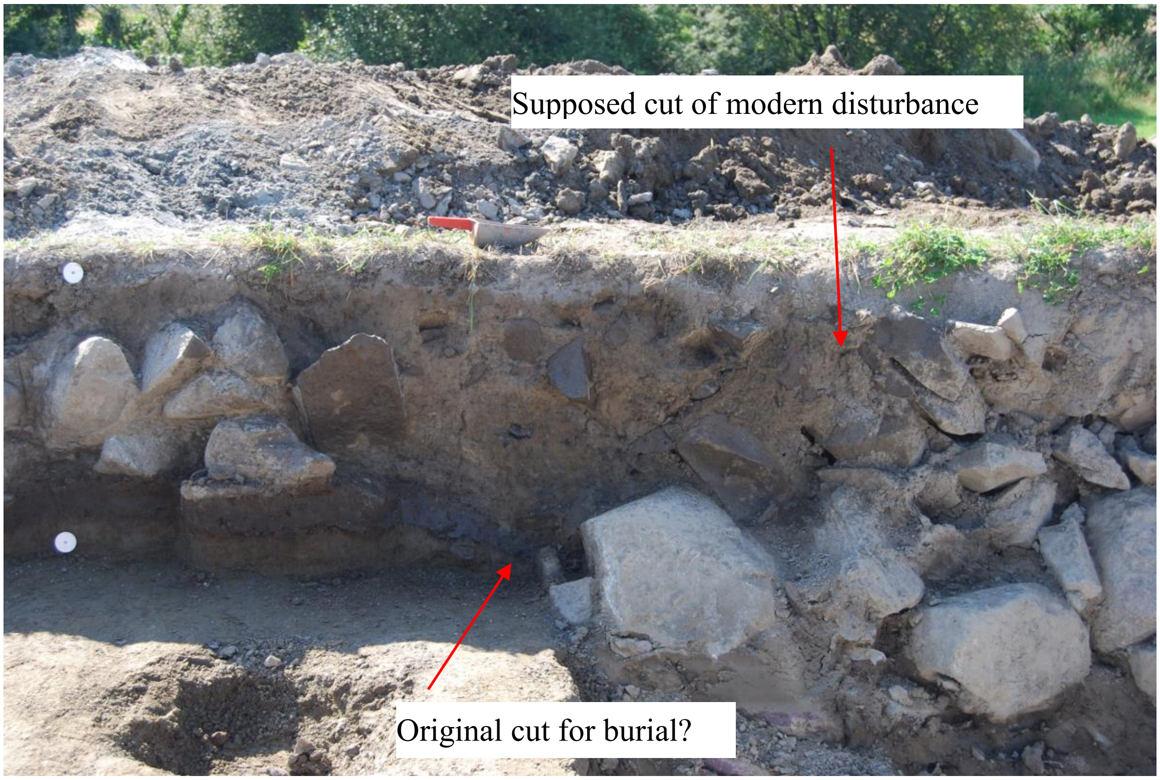

Fig. 11: *Cf34745_199.JPG. The photo shows that the original extent of the disturbance as a backfill of smaller angular stones seen to the right in the photo. The greyish iron panning layer (AL1052) has a slight inclination towards the large stone boulder. This may be a cut associated to a possible central burial chamber.*

7.1.2 THE DISTURBANCE

Following the removal of backfill debris, it was clear that the disturbance had a transverse cut, with an outwards angle. This meant that the area of the disturbance was of a larger circumference at a depth of c. 2 meters than it was at 1 meter.

Covering the bottom of the disturbance was a layer of flat transversely laid wooden planks. When removed, the wooden planks sealed a thin layer of debris, consisting of sandy silt, woodchips, roof-tiling fragments and iron-nails, followed by a layer of horizontally placed wooden beams.

It became evident that the center of the mound was disturbed by a wooden construction, which was thoroughly clarified by an elderly person visiting the site, who informed the investigative team that a potato-cellar had been dug into the burial mound during World War II. It seemed that the wooden beams and planks were situated quite firmly, possibly representing the wooden floor of the potato-cellar, which had collapsed and truncated, likely caused by structural instabilities.

Fig.12: *Cf34745_105.JPG. Backfill of the modern disturbance. Layer with wooden planks and debris of modern tiles seen to the right.*

Fig. 13: *Cf34745_115.JPG. Wooden beams fitted vertically in the bottom of potato-cellar.*

However, the wooden beams and planks seem to have been fitted *in situ* and wedged in between the aligned stone boulders. This is supported by the occurrence of a thin layer

(A1127) with woodchips and sandy debris between the horizontal wooden planks and the vertical wooden beams. The layer also contained pieces of modern roof-tiles.

Fig. 14: *Cf34745_126.JPG. Wooden beams found in the bottom of the potato-cellar.*

The beams were removed, in addition to further soil, to ensure that there was nothing preserved underneath the wooden flooring. Also, a metal-detecting search of the surface underneath the wooden beams did not reveal any signals and it became clear that the wooden layers flooring had been laid directly atop the sterile subsoil.

As the area of disturbance was larger than previously anticipated, the main trench was extended to the N and W of the disturbed area caused by the potato-cellar, to see if the N-S oriented stone wall extended further N. Also, the stratigraphy of the N-profile of the main trench suggested that the layers could be intact in this area, as they did not display any signs of disturbance and the extension of the backfill of the potato-cellar towards the N was fully exposed in the main trench.

To summarize, the excavation in this area of the trench established the E boundary of the disturbance caused by the potato-cellar. By excavating an N-W extension in the immediate area, it enabled an assessment of possible intact and undisturbed stratigraphy of the burial mound close to its central core. It also allowed an evaluation of the nature of the exposed stone wall and if parts of this could be original.

The extension measured 4 x 2 meters and covered an area of c. 6 m^2.

Fig. 15: *Cf34745_156.JPG. Overview of the extension of the trench.*

The excavation followed the same procedure and the area proposed the same stratigraphy as in the undisturbed area of the mound in the main trench. One of the main differences was that the damage caused by the modern cultivation, as several stones seemed to have been removed through ploughing, leaving empty indentations in the stone layer.

Upon the removal of the stone layer, the same layer of iron panning was observed, as well as a patchy charcoal area, as previously mentioned. One of the main aims of the extension was to figure out if and how much of the aligned stones could be original to a possible central burial.

On the photo above (fig..), the N-S oriented part of the aligned stones at the bottom of the potato-cellar, seemed to limit the eastern extent of the potato-cellar. Some of the angular stones located in the backfill of the disturbance in the main trench, was also to be found sporadically in the extension. This seemed, however, only to be superficial and the occurrence of the angular stones might have been subjected by ploughing activity.

The same layers were observed in the trench extension, following the stratigraphy of the main trench.

Fig. 16: *Cf34745_173.JPG. Overview of the faced stone wall alignment in the center of the burial mound at the conjoint stratigraphic surface of the extension and the main trench. Direction: S.*

After documentation of the stone wall, the stones were removed in order to evaluate the stratigraphy behind the boulders. The stratigraphy behind the N-S oriented part of the stone wall was intact and did not seem to have been disturbed. If disturbed, a backfill of intermixed topsoil should have been found around the large boulders and in the exterior cracks and crevices of the stones. This was not the case. The N-S aligned boulders seemed to originally belong to a burial chamber, as well as a small section of the E-W oriented part of the aligned stones.

This interpretation is further supported by the occurrence of the thin layer of woodchips and debris wedged in between the wooden planks and beams. The occurrence of this layer might suggest that the wooden planks and beams were fitted *in situ* to an already available space during the construction of the potato cellar. As such, it is possible that the N-S oriented part of the aligned stones belongs to an original burial chamber, which has been extended in the E-W oriented part.

Fig. 17: *Cf34745_173.JPG. The alignment of the supposed original sections of faced stone wall is shown in red. The proposed secondary modern extension is shown in yellow.*

Also, this part of the stone wall has a slight convex curve in the western part (highlighted in yellow in fig..). The direction of the faced stone wall does not coincide with the overall alignment of the faced stone wall in this area. This could support the interpretation of that this section of the faced stone wall alignment is a recent addition. The direction of the faced stone wall does not coincide with the overall alignment of the faced stone wall in this area.

However, the validity of this relation has to further investigated by exploring the southern boundary of the N-S oriented part of the faced stone wall alignment. This would also provide a better assessment of the supposed original cut for the burial chamber (see fig..). The relationship between the inclination of AL1052 and the faced stone wall alignment further south, could provide further information regarding this interpretation.

Fig. 18: *Cf34745_175.JPG. Photo of the eastern part of the profile in the extended trench upon removal of the E-W oriented part of the stone wall. The layer seems to have a slight inclination.*

In addition, upon the removal of the E-W oriented section of the stone-walling, another layer was observed. This layer also had a slight inclination towards the center of the potato-cellar, but it did not have the same characteristics as the iron panning layer. This layer could be original to the burial mound, but as this layer was located in the W-profile of the trench and situated as part of the disturbance caused by the construction of the potato-cellar, it is difficult to know whether the layer is original to the construction phase of the burial mound or if it is resulted by the construction of the potato-cellar.

The stratigraphy posed here was uncertain in context and the available space for test trenching had been exceeded, so the interpretation of the stratigraphy in this area cannot be clarified at this point. The correct stratigraphic sequence has to be clarified through further excavations. However, the mixture at the layer interfaces and the slightly washed out color suggest that the layer is not recent. Due to the amount of disturbance in this area, the context for scientific sampling of this layer was regarded as unsafe. The nature of this layer should therefore be clarified through further investigations.

7.1.3 Circular ring ditch

The ring ditch was characterized as a slightly darker area, which covered the entire width of the trench. The ditch was situated c. 3 meters east of the boundary of the stone layer within the trench. The backfill of the ditch was darker, somewhat charcoal-flecked and seemed to retain more moisture than the surrounding soil.

Fig. 19: *Cf34745_032.JPG. Overview of the circular ring ditch upon removal of topsoil. The boundary of the ditch is more clear in the S-part of the trench. The NW-corner of the ditch is subjected to some soil-erosion from the burial mound. Direction: S.*

Fig. 20: *Cf34745_047.JPG.Overview of the ring ditch facing W (t.l) and upon partial excavation. Direction: E (t.r) (Cf34745_100.JPG).*

During the excavation of the ditch, it became clear that the backfill was very compact. Also, the ditch proved to be deeper and more extensive than originally thought. The boundary of the ditch was not sharply visible, but seemed clearer in the exposed S-part in the trench and was sharper in the exterior boundary of the ditch.

The soil was dense and consisted of dark grey clayey and sandy-silt, with some inclusions of charcoal (AL1334). During the removal of AL1334, a small concentration of charcoal and fire-cracked stones (AL1324) was exposed in the NW corner of the ditch, which resulted in the discovery of a few pieces of pottery (C59199/4).

Upon attempts of the removal of this, it became clear that AL1324 expanded into AL1450, which was situated below AL1334. Thus, layer AL1324 turned out to be the topmost surface of AL1450, which was a charcoal layer underlying AL1334. The removal of the layer resulted in the discovery of several additional pieces of coarse-grained pottery (C59155/5).

Fig. 21: *Cf34745_170.JPG. Overview of layer A1450 in the ring ditch. Direction: E.*

By further excavation of AL1450, small pieces of burned and vitrified clay were found (C59155/8), as well as six crucible-fragments (C59155/7). The layer also contained sporadically deposited fire-cracked stones, as well as a concentration of such (A1565) located in the N-part of the ditch (seen to the right in Fig..).

The charcoal-layer was consistent in its appearance throughout the excavated part of the exposed ditch. The subsoil underneath the layer did not show signs of high-temperature in situ burning, but the charcoal layer did not seem to be intermixed with other soil. Thus, it is not likely that A1450 is secondary deposited in the ditch and must have been burned *in situ* at a low temperature, such as an open fire of a short interval.

It is highly likely that the charcoal layer is a result of burning activity associated with the main burial and construction of the mound. However, the occurrence of a small erosion-layer (AL1412) in the NW part of the ditch, which directly overlies the charcoal layer, indicates that the ditch has remained open for some time after the activity associated with AL1450 occurred.

8 FINDS

During a metal-detecting search of the stone layer, a gold ring was found close to the exterior boundary of the layer. The ring was wedged in between two stones in mixed soil.

Fig. 22: Cf34745_073.JPG. Gold ring (C59155/1) found *in situ.*

In addition, a small number of pottery fragments of Early Iron Age-type were recovered during the excavation of AL1450 in the circular ring ditch. These are catalogued as C59155/4-5.

Also, several iron nails and corroded iron pieces were found during the excavation. These were especially abundant in the disturbed area. However, upon closer inspection, the iron objects turned out to be modern and were discarded. For more details of the finds, see Ch.11.3.

9 SCIENTIFIC SAMPLES, ANALYSIS AND RESULTS

9.1 WOOD ANATOMICAL AND C14-RESULTS

C. nr.	Sample no.	Context	Layer	Total weight of sample (g)	Aanalyzed	Wood anatomical analysis	Lab.nr.	Uncal. BP	Cal. Date
C59155/11	PK1673	Circular ditch enclosure	A1450, 3C1671	6,3	x	3 Quercus and 7 **Betula**	Beta - 377750	1850±30	80-240 AD
C59155/12	PK1668	Charcoal layer underneath stone-packing of grave mound	From profile 3C1657	2,1	x	4 Quercus and 6 **Betula**	Beta - 377749	1770±30	180-190 AD, 250-340 AD
C59155/13	PK1677	Circular ditch enclosure	A1450, 3C1675	6					

Table I: Overview of charcoal samples. Material provided for ^{14}C-analysis is highlighted.

9.2 SOIL MICROMORPHOLOGY

Two monoliths for micromorphological analysis (PX1670 (9,5 cm) PX1669 (30 cm) was sent to Dr. Richard McPhail for processing and analysis. Additionally, two macrophossil samples (PM1669 and PM1674) were sent to Dr. Johan Linderholm for processing and analysis. However, there were no finds of macrofossils in the samples.

The results of the scientific analysis of the investigated layers are included in a finalized report in the appendix.

10 SUMMARY AND ASSESSMENT OF THE PRELIMINARY INVESTIGATIONS, ANALYSIS AND RESULTS

Preliminary test trenching of the disturbed and damaged grave mound at Rom Mellem revealed a dense and compact stone layer, consisting of larger round-edged boulders. The central area of the mound had been disturbed by a later construction of a potato-cellar during World War II. The potato-cellar was situated directly on top of the sterile marine clay.

However, parts of the stone wall surrounding the potato-cellar might belong to a central burial chamber. In order to access this properly, further investigations need to be conducted, such as an assessment of the southern perimeter of the potato-cellar, which was not exposed in the trench and thus unexcavated.

In addition, two charcoal patches were partly exposed. It is likely that these represent secondary burials, such as cremation patches, which has been deposited as part of the burial ritual. Both of these were underlying and sealed by the stone layer, which confirms their deposit to be current with the overall construction of the mound. However, the micromorphology analysis could not confirm these patches as being resulted by cremation. Normally, one might have expected small inclusions of burned bones, ash or other residues associated with cremations. However, only a smaller area of the layer was sampled and the other charcoal patch (AL939) was not sieved. One cannot rule out that these patches are in some way associated with cremation activity, either the remnants of a cremation pyre or a cremation spread when regarding its context and stratigraphy. This interpretation should be further clarified when excavating the S boundary of AL939, which exceeded the boundary of the trench, in addition to the charcoal patch in the NE corner of the trench.

Both possible cremation patches were overlying the greyish, iron-concreted layer (AL1052), which has been interpreted as a cultivation layer and the soil-horizon pre-dating the erection of the mound. According to the micromorphology analysis, AL1052 and AL1159 were intermixed, which corresponds well with the interpretation of its character as a relict plough soil, subjected to post-depositional waterlogging and alluvial/marine flooding. Lastly explains the abundant iron mottling and concretions (McPhail 2013).

Upon removal of this, a surface with ard-marks was revealed, which represents prior cultivation activity in the area. The layer of ard-marks did not exceed the boundaries of the circular ring ditch, which supports that the archaeological surfaces pre-dating the burial mound has been preserved by the stone layer.

The circular ring ditch seemed intact, although subjected to some soil erosion from the mound. There were no signs of disturbance by modern drainage ditches. Two main activity phases was identified in the ditch, as well as a few smaller deposits, such as minor concentrations of fire-cracked stones in AL1450. The initial and first phase of the ditch seemed to be a burning activity, perhaps associated with the burial ritual. After its deposition, the ditch seemed to have remained open for some time and long enough for it to be overlapped by eroding soil (AL1412) from the burial mound. Further excavations could confirm if the burning layer is consistent throughout the entire ditch.

In sum, there seems to have been a number of burial rites associated with the mound, which is suggested by the secondary deposited cremation patches, as well as the burned ring ditch. C14-analysis of the cremation patch in the N-profile of the trench extension, have supplied a date range between 180-190 AD, 250-340 calAD (1770±30 unCal), which places the activity to the Roman Period. Another C14-analysis of the charcoal layer in the ring ditch, place the burning activity here to 80-240 calAD (1850±30 unCal), and is in correspondence to the coarse-grained pottery found in the ditch.

Thus, C14-results suggest that the mound belongs to the Roman period.

11 LITERATURE

Bill, J. 2013: «Prosjektbeskrivelse for forskningsundersøkelse av gravhaug Rom Vestre 113/106, lokalitet ID 140556, Tønsberg kommune, Vestfold.» Arkeologisk seksjon, MCH.

Brun, A. T. 2001: «Rapport fra arkeologisk undersøkelse ved Vestre Rom Søndre »

Harris, E. C., 1979: Principles of Archaeological Stratigraphy, London.

12 APPENDIX

12.1 TABLE OF ARCHAEOLOGICAL UNITS

Id	Context	Description
604	Layer of stones	Visible extent of the stone packing and filling upon removal of the topsoil.
630	Circular ditch enclosure	Outline and surface of foot ditch. Characterized by an elongated area of backfill covering the width of the trench.
667	Grave mound	Stones belonging to the burial mound
673	Grave mound	Stones belonging to the burial mound
685	Grave mound	Stones belonging to the burial mound
692	Grave mound	Stone package - cleaning layer
751	Grave mound	Stones belonging to the burial mound
761	Grave mound	Stones belonging to the burial mound
770	Grave mound	Stones belonging to the burial mound
778	Grave mound	Stones belonging to the burial mound
785	Grave mound	Stones belonging to the burial mound
795	Grave mound	Stones belonging to the burial mound
803	Grave mound	Stones belonging to the burial mound
811	Grave mound	Stones belonging to the burial mound
821	Grave mound	Stones belonging to the burial mound
842	Potato-cellar	Cut of potato-cellar - assumed extent of modern disturbance
878	Potato-cellar	The supposed extent of undisturbed surface.
900	Potato-cellar	Modern disturbance, identified through loose fill consisting of angular stones and pieces of tiles.
939	Grave mound	Patchy charcoal-layer, intermixed with medium grey to light sandy silt. Possible cremation patch, secondary deposit.
985	Grave mound	Stones belonging to 985, 604 and 692. Part of stone package of the grave mound.
1008	Grave mound	Stone at the edge of the modern disturbance. Big rounded stones - originates from the burial mound and is most likely not in situ, so close as it is to the modern disturbance of the potato cellar. The trench profile in this area suggests that the stones have slid down towards the depression of the potato-cellar, as emphasized by the inclination of A1052.
1032	Grave mound	Stones belonging to 985, 604 and 692. Part of stone package of the grave mound.
1052	Grave mound	Characterised through considerable iron concretions especially underneath the stones of unit 692.

