Fornleifauppgröftur á Pálstóftum við Kárahnjúka 2005



Gavin Lucas,
með viðaukum eftir Magnús Á. Sigurgeirsson, Knud Rosenlund, Colleen Batey, Garðar Guðmundsson, Lucy Verrill, Phil Buckland, Jacques Chabot, Karen Milek, Sólveigu Guðmundsdóttur Beck og Stefán Ólafsson

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Fornleifastofnun Íslands
Sjálfseignarstofnun

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Samantekt

Síðla sumars árið 2005 fór fram uppgröftur á svonefndum Pálstóftum skammt austan við Jökulsá á Brú, en þær eru stundum nefndar svo eftir Páli Pálssyni á Aðalbóli sem fann þær. Verkið var unnið fyrir Landsvirkjun. Tóftirnar eru í um 580 m hæð yfir sjávarmáli, innan svæðis sem mun hverfa undir Hálslón, miðlunarlón Kárahnjúkavirkjunar. Sú tilgáta hefur verið sett fram að tóftirnar séu af Reykjaseli sem getið er í Hrafnkelssögu. Það er ekki útilokað en þó erfitt að staðfesta, enda tengja hvorki ritaðar heimildir né örnefni þessar tóftir við það. Tilgangurinn með verkinu var að grafa rústirnar upp að fullu og safna eins miklum upplýsingum um þær og hægt var áður en þær hverfa undir vatn. Meðal þess sem grennslast átti fyrir um var aldur tóftanna, hversu lengi þær voru í notkun og til hvers þær voru notaðar.

Grafin var upp þrískipt tóft og önnur stakstæð. Í þeim mátti greina tvö megin notkunarskeið ásamt smávægilegum endurbyggingum. Gólflög inni í tóftunum benda til að notkun hafi verið árstíðabundin. Aldursgreining á gjóskulögum bendir til að tóftirnar hafi verið í notkun milli 950 og 1070. Tvær af byggingunum voru íveruhús með eldstæðum og gólflögum, sú þriðja líklega af geymsluherbergi en sú staka ekki eiginlegt hús heldur skepnuaðhald eða kvíar. Allar tóftirnar voru hlaðnar úr torfi eingöngu en í íveruhúsunum hafa verið timburstoðir sem báru uppi þak. Þunn ruslalög, aska og úrgangur, fundust vestan við tóftirnar í smáhalla og þaðan komu flestir gripirnir sem fund-ust við rannsóknina. Þeir voru fremur fáir en á meðal þeirra helstu má nefna nokkra gripi úr steini, glerperlu, tvær enskar myntir, brot úr deiglu og fleiri óskilgreind málmbrot. Lítið safn dýrabeina úr uppgreftinum samanstóð að mestu úr beinum úr villtum fuglum og kindabeinum. Greining á gripum og öðrum fundum stendur enn yfir en af fyrirliggjandi upplýsingum að dæma bendir flest til að tóftirnar séu af seli.

Non-technical Summary

In late summer of 2005, total excavation of a site named Pálstóftir (after its discoverer) in Jökulsá á Brú in Norður-Múlasýsla was conducted by Fornleifastofnun Íslands on behalf of Landsvirkjun. The site lies high at c. 580 m above sea level but within an area later submerged after completion of a hydroelectric dam (Hálslón) being constructed to supply power for a new aluminium smelting factory in Reyðarfjörður. The ruins have been suggested to be the site of Reykjasel mentioned in Hrafnkelssaga because of their location, but there is no specific documentary or place name evidence associated with the ruins and any association to the site of Reykjasel (even if it actually existed) is speculative. The objective of this project was to excavate completely the ruins and associated features to recover as much information as possible about the site before it was submerged, including the duration of its occupation, what it was used for and what activities were conducted there.

During the excavation four structures were uncovered, three of which were adjoining, and two main phases of occupation were identified with further subphases relating to minor modifications. There is nothing to suggest any hiatus between the phases, although the general nature of the floor deposits inside the main structures does indicate seasonal occupation. Absolute dating from the tephra sequence indicates the site was used between c. AD 950 and 1070. Of the four structures, two were dwellings with hearths and floor layers, the third a small storage room and the fourth, an animal pen. All the structures were built from turf and the two dwellings would have had timber frames supporting a roof. There was also an extensive sheet midden fanning out west and downslope from the buildings, from which most of the artifacts were recovered. The finds were few, but included many worked stone flakes, a glass bead, two English coins, part of a crucible as well as other small fragments of metal. A small faunal assemblage comprised mostly wild fowl but also sheep. Analysis of all the material is ongoing but a preliminary interpretation suggests this was a seasonally occupied shieling.

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Bakgrunnur og aðferðir 1

Dagana 31. júlí til 14. ágúst 2005 gróf Fornleifastofnun Íslands upp minjastað sem nefndur hefur verið Pálstóftir eftir Páli Pálssyni frá Aðalbóli í Hrafnkelsdal sem fann rústirnar. Verkið var unnið fyrir Landsvirkjun og samkvæmt fyrirmælum Fornleifaverndar ríkisins og þjóðminjalögum nr. 107/2001. Minjastaðurinn er á svæði því sem fer undir vatn í svonefndu Hálslóni sem myndast við stíflugerð vegna virkjunar sem sjá á nýju álveri á Reyðarfirði fyrir raforku. Sett hefur verið fram sú tilgáta að þetta séu rústir Reykjasels þess sem nefnt er í Hrafnkelssögu, en reyndar eru hvorki til skriflegar heimildir né örnefni sem tengja má þessum rústum. Tengsl minjastaðarins við Reykjarsel (ef það var þá raunverulega til) eru hrein ágiskun.

Á minjastaðnum voru tvö mannvirki sem hægt var að sjá á yfirborði. Páll Pálsson fann minjarnar í október 2003. Þær voru skráðar sumarið 2004 og var það liður í mati á minjunum á svæði því sem fyrirséð var að virkjanaframkvæmdirnar myndu raska (Garðar Guðmundsson & Gavin Lucas 2004). Sama ár gerði Fornleifavernd ríkisins athugun á staðnum og var þá grafinn könnunarskurður (1 x 1,7 m) niður á 1,2 m dýpi ofan á suðurvegg annars mannvirkisins. Í ljós kom gjóskulag sem lá óraskað yfir tóttinni og mátti af því ráða að minjarnar væru frá fyrstu öldum Íslandsbyggðar (Hulda Sigurdís Þráinsdóttir o.fl. 2004). Tilgangur rannsóknar þeirrar sem greint er frá hér á eftir var að grafa upp að fullu og öllu þessar tóttir og önnur þau ummerki um mannvist sem á staðnum væru til að afla eins mikilla upplýsinga og unnt væri um stað þennan áður en hann færi á kaf, þar með talið lengd búsetu, notkun bygginga og hvað hefði farið þarna fram.



Mynd 1. Pálstóftir, afstöðumynd. Horft til norðausturs af Sandfellsöldu vestan Jökulsár á Brú. Sandfell norðan rústanna til vinstri, síðan Kárahnjúkarnir. (Mynd Fornleifastofnun Íslands.)

Hópur sem í voru fjórir fornleifafræðingar (Adrian Chadwick, Anies Hassan, Banu Aydinoglugil, Kirsty Dingwall) og þrír nemendur í fornleifafræði (Sigríður

Þorgeirsdóttir, Óskar Gísli Sveinbjarnarson og Stefán Ólafsson) vann undir stjórn Dr. Gavins Lucas og Garðars Guðmundssonar. Grassvörður og áfokslög voru fjarlægð með vélgröfu undir eftirliti fornleifafræðinga, en öll mannvistarlög og mannvirki voru handgrafin. Í fyrstu var opnað svæði sem var 310 m² að stærð, eins og Fornleifavernd ríkisins hafði mælt fyrir um. Þá voru einnig gerðir könnunarskurðir á völdum stöðum (samtals um 130 m²) til að komast að því hve langt mætti rekja lög sem til hefðu orðið við mannvist. Það kom ekki á óvart að vestan við rústirnar komu í ljós þunn sorplög sem þöktu töluvert svæði. Samið var um að þau yrðu einnig grafin upp og var uppgraftarsvæðið stækkað í vestur um 48 m² til viðbótar. Minjarnar voru grafnar upp og skráðar í einingum og öllum gögnum komið á tölvutækt form í eftirvinnslunni. Tekið var mikið af jarðvegssýnum, bæði stór magnsýni til að vinna úr, meðal annars kolaðar plöntuleifar og til að rannsaka efnainnihald mannvistarlaga. Einnig voru tekin sýni til frjógreiningar og örformgerðarrannsóknar. Allir fundnir gripir voru mældir inn í þrívídd.

Gjóskulagagreiningu vann Magnús Sigurgeirsson sem var á staðnum 8. og 9. ágúst 2005. Dýrabein rannsakaði Knud Rosenlund á Dýrafræðisafninu í Kaupmannahöfn. Dr. Colleen Batey við Háskólann í Glasgow rannsakaði gripi, Garðar Guðmundsson jurtaleifar, Dr. Alex Chepstow-Lusty og Dr. Lucy Verrill gerðu frjókornarannsóknir, Phil Buckland við Háskólann í Umeå í Svíþjóð annaðist rannsókn á skordýrum, Sólveig Guðmundsdóttir Beck annaðist fosfatmælingar, Jacques Chabot við Levant háskólann í Québec, Canada, rannsakaði tinnusteina, Stefán Ólafsson teiknaði gripi og Karen Milek við háskólann í Cambridge vann örformgerðarrannsókn á jarðlagasýnum.

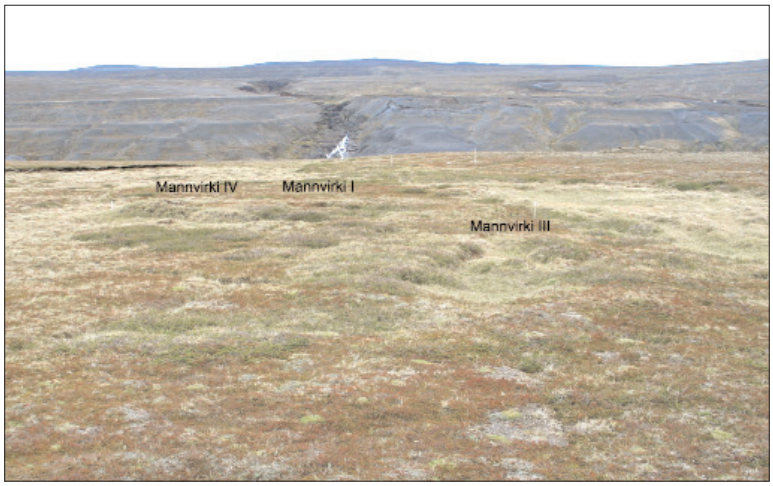
Fornleifarannsóknin 2

Inngangur 2.1

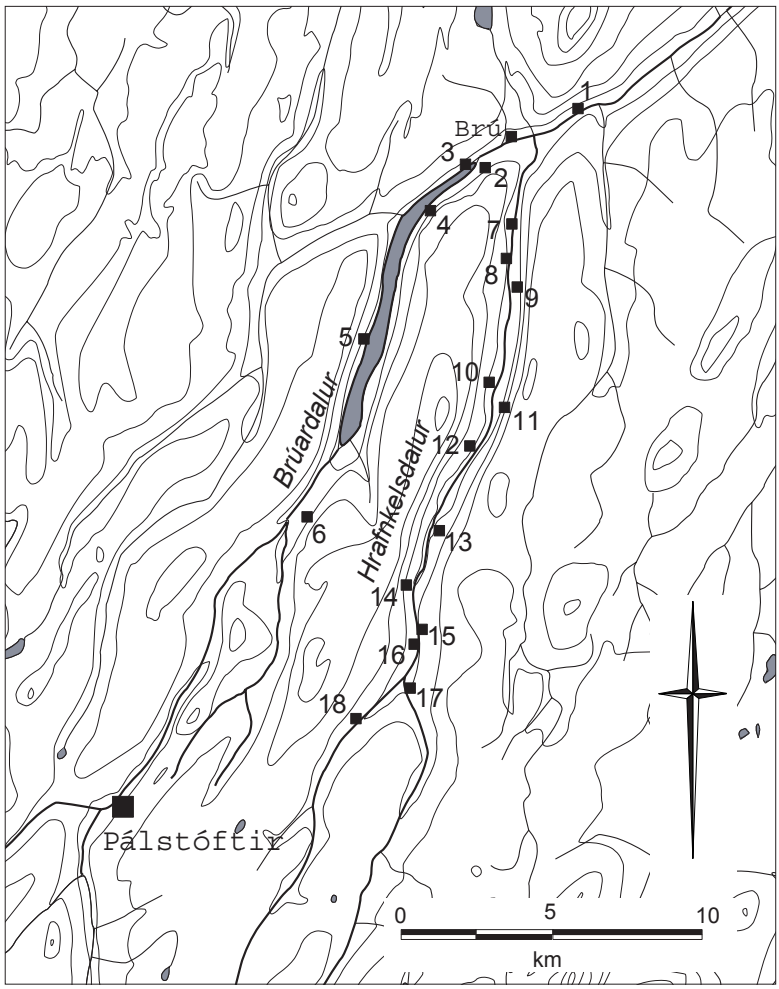
Hér á eftir er fjallað um niðurstöður rannsóknarinnar og fylgt þeirri tímaröð sem lesa má úr jarðlagaskipun. Greinilega má skipta notkunartíma staðarins í tvö meginskeið, en skipta mætti þeim aftur í nokkur styttri skeið eftir minni háttar breytingum á mannvirkjunum. Ekkert bendir til þess að orðið hafi hlé á mannvistinni milli skeiðanna tveggja, þó að gólflögin í rústunum bendi til árstíðabundinnar búsetu. Þetta mál er rætt frekar hér á eftir. Tímasetning styðst við athuganir á gjóskulögum, en einnig við gripi sem tímasetja má með nokkurri vissu. Annars vegar er það glerperla af gerð sem þekkist frá því um 950 e.Kr og síðar og hins vegar tveir peningar sem slegnir voru fyrir Harald harðráða Sigurðsson sem ríkti frá 1047 til 1066. Alls voru grafin upp fjögur mannvirki, öll úr torfi, tvö voru hús með eldstæðum, eitt var gerði eða aðhald og eitt var lítil geymslukró.

Umhverfi og staðhættir 2.2

Minjastaðurinn er í u.þ.b. 580 metra hæð yfir sjávarmáli, austan Jökulsár á Brú, spölkorn sunnan Sandfells á móts við þar sem Sauðá rennur úr Sauðárdal í Jöklu. Landinu hallar lítillega frá suðaustri til norðvesturs og er nú einkum þakið lágum heiðagróðri. Á uppgraftarstaðnum sjálfum var hvergi komið niður á berg, en neðar í slakkanum má sjá grágrýtisklappir. Í óröskuðum jarðvegssniðum má sjá ljósgráan og gulan fokjarðveg og þar eru mörg gjóskulög, bæði söguleg og forsöguleg. Gjóskulagið



Mynd 2. Pálstóftir fyrir uppgröft. Horft til vestnorðvesturs. Sauðá í bakgrunni. (Mynd Fornleifastofnun Íslands.)



Mynd 3. Afstöðumynd af Pálstóftum og stöðum á Brúardölum, Hrafnkelsdal og á Jökuldal sem taldir eru frá sama tíma. 1. Orrustustaðir/Steinsgróf, 2. Bakkastaðir, 3. Steingrímsstaðir, 4. Reykjasel, 5. Geithús, 6. Hóll, 7. Vaðbrekka, 8. Þrándarstaðir, 9. Þórisstaðir, 10. Hústóft, 11. Tobbhóll, 12. Aðalból, 13. Laugarhús, 14. ?, 15. Blesatangi, 16. ?, 17. Þuríðarstaðasel, 18. Glúmsstaðasel. (Byggt á Sveinbirni Rafnssyni 1990.)



Mynd 4. Starfsmenn við uppgröftinn. Fremri röð: Gavin Lucas, Sigríður Þorgeirsdóttir, Banu Aydinoglugil og Adrian Chadwick. Aftari röð: Garðar Guðmundsson, Kirsty Dingwall, Stefán Ólafsson, Óskar Sveinbjarnarson og Anies Hassan. (Mynd Fornleifastofnun Íslands.)

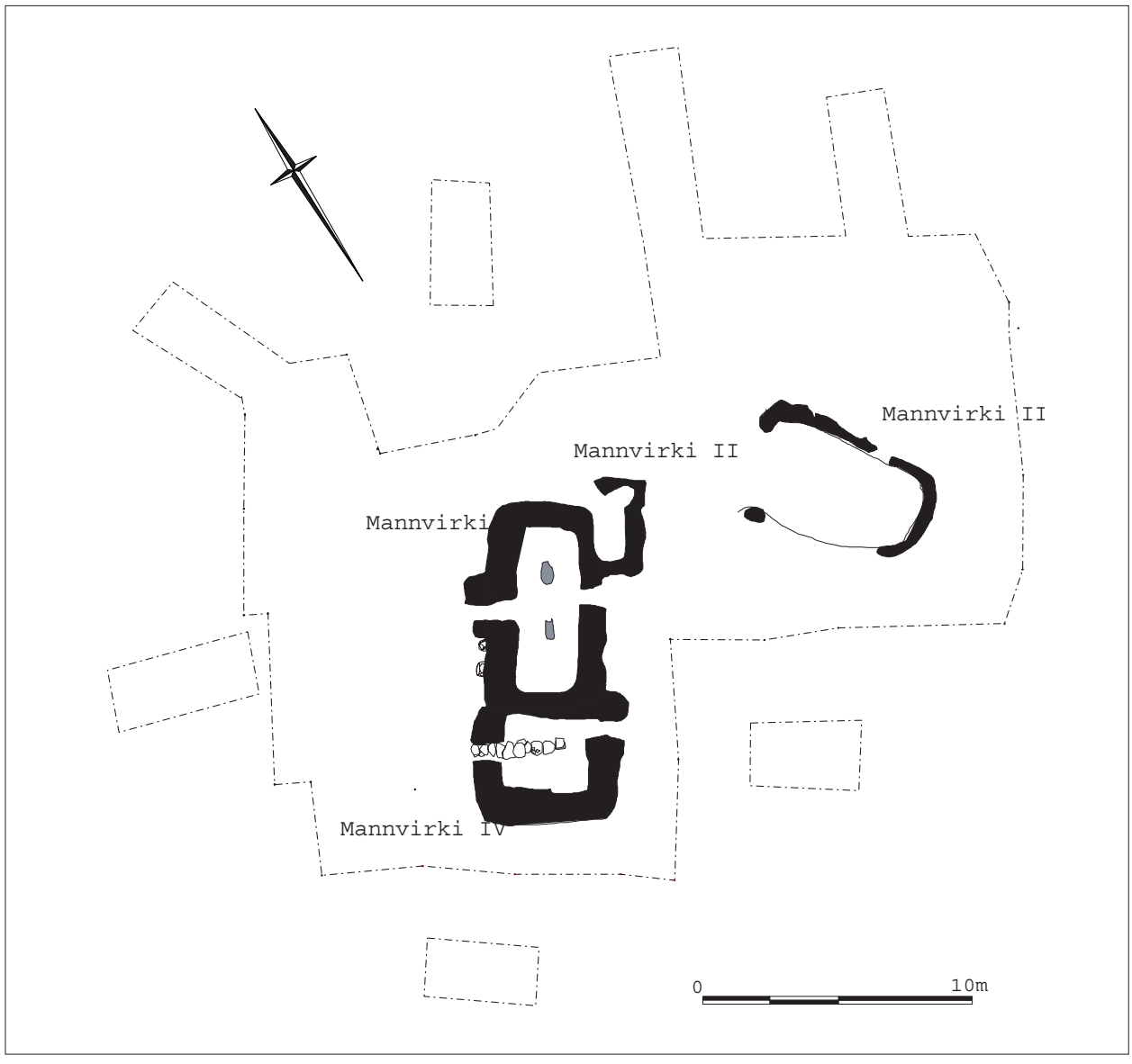
v-950 20 var undir öllum mannvistarminjum alls staðar þar sem það sást, en Katla-1262 lá yfir öllum mannvistarlögum og innsiglaði þau þannig. Á milli þessara gjóskulaga voru mörg önnur, þar á meðal ljósu Heklulögin frá 1158 og 1104 (og er þetta í fyrsta sinni sem hið síðara finnst svo austarlega) sem virðast falla um svipað leyti og staðurinn er yfirgefinn, en einnig a.m.k. tvö dökk gjóskulög sem aðeins hafa verið tímasett með því að mæla jarðvegsþykknum milli þeirra, og eru talin frá því á að giska 1005 og 1050 (sjá greinargerð Magnúsar Á. Sigurgeirssonar í viðauka). Þessi dökku gjóskulög sáust víða í uppgreftinum, en yfirleitt var ekki hægt að tengja þau með nokkurri vissu við lögin í óröskuðu jarðvegssniðunum. Á rannsóknarsvæðinu hafði orðið endurtekið rask og oft vantaði þar mikið í gjóskulagaröðina.

U.þ.b. 200 m vestsuðvestur af uppgraftarsvæðinu var tekið sýni í stokk til greiningar á frjókornum jarðvegs.

Á staðnum voru fjögur mannvirki, en þau voru örugglega ekki byggð á sama tíma. Skipta má byggingarsögunni í þrjú meginskeið. Við þá skiptingu er stuðst bæði við jarðlagaskipan og afstöðu

1. notkunarskeið	Mannvirki I, II og III
2. notkunarskeið	Mannvirki I (breytt), III (breytt) og IV
3. notkunarskeið	Staðurinn yfirgefinn

Minniháttar breytingar má sjá innan hvors notkunarskeiðs um sig, en aðalbreytingarnar verða milli 1. og 2. skeiðs. Þá voru tvö af mannvirkjunum endurbyggð og reist eitt í viðbót. Minjarnar eru tímasettar með bæði gjóskulaga-

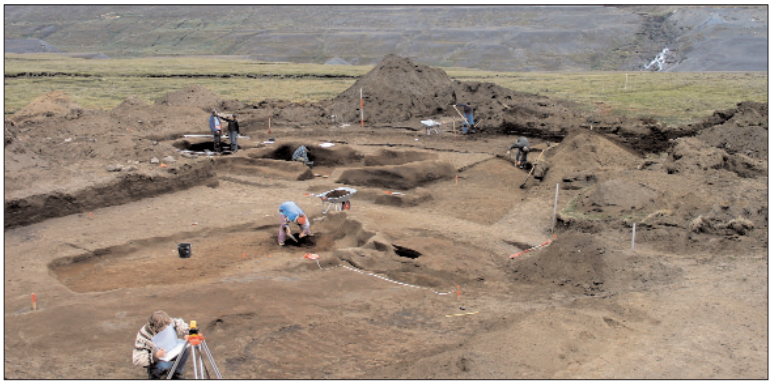


Mynd 5. Grunnmynd af uppgraftarsvæðinu og rústunum. (Mynd Fornleifastofnun Íslands.)

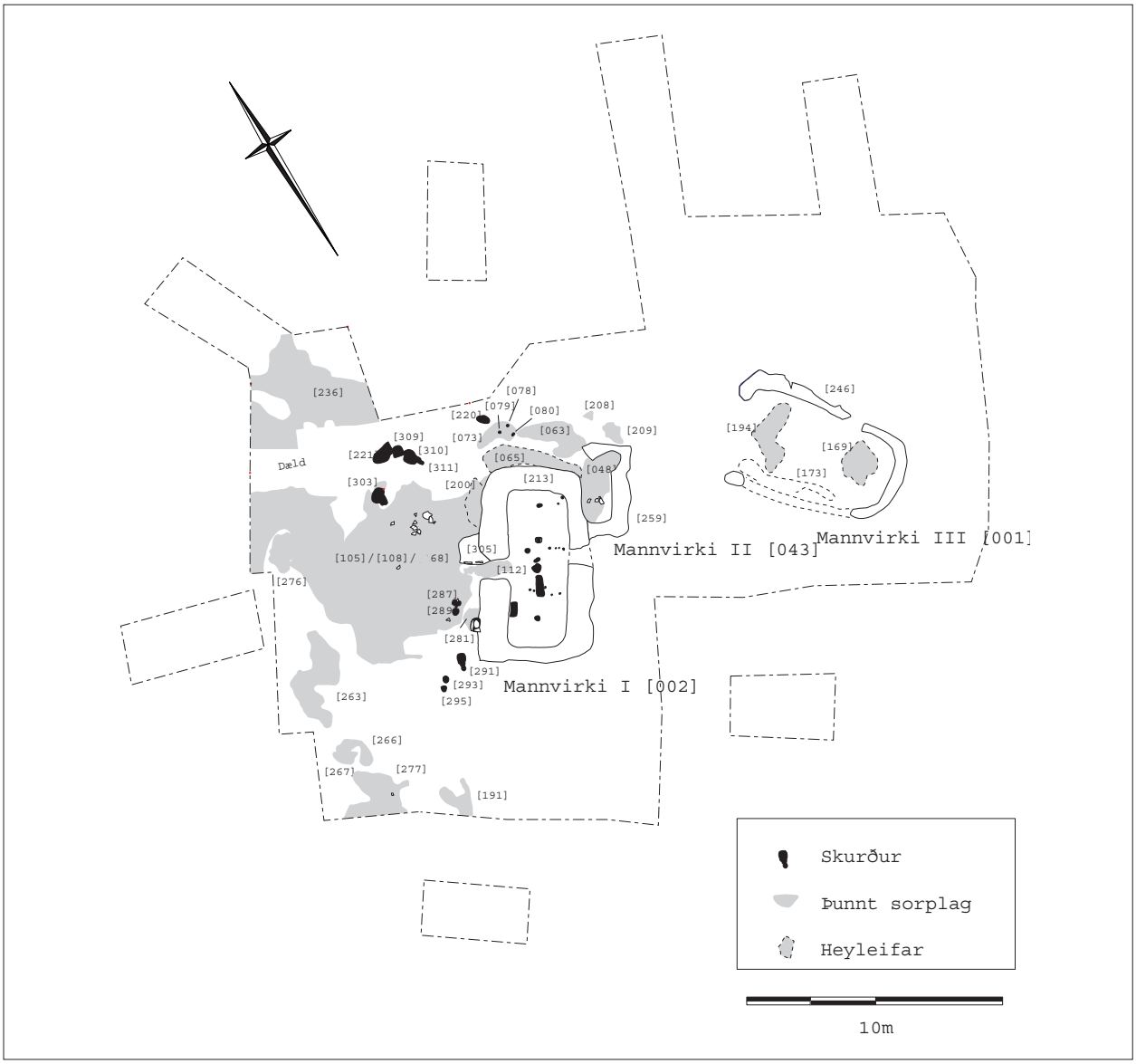
Tafla 1. Niðurstöður úr kolefnisgreiningu.

Númer sýnis	Eining	Notkunar skeið	Bein úr	Hlutfall 13C/12C	14C aldur	Aldur leiðréttur með 2 sigma
Beta 215979	[074]	II	Gæs	-21.1	1000 ±50BP	AD 970-1160
Beta 215981	[105]	I	Álft	-12.7	1300 ±40BP	AD 660-790
Beta 215982	[047]	III	Gæs	-21.5	950 ±40BP	AD 1010-1180
Beta 215983	[047]	III	Kind	-20.5	1080 ±40BP	AD 890-1020
Beta 215984	[154]	II	Kind	-21.0	1060 ±40BP	AD 900-1030
Beta 216811	[074]	II	Kind	-20.8	1000 ±40BP	AD 980-1060

greiningu og geislakoli. Sex sýni, fugla- og kindabein (ekki fundust nein fræ sem nota mætti), voru send til Beta Analytic Dating Laboratory (Miami, Florida) til geislakolsgreiningar. Niðurstöður eru sýndar í töflu 1 hér að ofan. Til að komast að því hve sambærilegar tímasetningar fuglabeina og kindabeina væru var sent eitt sýni af hvoru úr sama jarðlagi [047]. Niðurstöður reyndust töluvert mismunandi, og greindist gæsarbeinið mun yngra en kindarbeinið, þó skarast tímasetningarnar þegar miðað er við 2 sigma. Lagið sem beinin koma úr hefur hlaðist upp á alllöngum tíma. Það er myndað úr hrundu torfi og fokjarðvegi. Það gæti skýrt aldursmuninn. Því má gera ráð fyrir að treysta megi bæði gæsa- og kindabeinunum, einkum vegna þess að delta13-gildi þeirra er svipað. Svo er hins vegar ekki um álftarbeinið, delta13-gildi þess er miklu lægra en í hinum beinunum (líklega vegna þess að nokkuð af fæðu álftarinnar hefur verið úr sjó). Þetta skýrir af hverju beinið mælist eldra og af þeim sökum er ekki hægt að notast við þá tímasetningu. Því benda geislakolsgreiningarnar til þess að staðurinn hafi verið í notkun á 9. og snemma á 11. öld, og er sú tímasetning einnig studd gjóskulagagreiningu. Magnús Á. Sigurgeirsson hefur greint gjóskulög á staðnum og benda niðurstöður hans til þess að mannvirkin hafi verið í notkun frá því um 950 til 1070 e.Kr. (sjá skýrslu hans hér á eftir). Miðað við þann vitnisburð sem við höfum um tímasetningu verður ekki sagt með vissu hvenær notkunarskeið II hófst, en af gjóskulögum verður ráðið að notkunarskeið I hafi hafist um 950 e.Kr og skeið III um 1104 e.Kr. (hugsanlega aðeins fyrr, eða um 1070 e.Kr., ef taka má mið af jarðvegsþykknun undir H-1104). Giska má á að skeið II hafi hafist einhvern tíma um aldamótin 1000, þótt ekki verði sagt nákvæmlega hvenær. Tvær af kolefnisgreiningunum sem tilheyra þessu skeiði styðja þessa tímasetningu og eins eitt af dökku gjóskulögunum, sem virðist liggja á mörkum notkunarskeiðanna, og var talið frá því um 1005 e.Kr., miðað við jarðvegsþykknun .



Mynd 6. Horft yfir uppgraftarsvæðið til suðvesturs. (Mynd Fornleifastofnun Íslands.)

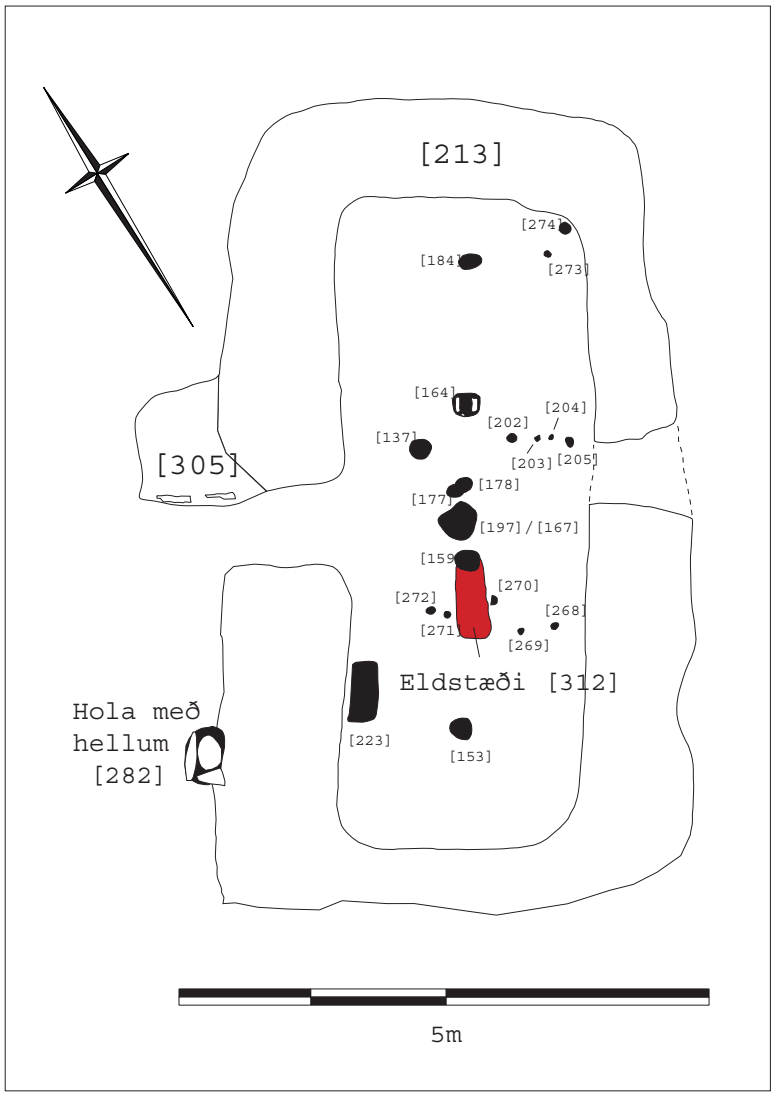


Mynd 7. Notkunarskeið I (um 950-1000 e.Kr.). (Mynd Fornleifastofnun Íslands.)

2.3.1 Notkunarskeið I (um 950-1000 e.Kr.)

Mannvirki 1 [002]

Þetta mannvirki var þannig gert að grafið var niður lítillega í slakkann í hlið dalverpisins, 0,12 m, á ferhyrndri skák og mannvirkið þannig afmarkað að innan. Þessi niðurgröftur [260] var 2,4 m að breidd og 6,18 m að lengd og lá NNA-SSV. Hann var mjög reglulegur, en umgangur manna hafði valdið því að smádæld var í miðju og önnur við dyrnar á vesturhlið. Veggirnir [213] voru hlaðnir við brúnir niðurgröfnu skákarinnar. Þeir voru aðallega úr streng nema í suðvesturhorninu, en þar hafði verið hlaðið bæði úr klömbru og streng. Þetta var lægsta hornið á byggingunni og kann að hafa átt að styrkja það sérstaklega. Að vestan (undan hallanum) voru veggir varðveittir upp í 0,56 m hæð, en að austan (upp í móti hallanum) aðeins um 0,4 m. Yfirleitt voru vesturveggirnir í rústunum betur varðveittir. Veggir mannvirkis I voru 1,18 m að þykkt og mátti greina í þeim 10-11 umför af streng. Strengjatorfið var misþykkt (30-70



Mynd 7. Notkunarskeið I (um 950-100 e.Kr.), mannvirki I. (Mynd Fornleifastofnun Íslands.)



Mynd 8. Mannvirki I. Horft til norðausturs. (Mynd Fornleifastofnun Íslands.)

mm) en yfirleitt 500-600 mm að lengd. Tvennar dyr voru á veggjum, fyrir miðjum vesturvegg og austurvegg, en ekki beint hvorar á móti öðrum. Dyrnar á vesturhlið eru upphaflegar (0,78 m á breidd), en opið að austan hefur verið gert síðar (sjá notkunarskeið II hér á eftir). Skjólveggur úr torfi [305] var byggður norðan við vesturdyrnar. Hann var ekki tengdur hleðslunni í húsveggnum sjálfum, en gerður úr samskonar torfi og líklega um sama leyti eða skömmu eftir að húsið sjálft var byggt.

Þakið á byggingunni var borið uppi af timburgrind. Hún hefur verið með mæniás eftir húsinu miðju, sem borinn var uppi af stoðum. Eftir miðju húsinu voru sex stoðarholur í röð, ([184], [164], [177]/8], [197], [159], [153]). Stoðin í miðjunni [197] hafði verið endurnýjuð [167]. Engin merki voru um stoðir meðfram veggjum, sem hinn endinn á röftunum hefði getað hvílt á, nema 2 litlar dældir í norðausturhorni ([273], [274]). Hugsast getur að stoðir við veggina hafi hvílt á steinum sem síðar voru fjarlægðir eða raskað. Í gólflaginu [071], einkum í suðausturhorni, voru nokkrir steinar sem gætu hafa verið stoðarsteinar (sjá annars notkunarskeið II hér á eftir). Einnig getur verið að þakið hafi verið nógu létt til þess að raftarnir hafi getað hvílt á torfveggjunum, enda er bilið frá mæni og út í vegg ekki breitt.

