Waterland–People:
On Structure and Origin of Crannogs
Geophysical and Environmental Evidence in Orkney

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Declaration

I declare that this dissertation represents my own work, except where otherwise acknowledged. The help with fieldwork was carried out by Orkney College Geophysics Department.

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Abstract

Crannogs have been a target object of theoretical approaches, sourrounded by mysteries concerning their origin since their discovery in the 19^{th} century.
Investigations comprised from large scale excavations to random sampling with few geophysical surveys and a range of theories concerned with their structural identity.
The Islands of Orkney provide an excellent environment in which a framework for local communities studies can be set up which helps finding patterns in the information of the site types crannog and other island settlements, of which there are more than 30 possible only on Mainland.
An attempt is made in this work to find reasons for the patterns associated with crannogs and other island–type settlements by looking at their possible origins in the Mesolithic through detailed environmental and a critical historical research, their structural evidence using geophysical instrumentation on the exposed surface as a first step and by comparison with similar sites in the world wide record.
Since the geophysical approach is relatively new, the practicability of such approaches is studied in detail and an evaluation of its application to different site types is given in order to estimate the value of a *site fingerprint*.
The conclusion is that site patterns and structural evidence (although sparse at this stage) give hints to their origins which are manifest in beliefs that emerged from observations and perceptions of humanity in the late Holocene and that these origins can be projected into different phases of civilization, all related by some few variables such as water, continuity, supply and, perhaps, transformation.
The first chapter introduces the approach, taken throughout the entire work and the second chapter unrolls the history of previous research generally, critically and in an european context, it also provides an insight in the main objectives of this work.
Chapter 3 assesses the sites localized in Orkney and chapter 4 introduces the geophysical methods used during fieldwork.
The succeeding chapter 5 gives and investigates the geophysical results in their context while chapter 6 discusses all results along the line of some related aspects.
The conclusion extracts from the local Orkney scale and projects by including all findings, onto a general, spacially and chronologically independent, scale, which is the topic of the final chapter 7.

An outlook that offers future objectives and a summary, that reassesses the preliminary aims and objectives follow. The appendices comprise of abbreviations, site lists and a photographic register.

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Chapter 1

Introduction

Being amongst the more enigmatic and mysterious of the archaeological sites in Britain, thereby spanning the longest periods of domestic activity (Dixon 2004, 31) and having been a target of research from early elaborate investigations and publications in the 19th and early 20th century (Wilde 1840; Mapleton 1870; Wood-Martin 1886; Munro 1879, 1881a,b, 1882a,b, 1885, 1886, 1890, 1893, 1899; Bruce 1899–1900, 1908; Blundell 1909, 1910, 1911, 1912, 1913), through the event of archaeological modernist approaches (Fraser 1917; Monteith 1937; Fairbairn 1937; Hencken and O'Neill 1937, 1942, 1950; Ritchie 1942; Piggott 1953; Scott 1960; Scott and Fairhurst 1961) right up to contemporary laborious environmental studies of related material from microbiological to radiocarbon-datable (Renfrew 1973; Dixon 1981, 1982b,a, 1989c,a,b, 2004; Dixon and Andrian 1989; Hanson and Macdonald 1985; Redknap and Lane 1994; Crone 1991, 2000; Armit 1986, 1987, 1988, 1989b,a, 1992a,b, 1997, 2003; Mills 2004; Cavers 2003, 2006; Cavers and Henderson 2005), Crannogs still tend to reject interpretive approaches (Armit 1997, 34). Equally difficult, it seems, is their appearance as targets of study in ways of excavation or geophysical investigation, which is why, in most aspects, their secrets are still to be unravelled, strategies of unravelling are still needed, approaches to strategy are still to be invented.

The content of this work may add to one strategy among many, that in one way or another, may yet await invention or is just presently hidden from access. The phenomenal computer revolution might just now give way for exactly the approach that is non-disturbing, time and cost efficient and highly informative towards subsurface studies: Geophysics.