Id	Context	Description
1092	Potato-cellar	Wooden structure; characterized by flat and straight wooden boards. Covering the entire surface in the area found.
1127	Potato-cellar	Unit between wooden beams. Sandy, clayey layer inbetween thick wooden beams. Sandier than underlying clay - has wood-chips in it, likely debris from the construction of the potato-cellar.
1159	Grave mound	Possible palaeosoil (together with 1052). Former soil preserved by stone-packing.
1214	Subsoil - geological interface in the potator-cellar	Marine clay, c-horizon. Represents the sterile sediment and bottom of excavated surface upon removal of potato-cellar.
1235	Subsurface of grave mound	Layer with ard marks, surface prior to the erection of grave mound. Main trench. Same as A1389 in trench extension.
1282	Trench extension	Topsoil, trench extension.
1291	Grave mound	Surface of original in situ stone package.
1311	Potato-cellar	Modern disturbance
1324	Circular ditch enclosure	Concentration og charcoal and fire-cracked stones visible in A1334. Upon removal of A1334, the charcoal layer continued enveloping into A1450, thus belonging to A1450.
1334	Circular ditch enclosure	Ditch, 3rd phase. Characterized by medium to dark greyish clayey silt. Compacted with minor inclusions of charcoal.
1355	Grave mound	Layer characterized by a iron oxide-rich unit underlying the stone package, trench extension.
1389	Subsurface of grave mound	Layer with ard marks, surface prior to the construction of grave-mound. Trench extension - same as A1235.
1412	Circular ditch enclosure	Unit deposited by erosion in ditch
1438	Potato-cellar, trench extension	Back-fill of potato cellar, modern disturbance, trench extension
1450	Circular ditch enclosure	Ditch, 2nd phase. Charcoal-rich unit within ditch. Covers the suface of the entire ditch. Includes wood charcoal, fragments of burnt clay and pieces of fire-cracked stones. Pieces of pottery (C59155/4-5) found. The layer is intermixed with silty sand. A bit more clayey in the middle of the depression of trench.
1489	Grave mound/potato-cellar	Cut/foundation fill of stone wall
1512	Grave mound	Stone wall - partly original to the chamber inside the gravemound.
1547	Circular ditch enclosure	Possible water-influenced back-fill at trench bottom.
1565	Circular ditch enclosure	Concentration of fire-cracked stones.
1582	Trench extension	Small charcoal patch in A1389.
1594	Circular ditch enclosure	Ditch, 1st phase. Surface of non-excavated part of ditch.
1630	Subsurface of excavated area of the entire trench	Unexcavated surface of the entire trench. Subsoil.

12.2 MATRIX

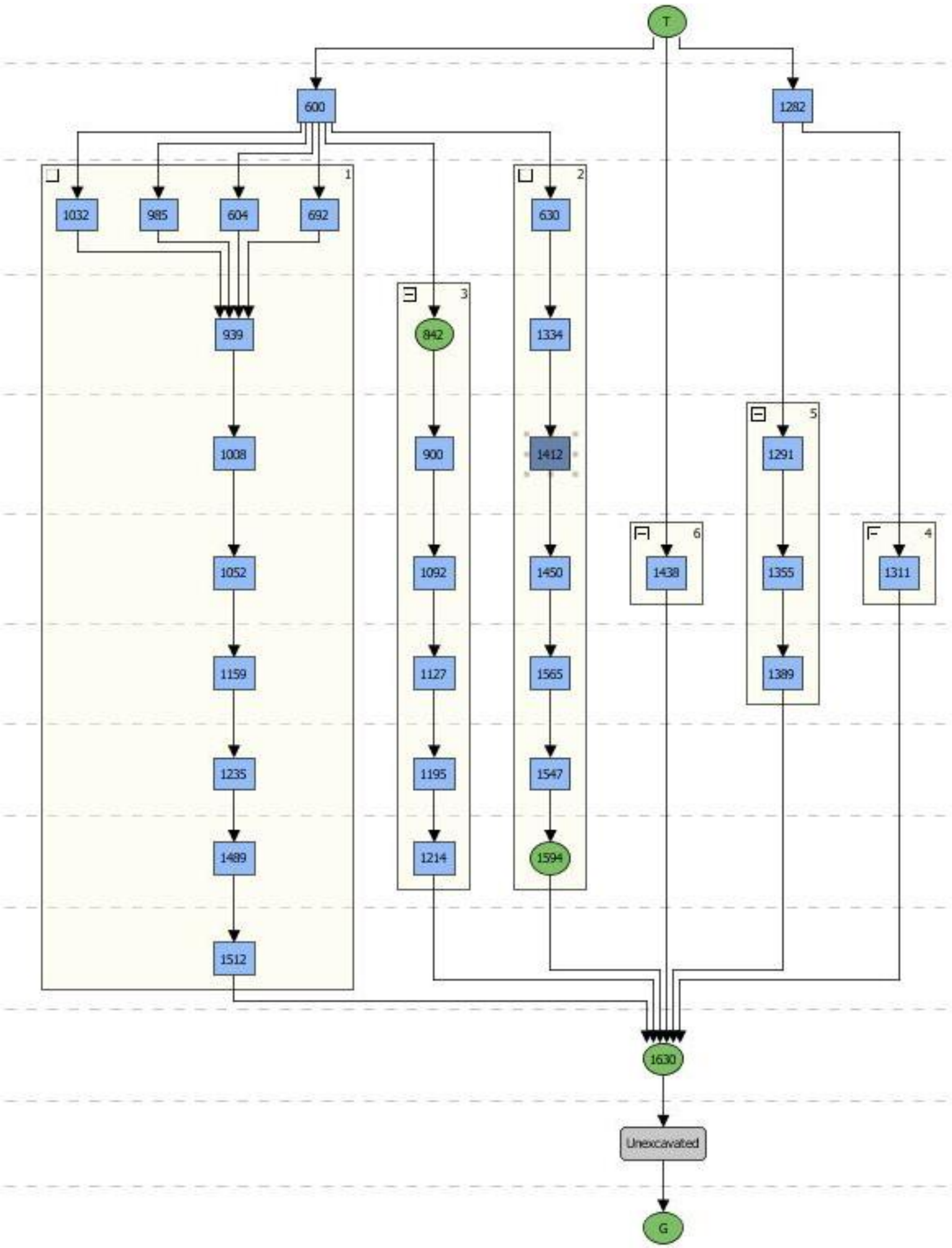

Fig. 23: *Suggested matrix of archaeological units. Produced through Harris Matrix Composer 2.0 by Petra Sneidhofer (LBI).*

12.3 CATALOGED FINDS, C59155/1-16

C59155/1-16

Gravfunn fra **romertid** ved ROM MELLEM (113/6), TØNSBERG K., VESTFOLD.
Funnomstendighet: Arkeologisk registrering/forundersøkelse Arkeologisk forundersøkelse og sjakting av sterk overpløyd storhaug ved Rom Mellem i tidsperioden 12.08-27.08.2013. Forundersøkelsen har som formål å avklare vernestatus og strategi for den utpløyde gravhaugen. Gjentatte geofysiske undersøkelser har blitt utført av haugen og omkringliggende område. Vekstsporene ble første gang observert på flyfoto i 1990, samt gjentatte ganger i 1993-1995. Registrering ble gjennomført av UKM og VFK i 2001, geofysisk prospeksjon med magnetometer og georadar ble utført i 2003, samt mer utførlig i 2012. I 2004 ble det fortatt jordboringer av UKM og VFK. I 2009 ble det utført laserskanning fra luften av fortidsminnet. Gjeldende forundersøkelse ble utført ved sjakting av deler av gravhaugen. Det ble påvist en jordblandet steinpakning med totalutstrekning innenfor sjakta pålydende et område på 8,5 x 3,3 meter. Denne besto henholdsvis av svært store stein, iblandet noen mindre. I antatt sentrum av gravhaugen, ble det påvist en forstyrrelse i form av en potetkjeller. Utstrekningen av steinpakningen er beregnet fra kanten av potetkjelleren mot SØ i sjakta. Det ble også påvist spor etter en kraftig fotgrøft, med en lengde på 3,3 meter innenfor sjakta og en bredde på 2,4 meter. Det foreligger 7 naturvitenskapelige prøver fra utgravningen, hvorav fire kullprøver, to makrofossilprøver og en mikromorfologisk prøve. Kullprøver ble vasket, tørket og det ble avsendt to kullprøver til vedanatomisk analyse ved Moesgård Museum (2014). Prøvene ble deretter videresendt til Beta Analytic Inc. (2014) for C14-datering. Uvaskede makrofossilprøver ble avsendt for analyse av Johan Linderholm ved Umeå Universitet (2013). Mikromorfologisk prøve ble analysert av Dr. Richard McPhail ved UCL (2013). Funn og prøver er sortert og katalogisert i henhold til material, deretter prøvenummer. Resultater og sammenfatning av analysene foreligger i rapporten.
Orienteringsoppgave: Overpløyd gravhaug 150 m S for hovedhuset til gårdsbruket Rom Mellem og ca. 1700 m. N for Oseberghaugen i Slagendalen. Fremstår som en lav høyde i flaten av terrenget, med vekstspor på ca. 35-40 m i diameter. Terrenget faller skarpt mot NNØ mot et mindre bekkefar som bunner ut i Slagenbekken.
Kartreferanse/-koordinater: Projeksjon: EU89-UTM; Sone 33, *N:* 6584820, *Ø:* 240607.
LokalitetsID: 140556.
Innberetning/litteratur: McGraw, J.L & Bill, J. 2014: "Report: Preliminary archaeological investigations of a burial mound." Arkeologisk Seksjon, KHMs arkiv.
Funnet av: Jessica Leigh McGraw.
Funnår: 2013.
Katalogisert av: Jessica Leigh McGraw.

1) sirkulær **ring** av **gull**.
Små slipespor og antydning til hamring i overflatene. Matt gull med noe blankere innside, trolig fra bruksslitasje. Ringen er jevnt tynn uten antydning til å ha hatt stensetting. Ytre diam.: 2,33 cm. Indre diam.: 1,99. St.t.: 0,17 cm. *Vekt:* 1,83 gram. *Fnr.* 840.
Funnet ved metallsøking. Nedkilt i jordmasser mellom steinpakning av gravhaug.
2) **avfall** av bly.
Avfall av bly, lik smelteavfall. Avlangt fragment. *Fnr:* 832. *Mål: Stl:* 2,1 cm. *Stb:* 0,7 cm. *Stt:* 0,3 cm. *Vekt:* 5,4 gram. Funnet ved metallsøking av nærområdet av sjakt. Rett Ø for

sjakt.
3) **ukjent** av kobberlegering.
Gjenstanden har to utstrakte armer, hvorav begge er brutt og den ene er bøyd. På den ene siden har armene små knopper, mens den andre siden er tilnærmet glatt. Nederste del av gjenstanden har avrundet brukken stang. Mulig del av spenne, sannsynligvis av nyere tid. *Fnr:* 835. *Mål: Stl:* 8,5 cm. *Stb:* 5,1 cm. *Stt:* 0,4 cm. *Vekt:* 24,1 gram. Funnet ved metallsøking i nærområdet rundt sjakt. Rett V for sjakt.
4) 3 **kar** av keramikk.
Tre **buk**skår av leirkar av keramikk. Godset er grålig med middels- til grovt magret gods. Det største skåret har glattet utside og er svakt konkavt. Godstykkelse: 0,4 cm. St. synlig magringskorn: 0,4. *Fnr:* 100000. *Mål: Stl:* 3,6 cm. *Stb:* 3,2 cm. *Stt:* 0,4 cm. *Vekt:* 24,7 gram.
Funnet i AL1324 (steinsansamling med kull) i fotgrøft. Laget er sannsynligvis del av A1450.
5) **kar** av keramikk.
Ni fragmenter av **buk**skår og et **rand**skår av leirkar av keramikk. Sannsynligvis tilhørende to kar. Fem fragmenter har lys brunlig utside og grålig/sotet innside. Fire fragmenter har gråsort utside og innside. Et av skårene med lys brun utside er et **rand**skår med rett avskåret rand. Godset er middels-til grovt magret med kvartsitt. Skår av gråsort gods ser ut til å ha hatt glattet utside. Godstykkelse: 0,3 cm. St. synlig magringskorn er 0,3 cm. *Fnr:* 100001.
Mål: Stl: 4,5 cm. *Stb:* 4,0 cm. *Stt:* 0,3 cm. *Vekt:* 87,0 gram. Funnet under sålding av A1450, kullag i bunn av fotgrøft.
6) **kar** av keramikk. *Antall fragmenter:* 1
Et fragment av leir**kar** av keramikk. Godset er middels- til grovt magret og har lys brunlig utside med grålig innside. Godstykkelse: 0,7 cm. St. synlig magringskorn: 0,2 cm. *Vekt:* 1,6 gram. Funnet i en av borreprøvene fra N1, lag 4, fra 2001-undersøkelsene. N-S vendt søkesjakt.
7) **smeltedigel** av brent leire.
Fem fragmenter av en smeltedigel av brent/sintret leire. Ett av skårene ser ut til å tilhøre et loddekar. St. tykkelse: 0,9 cm. *Fnr:* 100002. *Vekt:* 19,9 gram. Funnet i kullag (AL1450) i fotgrøft.
8) **brent leire** av brent leire.
Fem fragmenter av hardt brent/sintret leire. Sammensmeltet trekull og noe forglassede partier på fragmentene. *Vekt:* 54,5 gram. Funnet under sålding av (AL1450) kullag i fotgrøft.
9) 10 **bein, brente**.
Hvitbrente fragmenter av bein. *Vekt:* 4,1 gram. Funnet under sålding av kullag (AL1450) i fotgrøft.
10) **slagg** av slagg.
Ett fragment av forglasset slagg. *Vekt:* 3,4 gram. Funnet under sålding av (AL1450), kullag i fotgrøft.
11) **prøve, kull**.
10 biter er vedartsbestemt, hvorav 7 bjørk og 3 eik. Datert på bjørk (3,1 mg.) til 1850±30 BP, 80-240 calAD (Beta-377750). *Pnr:* 1673. *Vekt:* 6,3 gram. *Datering:* 80-240 calAD. Prøve tatt av AL1450 i profil 3C1671.
12) **prøve, kull.**
10 biter er vedartsbestemt, hvorav 6 bjørk og 4 eik. Datert på bjørk (2,3 mg.) til 1770±30

BP, 180-190 calAD, 250-340 calAD (Beta-377749). *Pnr:* 1668. *Vekt:* 6 gram. *Datering:* 180-190 calAD, 250-340 calAD. Prøve er tatt av kullag under steinpakning i profil 3C1657 i N-del av N-Ø utvidelse av hovedsjakt.
13) **prøve, kull**.
Prøve av kull. Ikke analysert. *Pnr:* 1677. *Vekt:* 6 gram.
Strukturnr: 1450 Prøve er tatt av AL1450 i profil 3C175 av fotgrøft.
14) **prøve, makro**.
Analysert. Ingen makrofossiler funnet. *Pnr:* 1669.
Strukturnr: 1355 Prøve tatt ut av profil 3C1657.
15) **prøve, makro**.
Analysert. Ingen makrofossiler funnet. *Pnr:* 1674.
Strukturnr: 1412 Prøve tatt av profil 3C1671 av fotgrøft.
16) **prøve, jordmikromorfologi.**
Analysert. *Pnr:* 1667.
Prøve tatt ut av profil i NV utvidelse av sjakt.

12.4 Samples

12.4.1 Wood anatomical analysis

MOESGÅRD
MUSEUM

Moesgård
DK-8270 Højbjerg

Telefon 89 42 11 00
Telefax 86 27 23 78

Moesgård, 25/2 2014

Rapport vedr. vedanatomisk analyse fra Rom Vestre 113/06, Tønsberg kommune, Vestfold fylke, ID: 140556, KHM 2013/8460 (FHM 4296/1570)

Metode

De udvalgte træstykker identificeres under anvendelse af henholdsvis stereolup og mikroskop med op til 500 X forstørrelse. Der udplukkes tilfældigt 10 stykker til analyse, hvor dette er muligt. Herefter gennemses prøven for at der kan dannes et generelt overblik over arts-sammensætningen. Der er udtaget en egnet 14C-prøve fra hvert X-nummer, som anbringes i plastiktut i en nummereret plastikpose. De analyserede trækulsstykker er ligeledes lagt i egen plastpose og placeret inde i den oprindlige fundpose.

Prøverne er analyseret af Peter Hambro Mikkelsen

Vedr. udtagelse af prøver til C14

Egenalderen på et stykke trækul udtaget til kulstof-14 datering, er den alder det pågældende stykke trækul skønnes at have i forhold til træets fældningstidspunkt (Loftsgarde et al 2013). Alderen bedømmes ud fra årringsbredde og årringens krumning og dens afstand til bark og det generelle indtryk man får af prøvens andre trækulsstykker af samme art. Hertil kommer et generelt kendskab til den pågældende træarts normale livscyklus og veddets bestandighed. Bedømmelsen kan være meget subjektiv når det gælder stammeved og måske optimistisk, når det gælder kul fra meget gamle træer af for eksempel eg og fyr.

Undersøgelsen

I forbindelse med undersøgelsen er træstykkernes anslåede størrelse angivet som henholdsvis ÆS: ældre stamme, YS: yngre stamme, ÆG ældre gren og YG: yngre gren. Vurderingen er foretaget i forbindelse med identificeringen af hvert enkelt trækulsstykke. Det skal understreges, at der er tale om en vurdering. I en del tilfælde er det umuligt at skelne kvalificeret mellem yngre stammer og grenved.

PK 1668, gravhaug
Prøven består af vel >75 små trækulsstykker. Trækullet er generelt mindre af størrelse end i prøve PK 1673.
6 stk. Betula, bjørk. 3S, 4ÆG, udtaget stykke af stamme til C14, >8 årringe og ingen bark.
4 stk. Quercus, eik. 2ÆS, 2S.

PK 1673, fotgrøft
Prøven består af vel 75 trækulsstykker, generelt større end end i prøve PK 1668.
7 stk. Betula, bjørk. 5S, 2G, udtaget stykke af stamme til C14, 4 årringe og ingen bark.
3 stk. Quercus, eik. 3S, i dårlig bevaringstilstand.

Undersøgelsens resultat

Der er undersøgt 2 kullprøver fra et gravanlæg. Prøverne er stort set identiske, bortset fra, at der ikke er set grenved i træet fra Quercus, eik.