Þó að húsið væri ekki stórt virtist því hafa verið skipt. Svo var að sjá að tvær raðir af litlum stoðarholum (sú syðri: [268-9]; sú nyrðri [202-5]) í húsinu austanverðu skipti austurhlutanum í þrjú hólf. Sunnanvert

í miðhólfinu var lítið eldstæði [312]. Þrjár litlar holur eftir stoðir voru hvorum megin við eldstæðið ([270-272]) og gætu verið eftir stoðir sem báru uppi grind yfir eldstæðinu. Ein stór stoðarhola [137] er í framhaldi af nyrðri holuröð að austan og gæti það verið vísbending um að skilveggur hafi haldið áfram um húsið þvert. Ekki voru fleiri ummerki innan húss nema grunn, ferhyrnd hola [223] við vesturvegg sunnan við dyr. Öll gólflög í mannvirki I voru mjög þunn og því var lagskiptingin aðeins skráð í sniðum, en gólfið í heild grafið upp sem ein heild [071] (en í 1 m reitum). Þó voru þunnar linsur í eldri lögum sem sáust í sniði ([119], [121]) skráðar sérstaklega og reyndust aðallega vera troðið náttúrulegt silt lítillega blandað viðarkoli. Best varðveitta gólfsniðið var í dyrum, þar sem gólflög fylltu dældina sem þar hafði myndast ([112]).

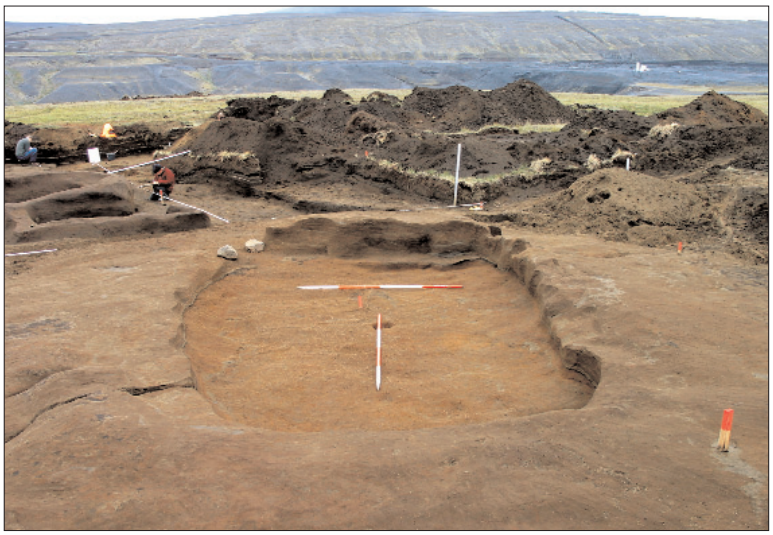
Utan við húsið, uppi við vesturvegg og sunnan við dyrnar, var lítil hola klædd grjóti að innan [282]. Grafin hafði verið þvínær kringlótt hola [284], flöt hella sett í botninn og tvær hellur á rönd [283] í vestur- og suðurhlið holunnar. Verið getur að einnig hafi verið hellur í hinum hliðunum en þær síðar verið fjarlægðar. Holan var full af rótuðu torfi, blönduðu viðarkoli og er sú fylling væntanlega frá því þegar staðurinn var yfirgefinn. Ekki er ljóst til hvers þessi hola hefur verið - ólíklegt er að hún hafi verið stoðarhola eða niðurgrafin undirstaða fyrir stólpa. Holan er ólík öllum öðrum ummerkjum um burðargrind og mikið hefur verið vandað til hennar. Þar eð ekki eru í henni lög sem orðið hafa til við notkun gæti verið að í henni hefði verið ílát. Ef til vill var þarna lítill sár eða eitthvað annað sem þurfti að vera utandyra. Þá er auðvitað ekki óhugsandi að þetta séu ummerki um eitthvað trúarlegt eða táknrænt þarna við dyrnar.

Mannvirki II [043].

Við norðausturhornið á mannvirki I hafði verið bætt litlu gerði eða kró úr torfi, 1,22 m á breidd og 2,6 m að lengd. Vegghleðslur í þessum tveimur mannvirkjum bundust ekki saman, en voru greinilega úr samskonar torfi og er mannvirki II eflaust byggt á sama tíma eða skömmu á eftir mannvirki I. Veggirnir í mannvirki II [259] voru 0,45 m þykkir og varðveitt hæð þeirra var 0,16-0,25 m. Þeir voru að mestu úr streng (50-70 mm að þykkt, 360-400 mm að lengd), nema í norðausturhorni þar sem klömbruhnaus var notaður með, eflaust vegna þess að þar var óvenjulegt horn á hleðslunni. Innan veggjanna var lag, líklega yfirborðslag [048], myndað úr rótuðu, blönduðu náttúrulegu silti og viðarkolum, en einnig var í því greinileg linsa úr hey- eða grasleifum. Ekki er víst að viðamikið þak hafi verið á þessu mannvirki og trúlegt að það hafi verið notað til geymslu.



Mynd 9. Mannvirki II. Horft til norðausturs. (Mynd Fornleifastofnun Íslands.)



Mynd 10. Mannvirki III. Horft til norðnorðvesturs. (Mynd Fornleifastofnun Íslands.)

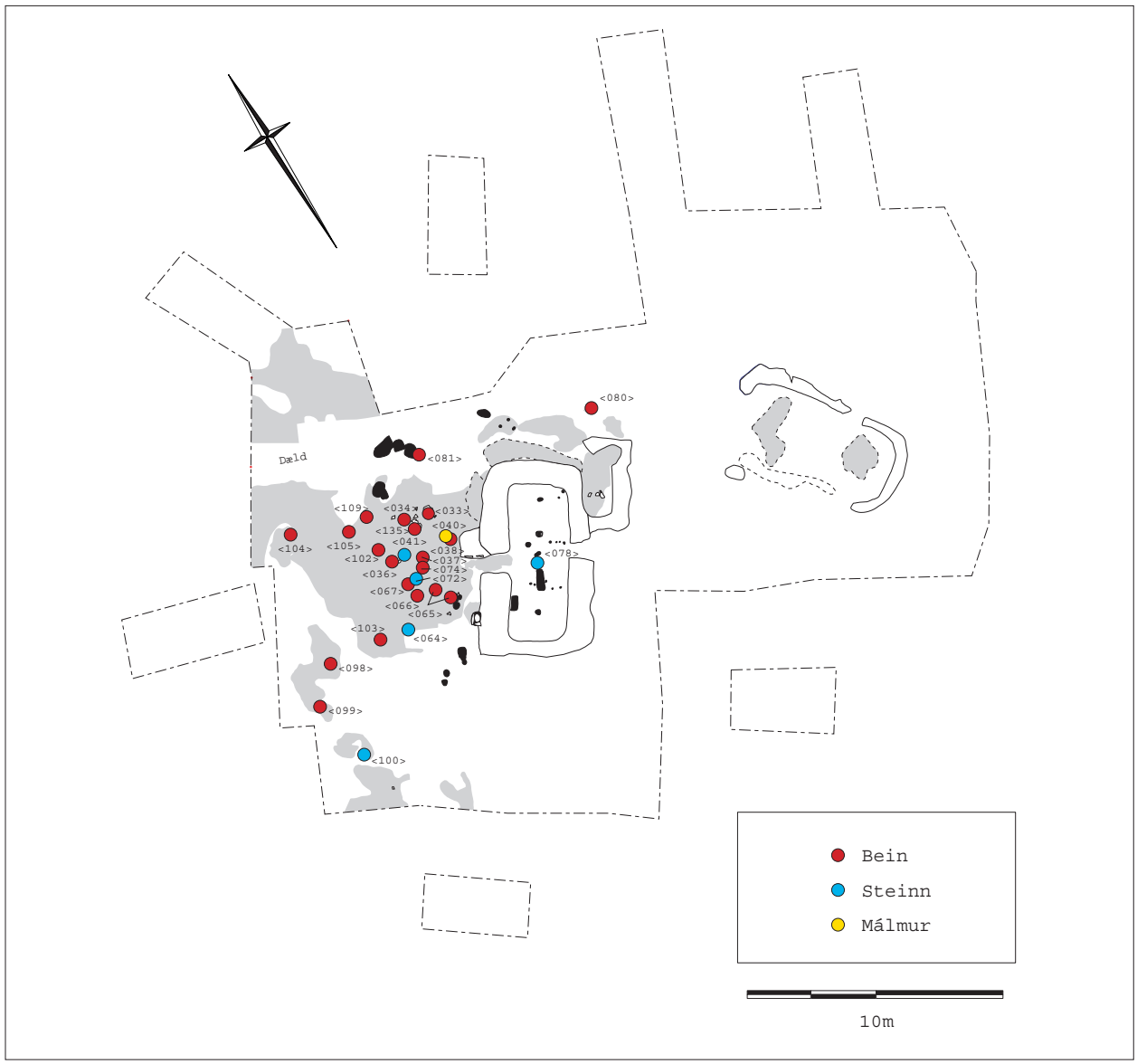
Mannvirki III [001]

Ofar í hallanum og um 3,5 m austan við hinar tóftirnar var mannvirki III og sneri allt öðruvísi (NNV-SSA). Þó varð af jarðlagaskipan ráðið að það væri frá nokkurn veginn sama tíma og hin. Það hafði verið gert þannig að grafið var niður (0,2 m í vesturenda, 0,4 m að austan) og þannig myndaður nálega ferhyrndur niðurgröftur [307], 2,66 m að lengd og 3,42 m á breidd, sem markaði mannvirkið að innan. Torfveggir [246] voru reistir umhverfis, á brún niðurgraftarins, á þrjá vegu og mátti sjá lag úr uppmokstri undir þeim [261]. Að sunnanverðu var veggurinn nær alveg hruninn. Þeim megin var grunnur skurður ([173]/[187]) við innbrún niðurgraftarins. Best var veggurinn varðveittur að norðan, og var þar 0,5 m þykkur og um 0,3 m hár. Veggurinn var úr streng, um 30-40 cm þykkum, mest voru varðveitt 14-16 umför. Hleðslan var úr tveimum röðum af streng, sem sums staðar voru bundnar saman. Ekki var neinn veggur á norðvesturhlið heldur var þar vítt op, 2,8 m á breidd. Verið getur að einhvern tíma hafi verið í því girðing. Þessari byggingu hefur augljóslega verið valinn staður og henni komið fyrir þannig að greið leið væri fram hjá norðausturhorni bæði mannvirkis I og II og tillit var tekið til þeirra þegar mannvirki III var reist. Inni í mannvirkinu voru nokkur þunn lög af röskuðum jarðvegi sem blandaður var heyleifum ([169], [194]). Líklega eru þetta leifar yfirborðslags sem hafði verið skaddað af umgangi eða útmokstri. Ekki voru nein ummerki um innri frágang í mannvirkinu, og líklegast er að það hafi ekki haft þak, heldur hafi það verið lítið gerði eða aðhald fyrir skepnur.

Ummerki utanhúss

Að undanskildu lagi sem er blanda af áfoki og þunnum sorplögum ([081], [279], [141], [099]) og er sennilega yfirborðslag frá því þegar húsin voru byggð, voru öll ummerki utandyra vestan við mannvirki I og neðar í hallanum. Umsvif manna utandyra höfðu greinilega einkum verið á þessu svæði. Það einkenndist af fjölmörgum lögum af móösku og viðarkoli úr eldstæðum, og mynda þessi lög allstórt sorplag ([278], [276], [105], [108], [168], [266], [267], [277], [191], [236]). Lögin eru óheilli syðst, einkum framan við mannvirki II. Þar getur verið að tekið hafi verið af þeim. Torf í mannvirki II innihélt linsur af slíku efni, m.a. móösku, sem mikið er af þarna. Við norðurendann á mannvirki I mátti sjá tvö lög úr áfoki, viðarkoli, og leifum af heyi eða grasi ([065], [200]) liggja upp að veggnum. Vera má að þau hafi staðið í sambandi við heylögin í mannvirki II. Einnig voru minni og afmarkaðri öskulög ([063]/[073]) norðan við mannvirki I og fyrir framan innganginn í mannvirki II.

Nokkrar aðrar holur voru á svæðinu. Sumar voru svo reglulegar, að líklegt er að þær hafi verið stoðarholur, en ekki verður sagt til hvers aðrar hafa verið. Fjórar stoðarholur, tvö pör, ([293]/[295] & [287]/[289]), snúa í NA-SV og eru um 2,4 m milli þeirra. Þær eru vestan við mannvirki I og má ráða af jarðlagaskipan að þær séu grafnar áður en það mannvirki var reist. Þær gætu því verið leifar skýlis sem þar stóð skamma stund, en gætu einnig hafa verið í notkun á sama tíma og mannvirkið og þá ummerki um eitthvað sem byggt hefði verið uppi við húsið (t.d. grind til að þurrka eða strekkja eitthvað). Allar stoðarholurnar höfðu fyllst af rótuðum jarðvegi, en ekki var neitt rusl í honum. Norðan til, andspænis dyrum á mannvirki II voru litlar stoðarholur í þríhyrning [077]. Milli þeirra voru um 05 m. Þær gætu verið eftir "þrífót" úr tré, til dæmis yfir eldstæði sem notað var skamma hríð. Kringum holurnar var þunnt lag af ösku [073], og var sú aska einnig ofan í holunum. Aðrar holur voru óreglulegri og voru þær allar á rannsóknarsvæðinu norðanverðu ([220], [221], [303], [309], [310], [311]). Í þeim öllum var rótaður jarðvegur, og sýndust vera

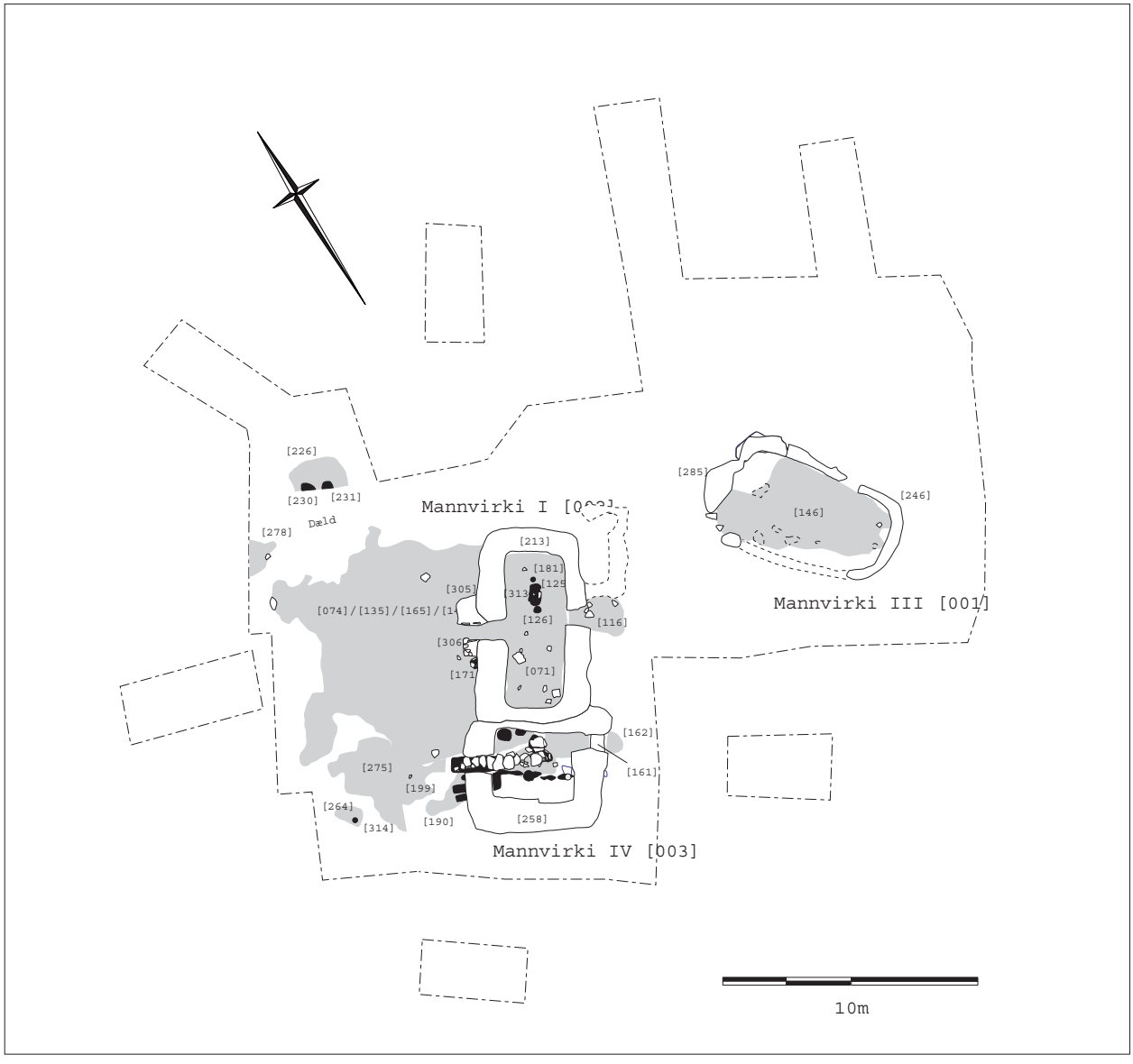


Mynd 11. Notkunarskeið I (um 950-1000 e.Kr.). Dreifing gripa og beina. (Mynd Fornleifastofnun Íslands.)

í honum örlitlar gróðurleifar. Enn ein óregluleg hola [291] var sunnan við stoðarholupörin tvö og nálægt þeim.

2.3.2 Notkunarskeið II (um 1000-1070 e.Kr.)

Mannvirki I [002]
Mannvirki I var áfram í notkun á þessu skeiði, en á því voru gerðar nokkrar breytingar. Aðalbreytingarnar voru tvær. Gert var op, dyr eða smuga, á austurvegg og eldstæðið var flutt til norðurs og í framhaldi af því voru nokkrar af stoðunum sem báru upp þakið færðar til. Opið í austurvegginn var ekki beint á móti upphaflegum vesturdyrum, heldur ívið norðar. Greinileg hola [116] í jarðveginn utan við þetta op bendir til þess að það sé ekki upphaflegt. Op þetta (0,58 m breitt) er einnig ofar en gólfið, svo munar um 0,20 m, og bendir það til þess að ekki hafi verið gengið út um þetta op, en frekar hafi þetta smuga til



Mynd 12. Notkunarskeið II (um 1000-1070 e.Kr.). (Mynd Fornleifastofnun Íslands.)

að skríða í gegnum, reykop eða ljóri. Yfirborðslagið framan við opið var harðtroðið sem sýndi að mikill umgangur hafði verið þar. Öðrum skjólvegg [306] var bætt við bygginguna að utan, við vesturdyrnar, og nú sunnan þeirra og var grjót í þeirri hleðslu öðrum megin. Í stað helluklæddu holunnar, sem ekki er ljóst til hvers var [282], kom önnur hola [171]. Hún var nær dyrum en svipuð hinni að stærð og frágangi. Grafin hafði verið reglu-leg hola, ferhyrnd [174], um 100 mm að dýpt. Í botni hennar var hella og hellur á rönd á öllum hliðum [172]. Nokkuð var af viðarkoli í kringum hellurnar, en annars var hreinn fokjarðvegur [170] í holunni, Ætla má að þessi hola hafi verið til sömu nota og holan [282] sem tilheyrði skeiði I.



Mynd 13. Helluklædd hola sunnan vesturdyra á mannvirki I. (Mynd Fornleifastofnun Íslands.)

Líklega hefur það gerst um svipað leyti að hætt var að nota upphaflega eldstæðið og nýtt [313] gert norðar. Á sama tíma var stoð [126] sett í staðinn fyrir stoðina [164] og einnig var bætt við tveimur stoðum öðrum ([125], [182]) við norðurenda nýja eldstæðisins, önnur [125] skar eldstæðið. Eldra eldstæði og stoðarholur að sunnan voru öll hulin, en steinhellur á yfirborði gólfs eru líklega raskaðir stoðasteinar, sem hafa komið í staðinn fyrir stoðarholurnar. Gólflagið [120]/[071] var 50 mm þykkt þar sem það var þykkast, og var gert úr fjölmörgum þunnum linsum úr blandaðri ösku og röskuðu náttúrulegu silti (1-4 mm að þykkt), þær lágu á víxl og voru torflinsur inni á milli.

Mannvirki III [001]

Helstu breytingarnar á mannvirki III á þessu skeiði voru þær að bætt var við vegg að norðvestan, og inngangurinn í gerðið þannig minnkaður niður í u.þ.b. 0,97 m. Hann var nú í suðvesturhorni, og því á móti opum á bakhlið mannvirkis I og IV. Inni í mannvirki III var einhvers konar yfirborðslag [146], einkum úr rótuðu silti með linsum af hey- eða grasleifum, það var 4-7 mm að þykkt. Hluti af þessu yfirborðslagi kann að tilheyra notkunarskeiði I, en ekki var hægt að greina skiptingu í jarðlögunum. Sennilega er þetta "yfirborð" orðið til við það að jarðvegur var fjarlægður, (annað hvort skafinn af við notkun, eða mokað burt og troðinn niður. Einkennilegt er að dyraopið skuli hafa verið minnkað og fært, ef til vill er það í sambandi við breytingu á því hvaða skepnur voru geymdar þar (e.t.v. sauðfé í stað nautgripa).

Mannvirki IV [003]

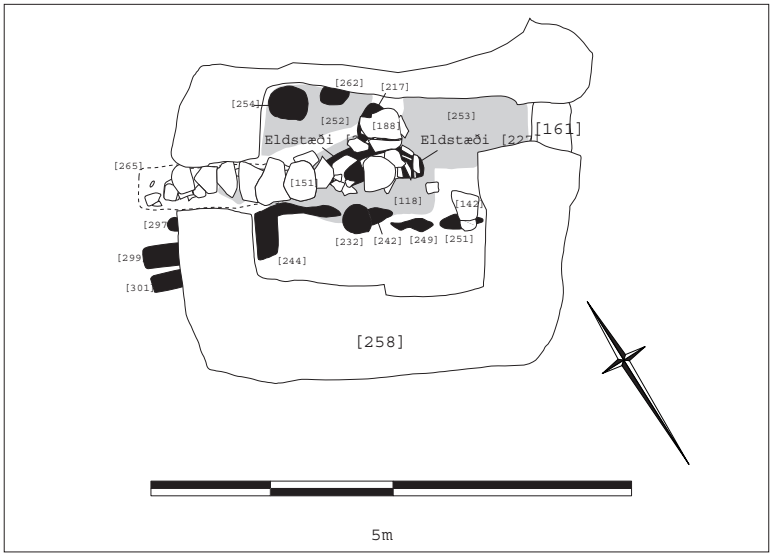
Mannvirki IV var þannig gert að reistur var torfveggur [258] áfastur suður-



Mynd 14. Mannvirki IV við lok uppgraftar. (Mynd Fornleifastofnun Íslands.)



Mynd 15. Mannvirki IV. Horft til suðausturs. (Mynd Fornleifastofnun Íslands.)



Mynd 16. Mannvirki IV. (Mynd Fornleifastofnun Íslands.)

endanum á mannvirki I, og er sá veggur byggður mikið til á upphaflegu yfirborði, þó að verið geti að eitthvað hafi verið grafið niður til að slétta undirstöðuna eða rista veggjatorf. Veggurinn var frá 0,95 - 1,08 m á þykkt og eftir var af honum 0,36-0,44 m. Hann var úr streng, 6-10 cm þykkum og 60-90 cm löngum. Í strengnum voru linsur úr forsögulegum gjóskulögum. Þar voru einnig 10-40 mm þykkar linsur úr viðarkoli og móösku, sem benda til að torfið hafi verið rist nærri húsunum (líklega rétt vestan við þau) og staðfesta þá að þetta mannvirki er yngra en hin. Eins og í mannvirki I voru klömbruhnausar í hleðslunni í suðvesturhorni. Tvennar dyr voru á mannvirkinu, á vestur- og austurvegg. Vesturdyrnar (0,8 m breiðar) eru nokkurn veginn á miðjum vegg, en austurdyrnar (0,55 m breiðar) í norðausturhorni. Hlaðið var upp í þær síðar [161]. Gegnum vesturdyrnar var troðin dæld [265] og bendir það til að þær dyr hafi verið meira notaðar.

Fá ummerki eru um burðargrind, en húsið er lítið. Norðan við vesturdyr var stór stoðarhola [217]. Grjót hafði verið rifið úr henni, svo að torveldara var að lesa úr jarðlagaskipan, en hún er þó líklega upprunaleg. Sunnan við dyrnar voru nokkrar dældir eða skurðir ([244], [242], [249], [251]) í röð og lágu um þvert húsið frá austri til vesturs. Í þessari röð, en ekki fyrir miðju, var stoðarhola [232]. Holurnar tvær [217] og [232] eru líklega eftir helstu burðarstoðirnar í húsinu, þó að þær séu ekki samhliða veggjum, og þar eð húsið er lítið hafa raftar án efa hvílt á torfveggjunum. Ekki eru önnur ummerki um burðarviði, nema

verið gæti að tvær stoðarholur ([254], [262]) í norðvesturhorni væru eftir frekari stuðning fyrir þakið. Ílöngu dældirnar gætu verið eftir frambrún af seti eða palli, þar eð sunnan við þessa línu voru engin mannvistarlög, aðeins síðar tilkomin torflög (sjá hér á eftir). Norðan við línuna voru aftur á móti troðnar dældir, gólflög og eldstæði.



Mynd 17. Horft til norðurs yfir mannvirki I og II í forgrunni og mannvirki IV við suðurenda I. (Mynd Fornleifastofnun Íslands.)

Líklega hafa verið tvö eldstæði í þessu húsi, eldra og yngra. Eldra elstæðið [237] var sporöskjulöguð hola [239] full af móösku [238] og yfir henni blandað öskulag [235]. Þegar þetta eldstæði fór úr notkun var gert annað aðeins austar. Síðara eldstæðið [227] var þannig gert að grafin hafði verið lítil ferhyrnd hola [207]. Hún var full af ösku og röskuðum hellum ([206], [160]), sem upphaflega höfðu staðið upp á rönd í holunni innanverðri. Framan (vestan) við eldstæðið var lítil steinlögn [201]. Gólflög voru varðveitt í nyrðri hluta hússins [252-3] milli ílangra niðurtroðinna dælda ([224], [238], [245]. Dæld [265] liggur milli fyrra eldstæðisins og vesturdyra, sennilega komin til vegna mikils umgangs. Austan við eldstæðin og við opið á austurvegg var engin dæld og reyndar engin gólflög. Þetta gæti bent til að minna hefði verið gengið um það op.

Utan við mannvirkið, uppi við vesturvegginn sunnan við dyrnar, voru þrjár holur. Þær sáust ekki fyrr en búið var að fjarlægja lög mynduð við húsbygginguna, en þó er ekki hægt að útiloka að þær hafi verið grafnar frá yfirborði sem var ofar. Ein holan var lítil og hefur ef til vill verið stoðarhola [297]. Hún er rétt við dyrnar og gæti hafa tilheyrt dyraumbúnaði. Hinar holurnar tvær voru grunnar og ferhyrndar ([299], [301]), fullar af rótuðu silti. Erfitt er að segja til um til hvers þær hafa verið, en ef til vill hafa þær verið til sömu nota og steinfóðruðu holurnar ([282], [171]) sem áður eru nefndar og voru skammt sunnan við innganginn í mannvirki I.

Mannvirkið virðist hafa verið alllengi í notkun, enda má sjá mörg lög af ösku úr eldstæðum ([193], [195], [192], [185], [179], [134]) og einnig lög úr torfi sem hefur verið lagt á gólfið til að jafna það og slétta ([198], [186], [180], [210], [212], [211], [139], [140], [130], [131], [149], [143]). Á sama tíma hlýtur að hafa verið gert við helstu burðarstoðir, líklega með því að taka neðan af þeim og setja þær á stoðarsteina. Rifið var innan úr stoðarholu [217] og hella [188] lögð yfir hana. Stoðarhola [232] virðist hafa verið fyllt. Þar var ekki samskonar hella, en að vísu gæti hún hafa raskast þegar húsið var yfirgefið. Nokkrar aðrar hellur [142] lágu yfir austurendanum á ílöngu dældunum, sem bendir til þess að þar hafi einnig farið fram viðgerð. Þegar húsið var yfirgefið var þykkt öskuborið gólflag [118] eftir húsinu miðju og röð af hellum ([133],

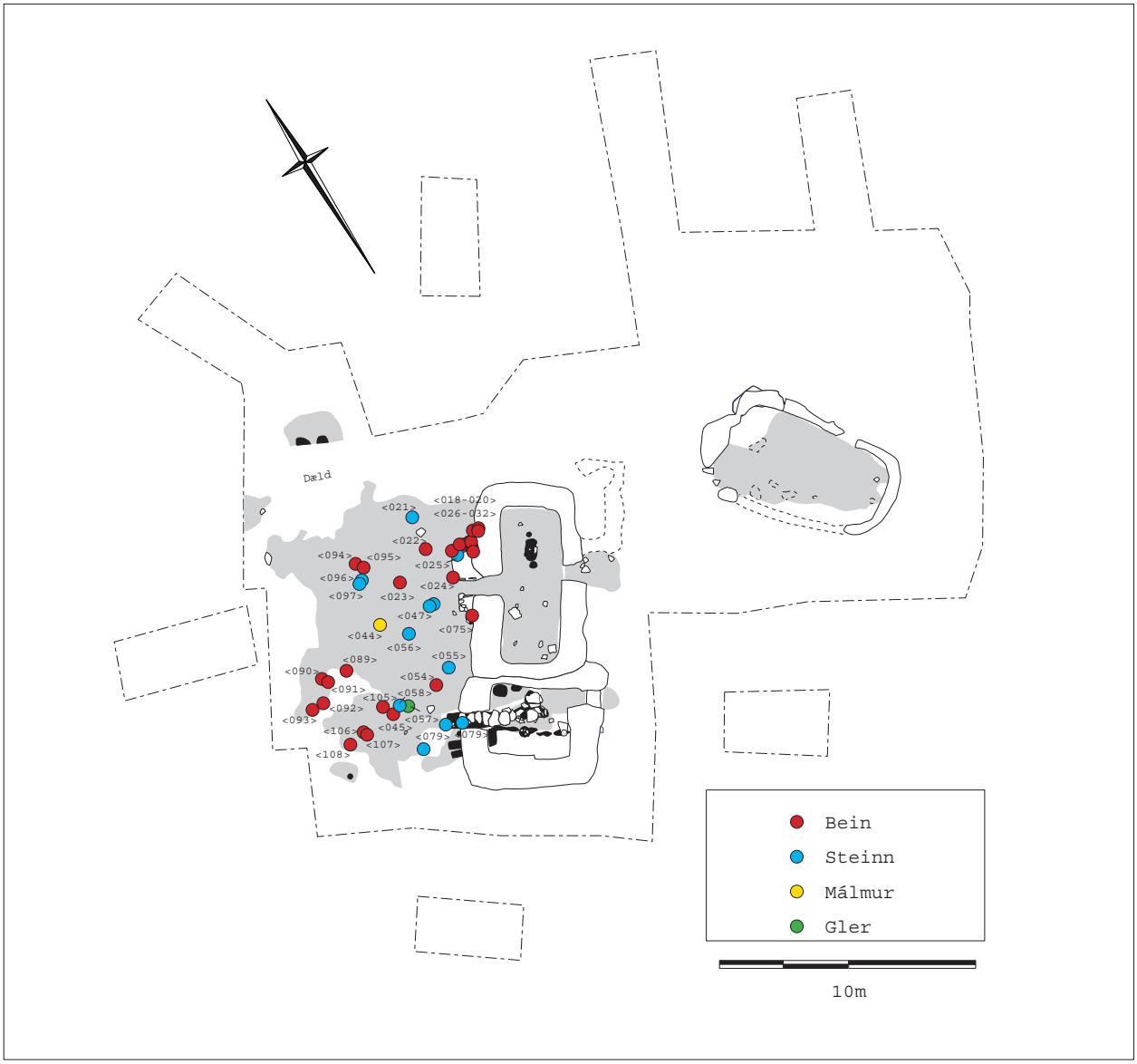


Mynd 18. Horft til austurs yfir uppgraftarsvæðið. Mannvirki IV syðst til hægri, mannvirki I fyrir miðju og III fjærst (Mynd Fornleifastofnun Íslands.)

[151]) lá milli eldstæðisins og dyranna, yfir troðnu dældirnar. Verið getur að þessi helluröð hafi verið lögð áður en færð upp smátt og smátt þegar gólfið var sléttað.

Ummerki utan við húsin

Vestan við aðalhúsin lá fremur þunnt sorplag sem myndað var úr mörgum öskulögum úr eldstæðum ([031], [060], [074], [135], [162], [165], [199], [264], [275]), en uppvið veggi mannvirkjanna I og II blönduðust torfleifar úr byggingunum í þessi ruslalög ([117],

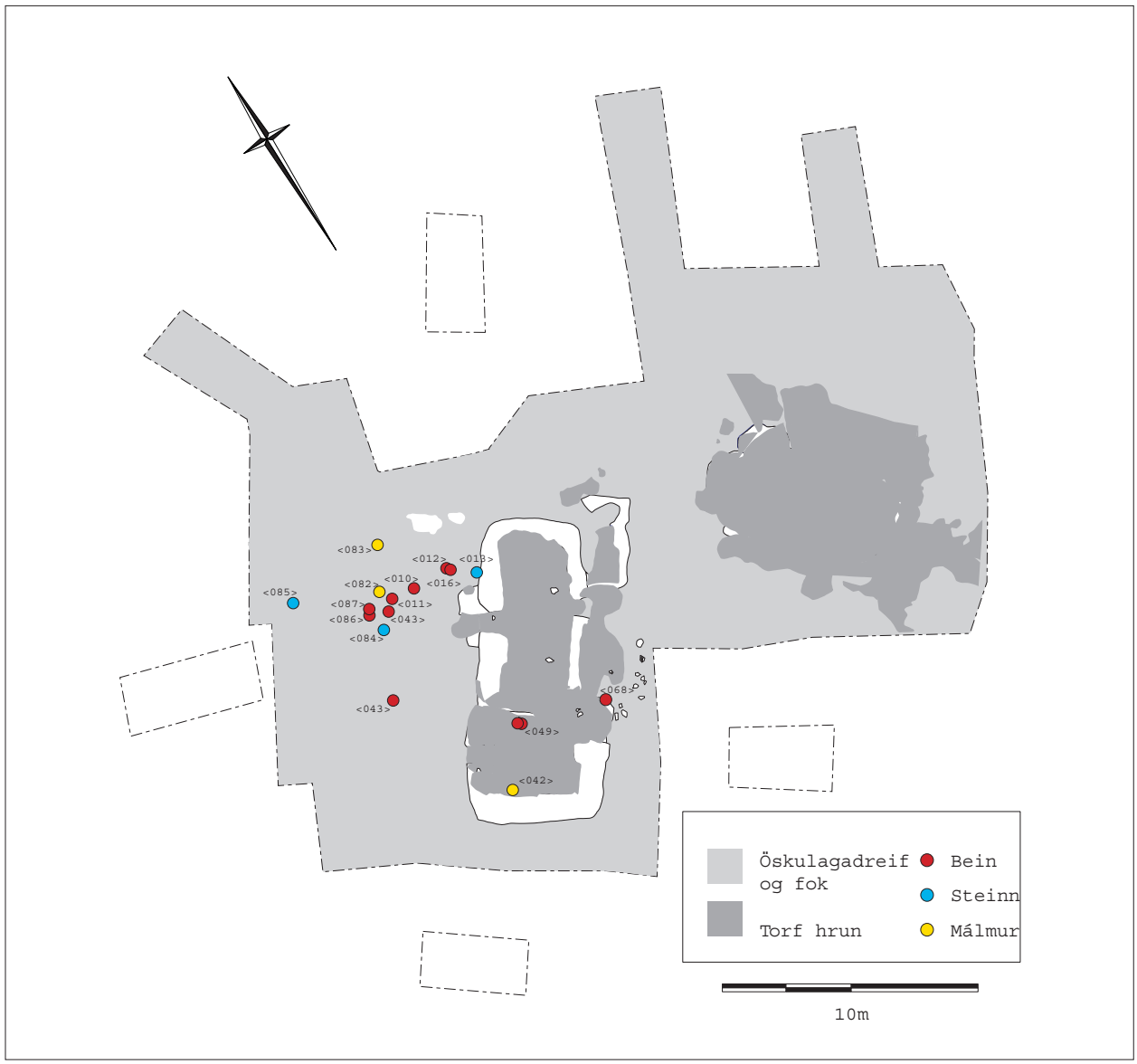


Mynd 19. Notkunarskeið II (um 1000-1070 e.Kr.). Dreifing gripa og beina. (Mynd Fornleifastofnun Íslands.)