Contemporary research strategies tend to take more and more into account the multidisciplinary approach needed to process the vast amounts of data accumulated in a single season. Moreover pre-seasonal investigations are needed at a preliminary level for the assessment of research strategies and potentiality of outcomes. Thereby, the difficulties involved in any stage have to be weighted against measures of outcome quality. It is these difficulties that are to be studied effectively in the first place, as pioneering work has shown tendencies of unwelcome effort and exploitation of pioneers' abilities to estimate the quality of the data in quest. In that regard, the effort and achievements of predecessor's in other disciplines feed in and looking at the planet becoming a global

community, the networks and strategies are just about to emerge rather autonomously and might be the centre strategy of future research.
As Greene in his Elegant Universe (Greene 2000, 283) remarks on the advent of Unified Theories, that were contemporary with the advent of Archaeology, Einstein's reflection on a Grand Unified Theory (GUT),
'*God could have made the Universe in a different way; that is, whether the necessity of logical simplicity leaves any freedom at all.* [...] articulated the nascent form of a view that is currently shared by many physicists: If there is a final theory of nature, one of the most convincing arguments in support of its particular form would be that the theory couldn't be otherwise. The ultimate theory should take the form that it does because it is the unique explanatory framework capable of describing the universe without running up against any internal inconsistencies or logical absurdities. Such a theory would declare that things are the way they are because they *have* to be that way. Any and all variations, no matter how small, lead to a theory that - like the phrase "This sentence is a lie" - sows the seeds of its own destruction.'
Despite his traditional religious beliefs, Einstein marked the turning point of humankind, looking upon their universe in a very different way. Somehow Einstein had managed to make reality seem unreal and to lead humankind into their strangest discoveries by predicting only a couple of experimental outcomes correctly and thereby challenging his many critics with fundamental confidence because of trust in his equations. Although, nowadays, his work covers a small but essential part of our understanding of the universe, it was still a necessity to do what he did: to gather all the information about a system and merge it into a new theory. Without the information about the system, therefore, the theory cannot be created. Without the theory, assumptions cannot be made, nor can predictions later become true and that way stress the validity of the theory.
'Establishing such inevitability in the structure of the universe would take us a long way toward coming to grips with some of the deepest questions of the ages. These questions emphasize the mystery surrounding who or what made the seemingly innumerable choices apparently required to design our universe.' (Greene 2000, 283)
Green's conclusion on GUTs is correctly adaptable to the world of the crannog builder/s creater/s as the constructor bears in mind the idea to create not just a site but a world in which general rules mark every day life's turning points, where structure is given through world order and only through accessing the rules we may find the idea behind it all.
Crannog research appears to be in the initial, and therefore, exciting phase, where not much is known, and henceforth, much is possible. Gathering of information therefore is the objective and the main reason for the approach, taken in this work. The outcome will, eventually, lead to certain theories about Crannogs and hopefully start another, exciting phase of discussion, erratum and solution.
A critical overview over the historical background of Crannog research in Scotland, Ireland and Wales in the general light of lakeside research will provide the background for the geophysical and environmental approaches, taken in this case as a means of investigation. The amount of data that has been gathered for this project does not account for being the fundament on which to build future research strategies but should rather and nevertheless be seen as an experimental outcome with which to formulate future

strategies concerning the sites and will simply add information to the sites in particular and to the approach in general. This point of view closely resembles that of the screw in the machinery that lacks knowledge of its own existence but will count when the apparatus comes alive as the machinist surely believes with confidence, and which is his fundamental point of view.

Chapter 2

General review

2.1 Definition of Crannogs

The vast variety of definitions concerned with the terminological expression of a ’Crannog’ makes it necessary to point out what, onwards from now on, the term, besides it’s gaelic root word ’crann’ (Armit 1997, 33), meaning ’wood’, shall imply.
For the purposes of this work the term ’Crannog’ describes a submerged or exposed island, partially or completely man-made with structural remains of any kind, ritual or domestic, and it’s underwater extensions, which is, throughout the periods of it’s usage, completely surrounded by water.
But this view and definition are a controversy when we assume that the initial settlement started on a later submerged, natural island. It might well be that one day we may find that the crannog–type site represents an advanced or late state of occupation into which it was forced to evolve naturally.