PK-nr.	Betula	Quercus	
1668	6	4	10
1673	7	3	10
Samlet	13	7	20

Tabel 1. Fordeling af trækul i prøverne

Vedarter i prøverne

Der er fundet træ fra 2 løvtræsarter. I det følgende beskrives de træsorter, som er repræsenteret i prøverne. Beskrivelsen tager sit udgangspunkt i O. A. Høegs etnobotaniske hovedværk: *Planter og tradisjon. Floraen i levende tale og tradisjon i Norge 1925-1973* fra 1974.

***Betula sp.*, bjørk**
Lavlandsbjørk, *Betula verrucosa* og vanlig bjørk, *Betula pubescens*, kan vedanatomisk ikke skelnes fra hinanden. Lyskrævende træer, som med tiden bukker under for andre træarter, som vokser frem under dem. Vanlig bjørk vokser på fugtigere bund, mens det er lavlandsbjørken man ser på den tørre, magre bund. Sår sig let og formerer sig gerne med stubskud. Typiske pionertræer. Væksten er hurtig. Veddet er tæt og hårdt og har en alsidig anvendelse i husholdningen og landbruget. Løv og kviste anvendes til foder.

***Quercus sp.*, eik**
Sommereik, *Quercus robur* og Vintereik, *Quercus petraea*, kan vedanatomisk ikke skelnes fra hinanden. Lyskrævende træer. Eiken vokser på næsten alle jordbundstyper og de mindste krav til jordbunden stiller vintereiken. De klarer sig nogenlunde i konkurrencen med andre lyskrævende træarter. Sår sig let. Væksten er hurtig. Veddet er tæt og hårdt og har en alsidig anvendelse i husholdningen og landbruget. Den unge bark er eftertragtet til garvning og oldenproduktionen er vigtig for svineavlen. Løv og kviste kan anvendes til foder.

understreges, at der er tale om en vurdering. I en del tilfælde er det umuligt at skelne kvalificeret mellem yngre stammer og grenved.

PK 1668, gravhaug
Prøven består af vel >75 små trækulsstykker. Trækullet er generelt mindre af størrelse end i prøve PK 1673.
6 stk. Betula, bjørk. 3S, 4ÆG, udtaget stykke af stamme til C14, >8 årringe og ingen bark.
4 stk. Quercus, eik. 2ÆS, 2S.

PK 1673, fotgrøft
Prøven består af vel 75 trækulsstykker, generelt større end end i prøve PK 1668.
7 stk. Betula, bjørk. 5S, 2G, udtaget stykke af stamme til C14, 4 årringe og ingen bark.
3 stk. Quercus, eik. 3S, i dårlig bevaringstilstand.

Undersøgelsens resultat

Der er undersøgt 2 kullprøver fra et gravanlæg. Prøverne er stort set identiske, bortset fra, at der ikke er set grenved i træet fra Quercus, eik.

PK-nr.	Betula	Quercus	
1668	6	4	10
1673	7	3	10
Samlet	13	7	20

Tabel 1. Fordeling af trækul i prøverne

Vedarter i prøverne

Der er fundet træ fra 2 løvtræsarter. I det følgende beskrives de træsorter, som er repræsenteret i prøverne. Beskrivelsen tager sit udgangspunkt i O. A. Høegs etnobotaniske hovedværk: *Planter og tradisjon. Floraen i levende tale og tradisjon i Norge 1925-1973* fra 1974.

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Litteratur

Loftsgarden, K., B. Rundberget, J.H. Larsen & P.H. Mikkelsen (2013): Bruk og misbruk af C14-datering ved utmarksarkeologisk forskning og forvaltning. I: Primitive Tider 2013, pp: 53-64

Peter Hambro Mikkelsen, ph.d.
Afdelingsleder
Konserverings og naturvidenskabelig afdeling
Moesgård Museum
Danmark

12.4.2 C14-RESULTS

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Darden Hood
President

Ronald Hatfield
Christopher Patrick
Deputy Directors

April 14, 2014

Ms. Jessica Leigh McGraw
University of Oslo
The Museum of Cultural History
Forvaltningsundersokelser St.
Olavsgate 29
Oslo, NO-0166
Norway

RE: Radiocarbon Dating Results For Samples RomVestrePN1668, RomVestrePN1673

Dear Ms. McGraw:

Enclosed are the radiocarbon dating results for two samples recently sent to us. The report sheet contains the Conventional Radiocarbon Age (BP), the method used, material type, and applied pretreatments, any sample specific comments and, where applicable, the two-sigma calendar calibration range. The Conventional Radiocarbon ages have been corrected for total isotopic fractionation effects (natural and laboratory induced).

All results (excluding some inappropriate material types) which fall within the range of available calibration data are calibrated to calendar years (cal BC/AD) and calibrated radiocarbon years (cal BP). Calibration was calculated using the one of the databases associated with the 2013 INTCAL program (cited in the references on the bottom of the calibration graph page provided for each sample.) Multiple probability ranges may appear in some cases, due to short-term variations in the atmospheric ^{14}C contents at certain time periods. Looking closely at the calibration graph provided and where the BP sigma limits intercept the calibration curve will help you understand this phenomenon.

Conventional Radiocarbon Ages and sigmas are rounded to the nearest 10 years per the conventions of the 1977 International Radiocarbon Conference. When counting statistics produce sigmas lower than +/- 30 years, a conservative +/- 30 BP is cited for the result.

All work on these samples was performed in our laboratories in Miami under strict chain of custody and quality control under ISO-17025 accreditation protocols. Sample, modern and blanks were all analyzed in the same chemistry lines by qualified professional technicians using identical reagents and counting parameters within our own particle accelerators. A quality assurance report is posted to your directory for each result.

As always, your inquiries are most welcome. If you have any questions or would like further details regarding the analyses, please do not hesitate to contact us.

Our invoice has been sent separately. Thank you for your prior efforts in arranging payment. As always, if you have any questions or would like to discuss the results, don't hesitate to contact me.

Sincerely,

Darden Hood
Digital signature on file

BETA ANALYTIC INC.
DR. M.A. TAMERS and MR. D.G. HOOD
4985 S.W. 74 COURT
MIAMI, FLORIDA, USA 33155
PH: 305-667-5167 FAX:305-663-0964
beta@radiocarbon.com

REPORT OF RADIOCARBON DATING ANALYSES

Ms. Jessica Leigh McGraw — Report Date: 4/14/2014

University of Oslo — Material Received: 4/8/2014

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 377749	1810 +/- 30 BP	-27.4 o/oo	1770 +/- 30 BP

SAMPLE : RomVestrePN1668
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid
2 SIGMA CALIBRATION : Cal AD 180 to 190 (Cal BP 1770 to 1760) and Cal AD 215 to 340 (Cal BP 1735 to 1610)

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 377750	1870 +/- 30 BP	-26.4 o/oo	1850 +/- 30 BP

SAMPLE : RomVestrePN1673
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (charred material): acid/alkali/acid
2 SIGMA CALIBRATION : Cal AD 80 to 240 (Cal BP 1870 to 1710)

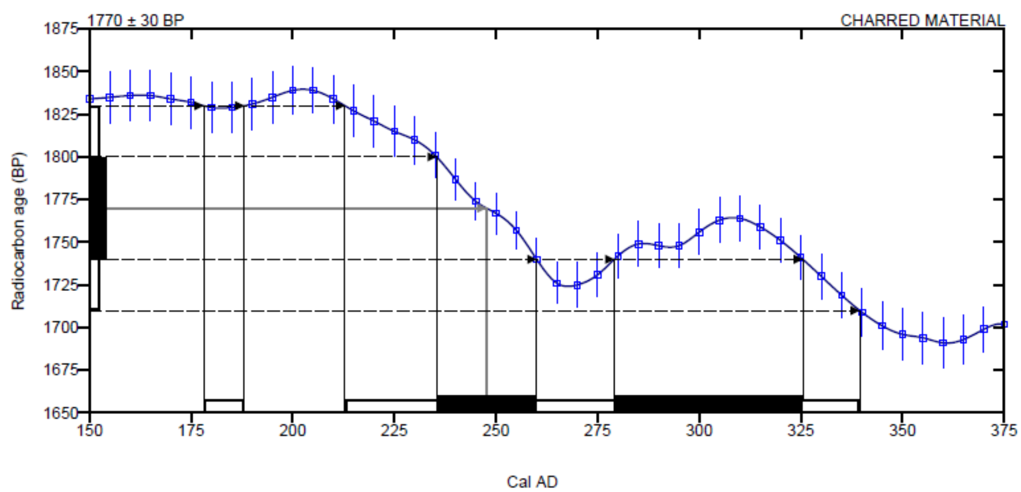
Dates are reported as RCYBP (radiocarbon years before present, "present" = AD 1950). By international convention, the modern reference standard was 95% the 14C activity of the National Institute of Standards and Technology (NIST) Oxalic Acid (SRM 4990C) and calculated using the Libby 14C half-life (5568 years). Quoted errors represent 1 relative standard deviation statistics (68% probability) counting errors based on the combined measurements of the sample, background, and modern reference standards. Measured 13C/12C ratios (delta 13C) were calculated relative to the PDB-1 standard.

The Conventional Radiocarbon Age represents the Measured Radiocarbon Age corrected for isotopic fractionation, calculated using the delta 13C. On rare occasion where the Conventional Radiocarbon Age was calculated using an assumed delta 13C, the ratio and the Conventional Radiocarbon Age will be followed by "*". The Conventional Radiocarbon Age is not calendar calibrated. When available, the Calendar Calibrated result is calculated from the Conventional Radiocarbon Age and is listed as the "Two Sigma Calibrated Result" for each sample.

CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12 = -27.4 o/oo : lab. mult = 1)

Laboratory number	**Beta-377749**
Conventional radiocarbon age	**1770 ± 30 BP**
2 Sigma calibrated result **95% probability**	**Cal AD 180 to 190 (Cal BP 1770 to 1760)** **Cal AD 215 to 340 (Cal BP 1735 to 1610)**
Intercept of radiocarbon age with calibration curve	Cal AD 250 (Cal BP 1700)
1 Sigma calibrated results 68% probability	Cal AD 235 to 260 (Cal BP 1715 to 1690) Cal AD 280 to 325 (Cal BP 1670 to 1625)



Database used
INTCAL13

References
Mathematics used for calibration scenario
A Simplified Approach to Calibrating C14 Dates, Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2):317-322
References to INTCAL13 database
Reimer PJ et al. IntCal13 and Marine13 radiocarbon age calibration curves 0– 50,000 years cal BP. Radiocarbon 55(4):1869– 1887.

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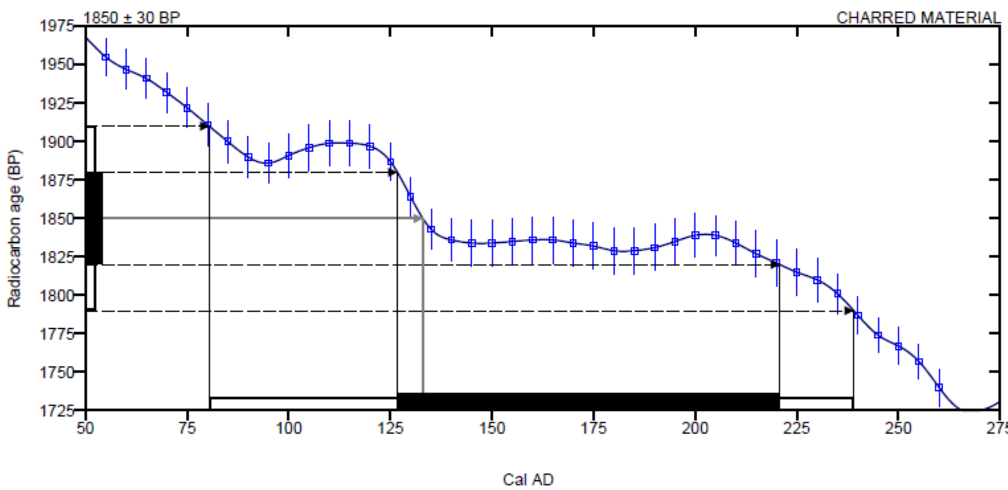
CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12 = -26.4 o/oo : lab. mult = 1)

Laboratory number	**Beta-377750**
Conventional radiocarbon age	**1850 ± 30 BP**
2 Sigma calibrated result 95% probability	**Cal AD 80 to 240 (Cal BP 1870 to 1710)**
Intercept of radiocarbon age with calibration curve	Cal AD 135 (Cal BP 1815)
1 Sigma calibrated results 68% probability	Cal AD 125 to 220 (Cal BP 1825 to 1730)



Database used
INTCAL13

References
Mathematics used for calibration scenario
A Simplified Approach to Calibrating C14 Dates, Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2):317-322
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12.4.3 SOIL MICHROMORPHOLOGY

Rom vestre 116/103, Tonsberg, Vestfold, Norway: soil micromorphology

by

Richard I Macphail Institute of Archaeology, University College London (UCL), 31-34, 31-34, Gordon Sq., London WC1H 0PY, UK

and

Johan Linderholm Environmental Archaeology Laboratory (MAL), University of Umeå, S-90187 Umeå, SWEDEN.

(Report for *Cultural History Museum, University of Oslo*, May 2014)

Extended summary

A six bulk soil sample study (LOI, MS, MS550, fractionated P) and an exactly correlated five thin section study of two buried soil monoliths, employing micromorphology, was carried out. A macrofossil investigation of two samples found it to be sterile. The soil study, however, found a gleyed mottled subsoil (AL1389), with a relict history of ice lensing. A manured cultivated soil (AL1159) was identified on the basis of its biological working by earthworms and inclusion of wood charcoal, sometimes probably stained with iron and phosphate, and burned mineral material. It also had an enhanced phosphate content (max 1090 ppm P_2O_5), with PQuotas and magnetic susceptibility indicating manuring with settlement waste that may have included some organic manure; the humic soil shows strong effects of organic matter oxidation. This cultivated soil was sealed by a manuring/midden spread (AL1052 at PM1667) which composed fire cracked siltstone rock (M1670) and coarse charcoal including monocotyledonous plant material (burned straw?)(M1667A). These soil layers again have an enhanced phosphate (510-750 ppm P_2O_5) content and magnetic susceptibility (max MSlf=50). An identification of manured cultivation is consistent with many previous experimental and case studies, especially from southern Norway. Ensuing alluvial flooding led to soil slaking, minor reworking of charcoal, inwash of clayey alluvium and sealing by alluvial laminated silts. No turf layers were observed; colour differences in buried soil layers probably relate to mound compaction, and perched water tables picking out the different porosity characteristics of the buried soils. The report is supported by 3 tables and 17 illustrations.

Introduction

Two monoliths (9.5cm-long PM1670; and 30 cm-long PM1669) from below the remains of a grave mound at Rom vestre 116/103, Tonsberg, Vestfold, Norway, were received from Jessica McGraw (Cultural History Museum, University of Oslo). Background information to sample location and preliminary field interpretations was kindly supplied by Petra Schneidhofer (Univ. of Vienna) and Rebecca Cannell (Univ. of Bournemouth). Samples from cultural layers and buried subsoil below an undated grave mound underwent a combined soil micromorphology, bulk chemical and magnetic susceptibility studies (Courty *et al*., 1989; Goldberg and Macphail, 2006)

1

Samples and methods

Bulk soil chemical and physical properties: A five parameter analysis routine was applied throughout the study. It has been developed and adapted for soil prospection and bulk analysis of occupation soils and features (see below). Analysed parameters comprise organic matter (loss on ignition [LOI], Carter 1993), two fractions of phosphate (inorganic [Cit-P], and sum of organic and inorganic [Cit-POI])(Engelmark & Linderholm 1996, Linderholm 2007) and magnetic susceptibility (MS-χlf) and MS550 (Clark 2000, Linderholm 2007, Engelmark & Linderholm 2008). These analyses provide information on various aspects concerning: phosphate, iron and other magnetic components and total organic matter in soils and sediments, and its relationship to phosphate. (Further details can be found in Viklund *et al*., 2013). Flotation of two bulk samples recovered no plant remains.

Soil micromorphology The two monolith samples were evaluated and 5 thin section subsamples processed (six bulk subsamples were also extracted [Tables 1-2] and analysed by Johan Linderholm, MAL, Umeå University). The undisturbed monolith sub-samples (Tables 2 and 3) were impregnated with a clear polyester resin-acetone mixture; samples were then topped up with resin, ahead of curing and slabbing for 75x50 mm-size thin section manufacture by Spectrum Petrographics, Vancouver, Washington, USA (Goldberg and Macphail, 2006; Murphy, 1986)(Figs 5, 10 and 15). The resulting 5 thin sections were further polished with 1,000 grit papers and analysed using a petrological microscope under plane polarised light (PPL), crossed polarised light (XPL), oblique incident light (OIL) and using fluorescence microscopy (blue light – BL), at magnifications ranging from x1 to x200/400. Thin sections were described, ascribed soil microfabric types (MFTs) and microfacies types (MFTs)(see Tables 1 and 2), and counted according to established methods (Bullock et al., 1985; Courty, 2001; Courty *et al*., 1989; Macphail and Cruise, 2001; Stoops, 2003; Stoops *et al*., 2010).

Results

Soil micromorphology Results are presented in Tables 1-2, illustrated in Figs 1-17, and supported by material on the accompanying CD-Rom. 17 characteristics were identified and counted from the 5 layers in the 3 thin sections analysed.

Monolith PM1667

Pale greyish brown subsoil AL1389 lower (M1667D): This is slightly heterogeneous with very dominant poorly sorted silt, and fine to very coarse sand, very few fine gravel, with few fine clayey soil (burrow fills). Massive with relict lamina structure, horizontal fissures (Figs 1-2), associated with abundant very dusty/impure clay void coatings. Occasional weak to moderate iron impregnative mottles, mainly associated with broad burrow fills of clayey, and occasional broad burrows, are present.

This layer consists of poorly sorted sterile lower subsoil silts and sands, with history of ice lensing associated with cool conditions (Van Vliet-Lanoë, 2010). Minor burrowing down of more clayey – once-humic(?) soil – of later (agricultural) formation is recorded. The homogenised alluvial sandy subsoil is generally affected by waterlogged conditions (Lindbo et al., 2010).

Pale greyish brown subsoil AL1389 upper (M1667C): Lower AL1389 is heterogeneous with leached silts and sands and burrow fills of relict humic clayey soil; it is massive with a channel microstructure (Figs 3-4). There is trace of fine burned mineral grains. This mixed upper subsoil is characterised by rare yellowish microlaminated clay infills, many dusty clay void infills and rare matrix infills, very abundant impregnative iron mottles, many thin and broad burrows, and a partial total excremental fabric.

This upper subsoil is affected by minor mixing and downwash from overlying cultivated horizon (Ap?), including trace amounts of manuring materials. There is a trace of alluvial post-depositional clay inwash (Figs 3-4).

Dark brownish buried soil A1159 lower (M1667C): Upwards in sample M1667C there is a moderately homogeneous relict weakly once-humic soil, with massive and broad channel microstructure. There are occasional charcoal – some rounded, some ferruginised, with rare rubefied and calcined mineral grains – with trace of very fine charcoal in matrix soil. Also present are many yellowish microlaminated clay infills, rare dusty clay void infills, abundant impregnative iron mottles, many thin burrows, and a partial total excremental fabric.