[129], [147]). Fáar holur tilheyra þessu skeiði, þó voru tvær stoðarholur ([230], [231]) norðvestanlega á svæðinu og ein í viðbót [314] sem aðeins sést í sniði suðvestantil.

2.3.3 Notkunarskeið III (um 1070-2004 e.Kr.)

Staðurinn var yfirgefinn og sést það á því að torf fer að hrynja úr veggjum og hrein áfokslög safnast upp. Svo er að sjá að töluvert hafi hlaðist upp af fokjarðvegi fyrir Heklugosið 1104. Það bendir til þess að staðurinn hafi verið að mestu yfirgefinn fyrir þann tíma. Húsin voru enn að hrynja og hrörna langt fram á 12. öld, þar eð hrun úr veggjum liggur yfir gjóskulaginu úr Heklu 1158. Þetta hrörnunartímabil virðist hafa staðið yfir í um það bil öld, en eftir það virðist sem rústirnar hafi lítið breyst og yfir þær lögðust lög af fokjarðvegi, silti og sandi. Undantekningin er mannvirki IV - þó að það hafi greinilega verið



Mynd 20. Notkunarskeið III (um 1070-2004 e.Kr.). Dreifing gripa og beina. (Mynd Fornleifastofnun Íslands.)

yfirgefið fyrir 1158 e.Kr. var enn að hrynja úr því fram á 14. öld. Mörg lög af hrundu torfi úr því lágu yfir bæði Kötlulagi sem tímasett er til 1262 og lagi úr Öræfajökli frá 1362. Þetta kann að standa í einhverju sambandi við eðli mannvirkisins frekar en nokkuð annað. Ekki er þó óhugsandi að mannvirki IV hafi einnig verið í notkun um skeið eftir að hætt var að nota hin, en þó ekki nema í hálfa öld.



Mynd 21. Lokastig uppgraftarins. Mannvirki I fyrir miðju, II áfast austurhorni þess og IV áfast suðurenda. Norðaustur upp. Samsett mynd; stærðarhlutföll kunna að vera ónákvæm; stika 2 m. (Mynd Fornleifastofnun Íslands.)

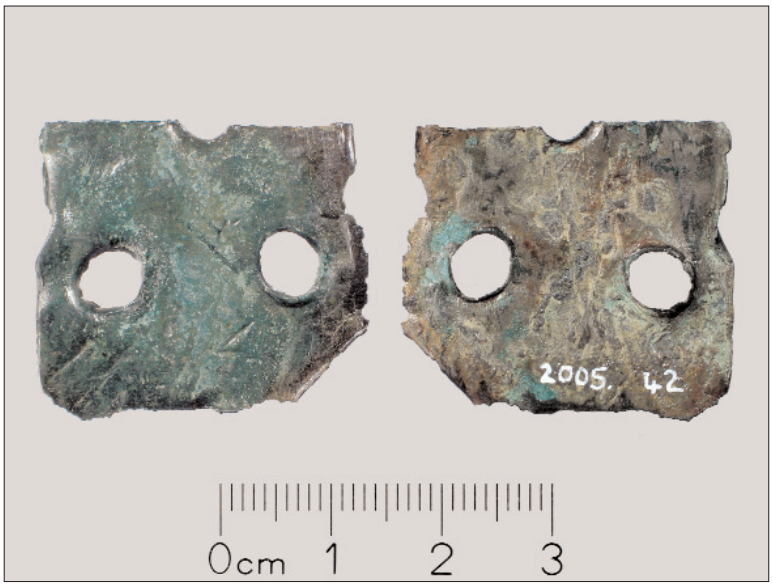
Gripamyndir og teikningar 3



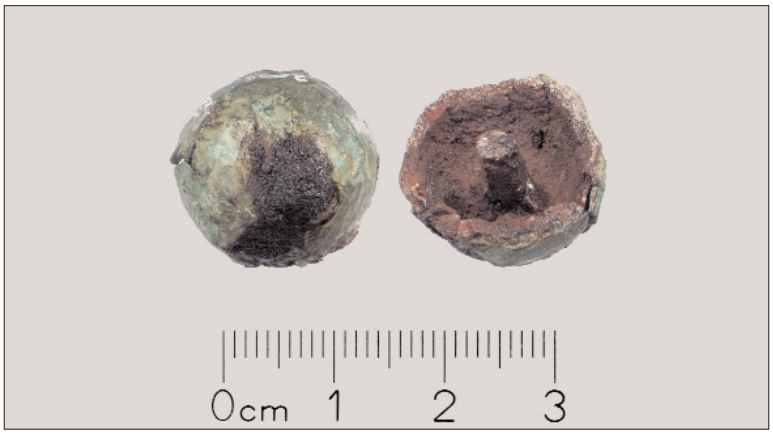
Mynd 22. Glerperla af B gerð. Gripur númer 57 úr jarðlagi 135. Tímasett til síðari hluta 10. aldar. (Mynd Fornleifastofnun Íslands.)



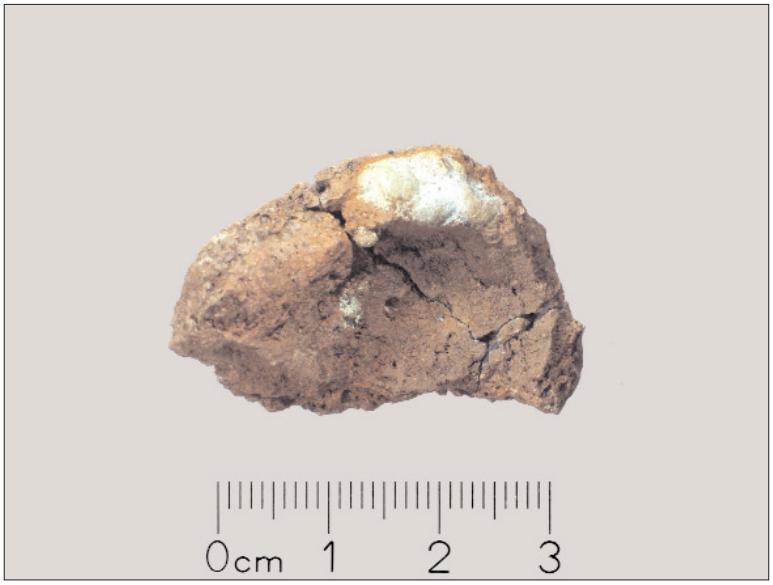
Mynd 23. Tvei peningar úr koparblöndu slegnir fyrir Harald harðráða sem ríkti frá 1047 til 1066. Fundur númer 82 úr jarðlagi 39. (Mynd Fornleifastofnun Íslands.)



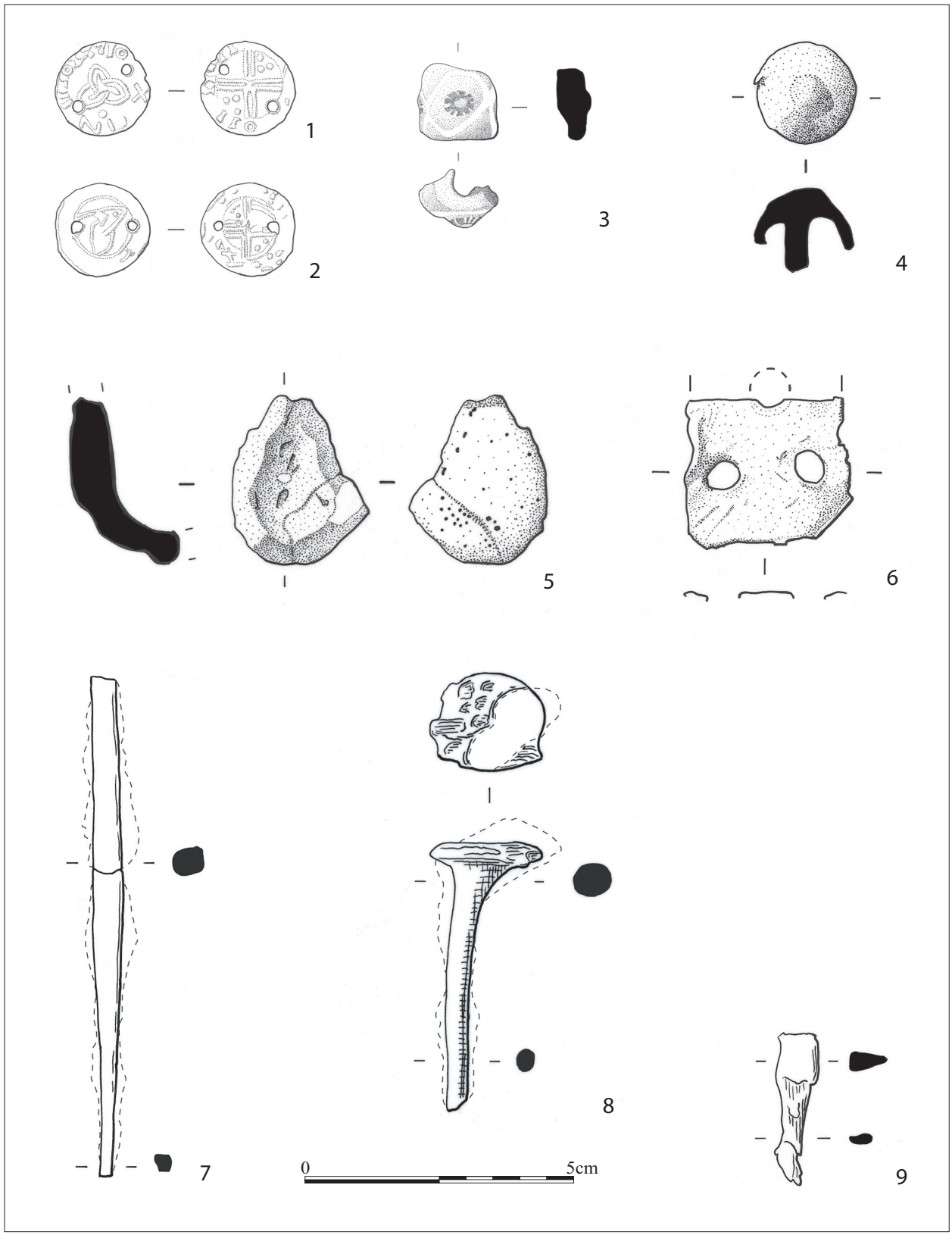
Mynd 24. Gripur númer 42 úr jarðlagi 106. Koparspeldi eða festing. (Mynd Fornleifastofnun Íslands.)



Mynd 25. gripur númer 44 úr jarðlagi 74. Kopar hnappur eða bóla. (Mynd Fornleifastofnun Íslands.)



Mynd 26. Gripur númer 39 úr jarðlagi 108. Lítill bolli eða deigla. (Mynd Fornleifastofnun Íslands.)



Mynd 27. Gripateikningar. Teikningar: Stefán Ólafsson, Fornleifastofnun Íslands.
1 og 2: fundur 82 úr lagi 39. Peningar úr koparblöndu slegnir fyrir Harald harðráða sem ríkti frá 1047 til 1066.
3: fundur 57 úr lagi 135. Glerperla frá 10.-11. öld.
4: fundur 44 úr lagi 74. Koparhnappur eða -bóla.
5: fundur 39 úr lagi 108. Deigla eða bolli.
6: fundur 42 úr lagi 106. Koparspeldi eða festing.
7: fundur 83 úr lagi 39. Járnnagli eða sýll.
8: fundur 100 úr lagi 266. Járnnagli.
9: fundur 77 úr lagi 188. járnblað eða hnífur.

Skrár 4

Fundaskrá 4.1

Númer	Jarðlag	Hlutur	Efni	Þyngd (g)	Fjöldi	Athugasemdir
1	14	Matarúrgangur	Bein	4	1	Dýrabein
2	16	Matarúrgangur	Bein	4	1	Dýrabein
3	17	Matarúrgangur	Bein	9	2	Dýrabein
4	31	Matarúrgangur	Bein	11	4	Dýrabein
5	34	Matarúrgangur	Bein	8	1	Dýrabein
6	2	Matarúrgangur	Bein	12	4	Dýrabein
7	3	Matarúrgangur	Bein	50	10	Dýrabein
8	29	Óunninn steinn	Steinn	604	3	Hitasteinn
9	39	Matarúrgangur	Bein	3	1	Dýrabein; smábrot
10	39	Matarúrgangur	Bein	2	1	Dýrabein; smábrot
11	39	Matarúrgangur	Bein	4	1	Dýrabein; smábrot
12	39	Matarúrgangur	Bein	6	1	Dýrabein; smábrot
13	39	Smíðagjall	Slag	4	1	Smíðagjall
14	44	Matarúrgangur	Bein	3	2	Dýrabein
15	38	Matarúrgangur	Bein	4	1	Dýrabein
16	39	Matarúrgangur	Bein	2	1	Dýrabein
17	48	Matarúrgangur	Bein	10	5	Dýrabein
18	60	Matarúrgangur	Bein	2	1	Dýrabein
19	60	Matarúrgangur	Bein	4	1	Dýrabein
20	60	Matarúrgangur	Bein	2	3	Dýrabein; brennt
21	74	Flaga	Jaspis	0	1	
22	74	Matarúrgangur	Bein	22	1	Dýrabein
23	74	Matarúrgangur	Bein	5	1	Dýrabein
24	74	Matarúrgangur	Bein	3	1	Dýrabein; smábrot
25	74	Flaga	Kvarts	0	1	Ógreint efni
26	74	Matarúrgangur	Bein	7	3	Dýrabein
27	74	Matarúrgangur	Bein	12	1	Dýrabein; sent í C14 greiningu
28	74	Matarúrgangur	Bein	35	1	Dýrabein; sent í C14 greiningu
29	74	Matarúrgangur	Bein	8	1	Dýrabein
30	74	Matarúrgangur	Bein	3	1	Dýrabein; smábrot
31	74	Matarúrgangur	Bein	4	1	Dýrabein
32	74	Matarúrgangur	Bein	3	1	Dýrabein

33	105	Matarúrgangur	Bein	6	1	Dýrabein
34	105	Matarúrgangur	Bein	4	1	Dýrabein
35	105	Matarúrgangur	Bein	4	1	Dýrabein
36	105	Matarúrgangur	Bein	9	2	Dýrabein; sent í C14 greiningu
37	105	Matarúrgangur	Bein	2	1	Dýrabein
38	105	Matarúrgangur	Bein	2	1	Dýrabein; smábrot
39	108	Deigla	Vikur?	8	3	Deigla; brot
40	108		Kopar	0	0	Pakkað í kassa með jarðvegi
41	108	Flaga	Jaspis	0	2	Flaga. Brennd
42	106	Kopar speldi?	Kopar	0	1	3X3 cm hlutur með 2 götum
43	39	Matarúrgangur	Bein	4	1	Dýrabein
44	74	Koparhlutur	Kopar	0	0	Pakkað í kassa með jarðvegi
45	74	Matarúrgangur	Bein	3	1	Dýrabein
46	47	Matarúrgangur	Bein	6	3	Dýrabein
47	117	Steinvala	Steinn	3	2	Steinvala (<10mm)
48	106	Matarúrgangur	Bein	13	7	Dýrabein
49	106	Gaming Piece	Bein	38	7	Völubein; spilatafla/skraut
50	37	Matarúrgangur	Bein	33	13	Dýrabein
51	47	Matarúrgangur	Bein	18	3	Dýrabein; sent í C14 greiningu
52	47	Matarúrgangur	Bein	7	4	Dýrabein
53	47	Flaga	Jaspis	0	1	Steinvala (<10mm)
54	129	Matarúrgangur	Bein	4	1	Dýrabein
55	129	Flaga	Jaspis	0	1	Jaspis
56	135	Flaga	Jaspis	0	1	
57	135	Bead	Glass	2	1	Hálf glerperla
58	135	Steinvala	Steinn	6	2	Smásteinn
59	130	Matarúrgangur	Bein	10	1	Dýrabein
60	121	Steinvala	Steinn	3	1	Steinvala (c.10mm)
61	121	Matarúrgangur	Bein	4	1	Bein
62	145	Matarúrgangur	Bein	25	2	Dýrabein
63	149	Matarúrgangur	Bein	10	2	Fuglabein + völubein
64	105	Flaga	Jaspis	0	1	
65	105	Matarúrgangur	Bein	2	2	Dýrabein, brennt
66	105	Matarúrgangur	Bein	8	1	Dýrabein
67	105	Matarúrgangur	Bein	8	2	Dýrabein
68	128	Matarúrgangur	Bein	2	1	Dýrabein
69	155	Steinvala	Steinn	3	1	Steinvala (c.13mm)
70	155	Flaga	Kvarts	0	1	Unnin kvarts flaga
71	154	Matarúrgangur	Bein	5	1	Dýrabein; sent í C14 greiningu
72	108	Flaga	Jaspis	0	1	Burnt flint
73	152	Matarúrgangur	Bein	8	1	Dýrabein
74	168	Matarúrgangur	Bein	4	2	Dýrabein
75	170	Matarúrgangur	Bein	3	4	Dýrabein
76	155	Flaga	Kvarts	0	1	Kvarts skrapa
77	188	Nagli	Járn	0	1	Járnhlutut/nagli?
78	196	Járnhlutur	Mineral	2	1	Smár járnhlutur/útfelling
79	199	Flaga	Kvarts	0	3	Kvarts
80	208	Matarúrgangur	Bein	3	1	Illa varðveitt dýrabein; smábrot
81	219	Matarúrgangur	Bein	3	1	Dýrabein; smábrot
82	39	Peningar	Kopar	0	2	2 peningar, með götum
83	39	Síll	Járn	0	3	langur grannur nagli/síll?
84	39	Flaga	Kvarts	0	1	Kvarts
85	39	Flaga	Kvarts	0	1	Kvarts ?
86	39	Matarúrgangur	Bein	3	2	Dýrabein

87	39	Matarúrgangur	Bein	6	9	Dýrabein
88	39	Matarúrgangur	Bein	3	2	Dýrabein
89	74	Matarúrgangur	Bein	12	1	Dýrabein
90	74	Matarúrgangur	Bein	13	1	Dýrabein; smábrot
91	74	Matarúrgangur	Bein	4	1	Dýrabein
92	74	Matarúrgangur	Bein	2	1	Dýrabein; smábrot
93	74	Matarúrgangur	Bein	8	1	Dýrabein
94	74	Matarúrgangur	Bein	5	1	Dýrabein
95	74	Matarúrgangur	Bein	2	1	Dýrabein; smábrot
96	74	Flaga	Jaspis	0	1	Jaspis ?
97	74	Flaga	Kvarts	0	1	
98	263	Matarúrgangur	Bein	2	3	Dýrabein
99	263	Matarúrgangur	Bein	18	1	Dýrabein; smábrot
100	266	Nagli	Járn	0	1	
101	105	Matarúrgangur	Bein	7	1	Dýrabein; smábrot
102	105	Matarúrgangur	Bein	5	1	Dýrabein; smábrot
103	105	Matarúrgangur	Bein	2	1	Dýrabein
104	276	Matarúrgangur	Bein	5	3	Dýrabein; mörg smábrot
105	275	Matarúrgangur	Bein	12	1	Dýrabein; mörg smábrot
106	275	Matarúrgangur	Bein	7	1	Dýrabein; smábrot
107	275	Matarúrgangur	Bein	10	1	Dýrabein; smábrot
108	275	Matarúrgangur	Bein	6	1	Dýrabein; smábrot
109	108	Matarúrgangur	Bein	3	1	Dýrabein; smábrot
110	81	Kengur vírlykkja	Járn	3	2	

Jarðlagaskrá 4.2

Númer jarðlags	Tegund jarðalags	Hópur	Lýsing, athugasemdir
1	Hópur	0	Eystra mannviki
2	Hópur	0	Vestara mannviki (N)
3	Hópur	0	Vestara mannviki (S)
4	Skurður	0	Uppgraftarsvæði
5	Skurður	0	Skurður
6	Skurður	0	Skurður
7	Skurður	0	Skurður
8	Skurður	0	Skurður
9	Skurður	0	Skurður
10	Skurður	0	Skurður
11	Skurður	0	Skurður
12	Lageining	0	Hrun í mannviki 002
13	Lageining	3	Hrun í mannviki 003
14	Lageining	0	Torfhrun
15	Lageining	0	Hrun í mannviki 002
16	Lageining	0	Torfhrun
17	Lageining	43	Torfhrun mannviki (002)
18	Lageining	0	Mögulegt hrun milli mannvirkja 002 + 003
19	Lageining	3	Hrun í mannviki 003
20	Lageining	1	Torfhrun á norðurvegg
21	Lageining	0	Torfhrun í SA horni [001]
22	Lageining	3	Torfhrun í mannvirki [003]

23	Lageining	0	Viðarkolaflekkur/lag
24	Lageining	0	Torfhrun milli mannvirkja 002 + 003
25	Lageining	3	Torfhrun í mannvirki [003] við V inngang
26	Lageining	0	Torfbland, fok N vegg mannvirki 001
27	Lageining	0	Torfhrun SV horni mannvirki [003]
28	Lageining	0	Torfhrun í mannvirki [002]
29	Lageining	0	Torfhrun í mannvirki [002]
30	Lageining	3	Torfhrun í mannvirki [003]
31	Lageining	43	Blandað fok + öskulagadreif
32	Lageining	1	Torf/fok, dökkbrúnt [001]
33	Lageining	0	Torf/foksandur
34	Lageining	43	Torfhrun
35	Lageining	0	Torfhrun
36	Lageining	3	Foksandur
37	Lageining	3	Torfhrun í mannvirki [008]
38	Lageining	0	Torfhrun N mannvirki 002
39	Lageining	0	Grábrúnn jarðvegur (topsoil)
40	Lageining	1	
41	Lageining	0	Torf/foksandur
42	Lageining	43	Fok með viðarkolum frákast
43	Hópur	0	Lítð mannvirki við NA horn [002]
44	Lageining	43	Torfhrun
45	Lageining	1	Foksandur og torf
46	Lageining	43	Torfhrun
47	Lageining	2	Fok/Torfhrun bland
48	Lageining	43	Fokjarðvegur í öskuhaugadreif
49	Lageining	3	Torfveggjarhrun
50	Lageining	1	Torf í mannvirki [001]
51	Lageining	0	Torfhrun
52	Lageining	3	Torfhrun í NV horni
53	Lageining	1	
54	Lageining	1	Torfhrun + silt/sandur í mannvirki [001]
55	Lageining	1	Torfhrun + silt/sandur í mannvirki [001]
56	Lageining	0	Torfhrun + silt/sandur í mannvirki [001]
57	Lageining	1	Torf innan við S vegg í mannvirki [001]
58	Lageining	3	Torfhrun við V inngang
59	Lageining	0	Grá-brúnn jarðvegur (topsoil ?)
60	Lageining	0	Jarðlag m torfflekkjum
61	Lageining	0	Torfhrun
62	Lageining	0	Torfflekkur
63	Lageining	0	Viðarkolaflekkur
64	Lageining	3	Torfhrun
65	Lageining	0	Torfhrun m.m.
66	Lageining	0	Torfhrun
67	Lageining	1	Torfhrun
68	Lageining	1	Torfhrun
69	Lageining	0	
70	Lageining	1	Torfhrun
71		2	Gólflag í mannvirki [002]
72	Lageining	1	Torfhrun
73	Lageining	0	Viðarkolaflekkur í fokjarðvegi
74	Lageining	0	Jarðlag meðviðarkolaflekkjum
75	Lageining	0	
76	Lageining	3	Torfhrun í NA horni

77	Lageining	0	Pinnahola 3 saman?
78	Lageining	0	Pinnahola
79	Lageining	0	Pinnahola
80	Lageining	0	Pinnahola
81	Lageining	0	Fokjarðvegur með viðarkolaflekkjum undir ?LNL
82	Lageining	1	Fokjarðvegur yfir S vegg [001]
83	Lageining	0	Yfirborðstorf
84	Lageining	0	
85	Lageining	0	
86	Lageining	0	
87	Lageining	0	
88	Lageining	0	
89	Lageining	0	Efri fylling
90	Lageining	0	Viðarkol frum fylling
91	Skurður	0	Skurður fyrir mannvirki
92	Lageining	0	Viðarkolalinsa
93	Lageining	0	Sandlinsa
94	Lageining	0	Viðarkolalinsa
95	Lageining	0	Frumfylling
96	Skurður	0	Skurður fyrir mannvirki
97	Lageining	0	Jarðlag
98	Lageining	0	Jarðlag
99	Lageining	0	Jarðlag
100	Lageining	0	Jarðlag yfir LNL ?
101	Lageining	0	Torfhrun
102	Lageining	0	Torfhrun + fokjarðvegur bland
103	Lageining	0	Torfhrun
104	Lageining	0	Torfhrun SA horn [003]
105	Lageining	0	Jarðlag með viðarkolum
106	Lageining	0	Fokjarðvegur/Torfhrun
107	Lageining	0	Steinar
108	Lageining	0	Jarðlag með viðarkolum
109	Lageining	0	Fok undir U-1158
110	Lageining	0	Torfhrun
111	Lageining	0	Torfsneplar + öskuhaugadreif
112	Lageining	0	Neðar gólf? í V inngangi
113	Lageining	0	Torfhrun + öskuhaugadreif
114	Lageining	0	Torfhrun + öskuhaugadreif
115	Lageining	0	Fylling
116	Skurður	0	Skorið fyrir mannvirki utan A útgang í [002]
117	Lageining	0	Hrun
118	Lageining	0	Viðarkol í mannvirki [003]
119	Lageining	0	Gólf-yfirborð í mannvirki [002]
120	Lageining	0	Gólf-yfirborð í mannvirki [002]
121	Lageining	0	Lag í mannvirki [002]
122	Lageining	0	Lag í mannvirki [002] + fyrirskurður
123	Lageining	0	Lag í mannvirki [002] + fyrirskurður [125]
124	Lageining	0	Lag í mannvirki [002]
125	Skurður	0	Skorið fyrir stoðarholu í mannvirki [002]
126	Skurður	0	Skorið fyrir stoðarholu í mannvirki [002]
127		0	Foksandur og torfleifar
128		0	Fokjarðvegur A mannvirkis [002]
129	Lageining	0	Torflag
130	Lageining	3	Torf í mannvirki [003] V garðs

131	Lageining	3	Torf í mannvirki [003] A garðs
132	Lageining	3	Torfsneplar úr (43) ?
133	Lageining	3	Steinhella
134	Lageining	3	Viðarkolalag laust
135	Lageining	0	Fokjarðvegur ?
136	Lageining	0	Fylling í stoðarholu, inngangur [126] í [002]
137	Skurður	0	Fylling í stoðarholu, inngangur í [002]
138	Lageining	0	Fylling í stoðarholu, inngangur [137]
139	Lageining	0	Torflag
140	Lageining	0	Torflag
141	Lageining	0	Fokjarðvegur
142	Lageining	0	Steinar
143	Lageining	0	Torflag, mjög lífrænt
144	Lageining	0	Steinar í vegg
145		0	Torfhrun
146		0	Gólfefni, troðið
147	Lageining	0	Torfhrun
148	Lageining	3	Torflag í mannvirki [003]
149	Lageining	3	Torflag, mjög lífrænt
150	Skurður	2	Skurður fyrir eldstæði í mannvirki [002]
151	Lageining	3	Steinaröð/stétt yfir rás?
152	Lageining	0	Fylling í stoðarholu í mannvirki [002]
153	Skurður	0	Skorið fyrir stoðarholu í mannvirki [002]
154	Lageining	0	Fylling í eldstæði í mannvirki [002]
155	Lageining	0	Fylling í eldstæði í mannvirki [002]
156	Lageining	0	Fylling í eldstæði í mannvirki [002]
157	Skurður	0	Skurður fyrir eldstæði í mannvirki [002]
158	Lageining	0	Fylling í stoðarholu í mannvirki [002]
159	Skurður	0	Skurður fyrir stoð í mannvirki [002]
160	Lageining	0	Fylling í eldstæði í mannvirki [003]
161	Lageining	0	Hrun
162	Lageining	0	Torflag / troðningur
163	Lageining	0	Fylling í stoðarholu í mannvirki [002] í eldstæði
164	Skurður	0	Fyrirskurður stoðarholu
165	Lageining	0	Blandað lag, frákast?
166	Lageining	0	Fylling í stoðarholu [157]
167	Skurður	0	Fyrirskurður stoðarholu í mannvirki [002]
168	Lageining	0	Blandað lag
169	Lageining	1	Torfblendingur undir golfi [146]
170	Lageining	171	Fok
171	Hópur	0	Steinhleðsla V [002]
172	Lageining	171	Hliðarsteinar
173	Lageining	1	Fylling í ræsi?
174	Skurður	171	Fyrirskurður hliðarsteina
175	Lageining	2	Fylling í eldstæði V [157]
176	Lageining	2	Fylling pinnaholu [177] + [178] mannvirki [002]
177	Skurður	2	Fyrirskurður pinnaholu í mannvirki [002]
178	Skurður	2	Fyrirskurður pinnaholu í mannvirki [002]
179	Lageining	3	Viðarkiolalag (=[118])
180	Lageining	3	Torflag, brennt
181	Lageining	2	Fylling í stoðarholu í mannvirki [002]
182	Skurður	2	Fyrirskurður stoðarholu [002]
183	Lageining	2	Fylling í stoðarholu í mannvirki [002]
184	Skurður	2	Fyrirskurður stoðarholu [002]

185	Lageining	3	Öskulag í eldstæði
186	Lageining	3	Torflag yfir öskulagi [185]
187	Skurður	1	Skurður fyrir ræsi
188	Lageining	3	Steinar í/á eldstæði
189	Lageining	0	Viðarkolalinsa
190	Lageining	0	Torflag
191	Lageining	0	Öskuhaugadreif
192	Lageining	3	Viðarkol-sandur
193	Lageining	3	Öskulag
194	Lageining	1	Torfviðgerð gólf í mannvirki [001]
195	Lageining	3	Viðarkolalag
196	Lageining	2	Fylling í [197]
197	Skurður	2	Skurður stoðarholu í [002]
198	Lageining	3	Torflag
199	Lageining	0	Lag með viðarkolaflekkjum
200	Lageining	0	Heylinsa
201	Lageining	3	Steinar
202	Skurður	2	Skurður pinnaholui í mannvirki [002]
203	Skurður	2	Skurður pinnaholui í mannvirki [002]
204	Skurður	2	Skurður pinnaholui í mannvirki [002]
205	Skurður	2	Skurður pinnaholui í mannvirki [002]
206	Lageining	3	Öskulag í eldstæði
207	Lageining	3	Skurður eldstæðis
208	Lageining	0	Viðarkolalag
209	Lageining	0	Viðarkolalag
210	Lageining	0	Viðarkol + torf
211	Lageining	3	Torf og viðarkol S ræsis
212	Lageining	3	Torf og viðarkol N ræsis
213	Hópur	2	Mannvirki, veggir [002]
214	Lageining	1	Fok og torfhrun
215	Lageining	1	Fok og torfhrun
216	Lageining	3	Steinar
217	Skurður	3	Fyrirskurður
218	Lageining	0	Rótað grasrótarlag
219	Lageining	0	Rótað grasrótarlag
220	Skurður	0	Fyrirskurður fyrir holur?
221	Skurður	0	Fyrirskurður fyrir holur?
222	Lageining	2	Fylling holu við V vegg í mannvirki [002]
223	Skurður	2	Fyrirskurður
224	Lageining	3	Aska
225	Lageining	3	Viðarkol + torf
226	Lageining	0	Viðarkol
227	Hópur	3	Eldstæði
228	Lageining	0	Fylling í [230]
229	Lageining	0	Fylling í [231]
230	Skurður	0	Skurður fyrir stoðarholu
231	Skurður	0	Skurður fyrir stoðarholu
232	Lageining	3	Skurður fyrir stoðarholu
233	Lageining	3	Stoðarholufylling
234	Lageining	3	Pökkunarsteinar í stoðarholu
235	Lageining	3	Viðarkolaríkt lag
236	Lageining	0	Fokjarðvegur
237	Hópur	3	Eldstæði
238	Lageining	3	Fylling í eldstæði

239	Skurður	3	Skurður fyrir eldstæði
240	Skurður	0	Stækkun aðalsvæðis [004]
241	Lageining	3	Fylling í [242]
242	Skurður	3	Styttur beinn skurður
243	Lageining	3	Fylling [244]
244	Lageining	3	´L´ lagaður skurður
245	Lageining	3	Lag sem breiðist gegnum dyr
246	Lageining	1	Veggir mannvirkis [001]
247	Lageining	1	Foksandur með flekkjum af uppkast
248	Lageining	3	Fylling [244]
249	Skurður	3	Beinn fyrirskurður
250	Lageining	3	Fylling [251]
251	Skurður	3	Beinn fyrirskurður
252	Lageining	3	Gólflag
253		3	Gólflag
254		3	Fyrirskurður
255		3	Efri fylling í [254]
256		3	Viðarkolarík fylling í [254]
257		3	Viðarkolafylling í [202]
258		3	Veggur í mannvirki [003]
259		43	Lítið mannvirki tengt mannvirki [002]
260		2	Skurður fyrir mannvirki [002]
261	Lageining	1	Uppkast undir vegg í [246]
262	Skurður	3	Fyrirskurður [257]
263	Lageining	0	Viðarkolalag
264	Lageining	0	Öskulag
265	Skurður	3	Lægð eða skurður gegnum dyr
266	Lageining	0	Öskulag
267	Lageining	0	Viðarkolalag
268	Skurður	2	Pinnaholur í mannvirki [002]
269	Skurður	2	Pinnaholur í mannvirki [002]
270	Skurður	2	Pinnaholur í mannvirki [002]
271	Skurður	2	Pinnaholur í mannvirki [002]
272	Skurður	2	Pinnaholur í mannvirki [002]
273	Skurður	2	Pinnaholur í mannvirki [002]
274	Skurður	2	Pinnaholur í mannvirki [002]
275	Lageining	0	Öskuhaugadreif
276	Lageining	0	Viðarkolalag
277	Lageining	0	Öskuhaugadreif
278	Lageining	0	Lag með viðarkolaflekkjum - fyrningar
279	Lageining	0	Raskað náttúrulegt / troðið
280	Lageining	0	Fok og torfsnepplar
281	Lageining	282	Torfhrun
282	Hópur	0	Óþekkt
283	Lageining	282	Hliðarsteinar + steinhellur
284	Skurður	282	Skurður fyrir steina
285	Lageining	1	Upprunanaleg vegglína í NV horni
286	Lageining	0	Fylling
287	Skurður	0	Ferningslaga skurður
288	Lageining	0	Fylling
289	Skurður	0	Hola
290	Lageining	0	Fylling
291	Skurður	0	Hola
292	Lageining	0	Fylling

293	Skurður	0	Eldstæði
294	Lageining	0	Fylling
295	Skurður	0	Eldstæði
296	Lageining	0	Fylling
297	Skurður	0	Stoðarhola
298	Lageining	0	Fylling
299	Skurður	0	Hola
300	Lageining	0	Fylling
301	Skurður	0	Hola
302	Lageining	0	Stoðarholufylling
303	Skurður	0	Skurður fyrir stoð
304	Lageining	0	Fylling [270] viðarkol grá - dökk
305	Hópur	2	N veggur við V inngang í mannvirki [002]
306	Hópur	2	S veggur við V inngang í mannvirki [002]
307	Skurður	1	Skurður stoðarholu / inngangur
308	Lageining	2	Náttúrulegur jarðvegur undir mannvirki [002]
309	Skurður	0	Stoðarhola/hola
310	Skurður	0	Stoðarhola/hola
311	Skurður	0	Stoðarhola/hola
312	Hópur	0	Eldra eldstæði í mannvirki [002]
313	Hópur	0	Yngra eldstæði í mannvirki [002]
314	Hópur	0	Stoðarhola séð í sniði en ekki skráð á vettvangi

Skýrslur sérfræðinga 5

Fornleifarannsókn á rústum á Vesturöræfum, N-Múlasýslu
Greining gjóskulaga

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Vettvangsferð var farin á rannsóknarsvæðið, sem er á Sandfellsöldu á Vesturöræfum, dagana 8.-9. ágúst 2005. Skoðuð voru gjóskulög í jarðvegssniðum bæði á uppgraftarsvæðinu og í næsta nágrenni þess. Gjóskulögum var lýst og sýni tekin til nánari skoðunar.