2.2 Historical overview

Research on lake side dwellings began in the year 1854, when Ferdinand Keller (Keller 1878) of the Society of Antiquaries in Zürich/Schweiz interpreted the first finds as the remains of Neolithic settlements, erected on platforms above the water of middle European lakes. The Neolithic finds until then had mainly consisted of grave goods from megalithic and other tombs. The settlement finds, and their state of preservation, represented artefacts in relation with lifestyle and everyday life for the first time. Among the finds were household items, tools for woodworking, forestry and farming, hunting and fishing, jewellery and clothes, along with their production residues. Furthermore, layers of cultural and gathered plants and bones from domestic and wild animals allowed an insight into cultural processes and food consumption of the inhabitants. The age of lake side dwellings began to take over Europe like a wave and excavations and surveys revealed settlements in wet environment in the Italian Po-valley, in northern Germany, Sweden, Scotland and Ireland but the chronological evidence, strengthened by material cultural and environmental evidence showed that the settlements around the alps were unique and earlier than any other sites (Schlichtherle 1997b, 7). The central European dendrochronological data reaches as far as 8000 BC and it is well known that the lake site settlement pattern spread from 6000 BC from Banyoles in Catalunya and the Lago di Bracciano in Latium towards and around the northern Alps, with the event horizon of wetland settlements beginning in Bavaria/southern Germany after 3800 BC (Schlichtherle 1997b, 13).

Scottish Crannog research really began in 1863 when Dr. J. Grigor (Grigor 1863) found and excavated a Crannog in the drained Loch of the Clans. He interpreted the rectangular structure he found below previous water levels as house walls, implying the assumption that the water levels were much lower at the time of inhabitation and construction. He even concludes that the way the construction was set upon a structural floor was chosen to keep the floor dry (Grigor 1864, 333).

Despite this evidence, that resembles the dry floor constructions of houses in wetlands around the Alps (Schlichtherle 1997a, 95), rectangular structural deposits in Crannog substructures are currently not interpreted as former dwellings above a lower water level but as structural deposits, initially drowned to carry the super structural houses on top. There is, indeed, no reason to reject the assumption that the raised floor level of a dwelling can represent the transitory state of rising water levels that evolves into a structure that rests entirely above water levels as the household is kept on the same location for generations. The sub structural remains of former dwellings can easily become included in the pile up of domestic deposits and will support piles driven into them easily.

The next Scottish researcher was Lord Dowalton who reported another five substantial and six single stone mounds in Loch Dowalton when it was drained. Millar's Cairn, one of the sites was then excavated by John Stuart, a secretary of the Society of Antiquaries of Scotland, and showed vertical piles mortised into horizontal bars in frames of beams of oak (Stuart 1866, 116).

The later truly pioneering research by Dr. Robert Munro included excavations and detailed drawings and plans of hundreds of finds and locations. 'Buston' (now referred to as Buiston) crannog, which he excavated long before work there commenced in 1991 (Crone 1991) seemed to show evidence of pre–Iron Age activity, as, similar to finds from early irish excavations, 'Pottery is represented by numerous fragments, some of which are of so–called Samian ware, but the most of them are of vessels of a glazed ware while a few are of an archaic type.' (Munro 1886, 460). '[...]a quantity of round pebbles and so–called sling–stones. [...] a very large percentage of the articles consist of querns, hammer–stones, polishers, flintflakes, and scrapers; [...]' Munro even goes so far as to imply the longevity of crannogs as permanently occupied places of domestic or other activity to account for the character of their finds and mentions the ongoing debate with Mr. G. Atkinson and Mr. A. Lewis, about their comparativeness to the dwellings of the Nicobar and other polynesian Islanders, the debate, at that time, being generally the same as today and concluding in a preliminary statement of undoubted logic: '[...]