This sample records the lowermost part of a manured, cultivated Ap horizon – with post-depositional effects of alluvial/marine flooding (yellowish brown clay inwash).

Dark brownish buried soil A1159 middle (M1667B): Here, there is a massive once-humic and minerogenic soil, with relict crumb, medium prisms and subangular blocky microstructure, and a current porosity including closed polyconcave vughs Fig 5). There are few gravel (max 4mm), many wood charcoal (max 2.5mm), some iron (and P?) stained (Figs 6-7), with rare burned mineral grains (including calcined granite sand), and anomalous iron nodules (max

3.5 mm). Pedofeatures comprise: many elutriated silts and sands infills, abundant very dark impure clay/matrix void coatings and infills, often associated with later very abundant microlaminated yellowish brown clay infills and coatings (max width 2.5mm)(Figs 5, 8-9), abundant impregnative iron mottles affecting fine soil, abundant broad burrows, and abundant relict broad organo-mineral excrements, with partial total excremental fabric.

This is a relict mixed ploughsoil (Ap horizon) with once-humic soil and subsoil, characterised by manuring inputs of likely iron and phosphate rich byre waste (stained charcoal and iron nodules), and earthworm working (Courty *et al*., 1989; Macphail *et al*., 1990; Viklund *et al*., 2013). This formed a crumb and blocky structured soil. Inundation, first caused soils to slake (dark matrix soil infills, elutriate – 'washed' – silts and sands), which was followed by marine(?)/fluvial alluviation (yellowish clay inwash)(Kühn *et al*., 2010; Macphail et al., 2010). Waterlogging caused iron mottling of finer relict humic plough soil.

Dark brownish buried soil A1159 upper (M1667A): Here the layer continues upwards, as found below in M1667B (Fig 10). Very abundant dark matrix infills and later yellowish brown clay infills, and very broad elutriated silts and sands infills, were also recorded.

This relict upper Ap horizon was increasing affected by soil slaking and inwash of marine/alluvial clay.

Charcoal-rich buried soil A1052 (M1667A): This is composed of essentially massive and layered, laminated humic and fine charcoal-rich fine soil-sediments, merging upwards into laminated silts. It is very poorly sorted with few gravel (max >3.5mm), and includes very abundant coarse wood charcoal (>8mm – some FE-P stained?) and monocotyledonous charcoal (straw?, max 12mm; Figs 10-11), and many burned granite gravel (max >3.5mm). Layer is characterised by very abundant laminated and layered silty clay, matrix soil and abundant yellowish to reddish intercalated clay infills, with elutriated silty fills.

Here, a manuring layer of burned gravel, wood and straw(?) charcoal – some probably Fe-P stained (byre waste), was locally reworked by flood inundation (cf Romano-British coastal site of Stanford Wharf, Essex and East London Wetlands (Macphail and Crowther, 2012; Macphail *et al*., 2012). Ensuing alluviation occurred.

Laminated Silts (M1667A): These are layered (max 6mm), laminated and microlaminated (0.5mm) silts (and clays - thin laminae), with channels, horizontal fissures and simple packing voids (Figs 10, 12-14). There is rare fine charcoal at base (reworked from Layer A1052), rare yellowish clay infills, and occasional thin burrows, are present.

The layer formed through low-medium energy flooding, and alluviation sealed and affected underlying manured cultivated soil and slightly reworked (floated) uppermost manuring layer (A1052). As an analogue, throughout prehistory at a number of sites located in the Gudbrandsdalen valley, manured agricultural soils were affected by ensuing flood silts, sands and clays (Macphail *et al*., 2013b).

Monolith PM1670

1052 (1389); (M1670):

Mixed relict humic silts and sands with very few more minerogenic areas (elutriated silts and sands); with massive, with welded relict crumb, medium subangular blocky, with possible weakly formed laminar microstructure (Fig 15). Chambers, closed polyconcave vughs, channels and fine possible horizontally oriented fissures, occur. There is an example of a likely iron fragment (1.7mm), along with many fine wood charcoal (max 1.5mm), some iron (and P?) stained, with possible monocotyledonous example (1.2mm), occasional burned mineral grains (including calcined granite sand), and occasional anomalous iron nodules (max 2.5 mm)(Figs 15-16). Soil is characterised by many elutriated silts and sands infills, minor laminated, abundant very dark impure clay/matrix void coatings and infills, often associated with later abundant microlaminated yellowish brown clay infills and coatings (max width 2.5mm), with abundant impregnative iron mottles affecting fine humic soil, plus relict included sharp edge iron nodules. Very abundant broad burrows and occasional fabric intercalations and very abundant relict broad organo-mineral excrements, with partial total excremental fabric, occur.

Cultivated Ap horizon with manuring material including burned sand, an iron fragment, charcoal (wood and possible straw example) and probable iron-phosphate stained charcoal, with enigmatic iron nodules, some probably of byre waste origin. Later waterlogging led to iron impregnation and weak ice lensing may also have been recorded.

1052 (M1670): This upper 1052 layer is essentially stony, humic and fine charcoal-rich fine massive and layered, laminated, including burrow fills. It is very poorly sorted with very dominant gravel (max >23mm) - fire-cracked angular siltstone (rubefication of iron stained rocks)(Figs 15 and17); there is a rare trace of fine charcoal. Abundant laminated and layered silty clay, matrix soil and many yellowish to reddish intercalated clay infills, infilling rare broad burrows (?), were found.

Presumed midden/manuring spread of fire cracked stones – household waste – with later *in situ* inundation effects.

Discussion

Subsoils (AL1389) are biologically homogenised silts and fine sands, which are currently iron depleted but show iron mottling due to waterlogging, and fluctuating water tables

(Lindbo *et al*., 2010). Finer, once humic soil in burrow fills from overlying (AL1159), has been preferentially iron impregnated (iron-mottled layer in field photo). The layer although essentially minerogenic (1.3% LOI), includes a moderate amount of phosphate and despite oxidation it has a slightly enhanced PQuota (1.39) associated with an organic phosphate content (440 ppm P_2O_5)(Table 1). This iron mottled layer is characterised by the highest MS550 at the site, which is a proxy measure of secondary iron concentrations (Crowther, 2003). Traces of ice lensing were also observed – probably a regular process in these soils (Van Vliet-Lanoë, 2010).

Thin section M1667C records the (probable earthworm) burrow mixed boundary between the sterile subsoil and a once-more humic soil, which is also characterised by very fine charcoal. This soil horizon (AL1159) in M1667B and M1667A also includes coarse anthropogenic components: wood charcoal (e.g. of monocotyledonous/straw charcoal in M1670), likely iron-phosphate stained wood charcoal, enigmatic iron nodules and burned sand (e.g. granite). These materials are 'exotic' components that can be best ascribed to manuring using household and byre waste – as recorded in numerous amended soils in Norway (Viklund *et al*., 2013). Here, organic matter rises to 2.3% LOI and a marked phosphate concentration is recorded (1090 ppm P_2O_5), with organic phosphate oxidation producing a relatively low PQuota (1.17). The effect of manuring on acid soils is to raise fertility and increase biological activity, for example as here recorded by earthworm working (broad burrows, crumb excrements and semi-total excremental soil microfabric) (Goldberg and Macphail, 2006, 262-267; Lewis, 2012; Macphail, 1998; Macphail *et al*., 1990).

Both thin sections M1667A and M1670 include a layer/spread of coarse manuring/midden material (fire cracked siltstone rock fragments in upper 1052 [M1670]; coarse wood and straw[?] charcoal in 1052 [M1667]; Layer 1167 has the highest magnetic susceptibility as a result of burned material being concentrated. Enhanced phosphate concentrations (510-750 ppm P_2O_5) with relatively poorly enhanced PQuotas (1.36-1.4) is also possibly indicative of both organic manures being added alongside burned settlement waste. This relatively humic layer (2.1-3.6% LOI) layer appears to seal the cultivated soil. No turf layers of constructional origin as found in UK experimental earthworks or at the Gokstad ship burial mound, were observed (Crowther *et al*., 1996; Macphail *et al*., 2013a). The alternating grey and brown soil layers below layer 1052 could relate less to different turf soil layers, than to buried soil compaction and associated perched water tables. The more porous Ap horizon may occur over the less well-draining ice lensed subsoil, for example, and an iron depleted zone thus formed at the junction.

Lastly, the sampled sequence is composed of minerogenic (1.4% LOI) layer and laminated/microlaminated silts and clay. This layer was probably also affected by groundwater fluctuations and a moderately low phosphate content is present (440 ppm P_2O_5), as in the subsoil examples. Washed silts and fine sands contaminate lower soil horizons, along with major microlaminated clay inwash. Without knowing the field geomorphology of the site, it can only be suggested that the cultivated soil was first affected by heightened groundwater levels, with some soil slaking, followed by the effects of overbank flooding and fine alluviation (Kühn, *et al*., 2010; Macphail *et al*., 2010). As noted in the Results, these effects can be typical of freshwater alluvial flooding events, and at the Gudbrandsdalen Valley manured cultivated soils were commonly affected by flooding, with some reworking of byre waste manures (as found at Rom)(Macphail *et al*., 2013b). The field photos of the Rom site suggest major alluvial inundation and sedimentation, inferring a change in river course and/or rise in base levels.

Conclusions

A six bulk soil sample study (LOI, MS, MS550, fractionated P) and an exactly correlated five thin section study of two buried soil monoliths, employing micromorphology, was carried out. A macrofossil investigation of two samples found it to be sterile. The soil study, however, found a gleyed mottled subsoil (AL1389), with a relict history of ice lensing. A manured cultivated soil (AL1159) was identified on the basis of its biological working by earthworms and inclusion of wood charcoal, sometimes probably stained with iron and phosphate, and burned mineral material. It also had an enhanced phosphate content (max 1090 ppm P_2O_5), with PQuotas and magnetic susceptibility indicating manuring with settlement waste that may have included some organic manure; the humic soil shows strong effects of organic matter oxidation. This cultivated soil was sealed by a manuring/midden spread (AL1052 at PM1667) which composed fire cracked siltstone rock (M1670) and coarse charcoal including monocotyledonous plant material (burned straw?)(M1667A). These soil layers again have an enhanced phosphate (510-750 ppm P_2O_5) content and magnetic susceptibility (max MSlf=50). An identification of manured cultivation is consistent with many previous experimental and case studies, especially from southern Norway. Ensuing alluvial flooding led to soil slaking, minor reworking of charcoal, inwash of clayey alluvium and sealing by alluvial laminated silts. No turf layers were observed; colour differences in buried soil layers probably relate to mound compaction, and perched water tables picking out the different porosity characteristics of the buried soils.

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Table 1: Rom vestre 116/103, Tonsberg; chemistry and magnetic susceptibility

Context	Thin section	MSlf	MS550lf	CitP°	CitPOI°	ppm P_2O_5	PQuota	%LOI
x1667/A Laminated silts	M1667A	25	69	63	108	470	1.7	1.4
x1167/B Surface charcoal spread	M1667A	50	95	87	118	510	1.36	3.6
x1167/C Ap horizon	M1667B	32	52	214	250	1090	1.17	2.3
x1167/1389 Subsoil Bg	M1667C	31	410	73	102	440	1.39	1.3
x1670/1052 Surface spread	M1670	23	36	123	172	750	1.4	2.1
x1670/1389 Subsoil Bg	M1670	42	67	64	101	440	1.57	1.5

Low frequency magnetic susceptibility; 2% citric acid extractable phosphate; loss on ignition at 550°C

Table 2: Rom vestre 116/103, Tonsberg; soil micromorphology counts

Monolith	Thin section	Depth	Context	Bulk sample	MFT	SMT	% voids	Gravel
PX1667	M1667A	0-35 mm	Lamin Silts	x1667/A	D1	LamSilts	40%	
PX1667	M1667A	35-50 mm	Charcoal-rich buried soil A1052	x1167/B	C1	2c	35%	f
PX1667	M1667A	50(65)-70 mm	Dark brownish buried soil A1159 upper		B2	2a,2b	40%	f
PX1667	M1667B	70-120 mm	Dark brownish buried soil A1159 middle	x1167/C	B2	2a,2b	40%	f
PX1667	M1667C	120-150 mm	Dark brownish buried soil A1159 lower		B1	2a, 2b, 1a	45%	*
PX1667	M1667C	150-190 mm	Pale greyish brown subsoil AL1389 upper	x1167/1389	A2	1a,2a	35%	*
PX1667	M1667D	190-240 mm	Pale greyish brown subsoil AL1389 lower		A1	1a(2a)	40%	*
PX1670	M1670	20-45 mm	Humic buried soil A1052 (upper)	x1670/1052	C1	2c	55%	ffff
PX1670	M1670	45-95 mm	A1052 /gleyed Bw(g) subsoil? A1389	x1670/1389	B2	2a,2b	40%	*

Table 1, cont

Thin section	Depth	Wood Charcoal	Fe-(P?) charcoal	Monocot Charcoal	Iron fragment	Yell-brown clay infill	V dusty clay infill	Horiz-orien. dusty clay
M1667A	0-35 mm	a				a		
M1667A	35-50 mm	aaaa	aaa	aaaa		aaaa	aaaaa	
M1667A	50(65)-70 mm	aaa	aa			aaaaa	aaaa	
M1667B	70-120 mm	aaa	aa			aaaaa	aaaa	
M1667C	120-150 mm	aa	a			aaa	a	
M1667C	150-190 mm					a	aaa	
M1667D	190-240 mm							aaaa
M1670	20-45 mm	a*				aaaa	aaaa	
M1670	45-95 mm	aaa	aa	a-1	a-1	aaaa	aaaa	

Table 2, cont

Thin section	Depth	Elutriated min infills	Lamin. silts	2ndary Fe	Thin burrows	Broad burrows	Broad Excrements	
M1667A	0-35 mm		aaaaa		aa			
M1667A	35-50 mm	aaa						
M1667A	50(65)-70 mm	aaa		aaaa		aaaa	aaaa	
M1667B	70-120 mm			aaaa		aaaa	aaaa	
M1667C	120-150 mm			aaaa	aaa		(part total)	
M1667C	150-190 mm			aaaaa	aaa	aaa		
M1667D	190-240 mm			aa		aa		
M1670	20-45 mm					(a)		
M1670	45-95 mm	aaa		aaaa		aaaaa	aaaaa	

* - very few 0-5%, f - few 5-15%, ff - frequent 15-30%, fff - common 30-50%, ffff - dominant 50-70%, fffff - very dominant >70%;

a - rare <2% (a*1%; a-1, single occurrence), aa - occasional 2-5%, aaa - many 5-10%, aaaa - abundant 10-20%, aaaaa - very abundant >20%

Table 3: Rom vestre 116/103, Tonsberg; soil micromorphology descriptions and preliminary interpretations

Microfacies type (MFT)/Soil microfabric type (SMT)	Sample No.	Depth (relative depth) Soil Micromorphology (SM)	Preliminary Interpretation and Comments
MFT D1/laminated silts MFT C1/SMT 2c	M1667A	0-35 mm SM: *Microstructure*: Layered (max 6mm), laminated and microlaminated (0.5mm) silts (and clays thin laminae), with channel, 40% voids, channels, horizontal fissures and simple packing voids; *Coarse Mineral*: C:F, 100:0 to 90:10; medium to coarse silts, with very few fine sand; *Coarse Organic and Anthropogenic*: rare fine charcoal at base (reworked from Layer A1052); *Fine Fabric*: *Pedofeatures*: *Textural*: rare yellowish clay infills; *Fabric*: occasional thin burrows. 35-50 mm SM: essentially humic and fine charcoal-rich fine SMT 2c, merging upwards into laminated silts; *Microstructure*: massive and layered, laminated, 35% voids, subhorizontal fissures; *Coarse Mineral*: C:F, 60:40, very poorly sorted with few gravel (max >3.5mm); *Coarse Organic and Anthropogenic*: very abundant coarse wood charcoal (>8mm) and monocotyledonous charcoal (straw?, max 12mm), and many burned granite gravel (max >3.5mm); *Fine Fabric*: as SMT 2b, with very dark speckled brown (PPL), isotropic (close porphyric, undifferentiated b-fabric, XPL), dark yellowish brown (OIL), very abundant very fine charred OM; *Pedofeatures*: *Textural*: very abundant laminated and layered silty clay, matrix soil and abundant	Laminated Silts: Layered (max 6mm), laminated and microlaminated (0.5mm) silts (and clays - thin laminae), with channels, horizontal fissures and simple packing voids. Rare fine charcoal at base (reworked from Layer A1052), rare yellowish clay infills, and occasional thin burrows, are present. *Low-medium energy flooding and alluviation sealed and affected underlying manured cultivated soil and slightly reworked (floated) uppermost manuring layer (A1052).* Charcoal-rich buried soil A1052 Essentially massive and layered, laminated humic and fine charcoal-rich fine soil-sediments, merging upwards into laminated silts. It is very poorly sorted with few gravel (max >3.5mm), and includes very abundant coarse wood charcoal (>8mm) and monocotyledonous charcoal (straw?, max 12mm), and many burned granite gravel (max >3.5mm). Layer is characterised by very abundant laminated and layered silty clay, matrix soil and abundant yellowish to reddish intercalated clay infills, with elutriated