Gjóskulög á Vesturöræfum og Brúardölum

Gjóskulagarannsóknir fyrri ára benda til að á Jökuldal og Brúardölum séu allmörg gjóskulög sem nota má við aldursgreiningu fornleifa (Guðrún Larsen 1982; 1984, Jón Benjamínsson 1982, Sigurður Þórarinsson 1958; 1977, Sveinbjörn Rafnsson 1990). Gosár og útbreiðsla allnokkurra gjóskulaga er þekkt, s.s. A-1875, V-1717, V-1477 (einnig nefnt "a"-lagið), Ö-1362, K-1262, H-1158 og Landnámslags (LNL) frá 870-875 (Karl Grönvold et al. 1995, Zielinski et al. 1997). Einnig er til staðar fjöldi annara gjóskulaga sem minna er vitað um. Þessi gjóskulög eru í flestum tilvikum þunn og með lítt þekkta útbreiðslu og óþekkt gosár. Flest þeirra hafa þó verið efnagreind þannig að vitað er í hvaða eldstöðvakerfum þau eiga upptök (sjá t.d. Guðrún Larsen 1982). Eitt þessara laga er gjóskulag sem varð til gosi á Veiðivatnakerfinu um 950, nefnt V~950 (Magnús Á. Sigurgeirsson et al. 2002). Þetta gjóskulag hefur reynst mikilvægt við aldursgreiningu elstu byggðar í Mývatnssveit.

Niðurstöður athugana

Í sniðum I-III á mynd 1 má sjá helstu niðurstöður gjóskulagagreiningarinnar. Sérstaka athygli vakti ljóst þunnt gjóskulag sem er 3-4 cm neðan H-1158. Þetta gjóskulag er ekki að sjá í sniðum sem birt hafa verið frá Austurlandi fram til þessa. Lagið er 1-2 mm að þykkt og víða slitrótt. Lítið er um ljós gjóskulög í jarðvegi frá því eftir landnám og fram undir miðja 12. öld. Beindust spjótin fljótt að gjóskulaginu H-1104 sem líklegasta möguleika (einnig nefnt H_1). Samkvæmt athugunum Guðrúnar Larsen (1992) á útbreiðslu H-1104 og H-1158 liggur vesturjaðar H-1104 við Jökulsá á Fjöllum. Rústirnar á Sandfellsöldu liggja um 20 km austan Jökulsár á Fjöllum, sem

ekki útilokar að lagið geti fundist á rannsóknarsvæðinu. Samkvæmt upplýsingum frá Guðrúnu Larsen (skeyti frá 5. sept. 2005) fundust merki um H-1104 fyrir nokkrum árum við Sauðá (vestari), sem er einungis fáum kílómetrum vestan rannsóknarsvæðisins. Í sniðum á uppgraftarsvæðinu liggur H-1104 um 2-3 cm ofan við mannvistarlög.

Fjöldi gjóskulaga er til staðar neðan við H-1104 (sjá mynd 1) og er eitt þeirra Landnámslagið svonefnda sem tímasett er til 870-875. Ekki tókst að greina LNL með vissu á vettvangi sökum þess hversu lík í útliti mörg þessara laga eru. Í sniði I voru tekin sýni úr sjö gjóskulögum neðan H-1104 til nánari skoðunar. Í smásjá koma ýmis einkenni gjósku betur í ljós en í mörkinni, s.s. litur glers, lögun og útlit korna og magn mismunandi kornagerða. Landnámslagið einkennist öðru fremur af óvenju miklu magni kristalbrota (aðallega af steindinni plagióklasi). Hins vegar verður þetta einkenni óljósara eftir því sem fjær dregur upptökum lagsins. Niðurstöður smásjárskoðunar á sýnunum benda til að sjötta lag neðan H-1104 sé Landnámslagið en í því eru kristalbrot áberandi og litur glersins er í samræmi við fyrri lýsingar, þ.e. mógrænleitur. Í sniðum Guðrúnar Larsen (1982) frá Jökuldal og Brúardölum má sjá allt að fimm dökk gjóskulög á milli Landnámslags og H-1158 sem er í ágætu samræmi við þessa greiningu.

Í sniði III er meint Landnámslag um 10 cm neðan elsta sorplagsins. Afstaða LNL til veggja rústanna er sú sama, þar er lagið um 10 cm neðan neðsta torflagsins. Gerð var tilraun til að finna aldur á lögin fyrir ofan LNL í sniði I með því að nota þykknunarhraða jarðvegs á milli LNL og H-1104. Út úr því komu ártölin 885, 920, 960, 1005 og 1050. Taka ber þessum ártölum með fyrirvara þar sem fá snið liggja til grundvallar, en auk sniðs I var stuðst við snið frá Brúarseli á Jökuldal (M.Á.S., óbirt gögn). Þykknunarhraði jarðvegs er mjög háður landslagi og ýmsum umhverfisþáttum, s.s. jarðvegseyðingu og gjóskufalli, og getur verið talsvert breytilegur frá einum tíma til annars. Á þetta ekki síst við um hálendissvæði þar sem jarðvegsþekjan er viðkvæmari gagnvart roföflunum en á láglendari svæðum landsins. Samt sem áður gefa þessir útreikningar nokkra hugmynd um aldur laganna. Samkvæmt þeim gæti þriðja lag ofan meints LNL verið gjóskulagið sem nefnt hefur verið V~950.

Í sniði III, sem liggur í gegnum sorphaug, eru tvö dökk gjóskulög varðveitt á milli sorplaga (mynd 1). Neðra lagið finnst ekki í sniði I og hefur að öllum líkindum

varðveist þarna vegna hraðrar uppsöfnunar úrgangs (mestmegnis ösku). Samkvæmt smásjárskoðun samsvarar efra lagið að flestum líkindum gjóskulaginu næst neðan H-1104 í sniðum I og II. Þetta lag gæti verið frá því um miðja 11. öld. Næsta lag neðan sorplaganna gæti samsvarað gjóskulaginu V~950. Sé notuð jarðvegsþykknun á milli H-1158 og H-1104, sem hefur verið svipuð á rannsóknarsvæðinu og nágrenni þess, til að áætla hvenær upphleðslu sorplaganna lauk kemur út að það hefur verið tæpum fjörtíu árum áður en H-1104 féll, þ.e. um 1065. Samkvæmt þessu má álykta með nokkurri vissu að sorplögin í sniði III séu frá tímabilinu 950-1070.

Athuganir á gjóskulögum undir og yfir torfveggjum mannvirkjanna, bæði húsa og meints gerðis, benda til að þau séu byggð eftir 950 og aflögð nokkrum áratugum áður en gjóskulagið H-1104 fellur. Yngsta gjóskulagið undir veggjum húsanna og gerðisins er að öllum líkindum það sama og er næst undir sorplögunum í sniði III, þ.e. frá því um 950. Sorplag sem er í torfi húsanna bendir til veru manna á þessum stað nokkru áður en húsin voru reist. Vegna þeirrar óvissu sem ríkir um aldur laganna á milli LNL og H-1104 er ekki raunhæft að fara nær um aldur byggingana en að ofan greinir. Niðurstaðan er því sú að mannvirkin séu reist um 950, eða skömmu síðar, og aflögð fyrir 1070.

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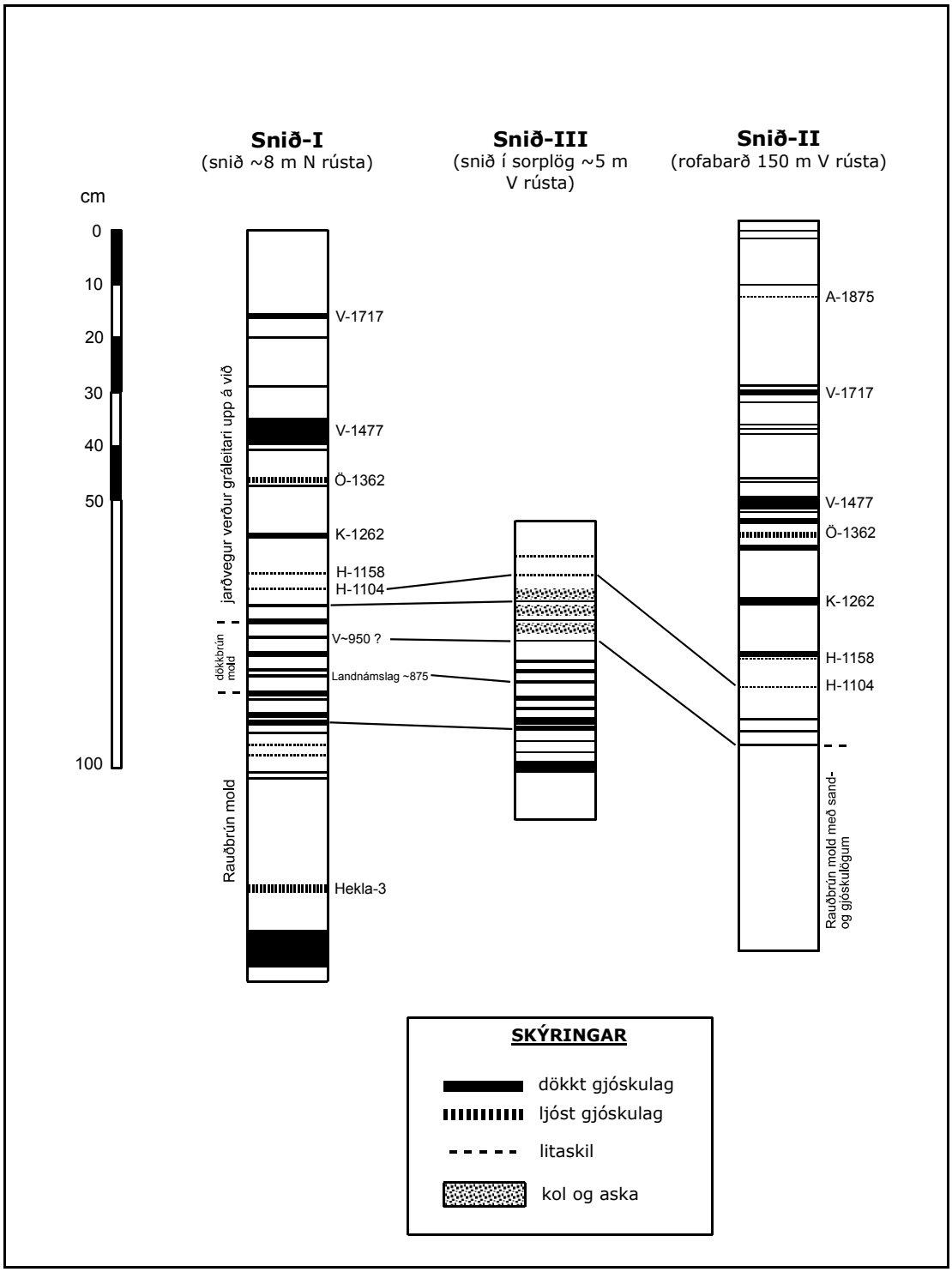
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Mynd 1. Jarðvegssnið frá meintu Reykjaseli á Vesturöræfum, N-Múlasýslu.

THE ANIMAL BONES

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[The following is based on correspondence between Knud Rosenlund and Garðar Guðmundsson].

Materialet har været vanskeligt at bestemme, på grund af den dårlige bevaringsgrad. Dette er naturligvis grunden til, at der er så mange forbehold på listen. Dette gælder navnlig de mange knogler af gæs. Jeg tør med rimelig sikkerhed sige, at der bedømt ud fra størrelsen, kun kan være tale om to arter: Grágæs *(Anser anser*) eller heiðagæs (*Anser* brachyrhynchus), men disse to arter er desværre vanskelige at kende fra hinanden på knoglerne. Derfor er det kun på de bedst bevarede, at jeg har foretage en artsbestemmelse. Som det se af listen, er det i samtlige tilfælde, hvor en sikker artsbestemmelse er mulig, altid tale om grágæs, men dette beviser naturligvis ikke noget for de øvrige knogler.

Albatros

Med hensyn til albatros kan jeg oplyse følgende: Der er tale om en art af den egentlige albatros-familie (Diomedeidae). Samtlige de arter, der i tidens løb er observeret i det nordlige Atlanterhav, er alle sjældne til ekstrem sjældne, og kun ganske enkelte iagttagelser kendes fra Island. Der er med andre ord tale om en stor sjældenhed.

Der kan være tale om følgende arter:

Latinsk navn	**Engelsk navn**	**Dansk navn**	**Forekomst i Nordatlanten**	**Knoglens størrelse**
Diomedea melanophris	Black-browed Albatross	Sortbrynet albatros	Sjælden, set enkelte gange på Island	For stor
Diomedea chlororhynchos	Yellow-nosed Albatross	Lille albatros	Ekstrem sjælden,	For stor
Diomedea chrysostoma	Grey-headed Albatross	Gråhovedet albatros	Ekstrem sjælden	?
Diomedea exulans	Wandering Albatross	Vandrealbatros	Meget sjælden	Passer

Hvilken af disse arter knoglen repræsenterer, kan desværre ikke afgøres på grund af manglende skeletmateriale til sammenligning her på Zoologisk Museum. Blandt de arter, af hvilke vi har skeletter, virker vandrealbatrossen umiddelbart som det bedste bud, men som sagt har vi ikke alle arter i samlingen.

Gæs

Mængden af gåseknogler og den anatomiske fordeling tyder absolut på, at der er tale om hele fugle, der er parteret og fortæret på stedet, fordi der er fundet knogler fra alle kroppens elementer.

De fundne knogler fordeler sig således:

Knogler fra kroppen:

Hvirvel	2
Clavicula	5
Coracoideum	5

Knogler fra vinger:

Overarm	14
Spoleben	14
Albueben	10
Mellemhånd	4

Knogler fra ben:

Lårben	2
Skinneben	8
Mellemfod	1

Som det ses, er vingeknoglerne i overtal, men dette er helt naturligt og normalt i denne type knoglematerialer, da disse er de største og kraftigste knogler i kroppen. På samme måde er det også helt normalt at elementer som kranium, brystben og bækken er i mindretal eller – som her – helt mangler, da disse er ganske tynde og skrøbelige.

Alle gåseknoglerne stammer fra voksne individer, og de dårlige bevaringsforhold taget i betragtning, er det nok tvivlsomt om knogler fra unge individer ville være erkendt under udgravningen. Hvornår på året gæssene er blevet nedlagt, er derfor umuligt at sige, men der er naturligvis intet til hinder for, at det er foregået i gæssenes årlige fældningsperiode om sommeren, hvor de ikke kan flyve.

Får og får/ged

Den anatomiske fordeling af de fundne knogler ser således ud:

Underkæbe	1
Overarm	2
Spoleben	2
Bækken	1
Skinneben	3
Rulleben	10
Mellemfod	2
Tåled	1

Her springer den store overvægt af rulleben straks i øjene. Men ser man bort fra disse, behøver der strengt taget kun at være rester at ét får. De ti rulleben, som mindst må repræsentere fem får, er formentlig brugt som legetøj og/eller spil, og er samlet sammen i forbindelse med slagtninger.

På grund af de dårlige bevaringsforhold har det ikke været mulig at iagttage snitmærker på knoglerne.

4. List of Animal Bones

Albatross, *Diomedea* sp.
Whooper Swan, Cygnus cygnus
Greylag Goose, *Anser anser*
Goose, *Anser* sp.
Bird, *Aves*
Sheep, *Ovis aries*
Sheep or goat, *Ovis aries/Capra hircus*

N.B. S in front a finds number indicates it came from a soil sample

Finds No	Unit No	Notes
6	2	**Goose:** Coracoideum, 1 part. Humerus, 1 shaft. Tibiotarsus, 1 shaft.
7	3	**Greylag Goose:** Femur, 1 complete. **Goose:** Humerus: 2 shafts. Tibio-tarsus, 2 shafts. **Bird:** 3 fragments. **Sheep or goat:** Radius, 1 shaft. Tibia, 1 shaft.
1	14	**Goose:** Radius, shaft.
2	16	**Sheep or goat:** Bone fragment.
3	17	**Greylag Goose:** Radius. **Goose:** Coracoideum-part.
4	31	**Goose:** Humerus, 1 distal part. Radius, 1 shaft.
5	34	**Greylag Goose:** Radius, 1 shaft.
50	37	**Greylag Goose:** clavicula, 1 complete. Ulna, distal part. **Goose:** Ulna, 2 parts. Radius, 1 part. Tibiotarsus, 2 fragmented. Tarsometatarsus, 1 fragmented. **Whooper Swan:** Clavicula, 1 part. **Sheep or goat:** Mandibula, 1 fragment.
15	38	**Albatross:** Ulna, 1 part of diaphysis.
9	39	**Bird?:** Small bone fragments.
10	39	**Indet.:** Small bone fragments.
11	39	**Bird?:** small fragments.
12	39	**Bird:** Bone fragments.
16	39	**Bird:** Small fragment of humerus.
43	39	**Bird:** 4-5 small fragments.
86	39	**Goose:** Coracoideum-part.
87	39	**Goose:** Vertebra-fragment.
88	39	**Goose?** Tibiotarsus fragments.
14	44	**Goose:** Ulna fragments.
46	47	**Goose:** Radius, 2 fragmented.
51	47	**Goose:** Radius, part. **Sheep or goat:** Metatarsus, shaft.
52	47	**Goose:** Carbometacarpus, 1 bone in 2 pieces. **Sheep or goat:** 1 bone fragment.
17	48	**Goose:** Radius, 3 fragments. Carbometacarpus, 1 fragment. Tibiotarsus,1 fragment.
18	60	**Sheep or goat:** Phalanx, fragmented.
19	60	**Sheep or goat:** Tibia-fragment.
20	60	**Indet.:** Bunt small fragments.
S11	71	**Greylag Goose:** Ulna, 1 distal part. **Goose:** Radius, 1 shaft. **Bird:** small fragments.
S20	71	**Goose:** Ulna, 1 shaft.
S23	71	**Goose:** Tibiotarsus, 1 shaft.
22	74	**Sheep:** Humerus, distal part.
23	74	**Sheep:** Astragalus, 1 complete.

24	74	**Bird:** Femur fragments.
26	74	**Goose:** Humerus, shaft.
27	74	**Goose:** Humerus, shaft.
28	74	**Sheep:** Tibia, complete ex. prox. epiphysis.
29	74	**Goose:** Humerus, shaft.
30	74	**Bird:** Small fragments.
31	74	**Goose:** Ulna part.
32	74	**Goose:** Femur, shaft.
45	74	**Goose:** Radius shaft.
89	74	**Sheep or goat:** Radius+ulna, prox. End, fragmented.
90	74	**Bird:** Bone fragment.
91	74	**Bird:** Small bone fragments.
92	74	**Bird:** Small bone fragments.
93	74	**Indet.:** Small bone fragments.
94	74	**Sheep:** astragalus, 1 complete.
95	74	**Bird:** Bone fragments
33	105	**Goose:** Humerus, shaft.
34	105	**Bird:** fragment.
35	105	**Goose:** Ulna part.
36	105	**Whooper Swan:** Tibiotarsus 1 distal part.
37	105	**Goose:** Clavicula-part.
38	105	**Bird?:** Small fragments.
65	105	**Indet.:** Burnt bone fragments.
66	105	**Sheep or goat:** Pelvis-fragment.
67	105	**Sheep or goat:** Pelvis-fragment.
101	105	**Bird:** Bone fragment.
102	105	**Indet.:** Small bone fragments.
103	105	**Goose:** Vertebra, 1 fragmented.
48	106	**Greylag Goose:** Carbometacarpus, 1 part. **Goose:** Clavicula, 1 part. Coracoideum 1 part. Ulna, 1 shaft. Radius, 2 shafts.
49	106	**Sheep:** Astragalus, 5 complete (2 left, 3 right).
109	108	**Indet.:** small fragments
61	121	**Sheep or goat:** Astragalus-fragment.
68	128	**Bird:** Coracoideum-fragment.
54	129	**Sheep or goat:** Humerus, 1 fragment.
59	130	**Goose:** Humerus, shaft.
S37	143	**Goose:** Humerus, 1 fragment of shaft.
62	145	**Goose:** Humerus, 2 complete but very bad preserved.
63	149	**Greylag Goose:** Carbometacarpus, 1 complete. **Sheep:** Astragalus. 1 complete.
73	152	**Goose:** Humerus, shaft.
71	154	**Sheep:** Astragalus, 1 complete.
74	168	**Goose:** Radius fragments.
75	170	**Goose:** Clavicula, 1 fragmented.
80	208	**Indet.:** Small fragments.
81	219	**Indet.:** Small fragments.
S95	224	**Bird:** 2 small fragments.
98	263	**Goose?** Clavicula-fragments.
99	263	**Indet.:** Small bone fragments.
105	275	**Bird:** Small fragments.
106	275	**Indet.:** Small bone fragments.
107	275	**Indet.:** Small fragments.
108	275	**Bird (goose?):** Humerus fragments.
104	276	**Sheep or goat:** Metatarsus-fragment.

FINDS

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The small group of finds from the 2005 season at this site include several different material types. Numerically the largest group is stone, comprising 18 out of the 31 total assemblage. Different stone types have been noted, including worked quartz and flint, a small number of pebbles which were deliberately introduced to the site, one burnt pebble or pot-boiler and a possible fragment of porphyry or jasper. Metallic finds of both iron and copper alloy were recovered, many in very poor condition which is several cases has made detailed identification impossible. Two perforated coins have been reused as mounts. The coins have been identified as having been minted for King Harald Hardrada of Norway who reigned from 1047 to 1066. A single glass bead in addition to parts of a crucible and a single piece of industrial debris complete this varied assemblage.

Stone

There are 6 pieces of flint and 7 of quartz, scattered across several different contexts. The flint is from layers 74 (2), 105, 108 (2) and 129, and the quartz from layers 39 (2), 74 (2), 155 (2) and 199. Layer 74 is a charcoal flecked soil and includes three pieces of both flint and quartz which are provisionally identified as having been worked as possible flakes (Finds 21, 25, and 96). Layer 155 is a hearth deposit and includes two finds which are classed provisionally as a worked flake (Find 70) and a quartz scraper (Find 76). Find 55 from Layer 129 also appears to be a retouched fragment. Further detailed analysis is required to confirm any use wear patterns on these peieces (see Chabot, below), however late Iron Age use of such stone resources is becoming an increasingly recognised phenomenon (see for example discussion by Batey and Paterson forthcoming) and is the inevitable result of a lack of substantial readily-available stone resources for tools through time. It is presumed that the flint is imported to Iceland (see discussion by Einarsson 1994, 122), although quartz may be locally available.

The find provisionally identified as porphyry, number 53 from layer 47 a mixed layer of windblown sand and collapsed turf requires further geological examination. This is a commodity known throughout Europe as an Eastern import, often in association with the spread of Christianity. There are a number of examples of the green variant of porphyry known in Iceland, for example at Þórarinstöðir in Seyðisfirður (Kristjánsdóttir 2000-2001, 122 fig 6) and from Viðey (Hallgrímsdóttir 1987, 82). If this identification is correct, this will indeed be worthy of further discussion. An alternative identification could be jasper, which is a common find in Western Iceland and was used as a strike-a-light (see for example Smith 2000, 217).

A small number of finds include pebbles which have been selected deliberately presumably due to their attractive qualities, such as colour or feel. These finds include number 47 from layer 117, number 60 from layer 121 and number 69 from layer 155. This

phenomenon is ubiquitous on most sites, but has been discussed in relation to the material from Whithorn in S W Scotland (Chadburn and Hill 1997, 468-474).

Metalwork

10 finds of metal are noted, of which 3 are of iron of indeterminate form. Amongst the remaining 3 pieces of iron, which is in badly corroded condition, there is a possible punch or similar tool (currently in three conjoining pieces), find 83 from layer 39 and the others are fragmentary nails. A distorted nail, find 100 from ashy dump 266 may represent an accidental discard from the clearing out of a working fire. Additionally 4 copper alloy pieces were recovered. Find 42 from a layer of windblown sand (106), is a small square sheet metal piece with two perforations which may have served as a patch for a vessel or a mount. The other copper alloy finds 40 (solid, irregular lump – probably a spillage rather than ingot), 44 (a raised stud or mount of indeterminate date) and 82 (two perforated coins which were presumably reused as mounts) are scattered across as many contexts.

Industrial Debris

In the light of the very limited metal assemblage from this part of the site excavated in 2005, it is perhaps surprising to have a part of a small crucible included in the finds assemblage. However, find 39 from the mixed layer 108, comprises three conjoining fragments of a small ceramic crucible which has traces of considerable vitrification throughout its thickness. Although this will require SEM analysis, its size would suggest the working of precious metal or copper alloy in small quantities rather than iron. A lava crucible was identified from Granastaðir (Einarsson 1994, 97-8). It is clear that small -scale metalworking was being undertaken in the Viking age in Iceland even at sites characterised as shielings, as suggested in the Faroe Islands by Mahler in relation to the site of Argisbrekka (Mahler 1993, 494).

Glass Bead

Find 57 is half of a polychrome eyed-glass bead in black with opaque white tracery and eye-insets of red,cream and green was recovered from layer 135, a windblown sand deposit. It is of a type already identified in Iceland from the grave site of Brú in Árnessýslu (Eldjárn and Friðriksson 2000, 85-6; Hreiðarsdóttir 2005, 96 and 114). In Callmer´s typology it is of a type B and dated to the late 10th (Callmer 1977, plate 6, type 0900, 85).The type is not very commonly found but it would probably be reasonable to assume that these two Icelandic examples may originally have come from the same workshop source.

Despite the rather small nature of this assemblage in numerical terms, it does include some very unexpected elements - possible flint and quartz tools or preforms, a crucible and several copper alloy finds (4 out of 31 finds) and a distinctive (albeit broken) decorative glass bead.

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Stórsæjar jurtaleifar frá Pálstóftum við Kárahnjúka

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Inngangur

Alls voru tekin 125 sýni við uppgröftinn á Pálstóftum sumarið 2005. Tilgangur sýnatökunnar var sem hér segir:

Til greiningar á stórsæjum jurta- og beinaleifum, skordýrum o.fl. í mannvistarlögum	Til greiningar á örformgerð mannvistarlaga	Til greiningar á efnainnihaldi mannvistarlaga	Til greiningar á tegund viðar eða annarra lífrænna efna	Til greiningar á frjókornum í jarð- og mannvistarlögum
73 sýni	9 sýni	32 sýni	7 sýni	4 sýni

73 magnsýni úr mannvistarlögum voru tekin í því augnamiði að greina stórsæjar jurtaleifar, einkum fræ, beina- og skordýraleifar og aðrar stórsæjar leifar. Af þessum 73 sýnum voru 18 tekin til greiningar og verður fjallað um þá rannsókn hér.

Aðferðir

Eins og að ofan greinir voru 73 sýni tekin við uppgröftinn á Pálstóftum til greiningar á stórsæjum koluðum jurtaleifum og öðrum fundaflokkum. Öll þessi sýni hafa verið verkuð. 65 sýnum var fleytt í fleytingavél. Notuð var vél sem kennd hefur verið við Ankara og var 1 mm grisja í tunnunni til að fanga fyrningar (residue), en flotið fangað í sigti með möskvastærðunum 1 mm og 0,3 mm. Vegna smæðar voru átta sýni sigtuð í vatni í sigti með 0,3 mm möskvastærð. Alls voru verkaðir, fleytt eða sigtað, um 442 lítrar af jarðvegi. Fyrir verkun voru tekin til varðveislu 25-50 ml sýni frá 69 þessara 73 sýna. Þetta var gert í því augnamiði að halda opnum möguleika á að rannsaka t.d. frjókorn og efnainnihald þessara mannvistarlaga í framtíðinni.

Þau sýni sem valin voru til rannsóknar voru skoðuð undir víðsjá (Leica MZ6), greinanlegar jurtaleifar tíndar út og greindar með hliðsjón af samanburðarjurtasafni og greiningarritum. Einnig voru á þessu stigi tíndar út skordýraleifar til greiningar.

Eftirfarandi 18 sýni voru tekin til greiningar á stórsæjum jurtaleifum: Úr gólflagi í húsi I (nefnt mannvirki 002 í frumgögnum á vettvangi) voru rannsökuð 2 sýni (15, 18) og eitt (106) úr gólfi í húsi IV (003 á vettvangi). Eitt sýni (4) var og tekið til skoðunar úr öskulagi í mannvirki II (43 á vettvangi), en það er smáhýsi eða kró tengd norðausturhorni húss I. Tvö sýni (60, 61) úr eldstæði 312 frá eldra byggingarstigi í húsi I voru rannsökuð og eitt sýni (43) úr eldstæði 313 frá yngra byggingarstigi í sama húsi. Úr eldstæðum í húsi IV voru tekin 2 sýni til rannsóknar. Eitt (97) úr eldra eldstæðinu, 237, og eitt sýni (86) úr því yngra, 227. Auk þessa var úr húsi IV tekið sýni (36) úr yfirborðslagi frá yngsta skeiði hússins. Úr mannvistarlögum utan mannvirkja voru tekin alls 8 sýni til rannsóknar (3, 6, 8, 24, 25, 57, 85, og 88).

Rannsókn og niðurstöður

Flest sýnin eru, eftir vinnslu, nánast hrein sýni af koluðum jurtaleifum, einkum viðarkolum. Í nokkrum sýnanna eru þó ókolaðar jurtaleifar, viðarspænir og smáflísar. Þessar ókoluðu leifar voru ekki þess eðlis að frekari rannsókn á þeim væri réttlætanleg

að svo komnu máli. Varðveisla í mannvistarlögunum má teljast nokkuð góð. Kolaðar jurtaleifar hafa ekki orðið fyrir teljandi hnjaski.

Eins og sést í töflunni hér að ofan eru sýnin sem hér er fjallað um tekin úr þremur megingerðum mannvistarlaga, þ.e. öskulögum, gólflögum og eldstæðum. Samsetning þessara laga er afar lík, en þó skera tvö gólflög og eitt öskulag sig úr vegna mikils magns ókolaðra jurtaleifa. Að jafnaði rotna og hverfa ókolaðar jurtaleifar fljótt úr jarðvegi. Þó er þekkt að í þéttum gólflögum geti skapast kringumstæður, einkum súrefnisleysi, sem hægir verulega á rotnun. Er það líklegasta skýringin á varðveislu ókolaðra plöntuleifa í sýnum 18 og 106. Ekki er fyrir hendi haldbær skýring á svipaðri varðveislu í sýni 3. Með tilliti til samsetningar efnisflokka í sýnunum skera gólfsýnin sig úr þar sem ekki fundust nein bein í þeim, hvorki brennd né óbrennd. Í öllum sýnunum úr eldstæðum fundust hins vegar brennd bein og einnig óbrennd bein í sumum þeirra. Einnig fundust brennd bein í 5 af 8 sýnum úr öskuhaugum.

Einungis eitt fræ fannst í þeim 18 sýnum sem greind voru. Var það í sýni 4, jarðlagi 48, öskuhaug, úr mannvirki II (43 á vettvangi). Þetta er kolað haugarfafræ (*Stellaria media*). Haugarfi vex í næringarríkum jarðvegi við mannabústaði, samanber nafnið, en ekki á heiðum uppi. Þrátt fyrir að dæmi séu til um að haugarfi hafi verið notaður til manneldis er ólíklegt að honum hafi verið safnað á Pálstóftum í þeim tilgangi og þannig hafnað í mannvistarlögum þar. Líklegt er að fræið hafi borist á staðinn í saur húsdýra sem þurrkaður hafi verið og notaður sem eldsneyti.

Í nokkrum sýnanna greindust lauf krækiberjalyngs (*Empetrum nigrum*) og einiberjalyngs (*Juniperus communis*). Einnig fannst fræhært blómhöfuð holtasóleyjar (*Dryas octopetala*) í einu sýnanna. Auk þessa voru í flestum sýnanna smágreinar, kvistir og brumhnappar.

Eins og áður segir er meginuppistaða sýnanna viðarkol. Lausleg greining á viðarkolum teknum úr sýnunum af handahófi leiddi í ljós víðitegundir (*Salix* sp.) annars vegar og birkitegundir, birki (*Betula pubescens*; *B. nana*) eða fjalldrapi, hins vegar. Ekki var farið í frekari tegundagreiningu.

Sennilegasta skýringin á tilveru þeirra jurtaleifa sem fundust í sýnunum frá Pálstóftum er að þær séu leifar eldsneytis sem safnað hafi verið í næsta nágrenni við bústaðinn og endurspegli því gróðurfar nánasta umhverfis. Þetta á við um viðarkolin sem stafa frá birki og víðitrjám og runnum og fjalldrapa. Líklegt er að krækiberjalyng hafi slæðst með á eldinn. Ekki fundust fræ einiberja né krækiberja og því ekki hægt að fullyrða að þessum berjum hafi verið safnað til átu. Þrátt fyrir að fræhært höfuð holtasóleyjarinnar sem fannst gefi tilefni til að ætla að það hafi borist á staðinn síðla sumars, er ekkert annað sem gefur vísbendingu um hvenær árs búseta á staðnum hefur verið né hvort búsetan hafi staðið árið um kring eða einungis hluta úr ári.

Sýna númer	Mannvirki eða svæði	Jarð-lag	Tegund jarðlags	Rúmmál jarðvegssýnis í lítrum	Vinnslu-aðferð	Rúmmál sýnis eftir fleytingu
3	Utan mannvirkis	39	Öskuhaugalinsa í fokjarðvegi	0,06	Sigtað	
4	II (43 á vettvangi)	48	Öskuhaugadreif	1,00	Fleytt	
6	Utan mannvirkis	60	Öskuhaugalinsa í fokjarðvegi	0,03	Sigtað	
8	Utan mannvirkis	74	Öskuhaugalinsa í fokjarðvegi	0,11	Sigtað	
15	I (002 á vettvangi)	71	Gólflag	4,00	Fleytt	
18	I (002 á vettvangi)	71	Gólflag	15,00	Fleytt	
24	Utan mannvirkis	105	Öskuhaugalinsa í fokjarðvegi	0,09	Sigtað	
25	Utan mannvirkis	105	Öskuhaugalinsa í fokjarðvegi	0,30	Sigtað	
36	IV (003 á vettvangi)	118	Yfirborðslag	19,00	Fleytt	
43	I (002 á vettvangi)	122	Eldstæði	18,00	Fleytt	
57	Utan mannvirkis	105	Öskuhaugalinsa í fokjarðvegi	0,14	Sigtað	
60	I (002 á vettvangi)	156	Eldstæði	3,00	Fleytt	
61	I (002 á vettvangi)	155	Eldstæði	5,00	Fleytt	
85	Utan mannvirkis	199	Öskuhaugalinsa í fokjarðvegi	0,04	Sigtað	
86	IV (003 á vettvangi)	160	Eldstæði	5,00	Fleytt	
88	Utan mannvirkis	209	Öskuhaugalinsa í fokjarðvegi	0,05	Sigtað	
97	IV (003 á vettvangi)	235	Eldstæði	8,00	Fleytt	
106	IV (003 á vettvangi)	252	Gólflag	4,00	Fleytt	
				Samtals 82,82		

Pálstóftir near Kárahnjúkar 2005 (KHN05)

Pollen analysis

Report by Dr Lucy Verrill

7 February 2007

INTRODUCTION

A good tephra sequence was of prime importance in the selection of a location for a pollen profile to aid interpretation of the archaeological results from Pálstóftir. Although peat would be preferable for pollen analysis, the nearest bog deposits to Pálstóftir did not contain good tephra sequences. A compromise was made whereby a 1m soil section from a location approximately 150m due west of the Pálstóftir site near Kárahnjúkar was sampled for pollen and tephra content. Ten samples from this soil sequence and two samples from on-site contexts were selected for pollen analysis. Details of sample provenance are given in tables 1 and 2.