attribute[ing] their first erection to a much earlier period, although they might have been occupied up to a comparatively late date, and in that case there might have been some sort of connection between the first builders in Switzerland and in Britain. The similar use of sites and materials under similar circumstances was, however, no proof of unity of origin unless it were carried into details unlikely to occur to different minds except from a common influence; this remark applied also to the megalithic monuments, which, however, so far as they existed in countries now or formerly Celtic, he believed to have been erected for the most part, by the Celtic populations.' (Munro 1886, 470)

Despite the general confusion about Neolithic and Celtic periods, the statements in Munro's paper from 1886 are strikingly logical, the debate certainly is more lively than ever and much attention should be given to any finds from any of these sites.

Unfortunately, Munro's work mainly concentrated on the south west of Scotland but nevertheless introduced scientific methods for excavations and research for the first time (Munro 1890).

As research techniques evolved throughout the 20th century, including the first underwater examinations by Odo Blundell (Blundell 1909, 1910, 1911, 1913), the main picture of a crannog as an artificially build islet containing one or more superstructures did not change a lot. The main building material remains wood in packed, post and wattle or floor layers varieties. The environmental aspects with samples from catchment soils has become an increasing part of research but the samples for radiocarbon dating mostly lack stratigraphic information and no dendrochronological atlas has been established, yet. Touching the key concern of modern crannog research - the dating debate -, Dr. N. Dixon (Dixon 2004, 31) states:

' The original times when crannogs were built are not yet clear but so far the majority of radiocarbon dates are in the latter part of the first millennium BC; from 600 BC - AD 0. The dates used in this [his] book are uncalibrated radiocarbon dates and, when the errors and inconsistencies of the method are taken into consideration, the date ranges can be plus or minus up to 200 years. Nevertheless, most of the crannogs that have been scientifically dated were built in the Iron Age and they were, at least in part, timber structures, which is not surprising as it was the existence of the timbers that allowed the dates to be calculated in the first place.' The whole dilemma of dating is almost obvious by Dixon's own contradiction. He then underpins his ambivalent position by explaining how the variety of samples was gathered:

'In the past, finds from sites were used to date them and often these finds were from the top of the site or even the loch bed surrounding it. However, objects could have been lost by people just visiting old sites and they are not the best method of dating unless they are found clearly embedded in the structure. A number of crannogs in the past have been dated by finds to later than their true date of construction. That was clearly shown in the case of Milton Loch Crannog [...].'

The Milton Loch Crannog was first dated to AD 200 by seriation (Piggott 1953, 143), then dated to 400 ± 100 BC and 490 ± 100 BC by radiocarbon sampling (Lerche 1969, K-1394; Guido 1974, 54, K–2027) and no samples were taken from the base of the crannog which was always under water during the excavations (Dixon 2004, 52).

This dating evidence can, at this state of research, only be an upper limit for the timescale of all the Crannog type sites. Hence, the first entirely Neolithic site that had initially been expected to be of much later inhabitation was only identified during his excavations by Ian Armit and deserves a closer look. The only feature it shared with other sites was the absence of monumental or any other structural remains on its relatively small surface. The absence of structures can be a result of the abandonment of the site in the Neolithic and later long-term erosion. Now that implies that ANY site, prior to excavation, potentially is to be allowed to originate in the Neolithic, and that includes numental island brochs and duns and the like.

Armit (Armit 1992b, 97-8) presents the historical classification of 3 distinct types of islets: **Walled Islets** of which he found 22 in the Outer Hebrides and which are a class of unroofed structures or enclosures that are irregularly following the edge of the islet,

island duns which are classified by their morphology but in the absence of a drystone roundhouse or any other structurally monumental appearing remains

and those **islets which lack any traces of substantial drystone construction at all** of which he found 52 in the Outer Hebrides, two of which, Eilean Domhnuill and North Tolsta Crannog, have been examined and are potential sites for early dates such as the later Neolithic or, like for Eilean Domhnuill, even early dates as are contemporary with the site of Knap of Howar in Orkney have been found (Armit 1998).