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MFT B2/SMT 2a, 2b		yellowish to reddish intercalated clay infills, with elutriated silty fills; Very irregular boundary. 50(65)-70 mm SM: As MFT B2, below, with very abundant dark matrix infills and later yellowish brown clay infills, and very broad elutriated silts and sands infills.	silty fills. *Here, a manuring layer of burned gravel, wood and straw(?) charcoal – some probably Fe-P stained (byre waste), was locally reworked by flood inundation. Ensuing alluviation occurred.* Dark brownish buried soil A1159 upper: As below, with very abundant dark matrix infills and later yellowish brown clay infills, and very broad elutriated silts and sands infills. *Relict Ap horizon increasing affected by soil slaking and inwash of marine/alluvial clay.*
MFT B2/SMT 2a, 2b	M1667B	70-120 mm SM: Heterogeneous, with dominant SMT 2a and 2b, with frequent more minerogenic areas (elutriated silts and sands); *Microstructure*: massive, with relict crumb, medium prisms and subangular blocky, 40% voids, relict moderately accommodated curved planar voids, chambers, closed polyconcave vughs; *Coarse Mineral*: C:F, as SMT 2a and 2b, with few gravel (max 4mm); *Coarse Organic and Anthropogenic*: many wood charcoal (max 2.5mm), some iron (and P?) stained, with rare burned mineral grains (including calcined granite sand), and anomalous iron nodules (max 3.5 mm); *Fine Fabric*: as SMT 2a and 2b; *Pedofeatures*: many elutriated silts and sands infills; abundant very dark impure clay/matrix void coatings and infills, often associated with later very abundant microlaminated yellowish brown clay infills and coatings (max width 2.5mm); *Amorphous*: abundant impregnative iron mottles affecting fine SMT 2a and 2b; *Fabric*: abundant broad burrows; *Excrements*: abundant relict broad organo-mineral excrements, with partial total excremental fabric.	Dark brownish buried soil A1159 middle: Massive relict humic and minerogenic soil, with relict crumb, medium prisms and subangular blocky microstructure, and porosity including, closed polyconcave vughs. There are few gravel (max 4mm), many wood charcoal (max 2.5mm), some iron (and P?) stained, with rare burned mineral grains (including calcined granite sand), and anomalous iron nodules (max 3.5 mm). Pedofeatures comprise: many elutriated silts and sands infills, abundant very dark impure clay/matrix void coatings and infills, often associated with later very abundant microlaminated yellowish brown clay infills and coatings (max width 2.5mm), abundant impregnative iron mottles affecting fine soil, abundant broad burrows, and abundant relict broad organo-mineral excrements, with partial total excremental fabric. *Relict mixed ploughsoil (Ap horizon) with once-humic soil and subsoil, characterised by manuring inputs of likely iron and phosphate rich byre waste (stained charcoal and iron nodules), and earthworm working. This formed a crumb and blocky structured soil. Inundation, first caused soils to slake (dark matrix soil infills, elutriate – 'washed' – silts and sands), which was followed by marine(?) alluviation (yellowish clay inwash). Waterlogging caused iron mottling.*
MFT B1/SMT 2a, 2b, 1a	M1667C	120-150 mm SM: Moderately homogeneous SMT 2a, 2b with frequent SMT 1a; *Microstructure*: massive with fine and broad channel, 45% voids; *Coarse Mineral*: C:F, SMT 2a-2b, C:F= 80:20; very few small gravel (>2mm); *Coarse Organic and Anthropogenic*: occasional charcoal – some rounded, some ferruginised, with rare rubefied and calcined mineral grains; *Fine Fabric*: SMT 2b – as 2a, with trace of very fine charcoal; *Pedofeatures*: *Textural*: many yellowish microlaminated clay infills; rare dusty clay void infills; *Amorphous*: abundant impregnative iron mottles; *Fabric*: many thin burrows; *Excrements*: partial total excremental fabric.	Dark brownish buried soil A1159 lower: Moderately homogeneous relict weakly once-humic soil, with massive and broad channel microstructure. There are occasional charcoal – some rounded, some ferruginised, with rare rubefied and calcined mineral grains, with trace of very fine charcoal in matrix soil. Also present are many yellowish microlaminated clay infills; rare dusty clay void infills, abundant impregnative iron mottles, many thin burrows, partial total excremental fabric. *Lowermost part of manured, cultivated Ap horizon – with post-depositional effects of alluvial/marine flooding.*

MFT A2/SMT 1a, 2a		150-190 mm SM: heterogeneous with leached silts and sands (SMT 1a) and burrow fills of relict clayey soil (SMT 2a); *Microstructure*: massive with fine and broad channel, 35% voids; channels; *Coarse Mineral*: C:F, as below; very few small gravel (>2mm); *Coarse Organic and Anthropogenic*: trace of fine burned mineral grains; *Fine Fabric*: as SMT 1a and 2a; *Pedofeatures*: rare yellowish microlaminated clay infills; many dusty clay void infills and rare matrix infills; *Amorphous*: very abundant impregnative iron mottles; *Fabric*: many thin and broad burrows.	Pale greyish brown subsoil AL1389 upper: Heterogeneous with leached silts and sands and burrow fills of relict clayey soil; massive with channel microstructure. There is trace of fine burned mineral grains. Upper subsoil is characterised by rare yellowish microlaminated clay infills, many dusty clay void infills and rare matrix infills, very abundant impregnative iron mottles, many thin and broad burrows, and a partial total excremental fabric. *Upper subsoil affected by minor mixing and downwash from overlying cultivated horizon (Ap?), including trace of manuring materials. Trace of alluvial post-depositional clay inwash.*
MFT A1/SMT 1a(2a)	M1667D	190-240 mm SM: slightly heterogeneous with very dominant SMT 1a and few fine clayey SMT 2a (burrow fills); *Microstructure*: massive with relict lamina, 40% voids, horizontal fissures, vughs, and vertical channels; *Coarse Mineral*: C:F (Coarse:Fine limit at 10µm), 85:15 (SMT 1a) and poorly sorted medium and coarse silt, fine to very coarse angular-subangular sand, very few fine gravel (quartz, quartzite, feldspar, weathered mica, granite present); *Coarse Organic and Anthropogenic*: *Fine Fabric*: SMT 1a: dusty grey (PPL), very low interference colours (close porphyric, stipple speckled b-fabric, XPL), pale grey (OIL); SMT 2a: dark brown (PPL), isotropic (close porphyric, undifferentiated b-fabric, XPL), bright orange (OIL), possible relict ferruginsed amorphous OM; *Pedofeatures*: *Textural*: abundant very dusty/impure clay void coatings associated with horizontally oriented vughs and fissures; occasional SMT 1a matrix infills; *Amorphous*: occasional weak to moderate iron impregnative mottles, mainly associated with broad burrow fills of clayey SMT 2a; *Fabric*: occasional broad burrows.	Pale greyish brown subsoil AL1389 lower Slightly heterogeneous with very dominant poorly sorted silt, and fine to very coarse sand, very few fine gravel, with few fine clayey SMT 2a (burrow fills). Massive with relict lamina structure, horizontal fissures, associated with abundant very dusty/impure clay void coatings. Occasional weak to moderate iron impregnative mottles, mainly associated with broad burrow fills of clayey, and occasional broad burrows, are present. *Poorly sorted sterile lower subsoil silts and sands, with history of ice lensing associated with cool conditions. Minor burrowing down of more clayey – once-humic(?) soil – of later formation; generally waterlogged conditions.*
MFT C1/SMT 2c MFT B2/ SMT 2a,2b	M1670	20-45 mm SM: SM: essentially stony, humic and fine charcoal-rich fine SMT 2c; *Microstructure*: massive and layered, laminated, 55% voids, chambers; *Coarse Mineral*: C:F, as SMT 2c, very poorly sorted with very dominant gravel (max >23mm); *Coarse Organic and Anthropogenic*: rare trace of fine charcoal and very abundant burned (fire-cracked) siltstone (max >23mm)(rubefication of iron stained rocks); *Fine Fabric*: as SMT 2c; *Pedofeatures*: *Textural*: abundant laminated and layered silty clay, matrix soil and many yellowish to reddish intercalated clay infills, infilling rare broad burrows (?). Sloping clear boundary. 45-95 mm SM: Heterogeneous, with very dominant SMT 2a and 2b, with very few more minerogenic areas (elutriated silts and sands); *Microstructure*: massive, with welded relict crumb, medium subangular blocky, with possible weakly formed	1052 (x1670) Essentially stony, humic and fine charcoal-rich fine massive and layered, laminated, including burrow fills. It is very poorly sorted with very dominant gravel (max >23mm) - fire-cracked angular siltstone (rubefication of iron stained rocks); there is a rare trace of fine charcoal. Abundant laminated and layered silty clay, matrix soil and many yellowish to reddish intercalated clay infills, infilling rare broad burrows (?), were found. *Presumed midden/manuring spread of fire cracked stones – household waste – with later inundation effects.* 1052 (1389) x1670 Mixed relict humic silts and sands with very few more minerogenic areas (elutriated silts and sands); with massive, with welded relict crumb, medium subangular blocky, with possible weakly

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		laminar, 40% voids, chambers, closed polyconcave vughs, channels and fine possible horizontally oriented fissures; *Coarse Mineral*: C:F, as SMT 2a and 2b, with very few gravel (max 5mm); *Coarse Organic and Anthropogenic*: example of likely iron fragment (1.7mm), many fine wood charcoal (max 1.5mm), some iron (and P?) stained, with possible moncotlyledenous example (1.2mm), occasional burned mineral grains (including calcined granite sand), and occasional anomalous iron nodules (max 2.5 mm); *Fine Fabric*: as SMT 2a and 2b; *Pedofeatures*: *Textural*: many elutriated silts and sands infills, minor laminated; abundant very dark impure clay/matrix void coatings and infills, often associated with later abundant microlaminated yellowish brown clay infills and coatings (max width 2.5mm); *Amorphous*: abundant impregnative iron mottles affecting fine SMT 2a and 2b, plus relict included sharp edge iron nodules; *Fabric*: very abundant broad burrows and occasional fabric intercalations; *Excrements*: very abundant relict broad organo-mineral excrements, with partial total excremental fabric.	formed laminar microstructure. Chambers, closed polyconcave vughs, channels and fine possible horizontally oriented fissures, occur. There is an example of a likely iron fragment (1.7mm), along with many fine wood charcoal (max 1.5mm), some iron (and P?) stained, with possible moncotlyledenous example (1.2mm), occasional burned mineral grains (including calcined granite sand), and occasional anomalous iron nodules (max 2.5 mm). Soil is characterised by many elutriated silts and sands infills, minor laminated, abundant very dark impure clay/matrix void coatings and infills, often associated with later abundant microlaminated yellowish brown clay infills and coatings (max width 2.5mm), with abundant impregnative iron mottles affecting fine humic soil, plus relict included sharp edge iron nodules. Very abundant broad burrows and occasional fabric intercalations and very abundant relict broad organo-mineral excrements, with partial total excremental fabric, occur. *Cultivated Ap horizon with manuring material including burned sand, an iron fragment, charcoal (wood and possible straw example) and probable iron-phosphate stained charcoal, with enigmatic iron nodules, some probably of*

			byre waste origin. Later waterlogging led to iron impregnation and weak ice lensing may also have been recorded.

Rom vestre 116/103, Tonsberg; Soil Micromorphology Figures 1-17

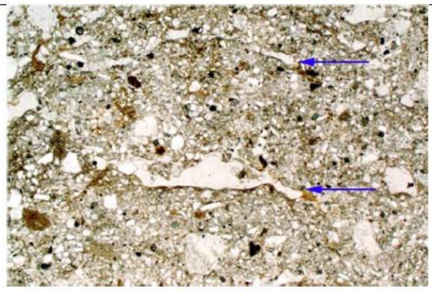


Fig. 1: Photomicrograph of thin section M1667D (Lower Context 1389); leached silty soil with horizontally oriented fissures of probable ice lensing origin. Plane polarised light (PPL), frame width is ~4.62mm.

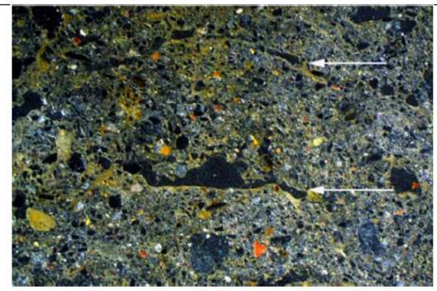


Fig. 2: As Fig, under oblique incident light (OIL), illustrating generally iron-depleted nature, with minor mottling.

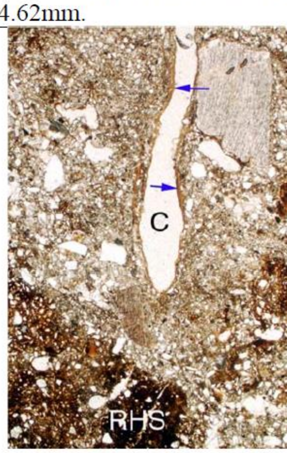


Fig. 3: Photomicrograph of thin section M1667C (Upper Context 1389); iron-depleted leached subsoil, with broad burrow fill of relict humic soil (RHS) – from overlying cultivated Context A1159; note semi-collapsed vertical channel (C) and associated brown clayey coatings (arrows) associated with site flooding. PPL, frame height is ~4.62mm.

Fig. 4: As Fig 3, under OIL.

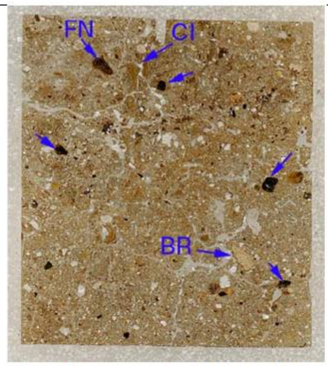


Fig. 5: Scan of thin section M1667B (Context 1159); manured cultivated soil with relict humic content, semi-collapsed crumb and fine blocky (earthworm-worked) structure, with burned rocks (BR), iron and phosphate(?) stained charcoal (arrows) and enigmatic iron nodules (IN). Later flooding led to major yellowish brown clay inwash (CI). Frame width is ~50mm.

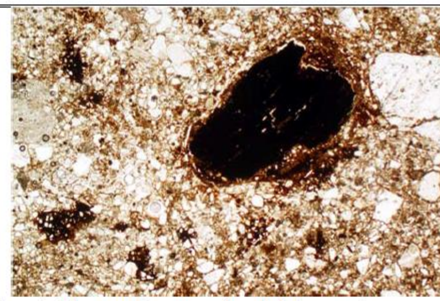


Fig. 6: Photomicrograph of thin section M1667B (Context 1159); relict humic cultivated soil with iron staining of fine soil and Fe-P stained charcoal (byre waste?). PPL, frame width is ~4.62mm.

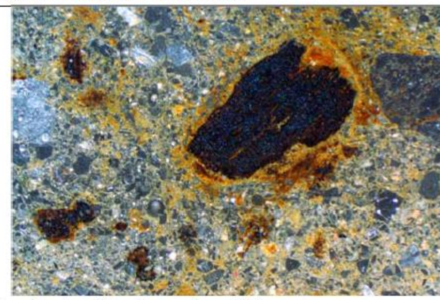


Fig. 7: As Fig 6, under OIL.

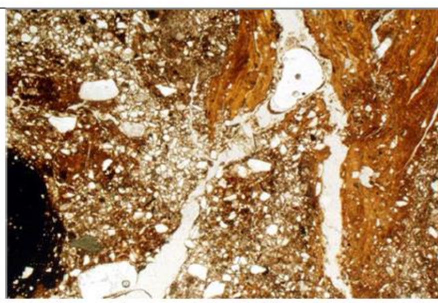


Fig. 8: Photomicrograph of thin section M1667B (Context 1159); cultivated soil with included iron-phosphate stained charcoal. later alluvial flooding led to thick microlaminated yellowish brown clay inwash (see Fig 5). PPL, frame width is ~4.62mm.

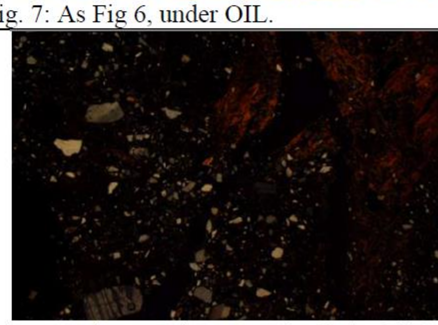


Fig. 9: As Fig 8, under crossed polarised light (XPL); note interference colours of laminated clay inwash.

Fig. 10: Scan of M1667A; laminated flood silts over manuring spread A1052 and buried cultivated and manured A1159. Frame width is ~50mm.

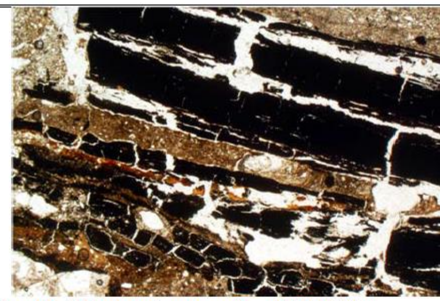


Fig. 11: Photomicrograph of M1667A; manuring spread A1052 includes coarse monocotyledonous (straw?) charcoal; note brown clayey infills. PPL, frame width is ~4.62mm.

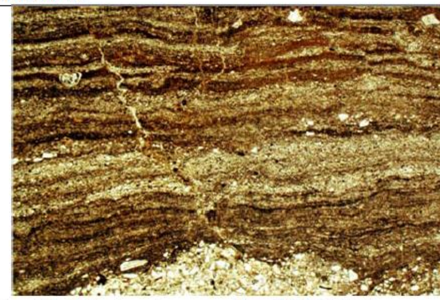


Fig. 12: Photomicrograph of M1667A; laminated silts – microlaminated silts and clay layer. PPL, frame width is ~4.62mm.

Fig. 13: As Fig 12, under XPL.

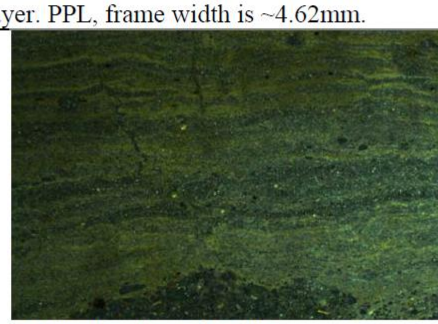


Fig. 14: As Fig 12, under OIL.

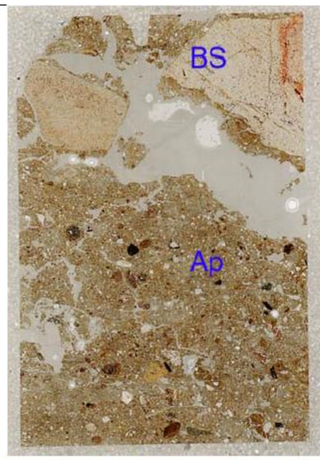


Fig. 15: Scan of M1670; upper layer 1052 is composed of coarse burned siltstone (BS) rock fragments with lower 1052 being essentially a once humic cultivated soil (Ap horizon), manured with byre and household waste. Frame width is ~50mm.

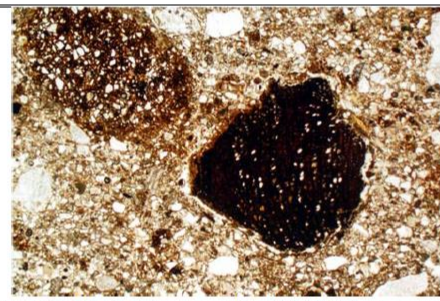


Fig. 16: Photomicrograph of M1670; lower layer 1052; biologically homogenised once-humic soil with stained charcoal (lower) and enigmatic iron nodule (upper). PPL, frame width is ~4.62mm.

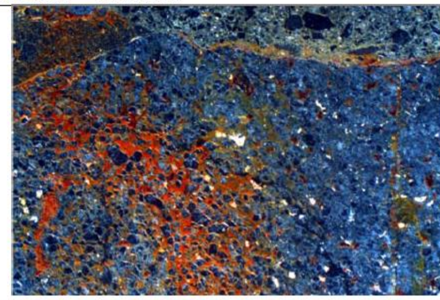
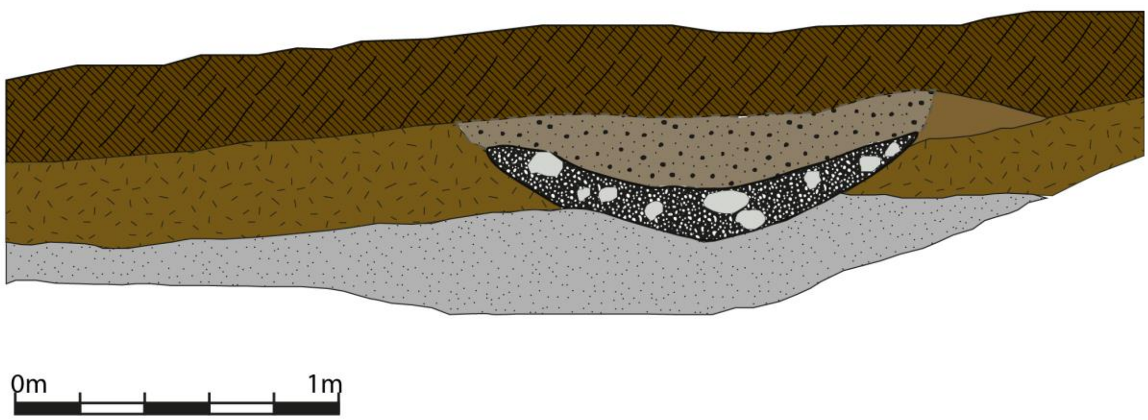


Fig. 17: Photomicrograph of M1670; upper layer 1052, with burned – rubefied siltstone rock (see Fig 15). OIL, frame width is ~4.62mm.