METHODOLOGY

Processing was not carried out by the present author. Samples were processed at the Department of Geography, University of Cambridge using standard preparation techniques, described in detail at:
http://www.geog.cam.ac.uk/facilities/laboratories/protocols/pollen.html.
Analysis took place at Geography, School of GeoSciences, University of Edinburgh, with identifications made using published pollen keys (Moore et al 1991) and reference material. Although a total pollen sum of at least 300 grains per sample (excluding spores and aquatics) is preferable for meaningful interpretation, the nature of the soils at Pálstóftir resulted in very low pollen concentrations. The result was that total pollen counts of only 100-200 grains were practicable. Three samples (2, 10 and 11) did not contain sufficient fossil pollen for analysis. Graphs were constructed using Tilia and TGView (Grimm 1991, 2004).

RESULTS

Figures 1 and 2 show the pollen percentage and pollen concentration diagrams from the soil sequence. Figures 3 and 4 show the pollen percentage and pollen concentration information from sample 12 in Structure 3. Figure 5 shows the pollen preservation details of all samples analysed.

As the samples analysed contained low pollen concentrations and counts achieved were less than ideal, it was deemed necessary to employ some of the techniques used by Bunting & Tipping (2000) in order to assess the statistical reliability of the pollen profile. They suggested that post-depositional assemblage biasing would be indicated by a sample characterised by low TLP counts, low pollen concentrations, few main sum taxa, high percentages of poorly preserved or indeterminate grains, and preferential preservation of resistant taxa and spores over pollen. The profile from Kárahnjúkar is generally low in palynological richness, with concentrations ranging between 1666 and 14260 grains/cm^3, averaging at 5113 grains/cm^3. The TLP counts varied between 98 and 215. However, other indications suggested that the assemblages could meaningfully be interpreted; although (especially upland) Iceland is not floristically diverse and pollen production is generally low (Caseldine & Hatton 1994, 42), satisfactory (greater than 10) numbers of taxa were identified in each level, preservation was generally good (see Figure 5) and as spores were poorly represented in comparison with pollen, and resistant pollen types were rare, there is no apparent preservational bias.

Soil section
Three principal pollen assemblage zones have been identified from the Kárahnjúkar profile, with zone KHN-3 further divided into two subzones:

KHN-1: 93-98cm; c. AD 880 - 960
The opening zone is characterised by relatively high (c. 50% TLP) levels of Cyperaceae pollen, relatively low (c. 25% TLP) levels of Poaceae pollen and relatively low (c. 25% TLP) representation of arboreal/shrub pollen; the principal component of the latter being *Salix*. Microscopic charcoal values are low. Overall pollen percentages are high in comparison with the rest of the profile.

KHN-2: 89-93cm; c. AD 960 – 1025
Overall tree and shrub pollen values decline sharply to c. 15% TLP. Within this group, *Betula* pollen percentages are initially higher than in KHN-1 but decline markedly, whilst *Salix* pollen percentages remain more or less steady at c. 10% TLP, having declined from c. 15% TLP in KHN-1. Whilst percentages of Cyperaceae pollen, at c. 20% TLP, are initially lower than in KHN-1, they increase to c. 40% TLP. Poaceae pollen increases gradually in percentage representation to c. 30% TLP. A more diverse suite of herb flora is seen than in KHN-1, with *Urtica*, Ranunculaceae and *Rumex* being well-represented. Microscopic charcoal percentages begin to increase in the upper spectrum. Total pollen percentages are lower than in KHN-1.

KHN-3: 50-89cm; c. AD 1025 – 1445

KHN-3a: 63-89cm; c. AD 1025 – 1290
The opening subzone of KHN-3 is characterised by a decline in herb pollen percentages from their high values in KHN-2. Cyperaceae pollen falls to c. 30% TLP and remains steady throughout the subzone, whereas a gentler decline in Poaceae pollen to c. 15% TLP occurs. *Salix* pollen percentages increase gradually to c. 35 % TLP, whilst *Betula* pollen remains stable at around 10% TLP. The herb flora suite is similar to that in KHN-2, with Caryophyllaceae and occasional *Empetrum* pollen grains also represented. Fern spores (principally *Selaginella selaginoides*, but also *Diphasiastrum* and *Polypodium*) are present at low levels. Microscopic charcoal increases steadily in representation to c. 65% TLP at 73.5cm. Total pollen concentrations are at their lowest levels in the profile during KHN-3a.

KHN-3b: 50-63cm; c. AD 1290 - 1445
Total pollen concentrations increase slightly in comparison to the previous subzone. The increase in *Salix* pollen percentages is accelerated, with the taxon reaching almost 60% TLP by the upper boundary. *Betula* pollen remains stable at the low percentage values achieved in KHN-3a. Slight declines are evident in percentage representation of Cyperaceae and Poaceae pollen, and on the whole, the herb suite is less floristically diverse and lower in percentage representation than in KHN-3a. Fern spores are also less well represented than previously. Microscopic charcoal values are lower than in KHN-3a also, and decline to c. 10% TLP by the upper boundary.

Sample 12 (Structure 3)
Pollen concentrations are high in this sample, indeed higher than in any of the soil section samples. Poaceae pollen dominates at nearly 40% TLP, with Cyperaceae pollen secondary at 25% TLP. *Betula* and *Salix* pollen are poorly represented, at c. 9%

TLP and c. 4% TLP respectively. A total of 12 herbaceous pollen taxa are present. Microscopic charcoal is overwhelmingly well-represented at 333% TLP.

INTERPRETATION

The pollen sequence from Kárahnjúkar opens at some time after initial Viking settlement. The Landnám tephra of c. AD 870 is not present, and therefore the opening of the profile has been estimated at c. AD 880 by extrapolation of soil accumulation rates from the nearest overlying tephra (see Table 1). Interpretation, particularly relating to rates of vegetation change, must proceed with caution due to the low sampling frequency. The occasional presence of taxa not native to Iceland (*Alnus* and *Pinus*) in the profile will have resulted from long-distance airborne transport.

Sediment accumulation commenced in a post-Landnám environment of clearance, recorded by the initially low tree/shrub pollen values in comparison to those of herb taxa, especially sedges. After this initial snapshot of vegetation conditions, birch began to expand, apparently to the detriment of sedge communities. This may reflect a readjustment following the first clearance activities of settlers.

Pollen zone KHN-2 marks renewed clearance activity, with grasses, sedges and herbs increasing in representation whilst tree and shrub representation was depressed. Relatively low microscopic charcoal values indicate that fire was not employed as a widespread clearance method. More likely is that relatively open ground was maintained by grazing pressure. This explanation supports the interpretation of the archaeological structures as a shieling. The estimated chronological span of this activity – c. AD 960 to 1025 – is in agreement with the on-site tephrochronological occupation sequence.

The dominance of grass and sedge pollen over birch and willow pollen in Sample 12 from Structure 3 suggests that this pollen assemblage represents a time early in the accumulation record of the soil profile, perhaps in zone KHN-2, which displays a similar pollen suite with comparable percentages. This interpretation is in accordance with the archaeological data which date occupation of the shieling to the period covered by KHN-2. The slightly higher representation of birch and willow pollen in the soil section than in the on-site spectrum may be a consequence of the vegetation patterning in the immediate vicinity of the shieling.

An initially sharp, then gentle, resurgence in scrub (principally willow) coverage is recorded after around AD 1025, to the detriment of grasses and sedges. This might be interpreted as a reduction in grazing intensity, especially when the on-site evidence for abandonment late in the eleventh century is considered. An increase in the variety of herb taxa from 18 in KHN-2 to 25 in KHN-3a perhaps reflects the reduction in grazing pressure, as biodiversity can be suppressed by grazing (Grant et al 1985; Hannon et al 2001, 136; see also Einarsson 1963). However, the extremely high values of microscopic charcoal in zone KHN-3a indicate that frequent, intense burning was taking place within the source region. Nonetheless, the open nature of the site, the largely aeolian origin of the soil-sediment and the sparse tree cover indicated by the pollen record are suggestive of a large pollen source area. Therefore, the interpretations of a reduction in local grazing pressure and an increase in regional burning activity need not be considered mutually exclusive.

A further reduction in grazing pressure is signified in the pollen record after c. AD 1290, as willow expands in population and grasses decline. There is a slight apparent reduction in floristic diversity, with 11 herbaceous taxa recorded, as opposed to 25 in KHN-3a, which may be related to the re-establishment of willow scrub.

SUMMARY

Pollen analysis undertaken on a short soil profile 150m distant from the archaeological site Pálstóftir near Kárahnjúkar recorded a post- Landnám vegetation sequence indicating clearance of upland scrub for grazing during the shieling occupation phase, between c. AD 950 – 1025. A single pollen spectrum from a context interpreted as a floor layer in the shieling contained a similar pollen assemblage to time-equivalent spectra in the soil section. Following abandonment of the shieling in the mid-eleventh century, willow scrub was allowed to return and biodiversity initially increased as a result of reduced grazing pressure. Human activity was still occurring within the region, as reflected by the microscopic charcoal record. In the fourteenth century, diversity decreased as scrub became better established.

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Table 1: Pollen samples from soil section

Depth cm	Feature	Est. soil accumulation rate	Calculated date of sample
31	1717 tephra bottom		
40	Top of column		
43	<10> sample	0.07 cm/year	2546
47.8	1477 tephra top		
48.2	1477 tephra bottom		
51	<9> sample	0.07 cm/year	1431
55.8	1362 tephra top		
56.4	1362 tephra bottom		
62.5	<8> sample	0.09 cm/year	1294
65.4	1262 tephra top		
66	1262 tephra bottom		
73.5	<7> sample	0.1 cm/year	
77.8	1158 tephra top		1201
78.1	1158 tephra bottom		
81	<6> sample	0.1 cm/year	1128
83.4	1104 tephra top		
83.7	1104 tephra bottom		
86	<5> sample	0.06 cm/year	1075
90.5	<4> sample	0.06 cm/year	1000
92.5	<3> sample	0.06 cm/year	967
93.5	950 tephra top		
93.8	950 tephra bottom		
96	<2> sample	0.06 cm/year	913
98	<1> sample	0.06 cm/year	880
100	Bottom of column		

Table 2: pollen samples from on-site contexts

Sample	Context
<11>	From context [71] in structure 2. Sampled near micromorphology sample <28>. Sub sample from <33>.
<12>	From structure 3. Organic layer going through the middle of micromorph sample <68>. Sub sample from <73>.

Figure 1: Pollen percentage diagram, soil section

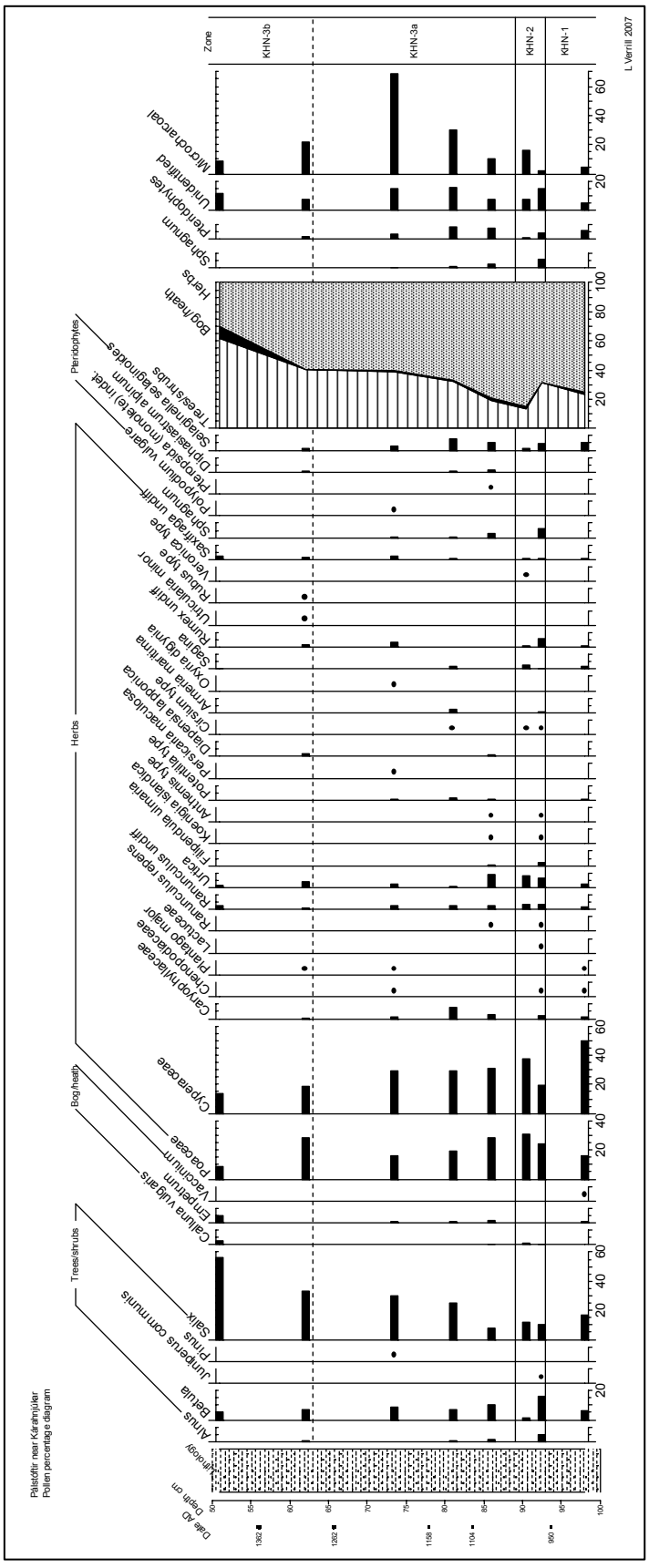


Figure 2: Pollen concentration diagram, soil section

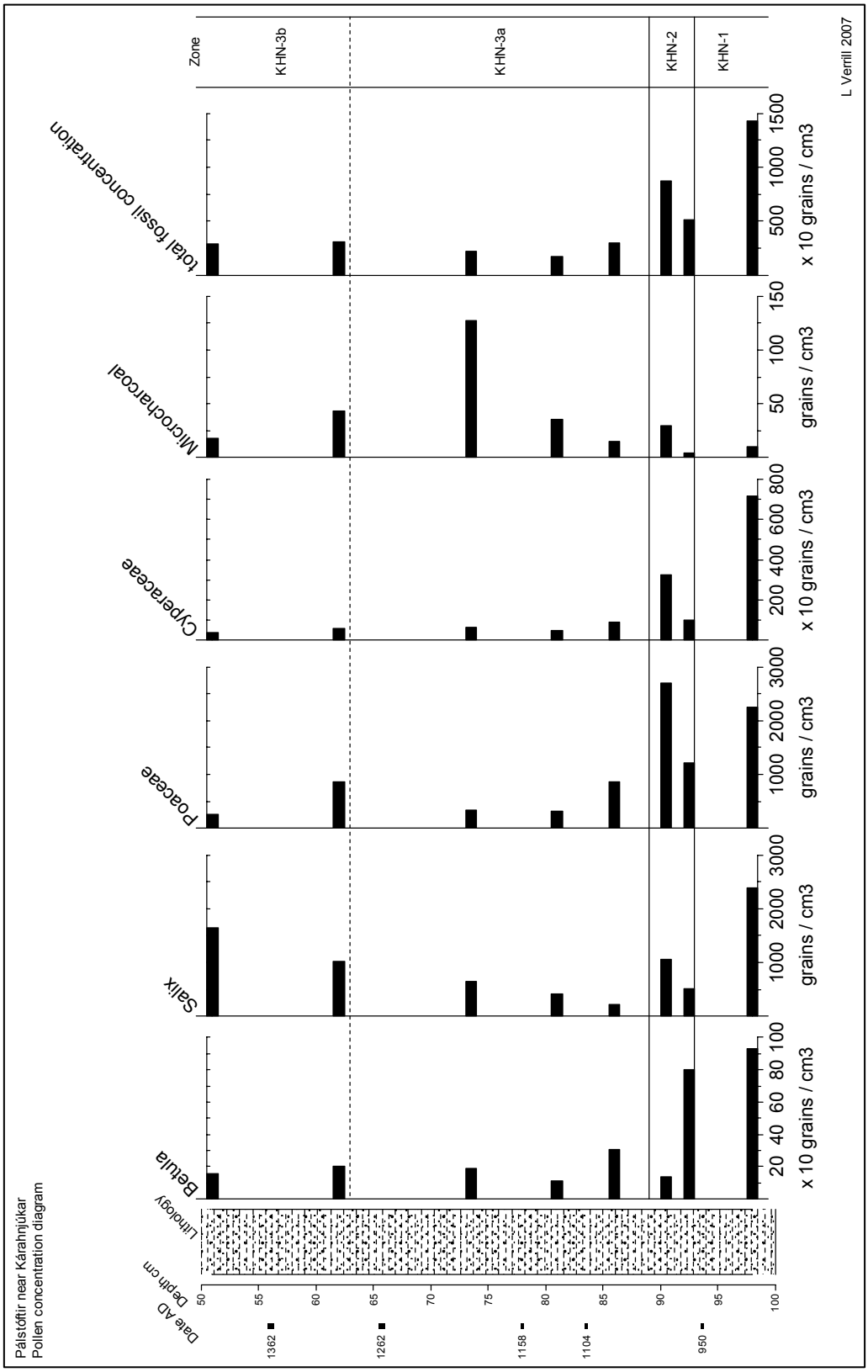


Figure 3: Pollen percentage diagram, Sample 12 (Structure 3)

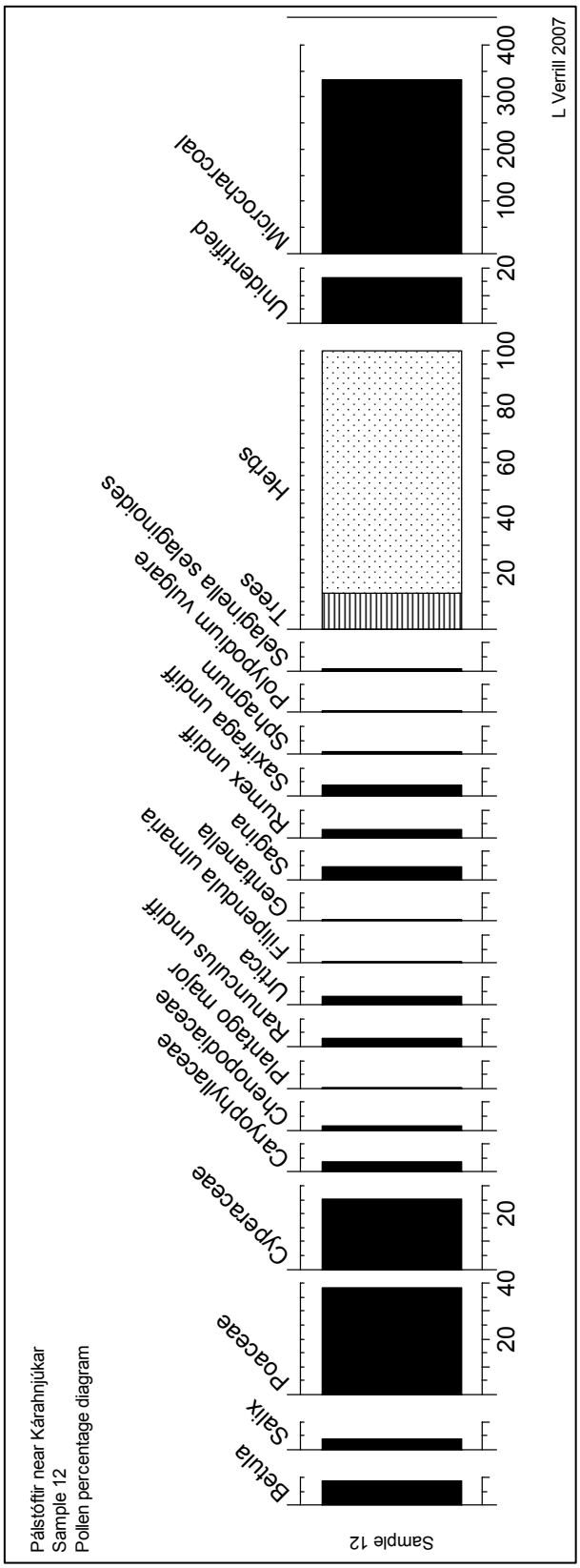


Figure 4: Pollen concentration details, Sample 12 (Structure 3)

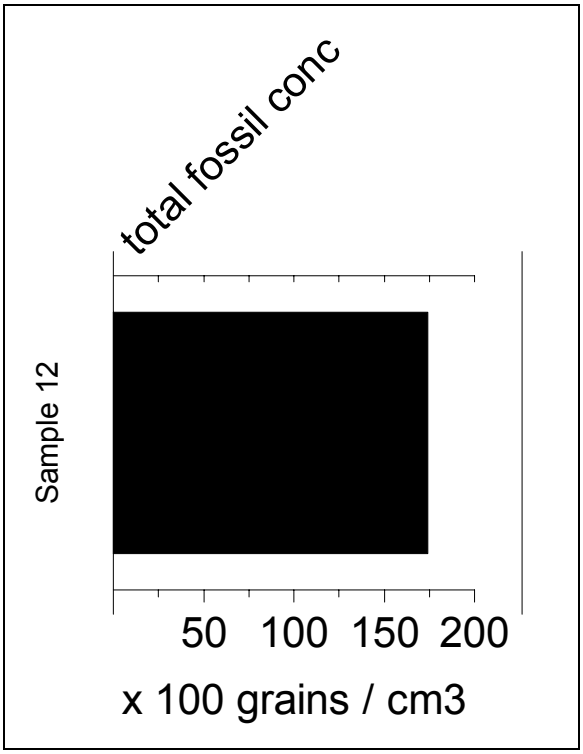
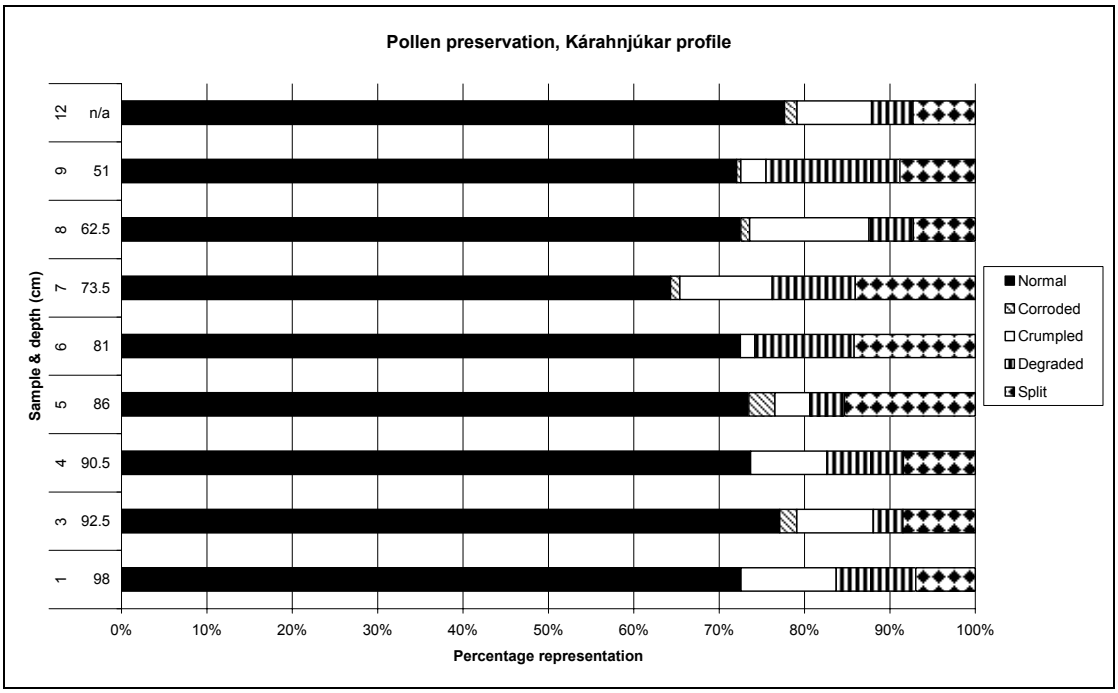
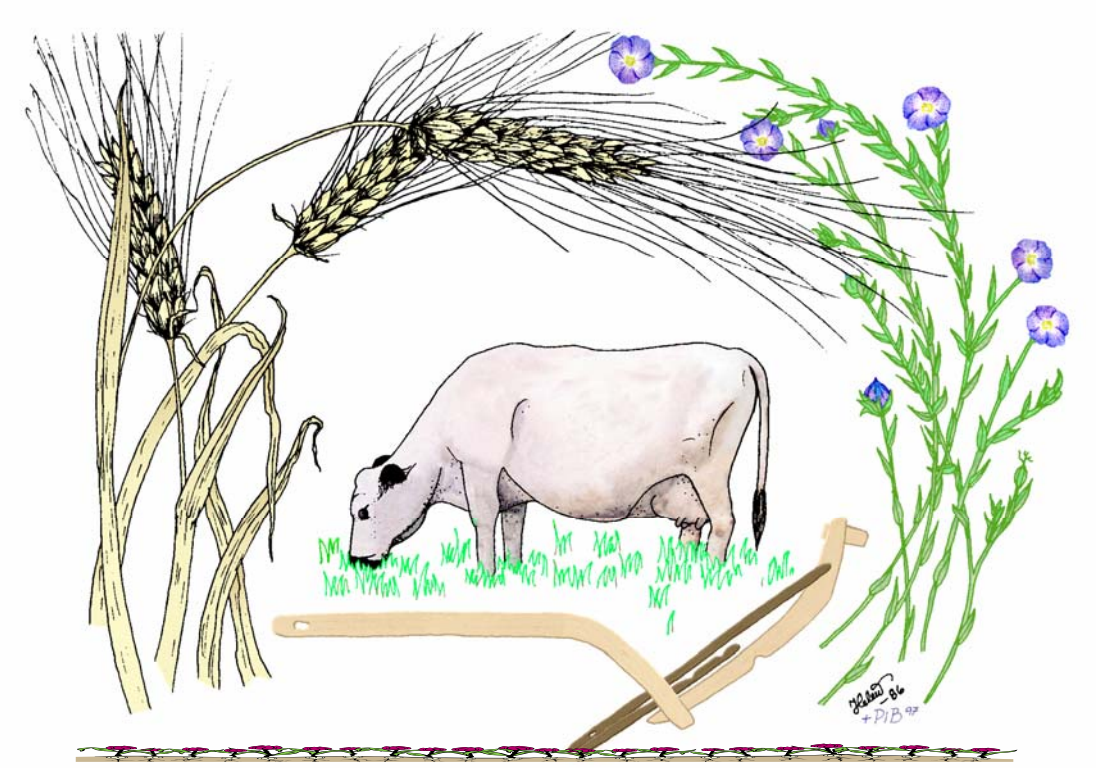


Figure 5: Details of pollen preservation



ENVIRONMENTAL ARCHAEOLOGY LAB.

REPORT nr. 2006-26



Fossil insect remains from Pálstóftir, Kárahnjúkar, Iceland

By

P. I. Buckland

DEPARTMENT OF ARCHAEOLOGY & SAMI STUDIES

UMEÅ UNIVERSITET

Fossil insect remains from Pálstóftir, Kárahnjúkar, Iceland

By Philip I. Buckland

2006-08-08

MAL Report nr. 2006-26

Project: Iceland: Karahnjukar
Contractor's reference: KHN05
MAL's Reference: 06.0012

Number of samples: 4
Job scope: Fossil insect analyses of floated and extracted insect remains.
Analyses & report by: Phil Buckland

Produced for:
Institute of Iceland
Bárugata 3
101 Reykjavik
Island

1 Introduction

Four pre-floated and sorted samples of fossil insect remains were analysed with respect to their environmental, archaeological and palaeoclimatic implications.

2 Methods

Specimens were identified under binocular microscope at a magnification of between 10x and 40x. Digital microscope photographs (Nikon DS-U1) were taken when necessary to aid comparison with modern reference specimens. Standard identification keys (see references), along with information in the BugsCEP Coleopteran Ecology Package software (Buckland & Buckland 2006), were used to confirm characters. Environmental, archaeological and climatic interpretation and diagram creation was aided by the BugsCEP software (*op. cit.*). Ecological classification of taxa follows BugStats software Beta version 1.008b (*op. cit.*). Thermal reconstruction was performed using the Mutual Climatic Range (MCR) method of Atkinson *et al.* (1986) as implemented in the BugsCEP software (Buckland & Buckland 2006). Temperatures are not calibrated, and most probably underestimate cold winters and warm summers.

Results

Overall preservation varied from poor to good, with a high degree of fragmentation and what appeared to be mineral concretion on the surface of some fossil. The extent of the latter was not great enough to hinder identification. Both sample and species abundance were poor, the largest sample (<18>[71]) containing no more than 27 identifiable individuals (MNI), and the most abundant taxon (*Patrobus septentrionis Dej*.) consisted of 13 individuals. The identified taxa by sample are shown in Table 1. Original sample volumes are presented in Table 2.

Taxon	<18>[71]	<106>[252]	<15>[71]	<4>[48]	*Taxon Sum*
Carabidae indet.	1				*1*
Patrobus septentrionis Dej.	10	1	2		*13*
Amara quenseli (Schön.)	1				*1*
Byrrhidae indet.		1	1		*2*
Byrrhus fasciatus (Forst.)	1				*1*
Aphodius lapponum Gyll.	1				*1*
Otiorhynchus arcticus (O. Fabricius)	6	1			*7*
Otiorhynchus nodosus (Müll.)	7	4		1	*12*
Otiorhynchinae indet.			1		*1*
Sample Sum	*27*	*7*	*4*	*1*	

Table 1. Identified taxa by sample.

Site code	Sample number	Sample volume (l)	Context number	Context type
KHN05	4	1	48	Aeolian with sheet midden
KHN05	15	4	71	Floor deposit
KHN05	18	15	71	Floor deposit
KHN05	106	4	252	Floor deposit

Table 2. Original sample volumes.

3 Discussion

A reliable environmental interpretation with such small numbers is at best tentative, and a climatic interpretation somewhat unreliable, although the MCR technique allows even small abundances to provide useful information. The interpretations should however be considered as provisional, and be considered in the light of other analyses from the same samples.

3.1 Environment

Sample <18>[71] contained enough identifiable fragments for a rudimentary environmental reconstruction, Figure 1 showing the relative environmental indications of the taxa in each sample. The greatest influence is of Meadowland and Heathland/moorland species, although abundance weighting shifts this balance a little towards the damper environments of wetland/marshes, with the larger numbers of the slightly hygrophilous Carabid *Patrobus septentrionis* Dej.. The moss feeder *Byrrhus fasciatus* (Forst.) tends to prefer dryer habitats. Although only one fragmented head was found, the dung beetle *Aphodius lapponum* Gyll. is an interesting occurrence. Breeding only in the excrements of larger mammals, its presence before the human colonisation of Iceland is improbable (Larsson & Gígja, 1959), and thus the find can provide a useful maximum age horizon for the sample. *A. lapponum* is one of the most common beetles in Iceland at the present day (Larsson & Gígja, 1959), extending out to all places were sheep and other livestock graze.

Sample <106>[252] indicates a somewhat similar environment to the above, although with considerably lower abundances and without the dung component.

Samples <15>[71] and <4>[48] contained only a few fragments of species already present in the above samples.

3.2 Climate

Too few MCR species were found to be able to reliably reconstruct the climate represented in any of the samples. The MCR diagram (Figure 2) is provided as an indication only, and may provide useful information in the context of other proxy data. All the species in the samples are currently present in Iceland and there is no indication of a climate different from the present day.

4 Conclusions

All samples represent what could considered as natural background faunas at the present day, indicating a heathland/moorland or meadow environment, probably more moist than dry. In addition sample <18>[71] could also easily represent any post Landnám environment where large herbivores are present.

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6 Figures

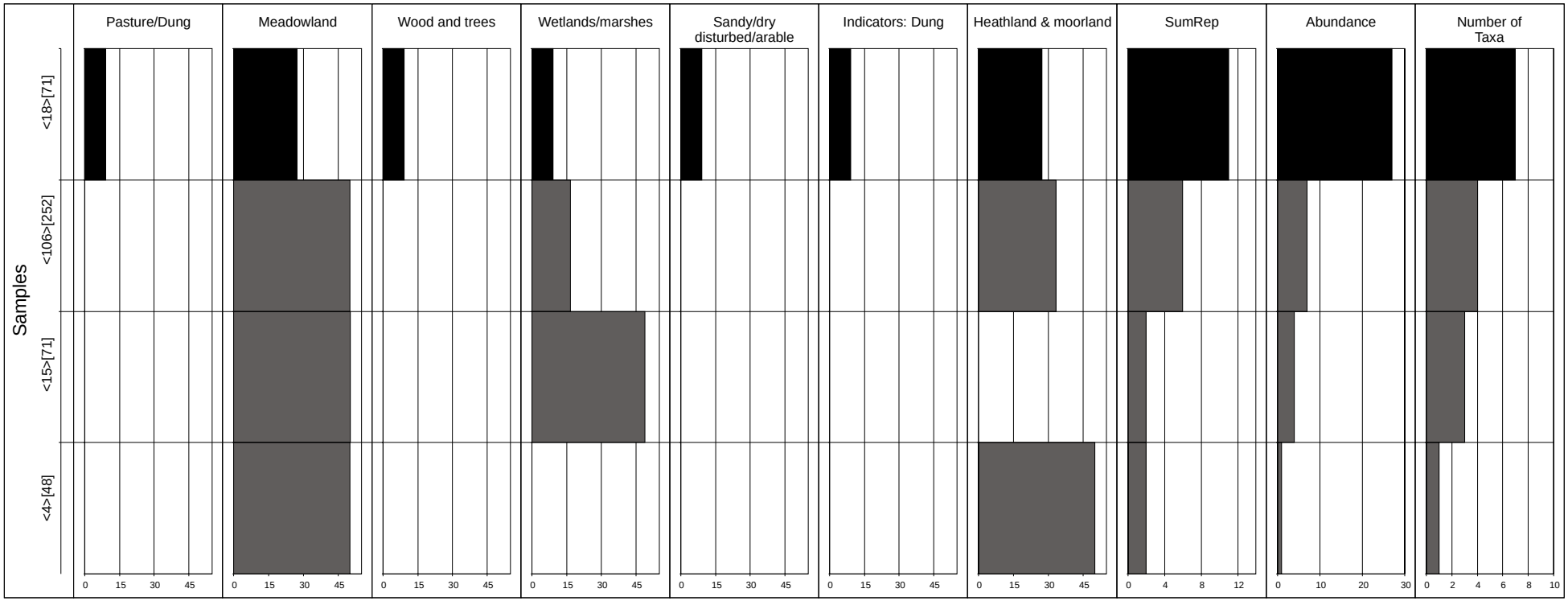


Figure 1. Bugs Ecofig showing proportional representation of environmental classes derived from the Karahnjukar samples. Horizontal scale is percent of environmental representations, and lighter shading shows samples with lower abundance than required for a reliable reconstruction. The diagram provides a rapid overview of the environment represented by the fossil insects, but should not be considered a true landscape reconstruction.
SumRep = Sum of environmental representations of species in sample – an indication of the relative reconstruction power of the sample.
Diagram produced by BugsCEP BugStats module Beta 1.008b (Buckland, in prep.).