Very obviously these classes are likely to be unseparatable, as the chronology of the sites is unclear apart from the probability of the ’slighter’ sites being earlier in general. The full site report of the excavations of Eilean Domhnuill in Loch Olabhat, a small islet in North Uist, is at this time in preparation and will certainly change the perspective of Crannog studies, for it has turned out that the site is entirely Neolithic in origin while being still known as ’island of Donald of strength’ despite it’s abandonment about 5000 years ago (3200-2800 BC Wikipedia 2008a; Armit 1997, 44; Armit 1998, 34). Its debris of building material, including jumbled stones around the shoreline, has initially been interpreted as a wall, which would classify it as a **walled islet**. The wall, however, has turned out to be a part of the internal structures.

’Initial occupation of the site lies well below modern loch levels but as the islet grew higher with the accumulation of generations of occupation debris so the loch level also rose, [...]. No natural rock foundation was found during the excavations but the present islet is entirely composed of the debris of human settlement [...]’.(Armit 1992b, 45)

Armit also suggests that the preserved underwater sequence which extends several meters from the shore of the islet under water indicates that it was much larger in its earlier phases. Early phases indicate an approach from a timber walkway that lead to a facade of stone slabs, surmounted by a timber palisade while, after being abandoned and submerged for unknown time indicated by ’[...] a thin uniform layer of lake silt across the site, a stone causeway was build and occupation resumed on the somewhat reduced interior without the elaborate entrance works which accompanied the earlier occupation.’ (Armit 1992b, 46–7)

The general lack of underwater examinations was compensated by Dr. M. Holley (Holley 2000) by underwater surveys of no less but all of the Central Inner Hebrides Lochs, and recently Loch Awe, leaving aside attempts of dating. Geophysical investigations for a TV program included Ground Penetrating Radar and Electrical Sounding on two Irish sites but no data was published (Ovenden 2008). Unpublished Resistivity survey of the dry and cleared part of the crannog at Llangorse, Powys by Mike Hamilton from the University of Wales, Cardiff, was used to establish the location of a trench during the underwater excavations (Redknap and Lane 1994, 191). Unfortunately, the resulting data is unavailable.

Marine Crannogs in estuarine firths are currently gathering interest representing tidal sites which are different in aspects of construction phases and maintenance as well as in means of transport and access and are an object of study to Dr. A. Hale (Hale 2000b,a, 2003).

Very generally speaking, the era of Underwater Archaeology in Scottish Lochs has just begun.

Crannog research in Ireland effectively started in 1839 when Sir William Wilde (Wilde 1840) recorded the finds of the Lagore Crannog excavation. Munro comments on the advanced Irish crannog research: 'When Sir W. R. Wilde published his Catalogue of the Museum of the Royal Irish Academy in 1857, [...] no less than forty–six were known, [...]' (Munro 1886, 453). Fascinatingly, Wilde's perception of what a crannog might be differs from everyone else's of his time, maybe even contemporary researchers would not agree to his statement that Munro recites: 'crannogs ' "were not, strictly speaking, artificial islands, but cluans, small islets or shallows of clay or marl in those lakes which were probably dry in summer time, but submerged in winter. These were enlarged and fortified by piles of oaken timber, and in some cases by stonework. [...]" ' (Munro 1886, 453–4) The vastness of finds that must have been discovered among the many excavations that must have taken place in this exciting Irish period of crannog research and the depth of stratigraphy that must have been reached due to rather rapid attempts of unraveling the truth of the crannog's underlying structure is summed up in Munro's recurring sketches of finds:

'[...] articles made of stone, bone, wood, bronze, and iron; and within the last few years, according to Mr. Wakeman, many fragments of pottery of a similar character to the fictile ware used for mortuary purposes in the prehistoric and pagan period have also been found in some of them.'

Mr. W. F. Wakeman also is said to have been the first to define crannogs as, at least, partially man–made islands, great or small, with rows of palisades for defense (Munro 1886, 454).