12.5 ILLUSTRATIONS

Rom Vestre, 113/106, Tønsberg k., Vestfold
Søndre profil av fotgrøft
Tegnet av: JKØA
Rentegnet av: JLM
Dato: 11.03.2014
Målestokk: 1: 20

3C1671



Matjord - dagens pløyelag

Lik A1412. Brungul siltblandet leirejord

AL1334. Grå, kullblandet leire. Enkelte biter med brent leire.
Har makrofossilprøve (PM1674).

AL1450. Tett kullag med oppsprukne biter av skjørbrent stein. Grusholdig, noe brent leire.
Har kullprøve (PK1673).

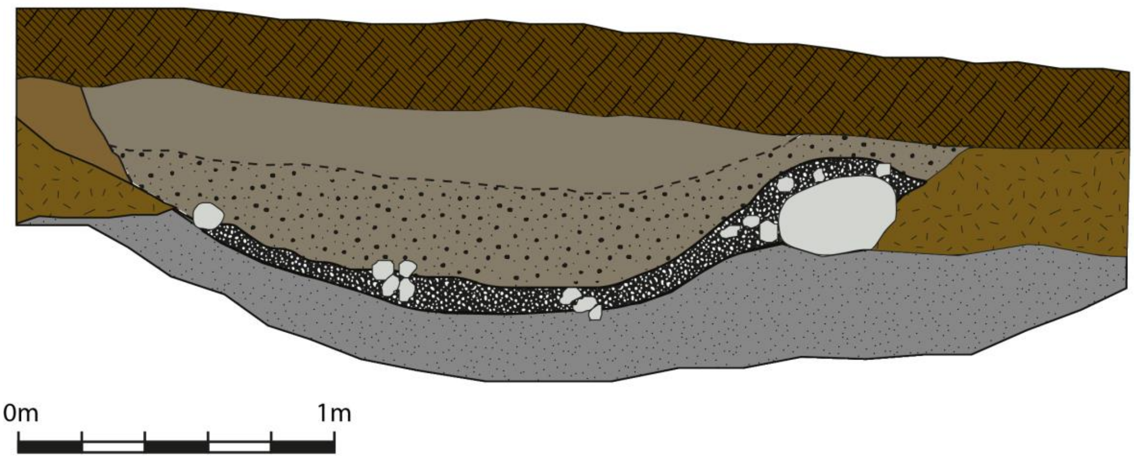
Lik AL1235, men med mindre jernutfelling og uten ardspor.
Gulbrun spettet undergrunnsleire.

AL1594. Blågrå, brunspettet undergrunnsleire. Svært kompakt og klebrig.

Rom Vestre, 113/106, Tønsberg k., Vestfold
Nordre profil av fotgrøft
Tegnet av: JKØA
Rentegnet av: JLM
Dato: 11.03.2014
Målestokk: 1: 20

N

3C1675



Matjord - dagens pløyelag

Lag A1412. Brungul siltblandet leirejord - trolig eroderte jordmasser fra gravhaug.

Lik A1334. Relasjonen mellom disse kunne ikke observeres i plan, kun i profil. Består av gråbrun siltblandet leire, noe kullspettet.

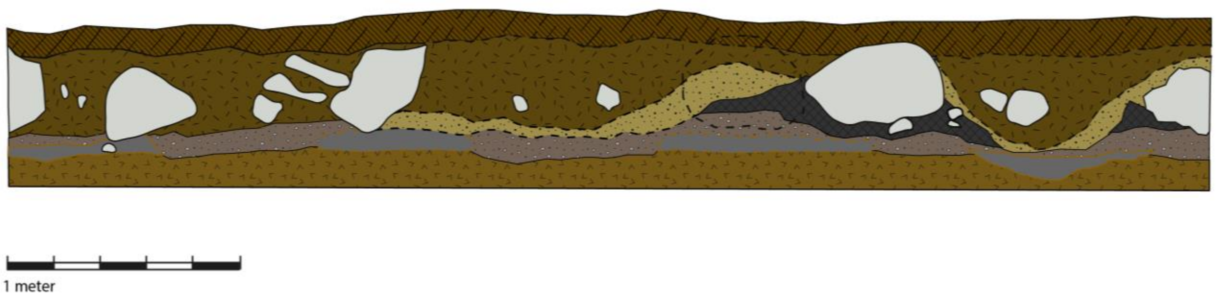
AL1334. Grå, kullblandet leire. Enkelte biter med brent leire

AL1450. Tett kullag med oppsprukne biter av skjørbrent stein. Grusholdig, noe brent leire. Har kullprøve (PK1677).

Lik AL1235, men med mindre jernutfelling og uten ardspor. Gulbrun spettet undergrunnsleire

AL1594. Blågrå, brunspettet undergrunnsleire. Svært kompakt og klebrig

Rom Vestre, 113/106, Tønsberg k., Vestfold
NØ profil i utvidet del av sjakt
Tegnet av: JLM
Rentegnet av: JLM
Dato: 11.03.2014
Målestokk: 1: 20



Matjord - dagens pløyelag

A1291. Medium brun leirblandet og humøs silt. Representerer trolig omblandet matjordsmasser, iblandet orginal haugfyll. Trolig forårsaket av gjentatt oppdratt stein fra pløying.

Lysere lommer med leirblandet silt lagt rundt enkelte stein. Mulig vannavsatt. Kompakt og homogent, men diffus overgang mellom siltlommer og A1291 enkelte steder.

Flekkete kullag iblandet oppsprukne biter med skjørbrent stein. Lik A939 i hovedsjakta. Kullaget er kun observert i profil og ikke i flaten. Har kullprøve PK1668.

Gråbrun, grus- og noe kullflekket leirholdig silt. Svært kompakt og klebrig. Representerer trolig fortsettelse av A1052 fra hovedsjakten. Innmålt som A1355 i utvidelsessjakta. Karakteriseres ved mye jernutfelling. Har makrofossilprøve PM1669.

Del av A1355. Områder med særlig konsentrasjon av grått kompakt feit lag forseglet med jevn kant av jernutfelling.

A1389, lik A1235 i hovedsjakta. Lag med ardspor sammensmelted med A1630, steril undergrunn. Avgrensingen mellom laget med ardsspor (A1389) og A1630 var svært diffus og umulig å observere i profil. Lagene karakteriseres av å være lys gulbrun homogen siltholdig leire. Svært kompakt og jevnt spettet med jernutfelling.

12.6 TABLE OF PHOTOGRAPHIC DOCUMENTATION

Filnavn	Motiv	Retning	Fotograf	Dato
Cf34745_001.JPG	Oversiktsbilde før avdekking	NV	Magnar Mojaren Gran	12.08.2013
Cf34745_002.JPG	Oversiktsbilde før avdekking	SØ	Magnar Mojaren Gran	12.08.2013
Cf34745_003.JPG	Oversiktsbilde før avdekking	N	Magnar Mojaren Gran	12.08.2013
Cf34745_005.JPG	Påbegynt åpning av sjakt	SV	Julie K.Ø. Askjem	12.08.2013
Cf34745_006.JPG	Påbegynt åpning av sjakt	SV	Julie K.Ø. Askjem	12.08.2013
Cf34745_008.JPG	Arbeidsbilde, avdekking av steinpakning	SØ	Jessica Leigh McGraw	12.08.2013
Cf34745_009.JPG	Besøk, formidling til presse	SV	Julie K.Ø. Askjem	12.08.2013
Cf34745_011.JPG	Oversiktsbilde, sjakt m/fotgrøft	V	Julie K.Ø. Askjem	12.08.2013
Cf34745_012.JPG	Oversiktsbilde, sjakt m/fotgrøft	Ø	Jessica Leigh McGraw	13.08.2013
Cf34745_032.JPG	Oversiktsbilde, fotgrøft	SV	Julie K.Ø. Askjem	13.08.2013
Cf34745_042.JPG	Oversiktsbilde, hele sjakta etter rensing av matjord	SV	Julie K.Ø. Askjem	13.08.2013
Cf34745_044.JPG	Oversiktsbilde, hele sjakta etter rensing av matjord	SV	Julie K.Ø. Askjem	13.08.2013
Cf34745_047.JPG	Oversiktsbilde, hele sjakta etter rensing av matjord	SV	Julie K.Ø. Askjem	13.08.2013
Cf34745_049.JPG	Oversiktsbilde, hele sjakta etter rensing av matjord	SV	Julie K.Ø. Askjem	13.08.2013
Cf34745_051.JPG	Arbeidsbilde, metallsøking under fjerning av 604	SSØ	Jessica Leigh McGraw	14.08.2013
Cf34745_052.JPG	Arbeidsbilde, fjerning av stein med klo	N	Jessica Leigh McGraw	14.08.2013
Cf34745_053.JPG	Arbeidsbilde, fjerning av stein med klo	NØ	Jessica Leigh McGraw	14.08.2013
Cf34745_054.JPG	Oversiktsbilde av mulig plyndringsgrop, lag med mindre bruddstein i vestlige del av sjakt	SØ	Julie K.Ø. Askjem	14.08.2013
Cf34745_055.JPG	Oversiktsbilde av relasjonen mellom mulig plyndringsgrop og intakte haugmasser	SØ	Julie K.Ø. Askjem	14.08.2013
Cf34745_061.JPG	Oversiktsbilde av hele steinpakning innenfor sjakta	Sv	Julie K.Ø. Askjem	14.08.2013
Cf34745_063.JPG	Arbeidsbilde, Petra og Julie i sjakt	SØ	Jessica Leigh McGraw	14.08.2013
Cf34745_064.JPG	Arbeidsbilde, metallsøking av matjord rett ved sjakt, med Magnar og Jan Fredrik	N	Jessica Leigh McGraw	14.08.2013
Cf34745_065.JPG	Arbeidsbilde, Petra dokumenterer	Ø	Julie K.Ø. Askjem	14.08.2013
Cf34745_066.JPG	Arbeidsbilde, fjerning av A692	NV	Jessica Leigh McGraw	14.08.2013
Cf34745_067.JPG	Arbeidsbilde, fjerning av A692	NV	Jessica Leigh McGraw	14.08.2013
Cf34745_069.JPG	Første observasjon av kull under stein (A939)	NØ	Julie K.Ø. Askjem	15.08.2013
Cf34745_070.JPG	Journalist fra Tønsberg Blad filmer	N	Julie K.Ø. Askjem	15.08.2013
Cf34745_071.JPG	Mørk grålig lag i nordre profil (A1052)	N	Julie K.Ø. Askjem	15.08.2013
Cf34745_072.JPG	In situ, funn av gullring ved metallsøking	NV	Julie K.Ø. Askjem	16.08.2013

Filnavn	Motiv	Retning	Fotograf	Dato
Cf34745_073.JPG	Detaljfoto, gullring m/målestokk	NV	Julie K.Ø. Askjem	16.08.2013
Cf34745_074.JPG	Detaljfoto, gullring	NV	Julie K.Ø. Askjem	16.08.2013
Cf34745_076.JPG	Arbeidsbilde, Rensing av profiler og rensing av flater	NØ	Julie K.Ø. Askjem	16.08.2013
Cf34745_077.JPG	Oversiktsbilde, bruddstein delvis fjernet fra antatt plyndringsgrop	V	Jessica Leigh McGraw	16.08.2013
Cf34745_079.JPG	Detaljfoto, treverk med tegl i blåleire, hjørnet av antatt plyndringsgrop	NØ	Julie K.Ø. Askjem	16.08.2013
Cf34745_080.JPG	Detaljfoto, treverk med tegl i blåleire, hjørnet av antatt plyndringsgrop, med graveklo	NØ	Julie K.Ø. Askjem	16.08.2013
Cf34745_081.JPG	Arbeidsbilde, Terje Gansum nede i antatt prlyndringsgrop	S	Julie K.Ø. Askjem	16.08.2013
Cf34745_082.JPG	Arbeidsbilde, Terje Gansum nede i antatt prlyndringsgrop, mye treverk	N	Julie K.Ø. Askjem	16.08.2013
Cf34745_083.JPG	Detaljfoto, treverk i bunn av antatt plyndringsgrop	S	Julie K.Ø. Askjem	16.08.2013
Cf34745_084.JPG	Arbeidsbilde, mye regn og forsøksvis rensing av treverk i bunn av antatt plyndringsgrop	SSØ	Julie K.Ø. Askjem	16.08.2013
Cf34745_085.JPG	Tilstandsbilde, sjakta etter opprensing og regnskyll	Ø	Jessica Leigh McGraw	19.08.2013
Cf34745_086.JPG	Oversiktsbilde, treverk tildekket og relasjon mellom antatt plyndringsgrop og intakt gravhaug. A939 synlig til venstre	S	Julie K.Ø. Askjem	19.08.2013
Cf34745_087.JPG	Oversiktsbilde, kullag A939 etter fjerning av steinpakning	S	Julie K.Ø. Askjem	19.08.2013
Cf34745_088.JPG	Oversiktsbilde, lag med treverk tildekket	V	Julie K.Ø. Askjem	19.08.2013
Cf34745_089.JPG	Arbeidsbilde, påbegynt rensing av treverk	NØ	Jessica Leigh McGraw	19.08.2013
Cf34745_090.JPG	Tilstandsbilde, vann i bunn av forstyrrelsen, med trelag	N	Julie K.Ø. Askjem	20.08.2013
Cf34745_091.JPG	Oversiktsbilde, bunn av forstyrrelsen (potet-kjeller), med lineær NV-SØ orientert steinmur	SØ	Julie K.Ø. Askjem	20.08.2013
Cf34745_092.JPG	Oversiktsbilde, bunn av forstyrrelsen (potet-kjeller), med lineær NV-SØ orientert steinmur	SØ	Julie K.Ø. Askjem	20.08.2013
Cf34745_093.JPG	Arbeidsbilde, Jan Bill og Terje Gansum undersøker trelaget	N	Julie K.Ø. Askjem	20.08.2013
Cf34745_094.JPG	Arbeidsbilde, Jan Bill og Terje Gansum undersøker trelaget	N	Julie K.Ø. Askjem	20.08.2013
Cf34745_095.JPG	Hjørnet av trelag (NØ) renset frem	Ø	Julie K.Ø. Askjem	20.08.2013
Cf34745_096.JPG	Hele trelaget. Planker ovenfor lagt ned for beskyttelse under opprensning	Ø	Julie K.Ø. Askjem	20.08.2013
Cf34745_097.JPG	Petra og Jan renser	N	Julie K.Ø. Askjem	20.08.2013
Cf34745_100.JPG	Oversiktsbilde, sjakt mot fotgrøft	Ø	Julie K.Ø. Askjem	20.08.2013

Filnavn	Motiv	Retning	Fotograf	Dato
Cf34745_101.JPG	Nærbilde av trelag (A1092).	S	Julie K.Ø. Askjem	20.08.2013
Cf34745_102.JPG	Nærbilde av trelag (A1092).	NV	Jessica Leigh McGraw	20.08.2013
Cf34745_103.JPG	Nærbilde av trelag (A1092).	NV	Jessica Leigh McGraw	20.08.2013
Cf34745_104.JPG	Nærbilde av trelag, med tegl (A1092).	NV	Jessica Leigh McGraw	20.08.2013
Cf34745_105.JPG	Oversiktsbilde, profil, med trelag i front	SV	Jessica Leigh McGraw	20.08.2013
Cf34745_106.JPG	Oversiktsbilde, steinmur, trelag og bruddstein	V	Julie K.Ø. Askjem	20.08.2013
Cf34745_107.JPG	Oversiktsbilde, steinmur, trelag og bruddstein	V	Julie K.Ø. Askjem	20.08.2013
Cf34745_108.JPG	Oversiktsbilde, sjakt ned mot fortgrøft	Ø	Julie K.Ø. Askjem	20.08.2013
Cf34745_109.JPG	Oversiktsbilde, flate treplanker fjernet og eksponert avrundede tverrgående trebjelker, med A1127	V	Julie K.Ø. Askjem	20.08.2013
Cf34745_111.JPG	Oversiktsbilde, flate treplanker fjernet og eksponert avrundede tverrgående trebjelker, med A1127	Ø	Julie K.Ø. Askjem	20.08.2013
Cf34745_114.JPG	Oversiktsbilde, flate treplanker fjernet og eksponert avrundede tverrgående trebjelker, med A1127	S	Julie K.Ø. Askjem	20.08.2013
Cf34745_115.JPG	Oversiktsbilde, flate treplanker fjernet og eksponert avrundede tverrgående trebjelker, etter A1127 er fjernet	V	Julie K.Ø. Askjem	21.08.2013
Cf34745_116.JPG	Oversiktsbilde, flate treplanker fjernet og eksponert avrundede tverrgående trebjelker, etter A1127 er fjernet	V	Julie K.Ø. Askjem	21.08.2013
Cf34745_117.JPG	Oversiktsbilde, overflaten mellom sjakt og potetkjeller	V	Julie K.Ø. Askjem	21.08.2013
Cf34745_121.JPG	Arbeidsbilde, fjerning av trebjelker	NØ	Jessica Leigh McGraw	21.08.2013
Cf34745_122.JPG	Arbeidsbilde, fjerning av trebjelker	NØ	Jessica Leigh McGraw	21.08.2013
Cf34745_123.JPG	Arbeidsbilde, fjerning av trebjelker	NØ	Jessica Leigh McGraw	21.08.2013
Cf34745_124.JPG	Oversiktsbilde, etter fjerning av trebjelker	NØ	Julie K.Ø. Askjem	21.08.2013
Cf34745_125.JPG	Detaljfoto, trebjelker	S	Julie K.Ø. Askjem	21.08.2013
Cf34745_126.JPG	Detaljfoto, trebjelker	S	Julie K.Ø. Askjem	21.08.2013
Cf34745_127.JPG	Arbeidsbilde, metallsøking i bunn av potetkjeller	Ø	Jessica Leigh McGraw	21.08.2013
Cf34745_128.JPG	Arbeidsbilde, metallsøking i bunn av potetkjeller	SØ	Julie K.Ø. Askjem	21.08.2013
Cf34745_129.JPG	Arbeidsbilde, Petra tar målinger av PH-verdi og vannmetning i blåleira	NØ	Julie K.Ø. Askjem	21.08.2013
Cf34745_130.JPG	Arbeidsbilde, avventer målinger	NV	Julie K.Ø. Askjem	22.08.2013