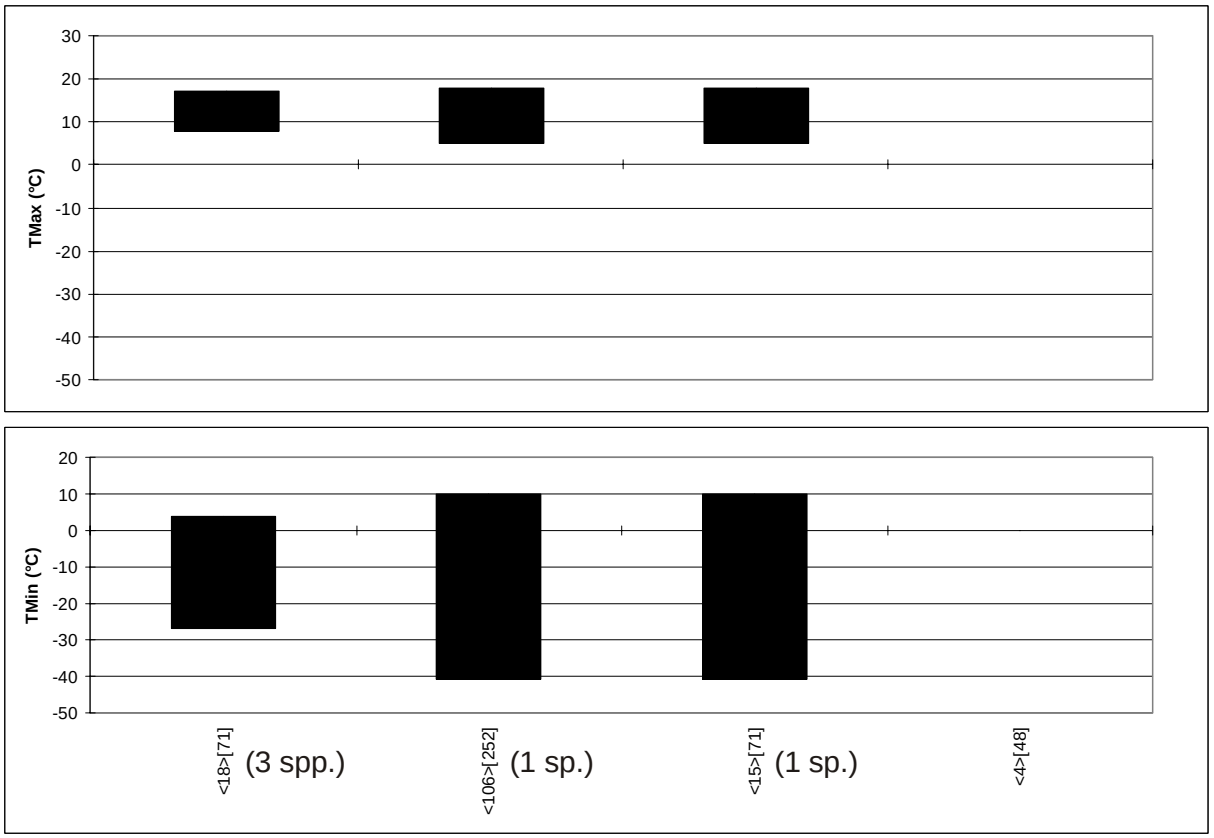


Figure 2. Mutual Climatic Range (MCR) thermal reconstruction in degrees Celsius for Karahnjukar samples.
TMax = mean temperature of warmest month
TMin = mean temperature of coldest month
The bracketed numbers show the number of species available for MCR reconstruction – the more species the more reliable the reconstruction.

Sample:	<18>[71]			
	Patrobus septentrionis Dej.	**CODE:** 1.032001	**Abundance:**	10
	BEco03	Meadowland		
	BEco05a	Wetlands/marshes		
	Amara quenseli (Schön.)	**CODE:** 1.065031	**Abundance:**	1
	BEco06b	Sandy/dry disturbed/arable		
	Byrrhus fasciatus (Forst.)	**CODE:** 47.011001	**Abundance:**	1
	BEco04	Wood and trees		
	BEco12	Heathland & moorland		
	Aphodius lapponum Gyll.	**CODE:** 85.019059	**Abundance:**	1
	BEco02	Pasture/Dung		
	BEco07c	Indicators: Dung		
	Otiorhynchus arcticus (O. Fabricius)	**CODE:** 93.015048	**Abundance:**	6
	BEco03	Meadowland		
	BEco12	Heathland & moorland		
	Otiorhynchus nodosus (Müll.)	**CODE:** 93.015057	**Abundance:**	7
	BEco03	Meadowland		
	BEco12	Heathland & moorland		
Sample:	<106>[252]			
	Patrobus septentrionis Dej.	**CODE:** 1.032001	**Abundance:**	1
	BEco03	Meadowland		
	BEco05a	Wetlands/marshes		
	Byrrhidae indet.	**CODE:** 47	**Abundance:**	1
	BEco03	Meadowland		

	BEco05a	Wetlands/marshes			
	BEco07a	Dung/foul habitats			
	BEco13	Halotolerant			
	Otiorhynchus arcticus (O. Fabricius)	**CODE:**	93.015048	**Abundance:**	1
	BEco03	Meadowland			
	BEco12	Heathland & moorland			
	Otiorhynchus nodosus (Müll.)	**CODE:**	93.015057	**Abundance:**	4
	BEco03	Meadowland			
	BEco12	Heathland & moorland			
Sample:	<15>[71]				
	Patrobus septentrionis Dej.	**CODE:**	1.032001	**Abundance:**	2
	BEco03	Meadowland			
	BEco05a	Wetlands/marshes			
	Byrrhidae indet.	**CODE:**	47	**Abundance:**	1
	BEco03	Meadowland			
	BEco05a	Wetlands/marshes			
	BEco07a	Dung/foul habitats			
	BEco13	Halotolerant			
	Otiorhynchinae indet.	**CODE:**	93.015168	**Abundance:**	1
	BEco02	Pasture/Dung			
	BEco03	Meadowland			
	BEco04	Wood and trees			
	BEco05a	Wetlands/marshes			
	BEco06a	Disturbed/arable			
	BEco06b	Sandy/dry disturbed/arable			
	BEco09a	General synanthropic			
	BEco12	Heathland & moorland			
	BEco13	Halotolerant			
Sample:	<4>[48]				
	Otiorhynchus nodosus (Müll.)	**CODE:**	93.015057	**Abundance:**	1
	BEco03	Meadowland			
	BEco12	Heathland & moorland			

Table 3. Sample by sample breakdown of Bugs Ecology codes for Karahnjukar. Output produced by BugsCEP BugStats module Beta 1.008b (Buckland, 2006).

MAL
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MICRO-WEAR

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[The following text is based on correspondence between Jacques Chabot and Gavin Lucas]

15 pieces were submitted for analysis, of which 7 are made of quartz (or a variety of quartzite), which are currently unsuitable for micro-wear study. Of the remaining 8 pieces, 5 are either debris or not anthropic, while 3 cherts were assessed as having potential use wear. Analysis and photography was done at x200 magnification on a Nomarski-DIC system (Differential Interference Contrast) to enhance the 3D aspect of the items. Of those examined, only two (find nos. <021> and <055>) showed signs of use wear. There were greasy traces present on both pieces, but neither were well developed which limits the possibilities of diagnosing a specific function. Consequently, interpretation is equivocal but two possible functions are suggested: scaling fish or working soft stone (e.g. steatite) or shell. What might favour the second hypothesis is the presence of parallel, multiple striations that can be seen in some places, especially of flint <055>.

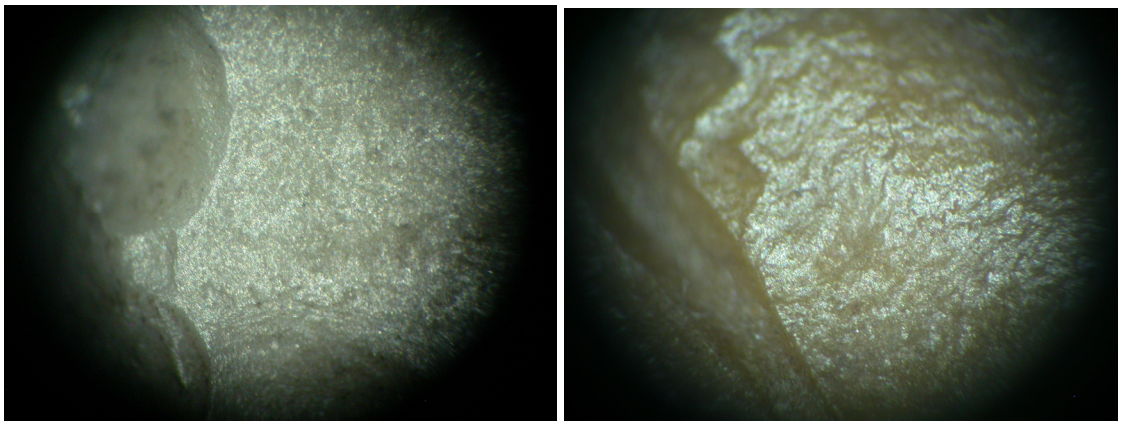


Figure 1. Micro-wear traces on chert at x200 magnification: <21> (left) and <55> (right)

Micromorphological Analysis of the Floor Sediments at Pálstóftir: Evidence for Seasonal Activity and the Functions of the Buildings

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Introduction

The location of Pálstóftir at c. 580 m above sea level, and the unusual forms of its buildings compared other Viking Age farm sites in Iceland, strongly suggest that the site was a shieling. However, the identification of shielings and their distinction from small, upland farms can be difficult, especially since some shieling sites could later have been converted to farms, and *vice versa*. In order to help determine the functions of the buildings at Pálstóftir, and to seek evidence for the nature and duration of their occupation, their floor deposits were sampled for micromorphological analysis – the study of undisturbed soils and sediments in thin section.

When thin sections of soils or sediments are observed under a petrographic microscope, it is possible to identify and quantify the mineralogy, structure, and texture of the soil material, as well as any bones, shells, artefacts, coprolites, phytoliths, diatoms, ash residues, pollen grains, charcoal fragments and plant remains that are present. It is also possible to observe post-depositional processes at work, including disturbance by soil fauna and roots, and the redistribution of clay, calcium carbonate, organic matter, iron, manganese and phosphorus due to the downward percolation of rain water and/or the effects of the water table. Because the floor sediments at Pálstóftir appeared finely laminated in the field, micromorphological analysis provided the opportunity to determine the precise composition and mode of formation of the many fine lenses, and permitted them to be easily compared. This report contains a preliminary analysis of the floor sediments, and discusses the available evidence for the function of the buildings and whether they were permanently or intermittently occupied. The report concludes with an assessment of the potential of conducting a full quantitative analysis of the thin sections with a view to eventual publication.

Methods

Nine block samples for micromorphological analysis were taken from the sediments that had accumulated within the four buildings at Pálstóftir. Following the method outlined by Courty (1989), the block samples were taken by pushing aluminium Kubiena tins into one of the sections exposed on the baulk left in the centre of each building: four samples were taken from the east-facing section in Structure I, one sample was taken from the north-facing section in Structure II, one sample was taken from the south-facing section in Structure III, and three samples were taken from the west-facing section in structure IV (Figure 1). The samples were sent to the University of Gent, Belgium, where they were air dried, impregnated with crystic polyester resin, and thin sectioned following the technique described by Murphy (1986).

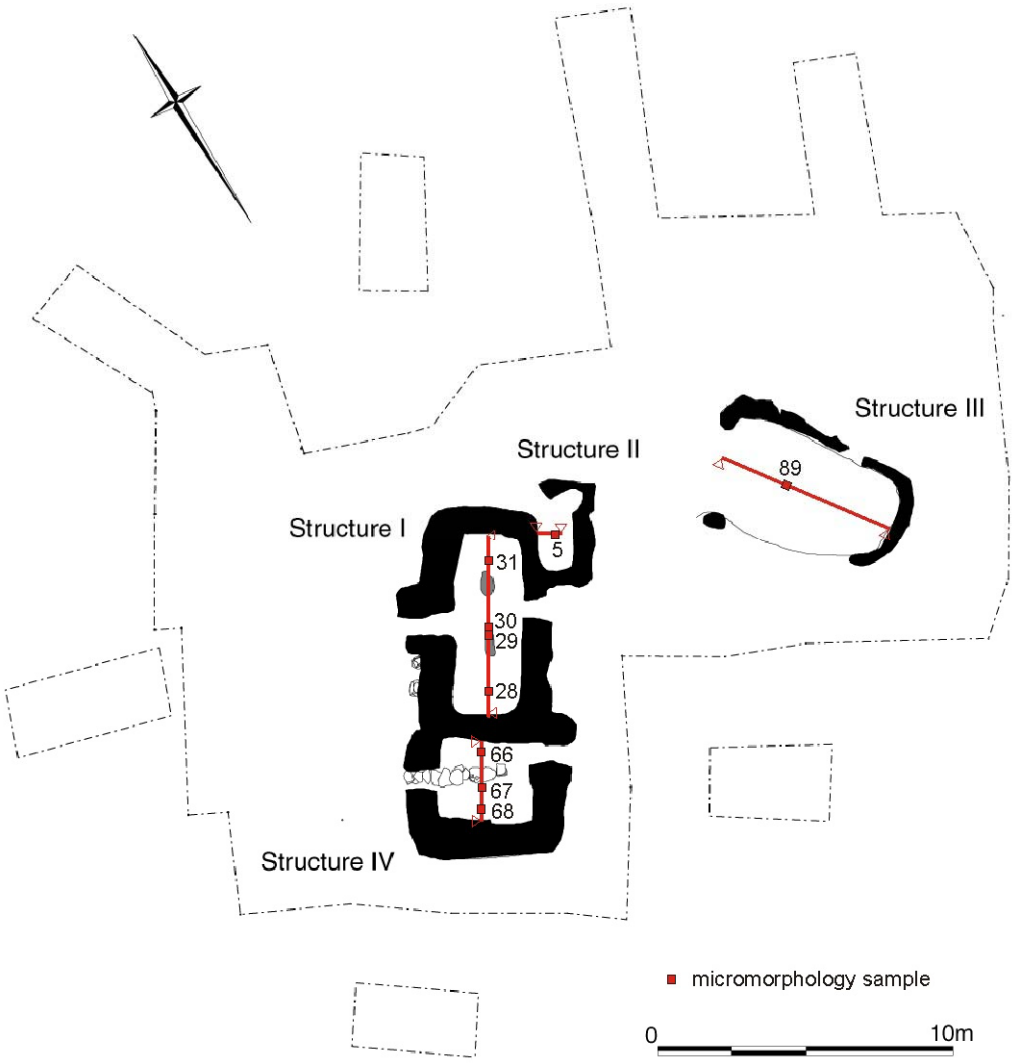


Figure 1. Plan of the site, showing the locations of the sections from which micromorphology samples were taken, and the locations of the micromorphology samples.

Once they reached the McBurney Geoarchaeology Laboratory at the University of Cambridge, the thin sections were scanned on a flatbed digital scanner, studied at a scale of 1:1, and analysed with petrographic microscopes at magnifications ranging from x4 to x250 using plane-polarized light (PPL), crossed-polarized light (XPL), and oblique incident light (OIL). The preliminary micromorphology descriptions provided in this report are based on the internationally accepted concepts and terminology outlined in Bullock et al. (1985) and Stoops (2003). The interpretation of thin sections was aided by reference to the experimental and ethnoarchaeological materials collected by the author and other researchers (e.g. Canti & Linford 2000; Canti 2003), and by the accumulated experience of soil scientists who have been applying micromorphological techniques to archaeological questions (e.g. Courty *et al.* 1989).

Results

The floor deposits in all four of the buildings were dominated by aeolian silts containing varying quantities of partially decomposed plant tissues. Although off-site samples were not taken for micromorphological analysis, identical soil materials were observed in the layers of turf collapse overlying the floor deposits (e.g. contexts [47] and [106]), and it may therefore be assumed that these silts originated in the Andosols that surrounded the site. In particular, they may be traced to the mineral-based A horizons (top soils) and the more organic, peaty soils that developed in wetter areas, both of which appear to have been used as building turves. In contrast to the floor deposits that have been studied in the main residential buildings of Viking Age farms (e.g. Milek 2006), the trampled floor surfaces at Pálstóftir that could be identified on the basis of their compaction, their platy microstructure (dominated by horizontal planar voids created by downwards compression), and the horizontal orientation of their components, were very thin. As may be expected for buildings that differed so much in their form and internal features, the composition of the floor deposits in each of the buildings differed, suggesting that they all had different functions.

Structure I

The floor at the southern end of Structure 1, where it was captured in micromorphology sample 28, contained four thin occupation surfaces separated by thicker deposits of aeolian silt (Figure 2). The lowermost and uppermost occupation surfaces, which were identified close to the lower and upper boundaries of floor layer [71], were slightly compacted relative to the aeolian silts above and below it, and contained a higher concentration of horizontally bedded plant tissues and phytoliths (10-20%) compared to the background amount of 1-2%, which was commonly observed in the aeolian silts (Figure 5 c-d). There were also two very distinctive lenses of diatomaceous sediment within floor context [71]. The lowermost of these was light grey, and contained a relatively small proportion of silt (other than diatoms) (Figure 5 a-b), while the uppermost one was dark grey, and contained some rubified minerals – minerals that were rich in iron, which may have had had their red colouring enhanced by being heated in a fire. It is difficult to know precisely where these diatomaceous sediments originated without having background reference samples from nearby riverbanks, lakes, and bogs, but it is likely that they are lenses of peat ash.

Samples 29 and 30, which come from the centre of Structure I, contained thicker lenses of subhorizontally bedded charcoal fragments, as well as minerals that were browned or reddened by fire (Figure 2). These lenses probably represent decalcified wood ash that had been spread – either accidentally or intentionally – from the hearth, and which had subsequently been trampled. The tephra lenses above and below the charcoal layer in sample 30 are undoubtedly in turves. Contexts [120] and [121], which underlie floor layer [71] in this central part of the building, do not contain any clear floor surfaces, and they more closely resemble the turf collapse layer [47] than floor [71]. If the thin lines of charcoal in these layers do represent surfaces, they were very ephemeral.

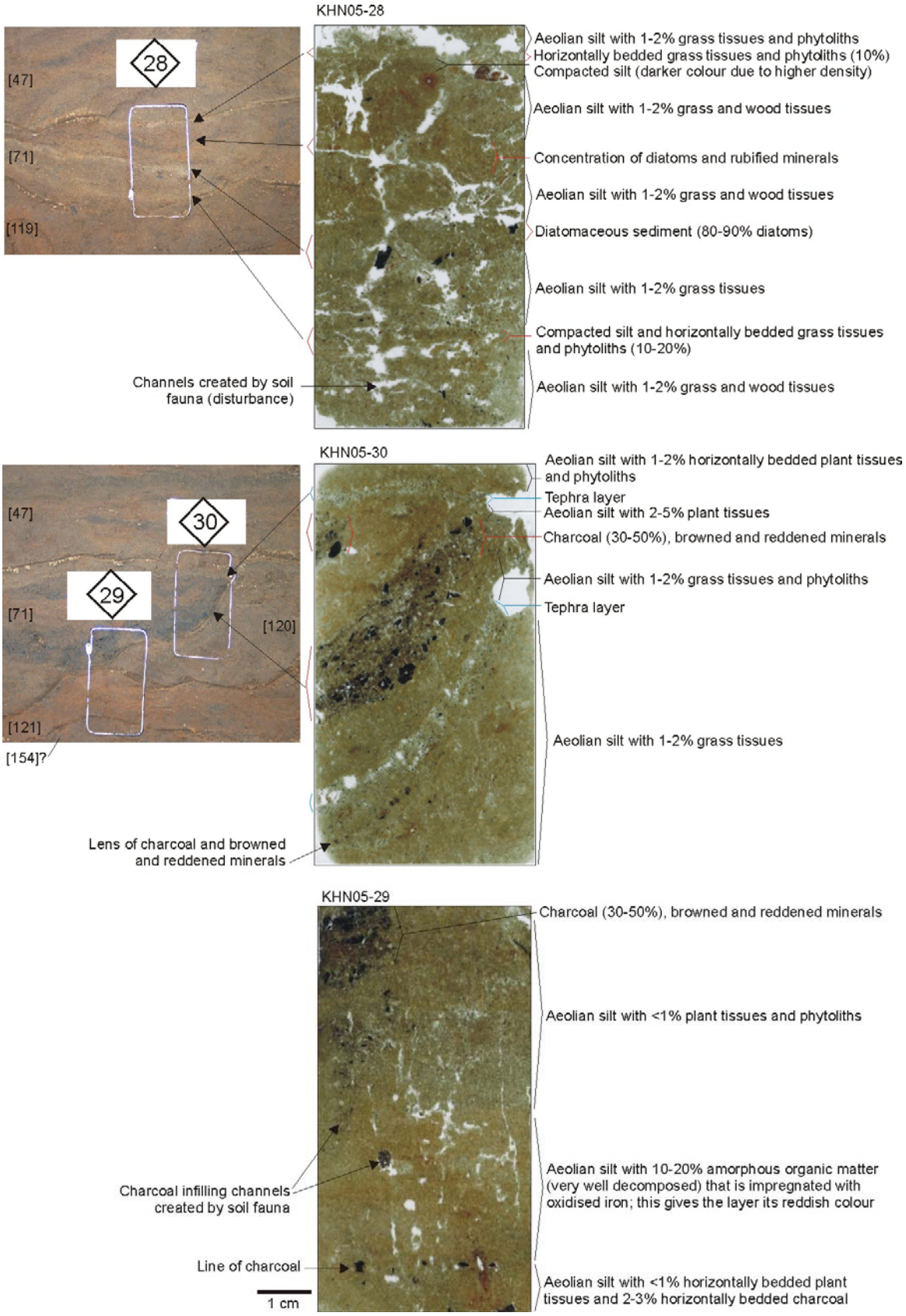


Figure 2. Micromorphology samples from Structure I (samples 28, 29, and 30), showing the contexts that were sampled in the field and how they relate to the layers that were observed in thin section.

In the northern part of Structure I, the floors once again appear to consist of intermittent occupation surfaces, separated by thicker accumulations of aeolian silt. Where context [121] was captured by micromorphology sample 31 in the northern part of the building, it consisted mainly of thick layers of aeolian silt and material that resembled peaty turf (with up to 30% organic matter impregnated with oxidised iron) within which were two very thin surfaces (Figure 3). The lowermost of these surfaces was slightly compacted and exhibited the horizontal planar voids typical of trampled and compacted silts, while the uppermost surface contained some horizontally bedded charcoal and plant tissues. Above context [121], context [71] also contained a series of surfaces, the lower of which was dominated by decalcified wood ash, the middle of which contained compacted silt and horizontally bedded plant tissues, and the upper of which consisted of diatomaceous sediment (probably peat ash). Between these thin surfaces, there were thicker accumulations of silt, sometimes containing low quantities of plant tissues or charcoal fragments.

Throughout Structure I, the aeolian silts between the thin occupation surfaces are likely to have accumulated during periods of disuse, when mineral and organic matter from the turf roof, and possibly some windblown silts, were able to rain for some time on the floors. The composition of the occupation deposits varied slightly in different parts of the house, and they also varied over time, consisting of either wood ash or peat ash residues, or very ephemeral accumulations of plant tissues (likely to be grasses). If the interpretation of the silt accumulations between the occupation surfaces is correct, the variability in the occupation deposits would suggest that the building itself changed function over time.

Structure II

Unlike Structure I, Structure II, the small building that abutted the northeast corner of Structure I, did not contain any ash or charcoal residues. Instead, floor deposit [48] consisted of relatively thick accumulations of aeolian silt punctuated by four thin lenses containing concentrations of organic matter (Figure 3). While the three lowermost organic lenses were distinguished by only slightly elevated quantities of horizontally bedded plant and/or lignified tissues, the organic lens two-thirds of the way up the sample was composed almost entirely of horizontally bedded phytoliths and decomposed plant tissues. In the field, this lens had been described as a ‘pinkish, decomposed hay lens’, and this interpretation is certainly born out by thin section analysis. Considering its size and the composition of its floor deposits, it seems likely that Structure II was used for the storage of hay.

Structure III

Like the floor deposits in the other structures, contexts [194] and [146] in Structure III consisted mainly of aeolian silt. They contained three zones or lenses that were visibly compacted, but these lenses were marked by only minor increases in the amount of organic matter, and there was little other evidence in thin section to distinguish the function of the building (Figure 5 e-f). The central compacted lens had a distinctive, massive structure (with negligible pore space), a feature that could have been produced by freeze-thaw processes, or by the compaction of this lens while it was wet. It is possible that Structure III functioned more like an enclosure than like a proper building, but it should be noted that there is no clear evidence for herbivore dung in the floor deposits.

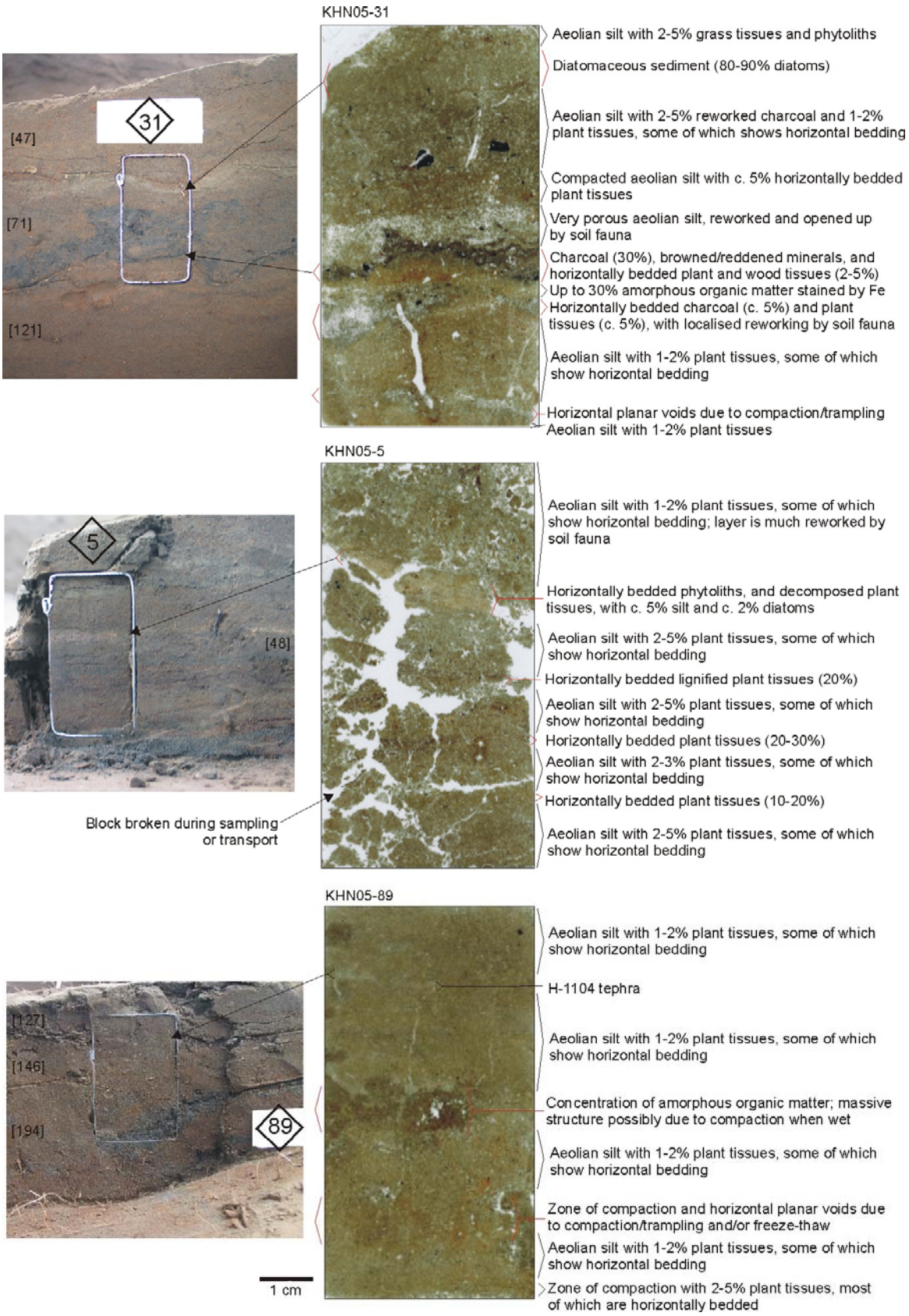


Figure 3. Micromorphology samples from Structure I (sample 31), Structure II (sample 5) and Structure III (sample 89), showing the contexts that were sampled in the field and how they relate to the layers that were observed in thin section.

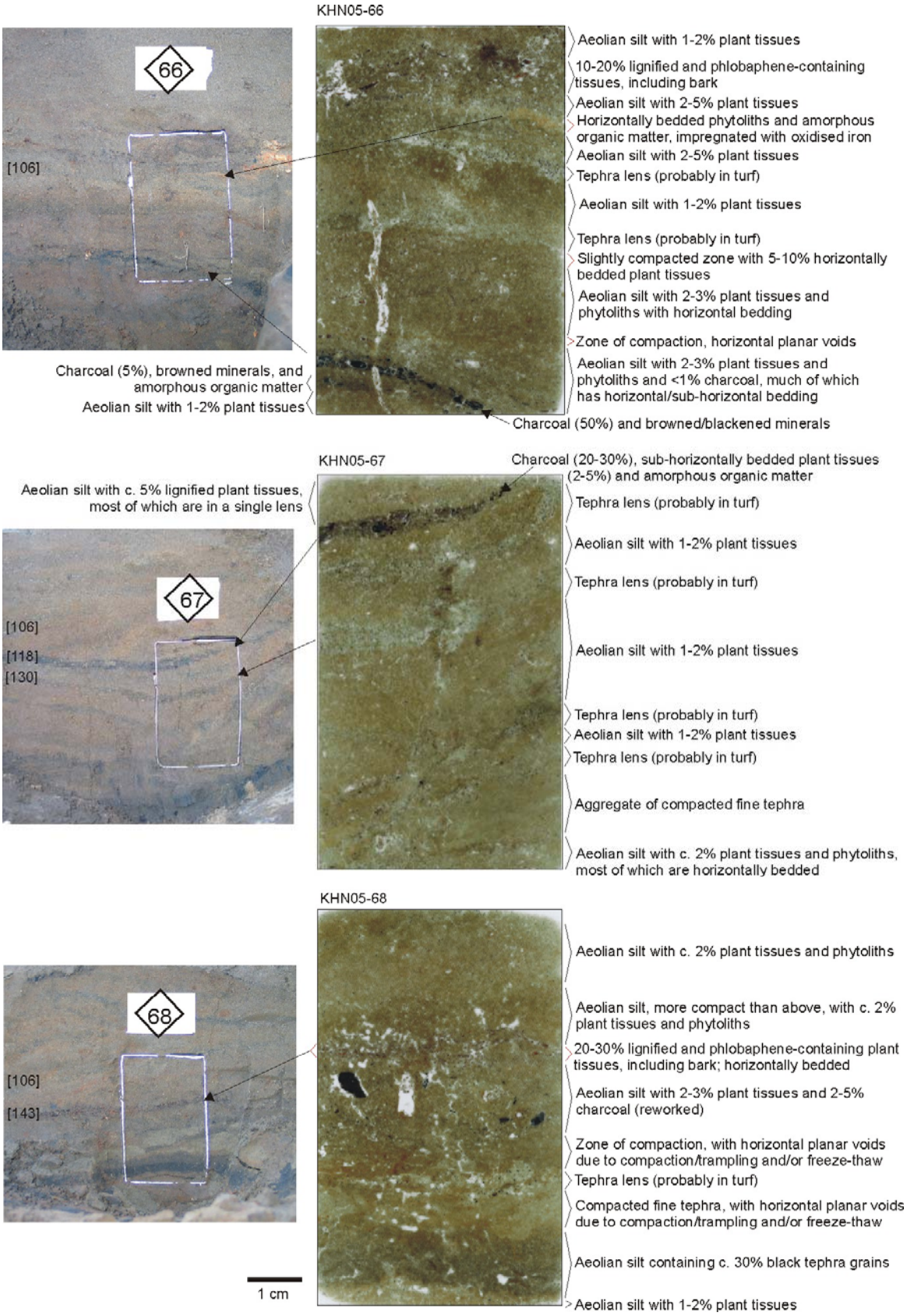


Figure 4. Micromorphology samples from Structure IV (samples 66, 67, and 68) showing the contexts that were sampled in the field and how they relate to the layers that were observed in thin section.

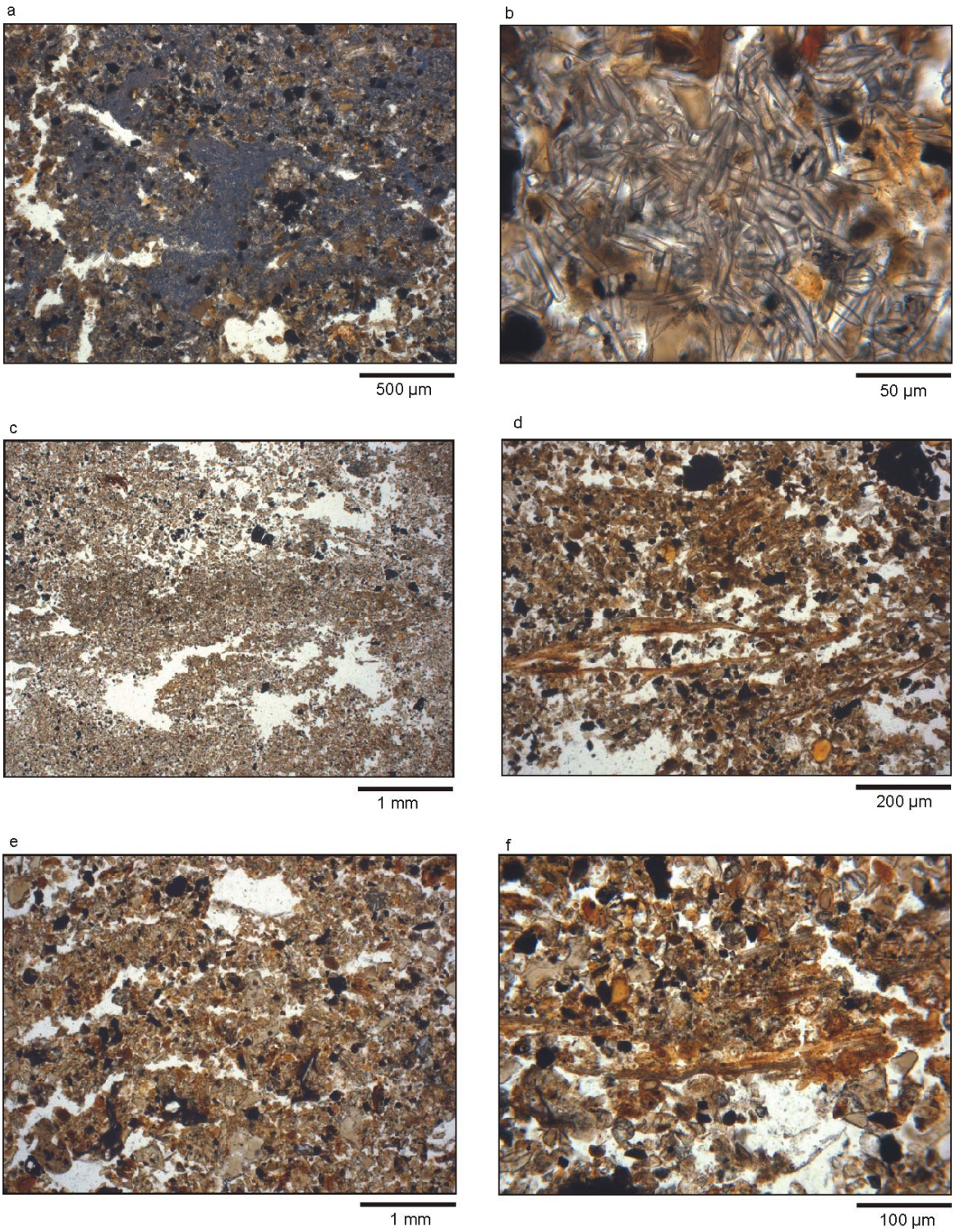


Figure 5. Photographs of micromorphology samples as seen through a petrographic microscope in plane-polarized light. **(a)** grey, diatomaceous lens in the middle of sample 28; **(b)** close-up of the diatomaceous lens in the middle of sample 28; **(c)** compacted silt lens with horizontally bedded grass tissues and phytoliths towards the bottom of sample 28; **(d)** close-up of horizontally bedded grass tissues and phytoliths towards the bottom of sample 28; **(e)** zone of compaction and platy structure created by horizontal planar voids towards the bottom of sample 89; **(f)** zone of compaction with horizontally bedded plant tissues and phytoliths at the very bottom of sample 89.