By 1886, irish scholars were able to present no less than 220 potential crannogs to the public (O'Sullivan 2000, 6) and William Gregory Wood–Martin published the first book entirely on irish crannogs (Wood-Martin 1886). The general belief in Ireland is that there evidently exist lake–shore settlements from the Mesolithic onwards but 'crannogs as we know them' tend to be dated to the period around AD 500–1200 in contrast to the mean earlier dates in Scotland (AD 300–500 with some examples from 400 BC) (O'Sullivan 2000, 8,9; Dixon 2004, 52). Remarkably, John Bradley's recent excavation of the multi–period site of Moynagh Lough crannog, Meath showed evidence of occupation in the Mesolithic and onwards into the ninth century AD (Bradley 1991). The question

arises whether a site that was build into marshland and later transforms into a crannog (after the medieval definition of an artificially build islet made mainly of wood), can be called a crannog or not. Should less substantial or naturally appearing settlements that are *sourrounded* by water, hence be called crannogs or not? Or, – in other words, shall we stop calling a site a crannog, once we encounter a natural elevation covered in mesolithic midden with a crannog sitting on top these contexts?
A whole new world of wetland archaeology seems to be emerging from that simple question just in front of the excited researcher's eye.

2.3 Crannogs in Orkney

The situation in Orkney rather simple as there are very few recorded sites crannogs, although one might argue whether or not Bretta Ness's classification as a crannog is questionable, given it's appearance as a promontory rather than as an islet. The records also are missing data from any of the large Islands in the Loch of Harray, some of which have causeways although their general appearance is of a natural kind.
The Royal Commission of Ancient Historic Monuments of Scotland lists 5 crannog type sites but there are at the very least 28 potential sites altogether, including a probable broch in marshland. There are seven potential larger island sites, mainly in the Loch of Harray. This large sum of islands and islets with possible human activity (s. table 1) points to around 40 single sites (excluding Bretta Ness), none of which experienced excavation or even surveyes up to now. Furthermore, this constitutes a preliminary sum for Orkney Mainland, North Ronaldsay and Sanday only.
Known sites in Orkney are listet in this table:
The few informations about crannogs in Orkney are mainly based on the rigorous review

Site Name/Location	NG Ref	RCAHMS/NMR/OS	Orkney records[HS]
(Bretta Ness/Loch Wasbister)	HY 39723325	HY33SE 12 (2004, WB2)	468
Burrian/Loch Wasbister – subst. CW	HY 395334	HY33SE 77 (2004, WB1)	466
Stoney Holm/Loch of Swannay	HY 31132731	HY32NW 6 (1946, 20)	1576
VoyA/Loch Stenness	HY 26031504	HY21NE 85 (2004, St1)	–
VoyB/Loch Stenness	HY 261149	NY21NE 1 (2004, St2)	–

Table 2.1: *RCAHMS list of crannogs in Orkney; Abbreviations are: NG Ref = National Grid Reference, RCAHMS = Royal Commission of Ancient Historic Monuments Scotland, NMR = National Monuments Record, OS = Ordnance Survey, subst. CW = substantial causeway.*

of maps, located in the Orkney Library and Archive (i.e. Blaeu's maps of Orkney (Blaeu and Jansson 1654) cannot be viewed online) , some notes by Odo Blundell (Blundell 1912, 1913, 12, 286) and the OS visits of the last 150 years. There is, indeed, not a single reference to the term 'crannog' in the Orkney Archive.
The dated aerial photography register is showing a lack of lake vegetation compared

to today's, probably related to soil enhancements of the last decades which tends to accumulate in the basins where all the Orkney Lochs are located. Therefore, most sites are momentarily inaccessible unless they have been grazed after a dry summer. In wintertime, wading and crossing of causeways is impractical due to the high water level and strong currents across the causeways.
All desk–based information that can be gathered at present will be given in section **??** at the end of chapter 3.