Filnavn	Motiv	Retning	Fotograf	Dato
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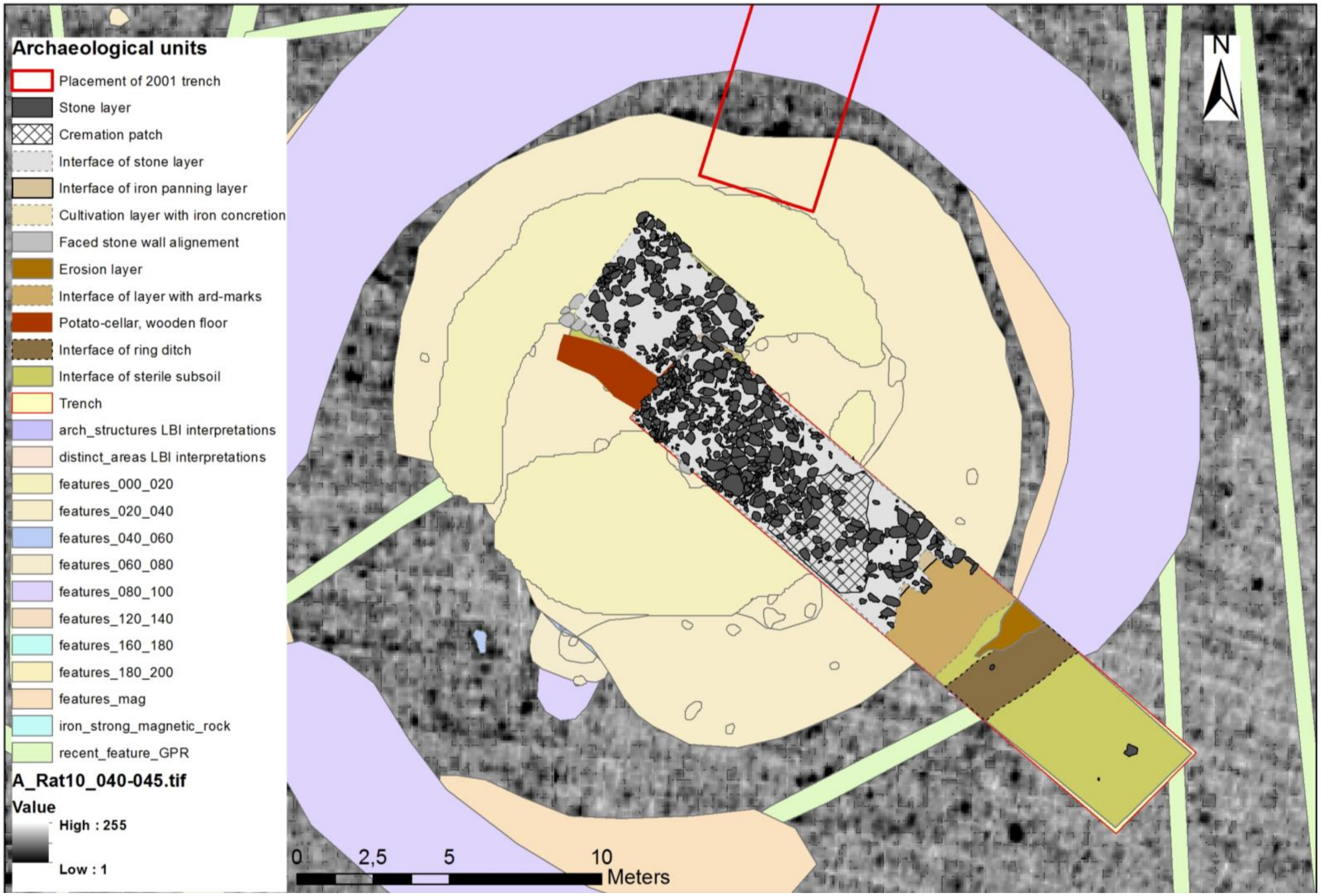
Cf34745_132.JPG	Arbeidsbilde, avventer målinger	SØ	Magnar Mojaren Gran	22.08.2013
Cf34745_133.JPG	Arbeidsbilde, Jan Fredrik med gravemaskin	Ø	Magnar Mojaren Gran	22.08.2013
Cf34745_134.JPG	Oversiktsbilde, A1235, lag med ard spor	SV	Magnar Mojaren Gran	22.08.2013
Cf34745_135.JPG	Oversiktsbilde, A1235, lag med ard spor	SV	Magnar Mojaren Gran	22.08.2013
Cf34745_140.JPG	Oversiktsbilde, A1235, lag med ard spor	Ø	Magnar Mojaren Gran	22.08.2013
Cf34745_143.JPG	Oversiktsbilde, lag (A1235) med ard-spor.	Ø	Magnar Mojaren Gran	22.08.2013
Cf34745_144.JPG	Profilbilde, østlige del av sjakt	SØ	Magnar Mojaren Gran	22.08.2013
Cf34745_148.JPG	Profilbilde, østlige del av sjakt	Ø	Magnar Mojaren Gran	22.08.2013
Cf34745_151.JPG	Oversiktsbilde, bunn av potetkjeller	S	Magnar Mojaren Gran	22.08.2013
Cf34745_152.JPG	Oversiktsbilde, bunn av potetkjeller	V	Julie K.Ø. Askjem	22.08.2013
Cf34745_153.JPG	Detaljbilde, lag (A1235) med ard-spor.	Ø	Julie K.Ø. Askjem	22.08.2013
Cf34745_155.JPG	Profilbilde, NV hjørnet av sjakt før utvidelse	NV	Jessica Leigh McGraw	22.08.2013
Cf34745_156.JPG	Oversiktsbilde, NV utvidelse av hovedsjakt. Etter fjerning av torv og rensing av flate	SV	Jessica Leigh McGraw	22.08.2013
Cf34745_158.JPG	Detaljfoto, stein fra gravhaug sekundært dumpet i en skråning 162 m lenger øst for gravhaug	Ø	Jessica Leigh McGraw	22.08.2013
Cf34745_159.JPG	Detaljfoto, stein i fotgrøft. Påbegynt fjerning av jordmasser A1334	SØ	Petra Schneidhofer	22.08.2013
Cf34745_166.JPG	Oversiktsbilde, lag 1389 i utvidelsessjakta. Samme som A1052 i hovedsjakta	S	Terje Gansum	22.08.2013
Cf34745_168.JPG	Arbeidsbilde, under fjerning av 1334 i fotgrøft	Ø	Petra Schneidhofer	22.08.2013
Cf34745_170.JPG	Oversiktsbilde, A1450, kullag i bunn av fotgrøft	Ø	Petra Schneidhofer	22.08.2013
Cf34745_171.JPG	Oversiktsbilde, A1450, kullag i bunn av fotgrøft	Ø	Petra Schneidhofer	22.08.2013
Cf34745_172.JPG	Oversiktsbilde, steinmur (1512) og 1489	S	Julie K.Ø. Askjem	23.08.2013
Cf34745_173.JPG	Oversiktsbilde, steinmur (1512) og 1489	S	Julie K.Ø. Askjem	23.08.2013
Cf34745_174.JPG	Oversiktsbilde, mot fotgrøft og scanner	Ø	Julie K.Ø. Askjem	23.08.2013
Cf34745_175.JPG	Profil, østlige del av utvidelse	Ø	Jessica Leigh McGraw	23.08.2013
Cf34745_176.JPG	Fjerning av steinmur (1512), skille i blåleira	NV	Julie K.Ø. Askjem	26.08.2013
Cf34745_177.JPG	Fjerning av steinmur (1512), skille i blåleira	NV	Julie K.Ø. Askjem	26.08.2013
Cf34745_180.JPG	Oversiktsbilde, delvis fjerning av kullag (1450) i fotgrøft	V	Julie K.Ø. Askjem	26.08.2013

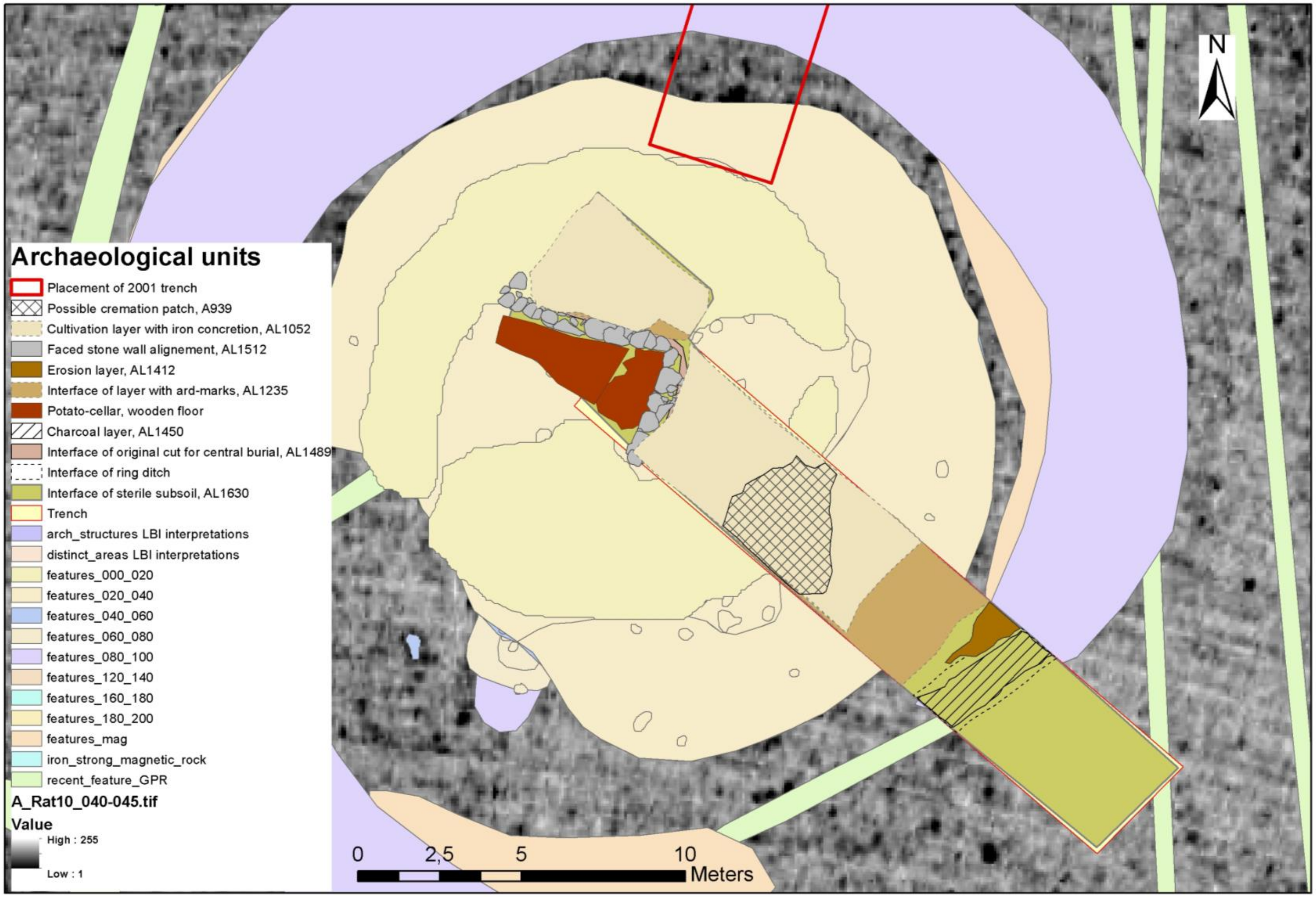
Filnavn	Motiv	Retning	Fotograf	Dato
Cf34745_181.JPG	Oversiktsbilde, delvis fjerning av kullag (1450) i fotgrøft	V	Julie K.Ø. Askjem	26.08.2013
Cf34745_182.JPG	Oversiktsbilde, hele sjakta mot potetkjeller	V	Julie K.Ø. Askjem	26.08.2013
Cf34745_184.JPG	Oversiktsbilde, etter fjerning av A1450 i fotgrøft	V	Julie K.Ø. Askjem	26.08.2013
Cf34745_186.JPG	Oversiktsbilde, sjakt og bortgravd potetkjeller	Ø	Jessica Leigh McGraw	26.08.2013
Cf34745_187.JPG	Oversiktsbilde, bunn av potetkjeller, sett ovenfra	N	Julie K.Ø. Askjem	26.08.2013
Cf34745_188.JPG	Oversiktsbilde, bunn av potetkjeller, sett ovenfra	N	Julie K.Ø. Askjem	26.08.2013
Cf34745_190.JPG	Legging av duk og gjenfylling av vestre del av sjakt	SV	Jessica Leigh McGraw	27.08.2013
Cf34745_191.JPG	Legging av duk og gjenfylling av vestre del av sjakt	SV	Jessica Leigh McGraw	27.08.2013
Cf34745_199.JPG	Del av sørlige profil av hovedsjakt, synlig kutt ved lag 1052	S	Julie K.Ø. Askjem	27.08.2013
Cf34745_200.JPG	Del av sørlige profil av sjakt, serie tatt fra vest mot øst	S	Julie K.Ø. Askjem	27.08.2013
Cf34745_201.JPG	Del av sørlige profil av sjakt, serie tatt fra vest mot øst	S	Julie K.Ø. Askjem	27.08.2013
Cf34745_202.JPG	Del av sørlige profil av sjakt, serie tatt fra vest mot øst	S	Julie K.Ø. Askjem	27.08.2013
Cf34745_203.JPG	Del av sørlige profil av sjakt, serie tatt fra vest mot øst	S	Julie K.Ø. Askjem	27.08.2013
Cf34745_204.JPG	Del av sørlige profil av sjakt, serie tatt fra vest mot øst	S	Julie K.Ø. Askjem	27.08.2013
Cf34745_205.JPG	Del av sørlige profil av sjakt, serie tatt fra vest mot øst	S	Julie K.Ø. Askjem	27.08.2013
Cf34745_206.JPG	Del av sørlige profil av sjakt, serie tatt fra vest mot øst	S	Julie K.Ø. Askjem	27.08.2013
Cf34745_208.JPG	Del av sørlige profil av sjakt, serie tatt fra vest mot øst	S	Julie Karina Øhre Askjem	27.08.2013
Cf34745_209.JPG	Del av sørlige profil av sjakt, serie tatt fra vest mot øst	S	Julie K.Ø. Askjem	27.08.2013
Cf34745_210.JPG	Del av sørlige profil av sjakt, serie tatt fra vest mot øst	S	Julie K.Ø. Askjem	27.08.2013
Cf34745_211.JPG	Del av sørlige profil av sjakt, nærbilde av kutt	S	Jessica Leigh McGraw	27.08.2013
Cf34745_212.JPG	Del av sørlige profil av sjakt, nærbilde av kutt	S	Jessica Leigh McGraw	27.08.2013
Cf34745_213.JPG	Del av sørlige profil av sjakt, serie tatt fra vest mot øst	S	Jessica Leigh McGraw	27.08.2013
Cf34745_215.JPG	Potetkjeller delvis gjenfylt	S	Jessica Leigh McGraw	27.08.2013
Cf34745_216.JPG	Større utsnitt av profil	S	Jessica Leigh McGraw	27.08.2013
Cf34745_217.JPG	Profilbilde av 3C1657, nordlige profil i utvidelsessjakta	N	Jessica Leigh McGraw	27.08.2013
Cf34745_218.JPG	Nærbilde, detalj i profil 3C1657, fra øst mot vest	N	Jessica Leigh McGraw	27.08.2013
Cf34745_219.JPG	Nærbilde, detalj i profil 3C1657, fra øst mot vest	N	Jessica Leigh McGraw	27.08.2013
Cf34745_220.JPG	Nærbilde, detalj i profil 3C1657,	N	Jessica Leigh McGraw	27.08.2013

Filnavn	Motiv	Retning	Fotograf	Dato
	fra øst mot vest			
Cf34745_221.JPG	Nærbilde, detalj i profil 3C1657, fra øst mot vest	N	Jessica Leigh McGraw	27.08.2013
Cf34745_222.JPG	Bilde av mikromorfologisk prøve i profil	N	Jessica Leigh McGraw	27.08.2013
Cf34745_223.JPG	Profil 3C1675, nordre profil av fotgrøft	N	Julie K.Ø. Askjem	27.08.2013
Cf34745_224.JPG	Profil 3C1671, sørlige profil av fotgrøft	S	Julie K.Ø. Askjem	27.08.2013
Cf34745_225.JPG	Profilbilde av 3C1657, nordlige profil i utvidelsessjakta	N	Jessica Leigh McGraw	27.08.2013

12.7 MAPS



Overview of archaeological units inside trench, including stone layer. Map produced by Jessica L. McGraw, KHM, UiO.



Overview of archaeological units in trench after removal of stone layer. Map produced by Jessica L. McGraw, KHM, UiO.

12.8 REPORT ON 3D-RECONSTRUCTION

Report on the 3D reconstruction of the excavation at Rom burial mound in Vestfold County, Norway

Report

December 2014

FIELD WORK

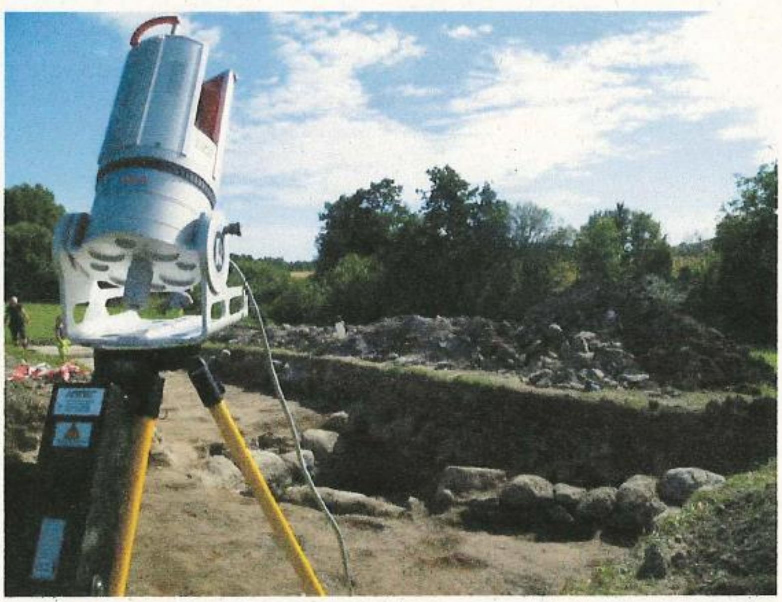
Petra Schneidhofer, Jessica Leigh McGraw, Magnar Mojaren Gran, Christer Tonning, Julie Øhre Askjem, Lars Gustavsen

DATA PROCESSING AND VISUALISATION

Petra Schneidhofer, Erich Nau

REPORT

Petra Schneidhofer



Ludwig Boltzmann Institut
Archäologische Prospektion und Virtuelle Archäologie

Ludwig Boltzmann Institute for Archaeological Prospection & Virtual Archaeology

Hohe Warte 38
A-1190 Vienna
Austria

Phone +43 1 36026 3001
+ 43 664 60277 40304

Contents

Introduction

In August 2013, Rom burial mound located in the Slagen Valley, Province Vestfold, was partially excavated by the Museum of Cultural History Oslo (UiO) and the Vestfold fylkeskommune. The excavation was part of a heritage management plan of action regarding the type and preservation status of the burial mound. In collaboration with the Austrian Ludwig Boltzmann Institute for Archaeological Prospection and Virtual Archaeology, the excavation process was digitally documented using the single surface approach with a 3D laser scanner. The three-dimensional documentation enabled the virtual reconstruction of the excavated part of the mound. In October 2014, the data were further processed and integrated into a 3D model. This report summarises the chosen methodology and results.