Structure IV

In Structure IV, the most significant occupation surface that was captured in thin section had also been seen in the field as the thin black layer, context [118]. In thin section, it was possible to see that that this layer was composed mainly of charcoal (50%), but it also contained significant amounts of sub-horizontally bedded plant tissues and amorphous organic matter (Figure 4). Above this layer, sample 66 had captured two other thin zones of compaction, between which there thicker layers of aeolian silt. The uppermost of these thin compacted surfaces coincided with a slight increase in the concentration of horizontally bedded plant tissues, but the lower one was merely associated with horizontal planar voids, and offered no clue about the function of the building. Below floor layer [118], there was no sign of an occupation surface. Sample 67 captured several successive layers of turf below context [118], each of which contained a tephra layer. Sample 68, which was taken close to the southern end of the building, did not appear to contain any floor surfaces at all. The tephra layers towards the bottom of the sample were associated in places with a platy structure, but in this case the microstructure more closely resembles that created by free-thaw processes than that created by compaction by trampling.

Conclusion

Overall, the floor deposits in the buildings at Pálstóftir appeared to consist of short-term, periodic occupation surfaces, between which there were thicker accumulations of cleaner and less compacted aeolian silts. These uncompacted aeolian silt layers very closely resemble the turf collapse deposits that sealed the buildings, and it seems likely that they were derived from the weathering and gradual disintegration of the roof turves. The simplest interpretation of this type of floor deposit is that it was produced by the intermittent occupation of the site, between which times the site was abandonment – perhaps for a year, but perhaps longer. This interpretation corroborates the entomological analysis of the floor deposits, which found that the floors were dominated by meadowland/ heathland/ moorland species rather than the synanthropic species that would normally be found in the buildings of a permanently occupied farm (Phil Buckland, pers. comm.). The invertebrates found at Pálstóftir are in fact most likely to be derived from the turf building materials that were raining sediment on to the floors of the buildings. Since the best evidence for the short-term, periodic occupation of the site is the floor deposits in Structures I and II, the future publication of the site should probably include the full micromorphological description of samples 5, 28, and 31.

The micromorphological samples provided evidence for different types of fuel use at Pálstóftir, with charred wood (decalcified wood ash) being deposited in the earlier parts of the floor sequence, and peat ash (if that is the origin of the diatomaceous sediment) being deposited in the later parts of the sequence. However, hammerscale, metallurgical slag, and non-metallurgical slag (fly ash) were not observed in thin section. Perhaps it is merely the small size of the thin sections (4 cm wide) that prevented this material from being captured. It is also noteable that no burnt bone was observed in thin section, even though minute fragments of burnt bone are commonly found in the floors deposits of Viking Age houses (Milek 2006).

Based on the composition of its floor deposits, Structure II was probably used for hay storage, but there is no evidence for animal stabling at the site. If Pálstóftir was a shieling, we must assume that it was used as the temporary accommodation for humans only, while animals were grazing in the area.

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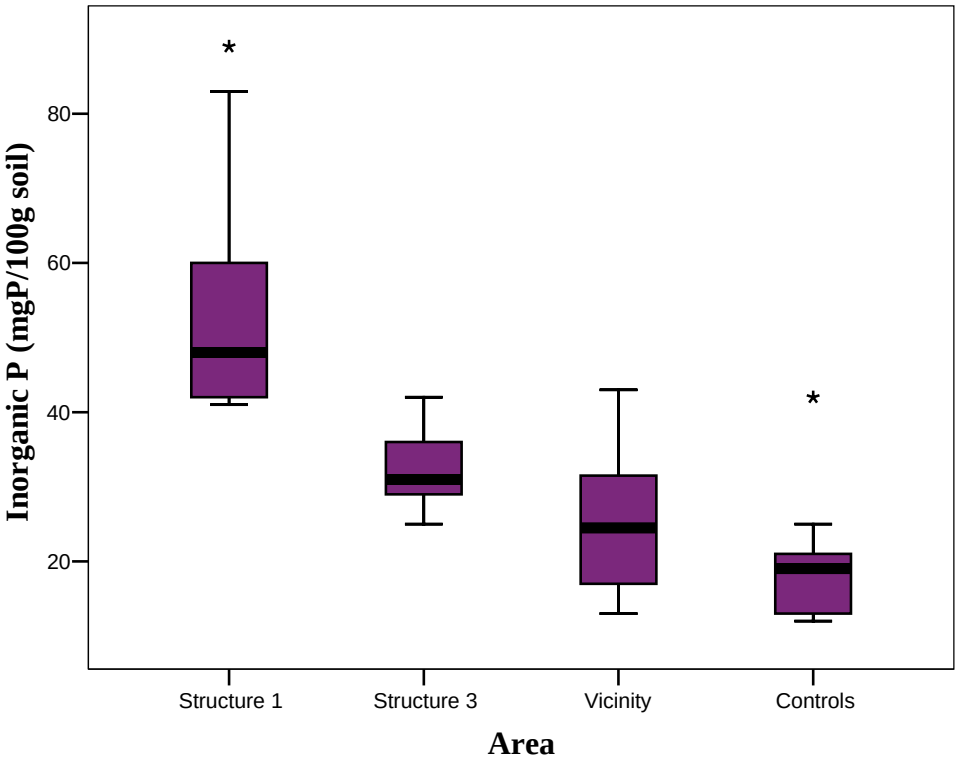
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Measurements of Soil Phosphorus in Floors and Surroundings of Pálstóft, Kárahnjúkar

by Sólveig Guðmundsdóttir Beck



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Front page image is a boxplot of inorganic P concentrations (mg P/100g soil, stars represent outliers)

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SOIL P IN ANDOSOLS AND ARCHAEOLOGY

Pure phosphorus is not found in nature due to its reactivity to air and many other oxygen containing compounds which are widely distributed (Zumdahl 1998, 866-869). Preservation and amounts of P in Andosols depends mostly on the mineralogy of the parent material, particle size, microbial activity and pH.

Phosphorus commonly occurs in low levels in igneous, sedimentary and metamorphic rocks as accessory apatite minerals ($Ca_5(PO_4)_3(OH,F,Cl)$). Fresh tephras, e.g., contain 4-60mg P/100g soil of acid extractable P (Deer et al 1992, 663; Shoji et al 1993, 171). With advanced weathering of volcanic ash and eolian deposits amounts of acid-extractable P in Andosols tend to decrease as amorphous and poorly crystallized silicate clays, such as allophane, imogolite and ferrihydrite, crystalline silicate clays, iron and aluminium oxide clays and organic colloids are formed which bind the P in the soil (Shoji et al 1993, 171-176).

The size of these soil particles is just as important as their type. Particles that are most important in P retention are the clay and organic (humus) particles collectively called the colloidal fraction due to their extremely small size (1-2 μm in diameter) and colloid-like behavior (Brady and Weil 2004, 236). Colloids have very large surface areas which carry positive and/or negative electrostatic charges which attract or repulse substances in ionic form in soil solution as well as other colloids. These small minerals and organic colloids react with orthophosphate ions (PO_4^{3-}, HPO_4^{2-}, $H_2PO_4^-$) to form relatively stable inorganic Al and Fe phosphate minerals and organic phosphate compounds through phosphate sorption reactions many of which are highly resistant to normal oxidation, reduction and leaching processes (Brady and Weil 2002, 70; Eidt 1985; Shoji et al 1993, 171-176). Ligand exchange has been identified as the most important P sorption process in Icelandic Andosols where

ligands (an atom, ion, or molecule that donates one or more of its electrons to one or more central atoms or ions) coordinated with Fe og Al are exchanged with orthophosphate ions (Arnalds et al 1995; Brady and Weil 2004, 70; Shoji et al 1993, 171-176). The major reactive components in allophanic Andosols in Iceland are the amorphous and poorly crystalline aluminosilicates and organic colloids which strongly sorbe phosphate (Arnalds 2004; Brady and Weil 2002, 70; Shoji et al 1993, 171-176). Icelandic Andosols are usually finely textured (e.g. Brown Andosols are dominated by silty loams and loams) and show clear trends of more clayey horizons further away from eolian sources. They therefore have very high phosphate retention (>90%) for most horizons (Arnalds 2004, 16). Sandy horizons in Icelandic Andosols are usually single tephra layers or glacial tills underlying eolian deposits (Arnalds 2004, 12). Within sandy horizons P is susceptible to leaching from the soil profile due to lack of clay and silt sized soil colloids which are so important in the P sorption processes (Shoji et al 1993, 177) but in Iceland, while P is indeed susceptible to leaching, sandy soils still have considerable tendency to hold on to P (25-80%) due to the presence of allophane (Arnalds 2004, 16).

Ligand exchange is dependent on pH. pH is essentially a measurement of the amount of hydrogen cations (H^+, positively charged) and hydroxide anions (OH^-, negatively charged) present in solution. When the amount of H^+ ions in a soil solution increases the pH decreases and vice versa. When the pH is 7 the solution is said to be neutral as it contains equal amounts of anions and cations (Zumdahl 1998, 223-230). Soil colloids exibit two major sources of negative and positive charges on their surface; hydroxyls and other groups that release or accept hydrogen ions, depending on pH, or isomorphous substitution in crystal structures which is not dependent on pH. Most charges in soils rich in humus, oxides of iron and aluminum and allophane

like Andosols are pH dependent (Brady and Weil 2004, 248-249) which is why maximum phosphate sorption in Andosols occurs between pH 3-4 but the amount decreases with increasing pH, being lowest around pH 7-8 (Shoji et al 1993, 171-176). When the pH is low there are large amounts of hydrogen ions to bond with the hydroxyl groups. This frees positively charged sites on the surface of the soil colloids which the PO_4 anions can now attach themselves to but when the pH is high there are many hydroxyl groups to compete with the PO_4 anions for those spaces. The pH is generally > 4,9 in all Icelandic soils and around pH 6 in Gleyic and Brown Andosols (Arnalds 2000, 13).

Phosphates taken from soils by plants and animals are incorporated into a variety of organic molecules, such as inositol phosphates, phospholipids and nucleotides (adenosine triphosphate), as well as inorganic molecules like apatite in teeth, bones and shells which do not break down for a long time (Holliday and Gartner 2007, 303; Mader 2004, 892). Natural organic materials (humus) are plant residues which have been broken down and altered by microorganisms into noncrystalline organic and inorganic substances available for renewed plant uptake. During and after deocomposition some soluble organic compounds are leached from soils but most are mineralized in situ or remain as refractory forms (Brady and Weil 2004, 245-247, 341; Shoji et al 1993, 154-163). Natural accumulation of organic compounds (measured as %C) in Andosols is rapid and due largely to its protection in Al-organic complexes and association with allophanes and allophane like minerals. Despite rapid decomposition of soil organic matter in soils, a relatively large fraction of original materials may remain in refractory organic forms for long periods of time (Arnalds et al 1995, 167; Brady and Weil 2004, 245-247; Holliday and Gartner 2007, 303; Schlezinger and Howes 2000, 479-480). Icelandic Andosols have a range of

<1% C (Vitrisols) up to 40% C (Histosols). Brown and Gleyic Andosols have a range of 4,5-7,5% C (Arnalds 2004, 8, table 4). Accumulation of organic materials in soils tends to lower pH because organic matter facilitates the leaching of nonacid nutrient cations by forming soluble complexes and organic matter also contains many acid functional groups which are a great source of H^+ ions (Brady and Weil 2004, 267-268). With increasing organic content in surface horizons Icelandic Andosols show a trend towards lower pH values (down to around pH 4) although they are higher pH values than commonly reported partly due to a steady influx of eolian materials which sustain the pH levels (Arnalds et al 1995, 166; Arnalds 2004, 13-16). When organic P is mineralized to inorganic P in Andosols during decomposition it is rapidly sorbed to soil particles like allophane and imogolite and eventually precipitated as insoluble compounds if it is not taken up again by plants or leached away (Brady and Weil 2004, 245-247, 341, 433; Shoji et al 1993, 154-163). In Andosols P mainly accumulates in the upper parts of A horizons and very little leaching of P down the soil profile takes place (Shoji et al 1993, 177) despite the fact that organic matter has very little capacity to strongly fix phosphate ions because humic molecules can hide phosphate fixation sites on colloids and organic anions compete with the phosphate anions for these same sites. Organic acids can also entrap reactive Al og Fe in stable organic complexes which makes them unavalable for reaction with P ions in solution encouraging phosphate leaching in soils (Brady and Weil 2004, 441). In Andosols the organic P fraction is possibly around 35-40 % (Brady and Weil, 432, table 13.3).

When humans live in the same place over long periods of time they often leave behind them large amounts of human refuse. Human refuse can cause elevated levels of P in soils often resulting in quite large concentrations of anthropogenic P compared to natural soils. This can then be used as an indicator of human presence

because before the time of chemical fertilizers most enrichment of P in anthropological sediments and soils is associated with human activities (Proudfoot 1976, 93-94; Schlezinger and Howes 2000, 479). There are many sources of anthropological P. Human refuse, e.g. organic and inorganic discard (bone, flesh etc.) derived from animals and plants, animal and human excrement as well as burial remains and ash from fires (Guttmann et al 2005; Holliday and Gartner 2007, 307-309; Proudfoot 1976, 93-94; Schlezinger and Howes 2000, 479). Hearths, cooking features, and middens with wood ash generally have elevated levels of P as do organic residues in food preparation, consumption and disposal areas (Holliday and Gartner, 2007; Mader 2004, 892-893). As discussed above the phosphate in organic matter and excrement has an organic component which is replaced by iron or aluminum in the inorganic form in soils through decomposition due to soil microbes breaking down the organic component and thereby making the phosphate temporarily available for uptake by plants. This available phosphorus also quickly formes bonds with inorganic ions and becomes fixed in soils. Burning also removes the organic component and so P in ash is mostly in inorganic form as well as P in bone. High levels of organic P are a strong indicator of addition of organic materials, such as food waste, animal manure and night soil while high levels of inorganic P are an indicator of addition of inorganic materials, like ash and bone, and of fire (Guttmann et al 2005). Levels of organic vs inorganic phosphorus (organic fraction %) have been used by Linderholm (1997) to distinguish settlements from manured arable fields by assuming that manure elevates levels of organic P while, within settlements, the P is mostly derived from ash and bone and therefore elevates levels of inorganic P. Ash and bone discards also elevate levels of pH while organic refuse lowers pH (Holliday and Gartner 2007, 308).

METHODS

Sampling and Sample Preparation

Sampling was done systematically on a 1 m grid in structure I (*N*=13) and structure III (*N*=13) and on a 5 m grid around and underneath them (*N*=16). The control samples were taken from an undisturbed soil column of a complex of Brown and Gleyic Andosols (Arnalds and Grétarsson 2001) about ??? away from the structures excavated. Older measurements of controls from Skálholt in the southwest of the country taken from undisturbed soil columns of Gleyic and Brown Andosols (Arnalds and Grétarsson 2001) were also used for the comparison. The depth of each sample taken within the soil profile can be seen in Appendix 1. Samples taken from pure tephra layers have also been marked with a T. All control samples were taken off site to minimizes the risk of contamination from human alteration of the soil chemistry as it is very high in close proximity to structures as refuse is even more likely to be deposited outside a structure than within it (Middleton and Price, 1996, 674-675). The floor in structure I was made up of thin lenses of trampled natural silts mixed with charcoal while the floor in structure III was very thin layers of natural silts mixed with decomposed hay (???). Samples were air dried and ground to a powder in a stone mortar.

Phosphate Analysis

The samples were digested in 6 M sulfuric acid (H_2SO_4) for inorganic phosphorus concentrations and burned at 550°C for one hour and digested in 6 M sulfuric acid for total phosphorus concentrations. The inorganic and total P concentrations were determined by mixing standards with known P concentrations, and the sulfuric acid solutions from the samples, together with an ammonium molybdate reagent and measuring the light absorbance of the resulting solutions (blue in color) in a 1 cm cell at 880 nm with a spectrophotometer. The calculated difference

between an unheated and a heated sample represents the concentrations of organic P. The sulfuric acid extraction method is a modified version of the method used at the Institute of Geography, Copenhagen University developed by Mikkelsen (1997) and this method does not include the natural phosphate bound in the soils silicate structures. The results are presented in mg organic, inorganic and total P per 100 g soil.

Many different methods have been used to measure the concentrations of P in soils in archaeology and soil P dynamics are complex and still not entirely understood today. Holliday and Gartner (2007) have shown that various analytical methods used to measure soil P can produce soil P values that vary significantly for the same sample and stress that inter-site comparisons of individual soil P values are inappropriate unless the same method has been used. For this paper a rather concentrated strong sulfuric acid has been used which has a great capacity to break up soil particles and free soil P molecules. It is not clear weather the anthropological P present in the samples has been extracted completely as Andosols show very high P retention (Arnalds 2004, 16) so total P values should be interpreted with caution. However, Holliday and Gartner´s (2006) research also showed that while the magnitudes of soil P values depended on acid strenght and P concentrations present all the methods usually yielded similar trends through soil profiles and always identified elevated levels of soil P where they were expected.

Data Analysis

All calculations and all tables were done in Microsoft Excel©. Boxplots and statistical analysis were done in SPSS® and spatial distribution plots were done with MapInfo. The statistical analysis (Miller and Miller 2005; Þorvarðarson 2004) was compriced of:

1. Boxplots and tables that compare and help interpret the measured P values of the controls to structures I and III and the surrounding area (figures 1, 2, 3 and 4, table 1, appendix 1)
2. Calculations of summary statistics
3. Skewness/Standard Error and Kurtosis/Standard Error tests for data normality (table 2)
4. An analysis of variance (ANOVA) test (table 3)
5. Calculations of the standardized normal variable Z (appendix 1) with an arbitrary estimation of the significant level of enrichment at 2Z (2 standard deviations)
6. Figures that show the spatial distribution of the Z values (figures 5-12)

RESULTS

The Measured Phosphorus Values

An overview of the measured and calculated P values can be found in appendix 1 and in table 1. The boxplots below (figures 1-4) show a five number summary of the data which precent the spread and variations of the values within the data: the lower quartile (25% of the values fall below this point), the upper quartile (75% of the values fall below this point), the median and the two extremes. The organic fraction in figure 4 gives us the percentage of organic P within the total P ((orgP/totP)*100).

Area	Range of total P values	Average total P	Range of inorganic P values	Average inorganic P
Structure 1	53-101	73	41-89	54
Structure 3	34-73	57	25-42	32
Visinity	13-94	48	13-43	25
Controls	13-55	40	13-42	20
Area	**Range of organic P values**	**Average organic P values**	**Range of organic fraction values**	**Average organic fraction**
Structure 1	7-32	19	10-41	26
Structure 3	9-38	25	25-58	43
Visinity	0-52	19	2-66	57
Controls	0-35	20	0-75	43

Table 1 – Phosphorus ranges (mg P/100g soil and %)

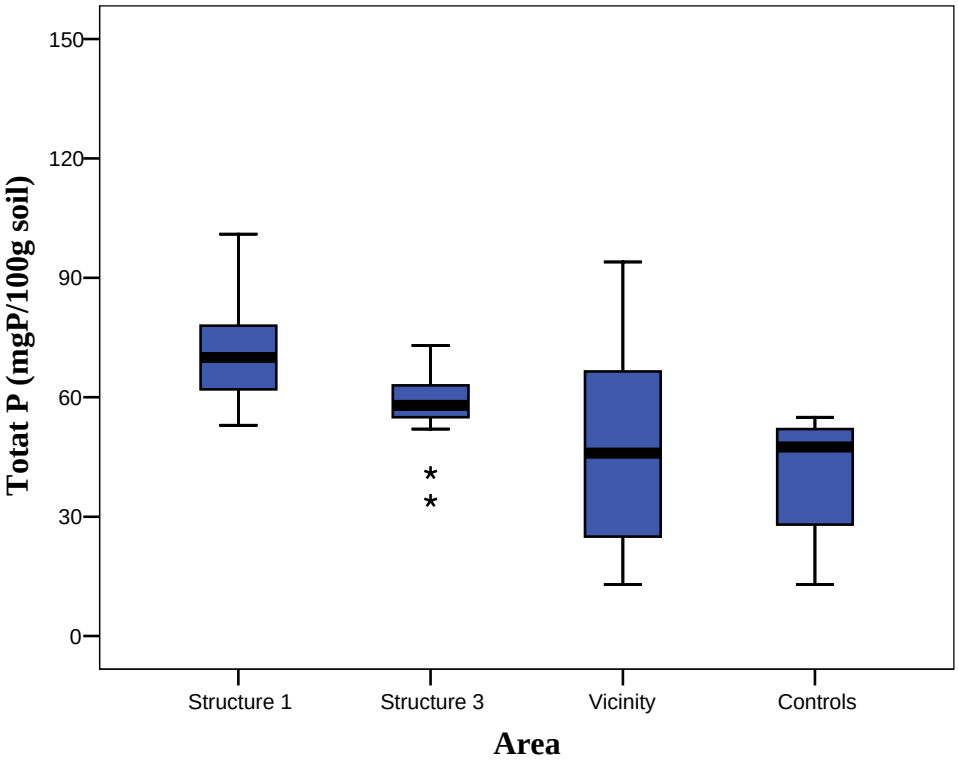


Figure 1 – A boxplot of total P concentrations (mg P/100g soil, stars represent outliers)

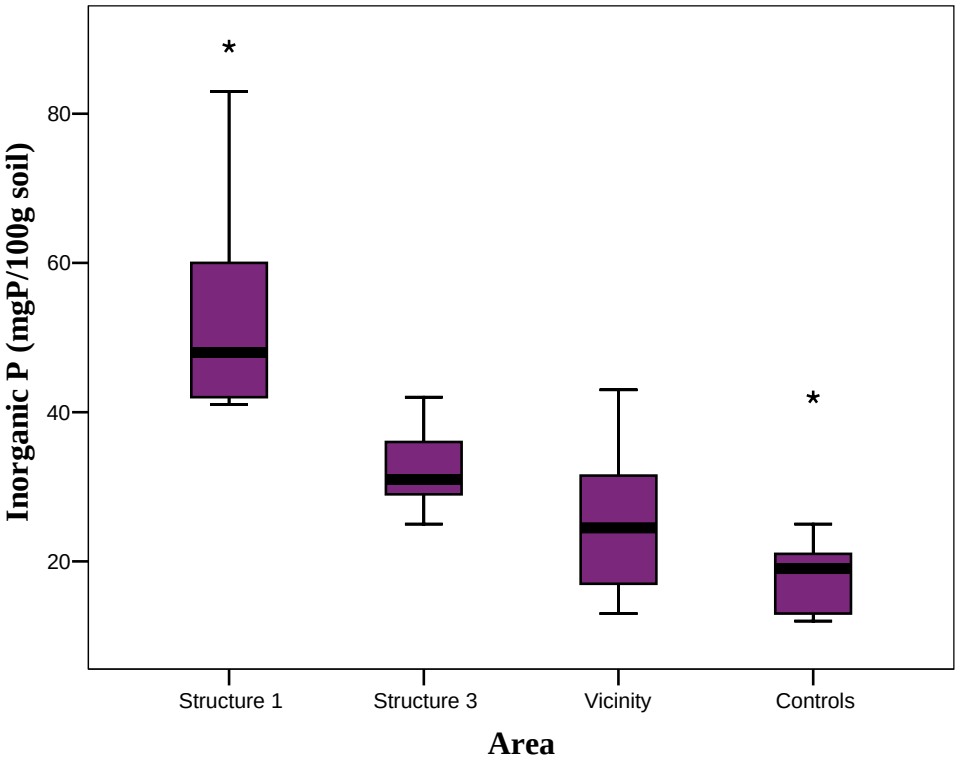


Figure 2 – A boxplot of inorganic P concentrations (mg P/100g soil, stars represent outliers)

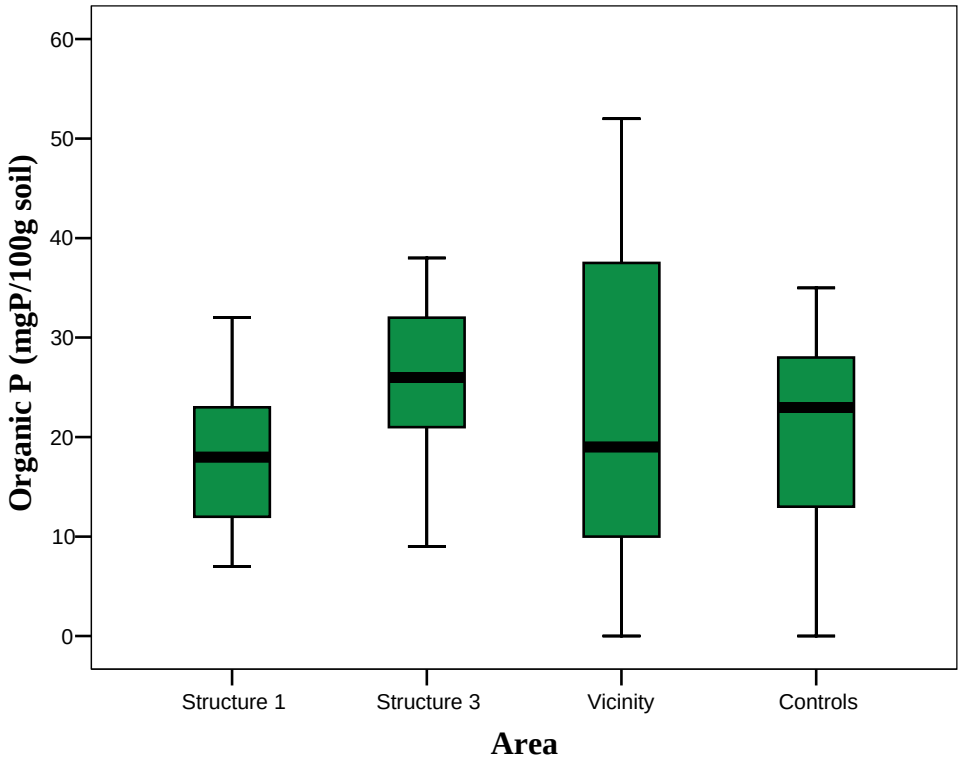


Figure 3 – A boxplot of organic P concentrations (mg P/100g soil)

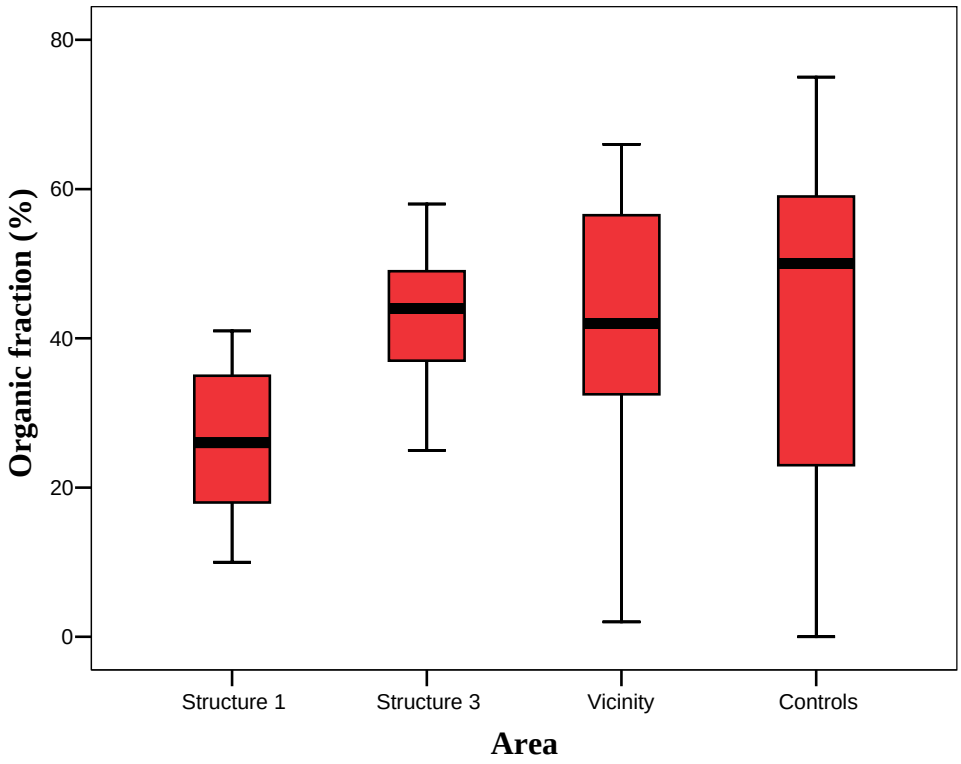


Figure 4 – A boxplot of the organic fraction (%)

In figure 1 we can see that the total P concentrations of both structures I and III are higher than the control values while the total P values of the vicinity show a very broad range and the average values in table 1 support this. In figure 2 the inorganic P concentrations of both structures are clearly higher than the control values, especially within structure I. This difference is not as clear however when inorganic P values of structure III and the controls are compared to the values measured in the vicinity of the structures where the range of values is again broad. In figure 3 and 4 it is clear that there is little or no difference in organic P and organic fraction values between structures I and III and the vicinity and the controls and the average values support this. However, the organic fraction values within structure I still seem to be slightly lower compared to the values within structure III, the vicinity and the controls as can be seen by the average values in table 1. To be certain whether there is significant statistical difference in P values between these areas an ANOVA test must be perfomed.

Normality Tests

To be able to compare the mean P concentrations and organic fractions of the controls versus structures I and III and the surroundings by analysis of variance (ANOVA) the data must be normally distributed. To test for data normality two simple tests based on the skewness, kurtosis and standard error statistics of the data were performed by doing the following calculations for each asssemblage:

Test 1 – Skewness/Standard Error

Test 2 – Kurtosis/Standard Error

Skewness/Standard Error				
	Inorganic P*	***Total P***	***Organic P***	***Organic fraction %***
Structure 1	-1,18	1,30	0,49	-0,23
Structure 3	-0,21	-1,43	-0,92	-0,74
Vicinity	0,92	0,39	0,72	-1,28
Controls	-0,25	-1,47	0,78	-1,23

Kurtosis/Standard Error				
	Inorganic P*	***Total P***	***Organic P***	***Organic fraction %***
Structure 1	-0,60	0,12	-0,81	-1,12
Structure 3	0,11	0,80	-0,26	-0,15
Vicinity	-0,85	-0,67	-1,04	0,78
Controls	-0,48	-0,42	-0,75	-0,41

**ANOVA calculated with P values after reciprocal transformation (1/x) due to negatively skewed data*

Table 2 – Outcomes of the data normality tests

The outcome can be seen in table 2. Data is considered normally distributed when Skewness/Standard Error and Kurtosis/Standard Error are <2, which means that the data for each group is normally distributed. Reciprocal transformation had to be done on the inorganic P values by dividing 1 by each value (1/x) to revert negatively skewed data into normally distributed data to be able to perform the analysis.

Analysis of variance - ANOVA (single factor)

The ANOVA test tells us whether there are significant statistical differences between the mean P concentrations and organic fractions of the controls and structures I and III and the surroundings. Null and alternative hypotheses for this test are:

H_0 = There is ***no*** statistically significant difference between the means of the different types of P concentrations or organic fractions within each group

H_1 = There ***is*** a statistically significant difference between the means of the different types of P concentrations or organic fractions within each group

With a confidence interval of 95% the p-value (value of significance) must be less than 0,05 for the H_0 hypothesis to be rejected and the H_1 hypothesis to be accepted. With the value of significance at 0,05 there is only a 5% likelyhood that the H_0 hypothesis has been rejected when it should be accepted. The results of the ANOVA

tests can be seen in table 3 and the p-values that portray that there is a significant difference between phosphorus values in the designated areas are bold.

Inorganic P (mg P/100g soil)

Significance level p = 0,05

	Structure 1	Structure 3	Visinity	Controls
Structure 1	-	-	-	-
Structure 3	**0,02**	-	-	-
Vicinity	**0,00**	**0,01**	-	-
Controls	**0,00**	**0,00**	**0,02**	-

Total P (mg P/100g soil)

Significance level p = 0,05

	Structure 1	Structure 3	Vicinity	Controls
Structure 1	-	-	-	-
Structure 3	**0,03**	-	-	-
Vicinity	**0,00**	0,17	-	-
Controls	**0,00**	**0,02**	0,20	-

Organic P (mg P/100g soil)

Significance level p = 0,05

	Structure 1	Structure 3	Vicinity	Controls
Structure 1	-	-	-	-
Structure 3	0,14	-	-	-
Vicinity	0,26	0,67	-	-
Controls	0,78	0,27	0,45	-

Organic fraction (%)

Significance level p = 0,05

	Structure 1	Structure 3	Vicinity	Controls
Structure 1	-	-	-	-
Structure 3	**0,01**	-	-	-
Vicinity	**0,01**	0,96	-	-
Controls	**0,02**	0,97	0,99	-

Probability value p=0,05, confidence interval of 95%
When the P-value (value of significance) is less than 0,05 the H_0 hypothesis has been rejected and the H_1 hypothesis has been accepted, with a 5% likelyhood that the H_0 hypothesis has been rejected when it should be accepted

Table 3 – Values of significance (p), results of the ANOVA tests

Table 3 shows that there is a significant difference between the mean P values of the areas in 13 out of 24 comparisons. According to the test there is a significant difference between the inorganic P concentrations of all the areas tested. The same is not true of the total P concentrations. There is a significant difference between the total P concentrations in Structures I and III and between the structures and the

controls however, there is no difference between the total P concentrations in Structure III and the samples taken in the vicinity of the structures nor between the control samples and the samples taken in the vicinity. The organic P concentrations show no significant difference between any of the areas sampled. The organic fraction (%) shows a significant difference between Structures I and III and between structure I and the controls. It also shows a difference between Structure I and the samples taken in the vicinity but not between Structure III and the controls nor the samples taken in the vicinity.

Spacial distribution of P concentrations and organic fractions

In order to estimate the level of enrichment of phosphorus in each of the samples taken inside structures I and III and in the nearest vicinity compared to the control samples taken outside the structures the standardized normal variable Z was calculated (appendix 2). The phosphorus values of the samples taken on site are expressed as standard deviations from the mean value of the control samples by subtracting the on site concentration values from the mean control value and dividing by the standard deviation of the mean control values. The significant level of enrichment was arbitrarily set at 2 standard deviations (2z) which means that there is a 95% chance that the enrichment is statistically significant.

The data represented as the standardized normal variable Z shows whether the soil is poor or rich of P compared to the mean concentrations of the controls. In figures 5-12 the Z values are plotted within and around a plan of structures I and III in order to determine the spatial distribution of the samples and whether there are any specific areas with high P concentrations which stand out within and/or around the structures. In figures 5-12 significant enrichment (chance >95%) is represented with

red dots. The gray area where the enrichment is 1-2 Z (chance of significant P enrichment between 68-95%) the dots are yellow and where the enrichment is thought statistically nonsignificant (chance < 68%) the dots are blue.

Figure 5 represents the spatial distribution of total P values (mgP/100g soil) within structures I and III. Within structure I there are six areas out of the 13 tested which show a statistically significant enrichment (Z>2) in P compared to the controls while in structure III there is only one area out of the 13 tested. The total P concentrations are all rather low when compared to the controls but 25 samples out of 26 still show some level of enrichment (Z>0) even if it is not very high. Only 1 sample in the southwest corner of structure I shows very little enrichment (Z<1) while in structure III there are 4, 2 at the east end of the structure (Z<1 and Z<0) and 2 towards the west end (Z<1).

Figure 6 represents the spatial distribution of total P values (mgP/100g soil) in the vicinity and from underneath structures I and III. There are only two areas of statistically significant enrichment (Z>2), one is directly underneath structure I and the other is 5 m northeast of structure III. Five areas show an enrichment of 1<Z<2. These areas are directly underneath structure II, directly underneath structure III, 3 m west of structure III, 4,5 m south of structure III and 10 m west of the northend of structure I.

Figure 7 represents the spatial distribution of inorganic P values (mgP/100g soil) within structures I and III. Within structure I all the areas show a statistically significant enrichment (Z>2) compared to the controls. In structure III there is only one such area near the middle of the structure but there are still only two areas out of 13 that show a Z value of < 1. 10 out of 13 areas show an inorganic P enrichment of 1<Z<2.

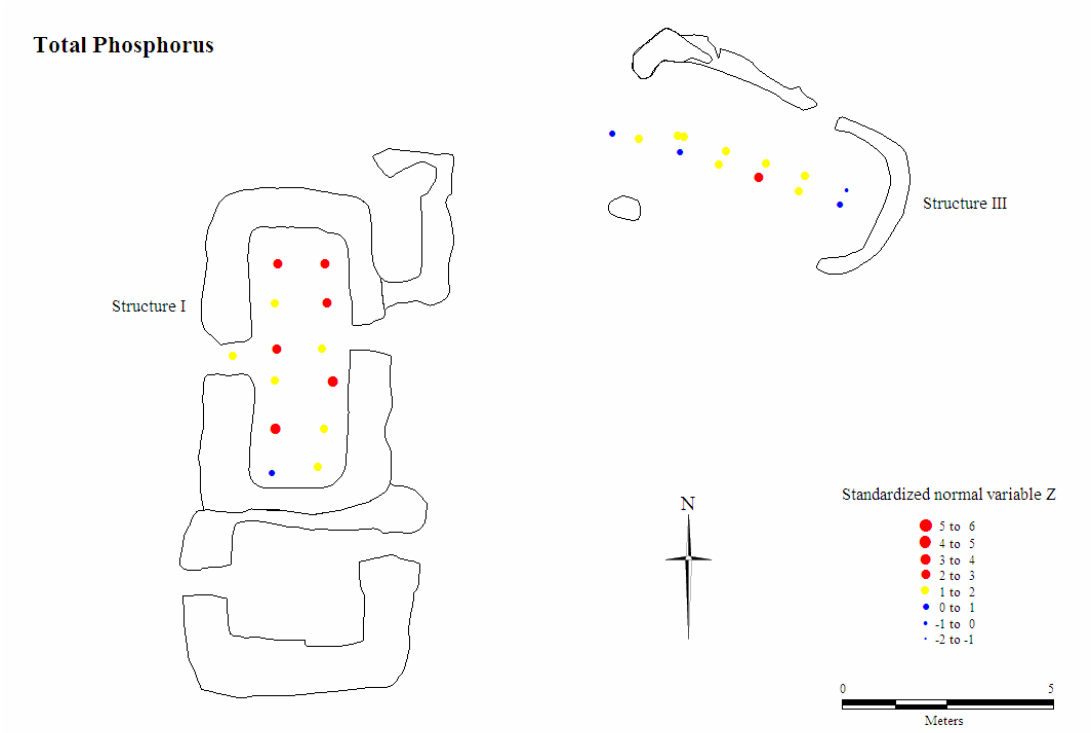


Figure 5 – Spatial distribution of samples and the standardized normal variable Z within structures I and III for total P

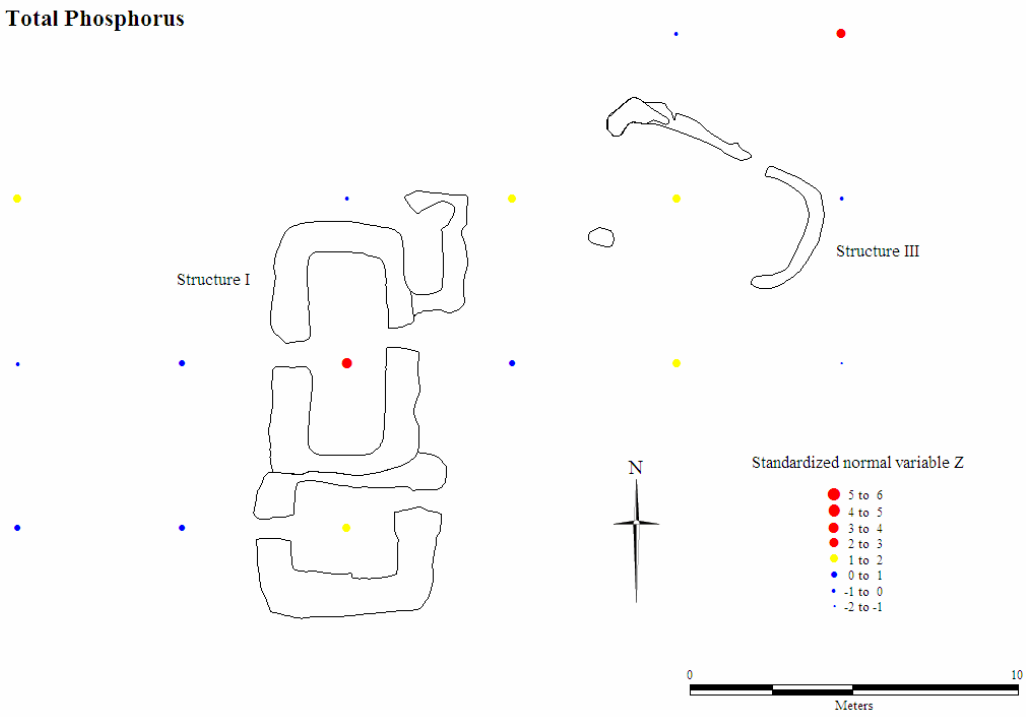


Figure 6 – Spatial distribution of samples and the standardized normal variable Z in the vicinity of structures I and III for total P

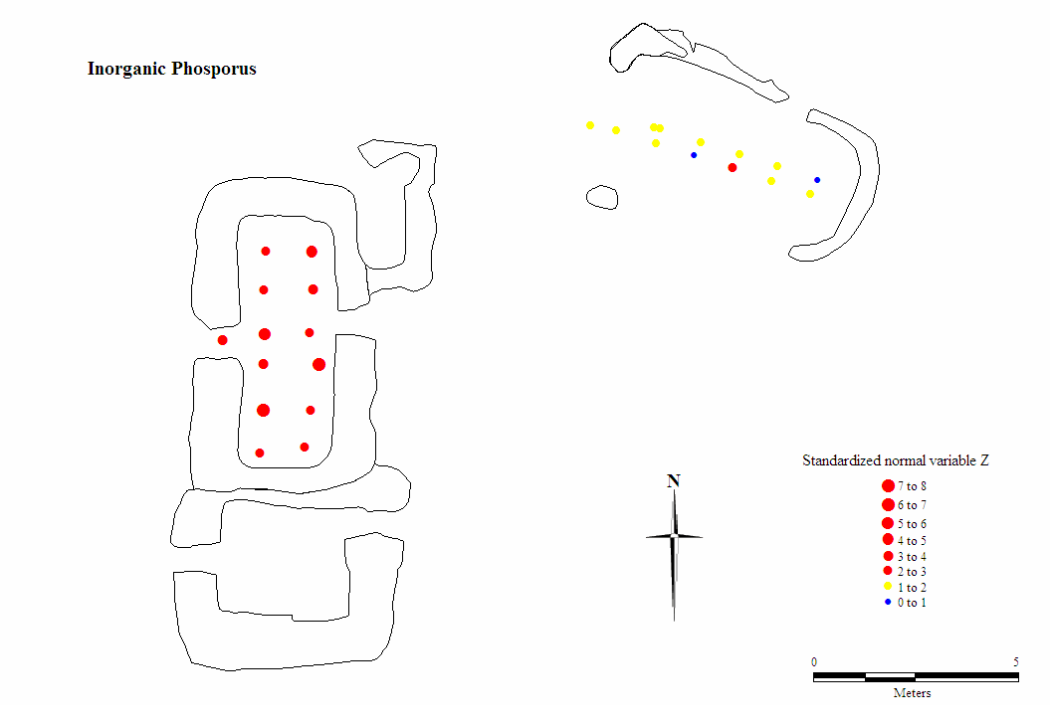


Figure 7 – Spatial distribution of samples and the standardized normal variable Z within structures I and III for inorganic P

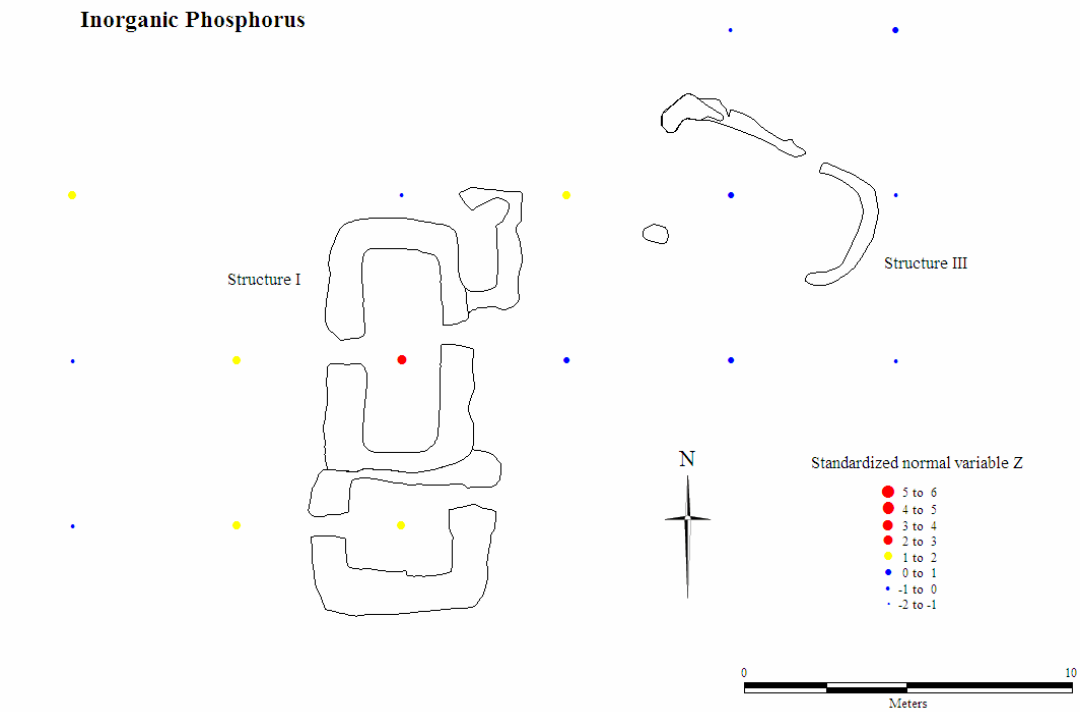


Figure 8 – Spatial distribution of samples and the standardized normal variable Z in the vicinity of structures I and III for inorganic P

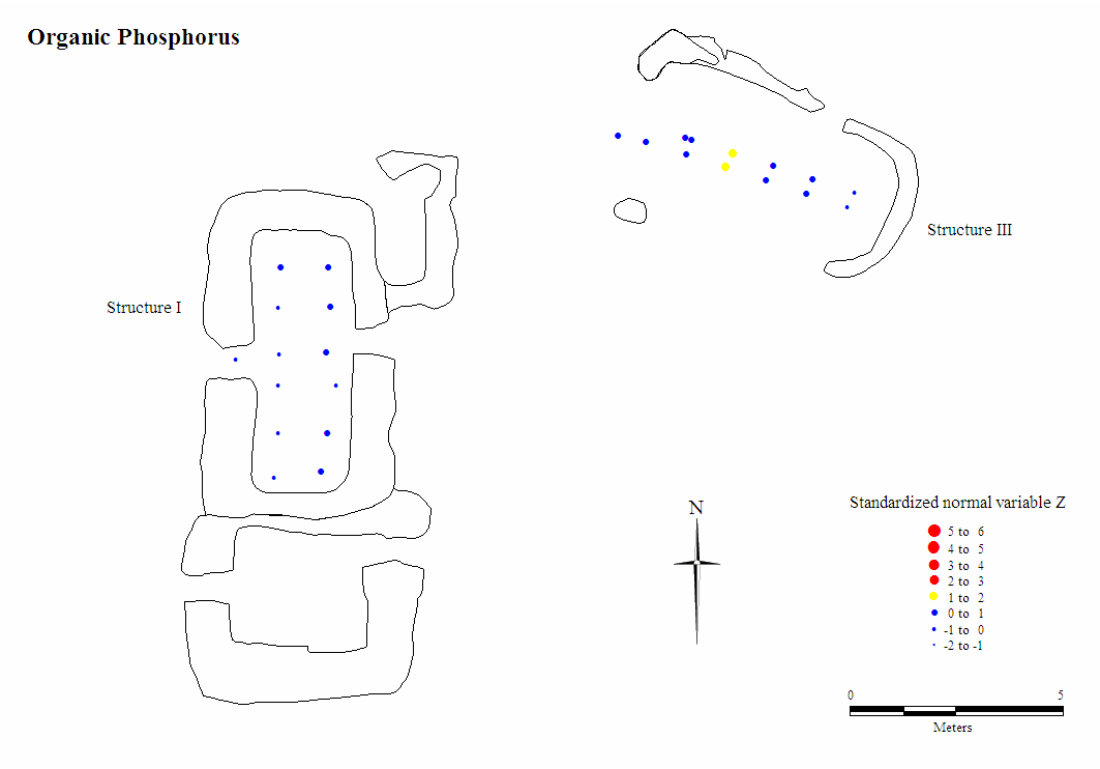


Figure 9 – Spatial distribution of samples and the standardized normal variable Z within structures I and III for organic P

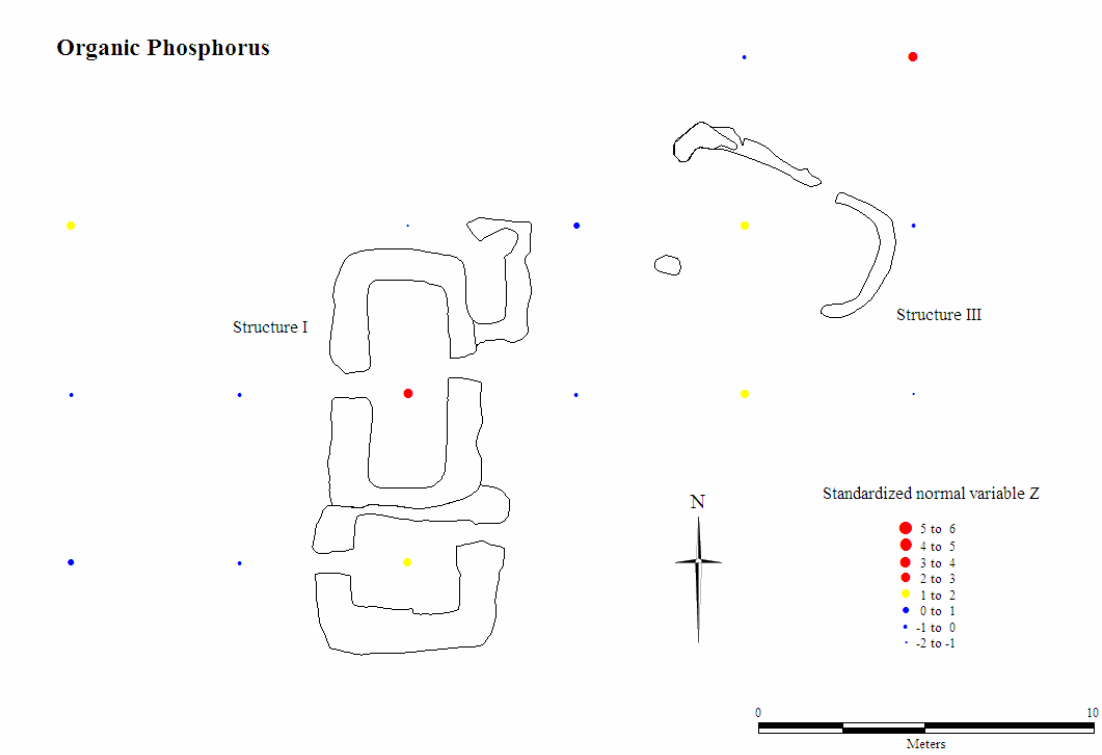


Figure 10 – Spatial distribution of samples and the standardized normal variable Z in the vicinity of structures I and III for organic P

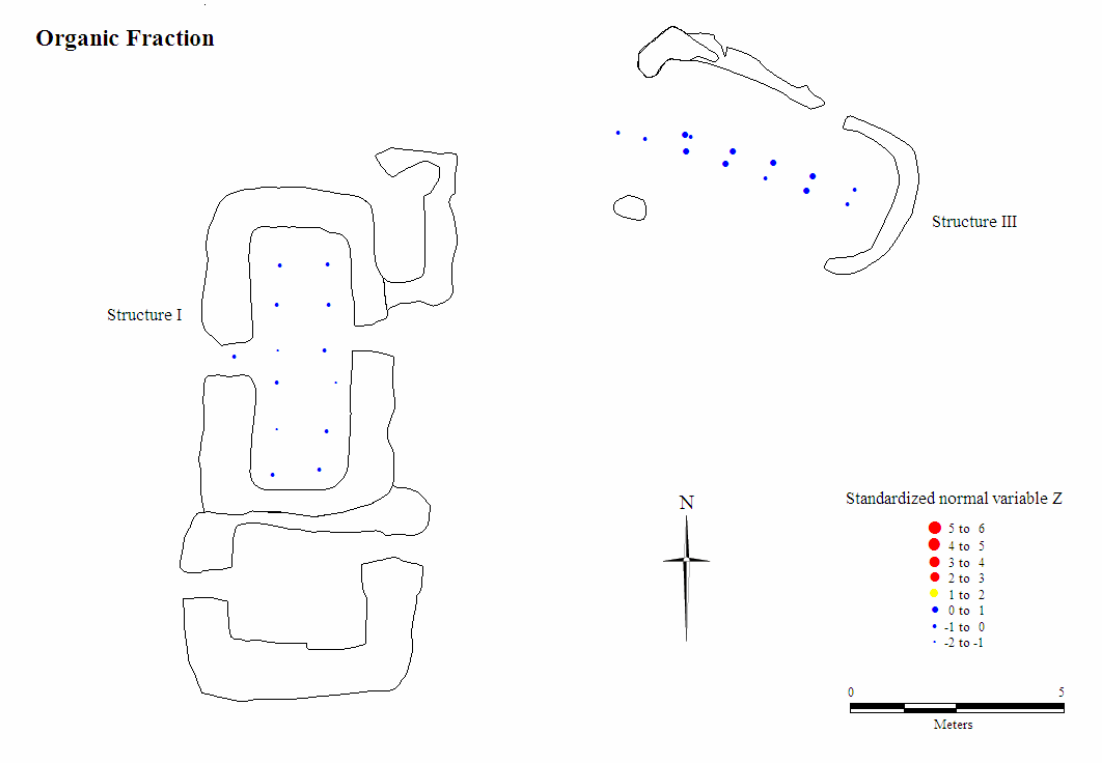


Figure 11 – Spatial distribution of samples and the standardized normal variable Z within structures I and III for the organic fraction

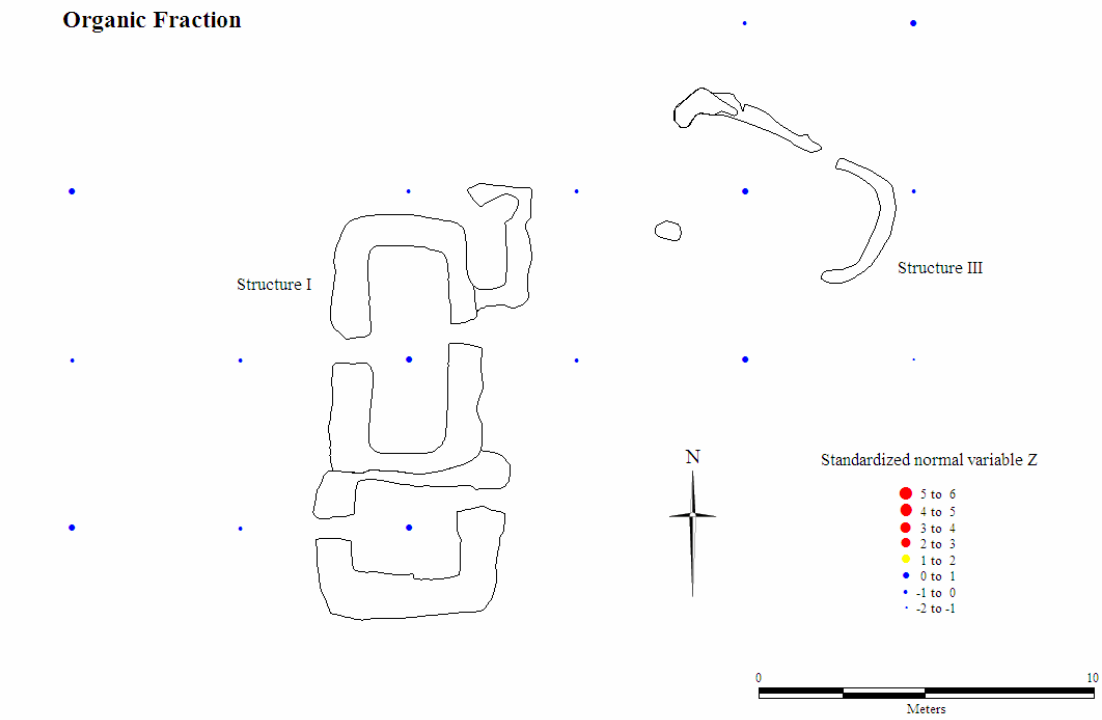


Figure 12 – Spatial distribution of samples and the standardized normal variable Z in the vicinity of structures I and III for the organic fraction

Figure 8 represents the spatial distribution of inorganic P values (mgP/100g soil) in the vicinity and from underneath structures I and III. Only 1 area shows statistically significant enrichment (Z>2) in inorganic P and that area is directly underneath structure I. Five areas show an enrichment of 1<Z<2. These areas are directly underneath structure II, 3 m west of structure II opposite its entrance, 2-2,5 m west of structure I opposite its entrance, 3 m west of structure III and 10 m west of the northend of structure I.

Figure 9 represents the spatial distribution of organic P values (mgP/100g soil) within structures I and III. Within structure I none of the areas show much enrichment (Z>1) compared to the controls. In structure III there are two areas that show an enrichment of 1<Z<2 towards the middle of the structure but there is no statistically significant enrichment (Z>2).

Figure 10 represents the spatial distribution of organic P values (mgP/100g soil) in the vicinity and from underneath structures I and III. There are two places that show a statistically significant enrichment in organic P, one is directly underneath structure I and the other is 5 m northeast of structure III. Four areas show an enrichment of 1<Z<2 These areas are directly underneath structure II, directly underneath structure III, 3 m south of structure III and 10 m west of the northend of structure I.

Figures 11 and 12 represent the spatial distribution of organic fraction values within, underneath and in the vicinity of structures I and III. In these figures there is no area that shows a significant difference in organic fraction (Z>1) from the controls. This is not what the ANOVA tests told us above as there it suggested a significant difference between structure I and structure III, the vicinity and the controls.

However, there is still a hint of a difference between the two structures as all the Z values in structure I are <0 while 7 out of 13 areas show a Z value of 0<Z<1. The difference between the structures lies in the fact that the percentages in structure I are lower than in the controls, the vicinity and structure III and so they are not represented properly through the standardized normal variable Z.

INTERPRETATIONS

Controls

The controls for this project were taken from complexes of Gleyic and Brown Andosols near Pálstóft and the Skálholt excavation sites. The samples were taken from different depths in three profiles from different horizons. The total P measurements of these samples all turned out to be below the total P limit of 4-60 mg P/100g soil of acid extractable P in fresh tephras discussed in Sohji et al (1993, 171), the highest being 55 mg total P/100g soil. Gleyic and Brown Andosols hold on to P very tightly, as it forms strong bonds with inorganic and organic compounds in the soil, so high P depleation in the control samples is unlikely even if the pH levels (~6 for Brown and Gleyic Andosols in Arnalds 2000, 13) suggests more P available for plant uptake.

Structure I

In Structure I the total P enhancement was clearest. The highest values were between 81 and a 101 mg P/100 g soil but they were not many. Compared to values from middens and soils from Neolithic to Late Iron Age Toft Ness, Scotland where the total P levels were from around 200 to 1400 mg total P/100 g soil (Guttmann et al 2006, 86) these levels are not high. This low input of P could suggest a very short

occupation span although cleaning of areas can also cause low levels of P where they are not expected. Measurements of inorganic P in all the areas sampled in Structure I showed a statistically significant enrichment (Z>2) and the organic fraction (%) showed that most of them contain a somewhat larger inorganic P component than most of the controls and the samples taken in the vicinity. This suggests that while the total P values in the soil are not very high the enhancement is more likely to be anthropological rather than natural as rules of P input are different within buildings than out in nature and high levels of inorganic P are a good indicator of addition of inorganic materials, like ash and bone, and of fire. The fact that the soil layer contained charcoal supports this. Ash and bone discards elevate levels of pH (Holliday and Gartner 2007, 308) which could enhance leaching of nutrients but as the soils sampled were mostly natural silts with high capacity to hold P in the soil this influence would not have significant effects on the total P values.

As samples were not taken on a smaller grid and due to the low levels of P there are no clear patterns of high or low P concentrations within the structure. Total P values are highest inside the entrance on the westside of the structure and to the far right of that entrance, to the left and right of the entrance on the eastside of the structure and at the north end. There is one poorly enriched area in the southwest corner which might suggest furniture or something else that hindered the deposition of P. The original source of the P (bone, dung, hey etc..) must be found by other means such as micromorphology.

Structure III

The enhancement of total P is even more unclear in Structure III than it was in Structure I. The highest values were between 60-70 mg total P/100 g soil and only one

area in the middle of the structure turned out to be significantly enhanced. There is more enrichment of inorganic P than organic P within the structure but the organic fraction (%) is still noticably higher than in structure I and more like the controls and the samples taken in the vicinity. This would suggest that there has been much less input of inorganic P in Structure III than Structure I and the absence of charcoal and bone from the soil support this. Some of the inorganic P measured could have been formed from the breakdown of organic P due to microbes and weathering. Hightened levels of organic P are a strong indicator of addition of organic materials, such as food waste and animal manure and this could suggest that there was more input of organic P in structure III than in structure I but the P levels are just too low to be sure although the precence of decomposed hay in the soil does support it. Organic refuse lowers pH (Holliday and Gartner 2007, 308) which helps prevent leaching of nutrients and the soil is mostly comprised of natural silts so it is unlikely that much of the P has been lost and should still be bound in organic and inorganic compounds. This low input of P could suggest a very short occupation span and/or regular cleaning of areas which can also cause low levels of P where they are not expected. E.g. if this structure was some sort of shelter for animals it would have to be cleaned out regularly which would prevent the accumulation of P to a certain degree. The thinness of the soil layer suggests that if the structure was an animal stall the dung was not allowed to accumulate.

The occupation layer was so thin that good samples could not be taken at one meter intervals within the whole structure. The distribution of the samples taken does not tell us much about specific P enhancement areas except that there seems to be more P towards the middle of the structure than towards its east and west ends.

Vicinity

It was immediately clear from the boxplots in figures 1-4 that some of the areas sampled in the vicinity of Structures I and III had to have enhanced P levels while others were seemingly unaffected due to the broad range of values it showed in all types of P. Most of the enriched areas are underneath or close to the structures but 7 out of 16 areas sampled show little or no enhancement at all ($Z<1$). The three enhanced samples taken underneath the structures can be dismissed as due to movement of P down profile from the floors above during and after abandonment but they do show us that a part of the P does move down profile. This also means that the other enriched areas not underneath structures could signify some movement of P down profile from P rich soils or sediments above but what those sediments are comprised of is impossible to predict precicely unless they are still present above.

The only area unconnected with the structures that shows a statistically significant enrichment is 5 m northeast of structure III and it is enriched in organic P. This area could be a site where there was a dung heap or some sort of a midden rich in organic waste. 3 m south of the structure there is an area slightly enhanced in organic P which could also have been the place of a dung heap, a mixture of organic and inorganic middenwaste or maybe there was a pathway there that people and livestock regularly travelled which lay northwest between Structures III and IV 2,5 m west of Structure III where there is also an area slightly enriched in inorganic P. There it would be unlikely to find a midden or a dung heap as there would have been need to travel between the two buildings unimpeaded unless a long time passed between the building of Structure I and Structure III.

Two areas closely west of structure I opposite the entrances to structures I and II are slightly enhanced in inorganic P which might be due to debris carried to and from structures I and II under shoes or perhaps from ash rich middens or other inorganic waste disposal from these same structures.

About 10 m west of the northend of structure I there is an area enhanced in inorganic and organic P which also could have been the place of a midden or a dung heap.

CONCLUSIONS

We have established that while enrichment of P is present it is rather low which makes it difficult to detect any clear patterns of significant enrichment areas within the structures. The enhancement is more likely to be anthropological rather than natural as rules of P input are different within buildings than out in nature. This low input of P suggests a very short occupation span although cleaning of areas can also cause low levels of P where they are not expected. The enhancement was clearest in structure I and probably largely due to addition of inorganic materials like ash. The enhancement of P was more unclear in structure III but there are hints that there was less input of inorganic P than in structure I. It was suggested that there was more input of organic P in structure III than in structure I but the P levels are just too low to be sure although the precence of decomposed hay in the soil does support it. There were also a few areas outside the buildings that showed some enrichment in P in the undisturbed soil possibly due to the movement of P down profile from an anthropological source. It is, however, impossible to predict the nature of these sources precicely unless they are still present above and it must be stressed that measurements of P values can not tell us the exact source of P and this data should be

viewed alongside other data such as descriptions of the soils micromorphology, organic C% and pH to accurately interpret the use of the structures.

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Appendices

Appendix 1 - Phosphate concentrations (mgP/100g soil) and the organic fraction (%)

Sample No	Area	x	y	Inorganic P (mgP/100 g soil)	Total P (mgP/100 g soil)	Organic P (mgP/100 g soil)	Organic fraction (%)
11	1	94,34	107,58	41	53	12	24
12	1	94,43	108,63	83	96	13	14
13	1	94,44	109,76	53	68	15	22
14	1	94,46	110,48	67	74	7	10
15	1	94,44	111,57	44	61	18	29
16	1	94,50	112,50	46	78	32	41
17	1	95,44	107,72	41	62	21	34
18	1	95,60	108,62	42	70	28	40
19	1	95,81	109,74	89	101	12	12
20	1	95,56	110,51	41	64	23	36
21	1	95,65	111,58	50	77	27	35
22	1	95,62	112,51	60	81	21	26
23	1	93,44	110,35	48	59	10	18
44	3	107,96	114,26	25	34	9	25
45	3	106,98	114,58	31	63	33	51
46	3	106,06	114,88	29	62	32	52
47	3	105,12	115,16	36	69	34	49
48	3	104,13	115,50	37	58	21	37
49	3	103,98	115,54	30	58	29	49
50	3	107,80	113,92	29	41	12	30
51	3	106,84	114,22	30	56	26	46
52	3	105,89	114,54	42	73	31	43
53	3	104,94	114,86	28	66	38	58
54	3	104,02	115,15	31	55	24	44
55	3	103,06	115,45	36	58	21	37
56	3	102,42	115,59	32	52	21	39
111	Visinity	85	105	18	42	24	57
112	Visinity	85	110	16	24	9	35
113	Visinity	85	115	30	67	38	56
114	Visinity	90	105	33	48	15	31
115	Visinity	90	110	30	44	14	32
116	Visinity	95	105	36	69	33	48
117	Visinity	95	110	43	94	52	55
118	Visinity	95	115	18	24	6	26
119	Visinity	100	110	23	40	17	42
120	Visinity	100	115	36	57	21	37
121	Visinity	105	110	23	66	43	66
122	Visinity	105	115	27	64	37	58
123	Visinity	105	120	16	24	8	33
124	Visinity	110	110	13	13	0	2
125	Visinity	110	115	15	26	11	42
126	Visinity	110	120	26	74	48	64
1	Controls	43 cm below surface		15	28	14	48
2	Controls	98 cm below surface		25	52	27	52
209*	Controls	118 cm below surfac		13	13	0	0
211*	Controls	94 cm below s. T		13	13	0	0
213*	Controls	50 cm below surface		18	52	34	66
214*	Controls	24 cm below surface		20	39	19	48
216*	Controls	138 cm below surfac		12	47	35	75
217*	Controls	90 cm below surface		21	49	28	57
218*	Controls	55 cm below s. T		42	55	13	23
219*	Controls	34 cm below surface		20	48	28	59

*** measurements of controls from an unpublished dissertation (Beck, 2005)**

Appendix 2 – Standardized Normal Variable Z

Sample No	Area	x	y	Z for Inorganic P	Z for Total P	Z for Organic P	Z for Organic Fraction
11	Structure 1	94,34	107,58	2,30	0,83	-0,57	-0,74
12	Structure 1	94,43	108,63	6,99	3,51	-0,49	-1,10
13	Structure 1	94,44	109,76	3,72	1,78	-0,37	-0,79
14	Structure 1	94,46	110,48	5,23	**2,14**	-0,97	-1,26
15	Structure 1	94,44	111,57	2,66	1,34	-0,18	-0,54
16	Structure 1	94,50	112,50	2,88	**2,39**	0,97	-0,05
17	Structure 1	95,44	107,72	2,31	1,37	0,10	-0,33
18	Structure 1	95,60	108,62	2,52	1,90	0,61	-0,13
19	Structure 1	95,81	109,74	7,72	**3,81**	-0,63	-1,19
20	Structure 1	95,56	110,51	2,36	1,54	0,28	-0,25
21	Structure 1	95,65	111,58	3,35	**2,33**	0,56	-0,29
22	Structure 1	95,62	112,51	4,46	**2,56**	0,08	-0,65
23	Structure 1	93,44	110,35	3,16	1,18	-0,73	-0,96
44	Structure 3	107,96	114,26	0,61	-0,35	-0,86	-0,67
45	Structure 3	106,98	114,58	1,23	1,48	0,98	0,32
46	Structure 3	106,06	114,88	1,07	1,36	0,95	0,35
47	Structure 3	105,12	115,16	1,75	1,83	1,06	0,22
48	Structure 3	104,13	115,50	1,90	1,15	0,11	-0,24
49	Structure 3	103,98	115,54	1,08	1,17	0,70	0,25
50	Structure 3	107,80	113,92	1,01	0,11	-0,57	-0,49
51	Structure 3	106,84	114,22	1,16	1,03	0,47	0,13
52	Structure 3	105,89	114,54	**2,44**	**2,07**	0,88	0,00
53	Structure 3	104,94	114,86	0,91	1,64	1,41	0,56
54	Structure 3	104,02	115,15	1,22	0,94	0,33	0,04
55	Structure 3	103,06	115,45	1,84	1,13	0,13	-0,22
56	Structure 3	102,42	115,59	1,32	0,78	0,06	-0,13
111	Vicinity	85	105	-0,23	0,12	0,31	0,55
112	Vicinity	85	110	-0,44	-0,94	-0,86	-0,29
113	Vicinity	85	115	1,08	1,71	1,37	0,50
114	Vicinity	90	105	1,42	0,49	-0,38	-0,44
115	Vicinity	90	110	1,11	0,28	-0,43	-0,40
116	Vicinity	95	105	1,75	1,81	1,03	0,21
117	Vicinity	95	110	**2,53**	**3,40**	**2,47**	0,46
118	Vicinity	95	115	-0,18	-0,94	-1,04	-0,65
119	Vicinity	100	110	0,38	0,02	-0,24	-0,04
120	Vicinity	100	115	1,76	1,05	0,08	-0,22
121	Vicinity	105	110	0,30	1,61	1,80	0,87
122	Vicinity	105	115	0,80	1,49	1,30	0,56
123	Vicinity	105	120	-0,42	-0,97	-0,91	-0,37
124	Vicinity	110	110	-0,78	-1,65	-1,51	-1,57
125	Vicinity	110	115	-0,52	-0,84	-0,69	-0,03
126	Vicinity	110	120	0,72	**2,13**	2,15	0,82

Significant level of enrichment was arbitrarily set at 2 standard deviations (2z)