Chosen Methodology

Terrestrial laser scanning

3D laser scanners permit the recording of three-dimensional information of surfaces at high speed and resolution. The measurement is based on the time of flight of a laser pulse combined with an opto-mechanical scanning unit measuring distance, vertical and horizontal angle of a target. The result is thus a 3D point cloud of the scanned surface usually composed of a very large number of points or vertices. Each vertex corresponds to a single laser distance measurement. Geometrical data are frequently extended by additional vertex descriptors containing information on surface reflectivity, surface color and signal intensity. Post-processing procedures are varying for different applications, but usually include data cleaning, data filtering and meshing or triangulating the point cloud to obtain a digital terrain model. A high resolution digital camera is mounted on top of the scanner body and delivers color information for every vertex. This information can be used for texturing of triangulated point clouds or triangulated surface models.

For complete documentation of an object, usually multiple scan positions are required to avoid shaded areas where no data could be acquired. Positions are linked within the scanner coordinate system through automatically detected retro-reflective targets. To convert the scanner coordinate system to a global coordinate system, targets are surveyed using a total station or RTK GPS.

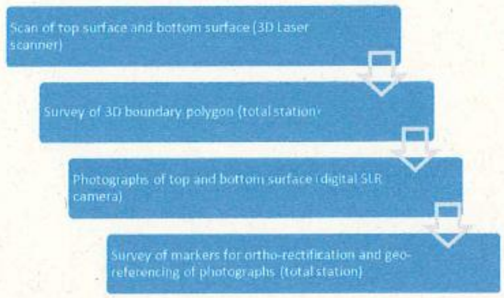
3D single surface documentation

Every archaeological site is stratified. Stratigraphical units (SU) consist of either deposit or immaterial surfaces. An archaeological deposit is a material volume that can be documented in 3D by mapping its outer hull. Naturally, most deposits are completely or partially buried and access to their complete hull is limited. In order to fully record a deposit, the documentation process has to be divided into successive steps. During the stratigraphic excavation process, the stratigraphically youngest unit is identified by its exposed top surface, which subsequently is documented. Dimension of the unit are surveyed as a 3D boundary polygon in a second step. Once the unit has been excavated, the bottom surface – the negative of the removed material deposit – is documented in a third step. All three steps – 3D documentation of top surface, boundary polygon and bottom surface – are post processed and eventually result in the volumetric representation of the archaeological stratification. Immaterial non volumetric surfaces, representing archaeologically significant periods of activities, are documented in two steps including documentation of top surface and boundary polygon.
The stratigraphic excavation process aims at the identification of these units and their removal in the reverse order of deposition. Physical and chronological relationships between stratigraphic units need to be recognized and documented as precise as possible. Relations are established upon topological observations of the distinct units during the excavation process and transferred into a Harris Matrix. The Harris Matrix is a graphic representation of a site's stratification, representing relative position and temporal succession of all stratigraphic units. 3D single surface documentation has the potential to depict the stratigraphic sequence captured in the Harris Matrix while transferring the graphics to three dimensions.

Field work

Laser scanning was conducted using a RIEGL LMS VZ-400 terrestrial laser scanner kindly supplied by the Norwegian Institute for Cultural Heritage Research (NIKU) (Table 1). It is characterized by a lightweight and robust construction, as well as high accuracy (< 5mm noise), fast and efficient data collection, an internal GPS for faster positioning and a long lasting battery. The outstanding feature of the scanner is the ability to collect full waveform data, meaning it collects the complete signal signature of the returning laser pulses. This technique allows for a more sophisticated data filtering and subsequently leads to more accurate data output.

Work flow in the field encompassed the following steps for every stratigraphical unit identified:



Multiple scan positions were needed in order to avoid shading and no data areas. The number of scan positions varied with surface conditions. Rough surfaces such as the stone packing (SU 604 and SE 692) required up to four positions. Different positions stored individually in the scanners own coordinate system (SOCS) were registered and transferred to a project coordinate system (PRCS). Eventually, scans were georeferenced to a global coordinate system (GLCS, UTM 32 N) in a later step in post-processing. For this purpose, retro-reflective targets mounted on fixed positions were placed around the excavation trench and surveyed using a total station.

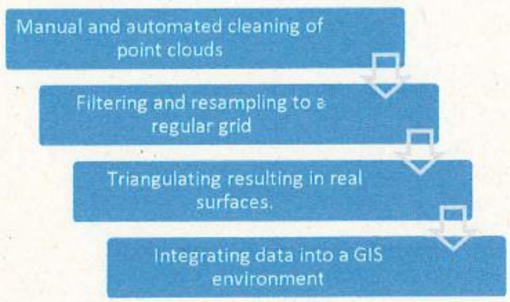
Photographs were taken from every unit's top surface for texturing purposes using the digital SLR camera supplied by the UiO excavation team. Markers on the surface were surveyed using a total station and ensured ortho-rectification and geo-referencing of the images. The scanner's own SLR camera could not be used due to technical problems.

Table 1 Riegl VZ-400 Technical data

Scan type	3D Terrestrial Laser Scanner RIEGL-VZ400
Measurement rate	Up to 122.000 meas./sec.
Scan Angle Range	100° (vertical) and 360° (horizontal)
Measurement range	1,5m – 600m
Laser class	1
Accuracy	5mm
Precision	3mm

Data processing and integration

Post processing of the scan data consisted of the following steps:



Point clouds were post-processed using the scanner acquisition software RISCANPro 1.7.6. All scans were registered in the project coordinate system and subsequently georeferenced using the retro-reflective markers with a general relative precision of <1cm. Point clouds were manually cleaned and filtered using deviation and range filters. Top and bottom surfaces were superimposed to determine their widest dimensions and the actual boundary polygon. Point clouds were resampled into a 1 cm octree data structure. Data were exported as .txt file formats in the project coordinate system to avoid issues with precision limitation and subsequent display errors. Point clouds were imported into the 3D software GeomagicStudio, where further data cleaning (removal of outliers and noise reduction) was conducted. Point clouds were meshed and repaired (non-manifold edges, self-intersections, highly creased edges, small components, small tunnels, small holes) and enhanced. Meshes of top and bottom surface of every SU were then combined to form a single volume. Display errors were sculpted. Volumes were reduced to 600.000 vertices and exported as .wrl 3D file format prior to import into Esri ArcScene 10.2. 3D volumes were shifted to global coordinates in UTM 32 N and imported into ArcScene 10.2. via toolbox. Texturing of selected top surfaces was carried out in GeomagicStudio.

Results

During the archaeological excavation at Rom, 32 stratigraphic units were identified – 29 deposits and three special surfaces (Table 2). For the 3D reconstruction, 20 stratigraphic units were modelled into volumes (Fig. 2 and 3). Because the excavation had to be extended beyond the two weeks initially budgeted, the final part of the excavation had to be recorded by the excavation team. Unfortunately, the RiscanPro project file delivered with these data was corrupted and could not be used for any virtual reconstruction. Some of the missing data could be partially reconstructed using other available scan data as is the case with final surface SS 1630. Deposits 1311, 1438, 1450, 1489, 1547 and 1565 as well as special surface 1594, however, could not yet be recovered. Three deposits (1235, 1389 and 1512) were already included into the Harris matrix, but have not been excavated yet and were therefore not modelled. The Harris matrix was partially updated based on the 3D information recorded (Fig. 1). Further adjustments, however, should be supervised by the post-excavation team. Volumes were coloured lifelike and displayed as an exploding model in order to illustrate the 3D volumetric nature of the excavation.

Scan data from the undisturbed excavation area (ts 600) had to be taken from Lidar data (0,5 m resolution), since the scan data provided by the excavation team proved to be too noisy due to vegetation growth. Ts 600 therefore displays a rather low resolution compared to the other volumes. For the import into ArcScene, volumes had to be reduced to 600.000 vertices, which inevitably involves a loss in resolution. This data reduction, however, enhanced the handling of the data in the 2.5 GIS environment. This issue also affected the handling of textured surfaces. For that reason, only three key surfaces (692,939 and 127) were textured and imported into ArcScene.

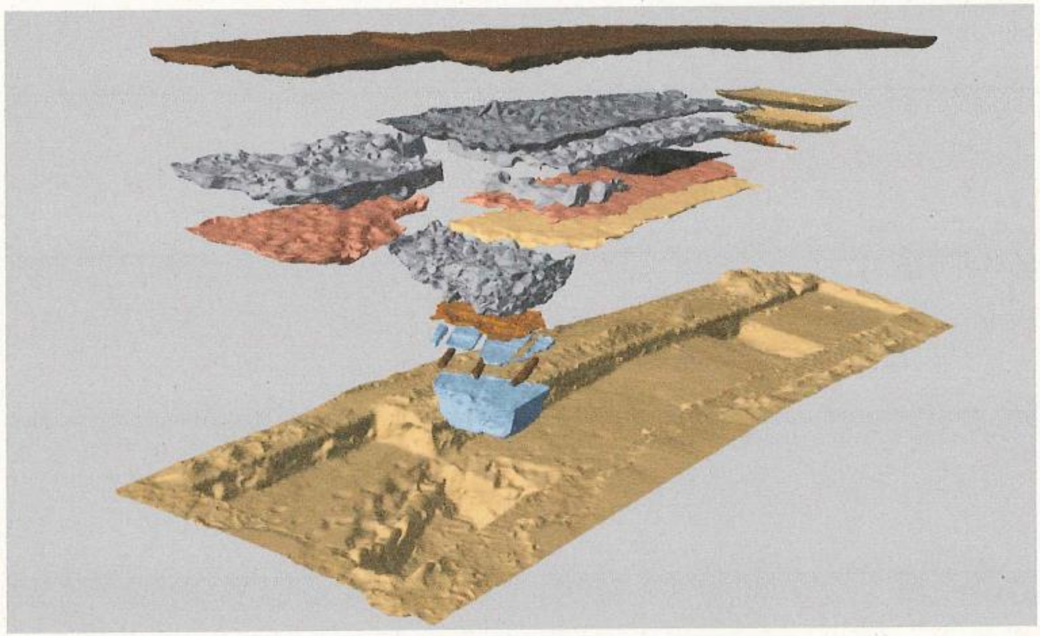


Fig. 2 Exploding 3D volumetric model of the excavation at Rom

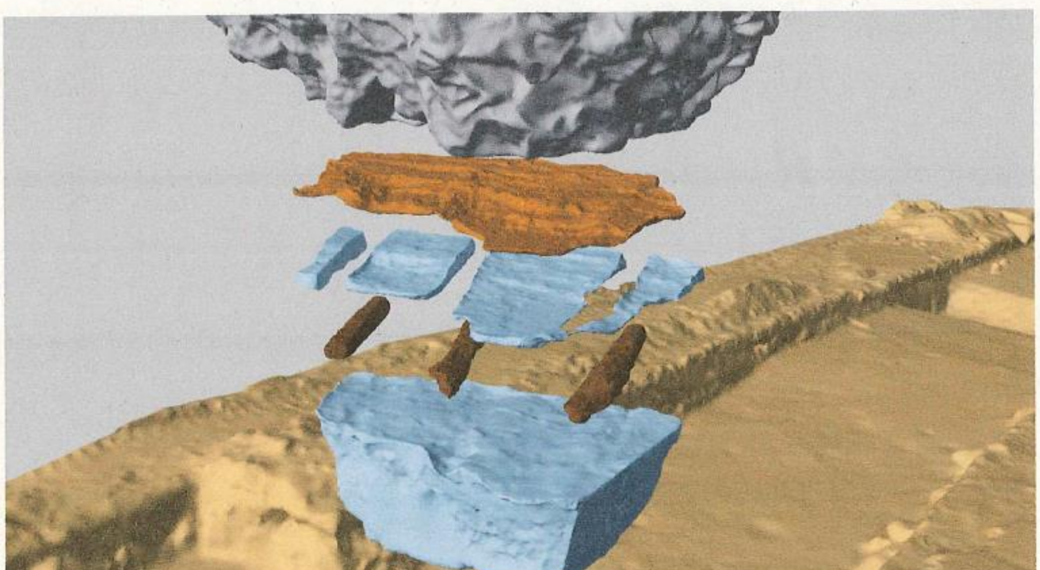


Fig. 3 Detail of the modern disturbance

Tab. 2 Stratigraphic units modelled

Stratigraphic unit	Description	3D Model	Comments
D 600	Topsoil	Done	
D 604	Stone packing, cleaning layer	Done	
D 692	Stone packing	Done	
D 630	Ditch backfill	Done	
SS 842	Modern disturbance	Done	
D 900	Modern disturbance backfill	Done	
D 939	Charcoal-rich deposit	Done	
D 985	Stone packing	Done	
D 1008	Stone packing	Done	
D 1032	Stone packing	Done	
D 1052	Iron-rich deposit	Done	
D 1092	Wooden structure	Done	
D 1127	Backfill between beams	Done	
D 1159	Palaeosoil ?	Done	
D 1195	Beams	Done	
D 1214	Marine deposit	Done	
D 1235	Plough marks?	--	Not excavated
D 1282	Topsoil	Done	
D 1291	Stone packing	Done	
D 1311	Modern disturbance	--	Data corrupted
D 1334	Ditch backfill	Done	
D 1355	Iron-rich deposit	Done	
D 1389	Plough marks?	--	Not excavated
D 1412	Ditch erosion	Done	
D 1438	Modern disturbance backfill	--	Data corrupted
D 1450	Charcoal-rich deposit	--	Data corrupted
D 1489	Foundation stone wall backfill	--	Data corrupted
D 1512	Stone wall	--	Not excavated
D 1547	Ditch backfill	--	Data corrupted
D 1565	Ditch backfill	--	Data corrupted
SS 1594	Ditch cut	--	Data corrupted
SS 1630	Final surface	Done	Created with available data

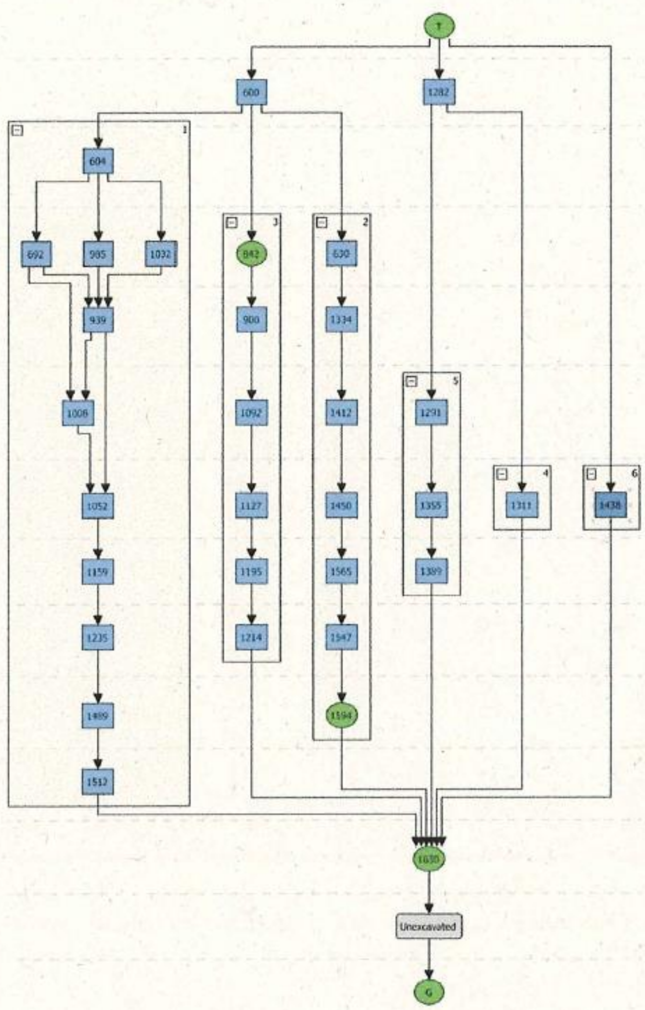


Fig.1 Harris matrix of Rom burial mound excavation (status 10.12.2014)

Data provided

Data provided include point clouds, meshes and volumes, a geodatabase with all volumes and textured surfaces, a folder with textured surfaces and two ArcScene projects with a visualisation and a corresponding layer file.

Table 3: Data provided

Data provided	Description
Folder point clouds	.txt files of point clouds of all SU's
Folder Volumes	.wrp project files (GeomagicStudio) of all SU's with meshed surfaces and combined volumes
Geodatabase 3DreconstructionRom	Geodatabase including all volumes and textured surfaces
Folder Texured surfaces	Including the textured surfaces
ArcScene project 3Dreconstruction	ArcScene project with all volumes displayed in an exploding model
ArcScene project RomMellem_texturedsurfaces	ArcScene project with the final surface and the three textured surfaces
Layerfile 3D reconstruction Rom Mellem	Layer file for the exploding model with lifelike colours

Data directory

12.12.2014 11:40 **3D reconstruction Rom Mellem.lyr**

16.12.2014 10:11 **3dreconstruction.avi**

16.12.2014 10:18 **3Dreconstruction.sxd**

12.12.2014 11:44 **3DreconstructionRom.gdb**

16.12.2014 09:49 **additional data**

dtm_rum_large

rad_A_ges_045-050.tfw

rad_A_ges_045-050.tif

16.12.2014 14:40 **pointclouds**

..

1008

1032

1052

1092

1127

1159

1195

1214

1282

1291

1334

1355

1412

600

604

630

692

842

900

939

985

Abschluss

16.12.2014 14:15	**Report_3dreconstruction_Rom.docx**
12.12.2014 11:43	**RomMellem_texturedsurfaces.sxd**
11.12.2014 14:28	**textured surfaces**

692

939

1127

16.12.2014 09:05	**Volumes**

1008.wrp

1032.wrp

1052.wrp

1092.wrp

1127ts_1.wrp

1127ts_2.wrp

1127ts_3.wrp

1127ts_4.wrp

1159.wrp

1195_1.wrp

1195_2.wrp

1195_3.wrp

1214.wrp

1282.wrp

1291.wrp

1334.wrp

1355.wrp

1412.wrp

600.wrp

604.wrp

630.wrp

692.wrp

900.wrp

939.wrp

985.wrp

Final.wrp

12.9 ARCHIVED DOCUMENTATION

- Original field recording