2.4 The geophysical approach

The combination of desk–based, environmental and geophysical analysis is a strong tool for site investigation. It can provide information that can lead to the decision, that an excavation would be worthwhile and costefficient. Even without the possibility or necessity of a succeding excavation, the information gained is useful as it is undisturbant. In this special case the method was chosen because of the latter facts and because of the idea, that geophysics could be a very good method for investigations on crannogs of a particular type, that is, those with surface cover for electrode connection and without too much vegetation because of the sensitivity of radar equipment to rough surface conditions. The question, whether a crannog is structurally differing from another might not be one of the easiest to answer because the conditions can vary from wet to dry and rubbly but because there is a good chance that one or the other method might work, it is always a matter of trying. Underwater equipment such as sonar can be extremely cost efficient but has to be operated from a boat. As there was one site proposed for this work that would have implied the shipping of equipment which was not covered by any insurance, this is usually one of the more difficult approaches, not in therms of practicability but of funding. This is most definitely one of the reasons why crannog research is still in it's awaikening phase, with so many sites inacessible without a boat.

2.5 Aims of study

The extend to which geophysical investigations can be applied will be investigated, and how the data compares to reality (if known) and other sites. Here, a strategy that is variable and practical will be established.
The tasks that were already outlined in the project design (Christen 2007, 4,5) can be subdivided into the following objectives:

2.5.1 Desk based

1. Site assessments, place names, environmental ascpects
2. General check for geophysical investigations on Crannogs for comparison
3. Investigations concerning *functionality and practicability* of geophysical methods
4. types (structural) of Crannogs to be expected in Orkney
5. General comparison to sites in Scotland

2.5.2 Practical

1. Access to the sites
2. Strategies of application of geophysical methods
3. Weather conditions analysis as pro/contra objectives

2.5.3 Benefits

1. Data publication
2. Data analysis methods and application for the Orkney College departments
3. Excavation strategies
4. *Fingerprint* for identification of further sites
5. First concrete strategy and method on such sites
6. General discussion of economical factors and *trustability* of measured geophysical data

2.5.4 Archaeological reasons

1. First concrete studies of Crannogs without Underwater Archaeology
2. Environmental context (time dependent), how the site relates to the landscape setting
3. Strategies for excavation designs
4. Multiperiod or not?
5. Comparison to *similar sites*, such as Brochs

6. Setting a framework for Crannog studies in general and, specifically, in Orkney

A discussion of the main achievements can be found in the summary (7).

2.6 Dissertation structure

Chapter 1 introduces Lake Side Settlement research in Europe and gives examples of various theories and locations while Chapter 2 aims to critically analyze the history of this research and tries to point out different approaches and viewpoints. It also summarizes local research and examines the aims of this work in general and in aspects of geophysics. Chapter 3 assesses the environmental and historical details of Orkney Crannog research and Chapter 4 introduces and explains the geophysical methods and the technical equipment and analysis software to the interested reader. The outcomes of fieldwork will then be presented and discussed in short and in detail in Chapter 5 while a general interpretive approach alongside a general discussion constitutes Chapter 6. The final Chapter 7 represents targets for further study and an update to present data files as well as an outlook and a summary.

Chapter 3

Sites assessment

Implying that human observation and evolution is strongly interconnected with natural events and their folklore and when researching lake settlements and the like it is necessary to have a wider look at previous natural events like the rise and fall of the sea level or tsunamis, the evolution of the climate - the environment 'water' in a wide and early range of contexts -, and at the same time search for possible 'mother' islands who could prove to be the 'mother' of the whole idea. The persistence of crannogs in the British isles over millennia is proof of a continuing idea that clearly involves all aspects of water, it's impression on human perception and its value.

3.1 Environment

The environmental evidence is sparse but remains an ongoing field of research, as recent studies in sea–level change around Orkney coasts show. There is a definite need for information as it is becoming clearer that sites of earliest occupation of the Orkney Islands may be generally submerged due to the Orkney Island's location at the outskirts of glaciation. In fact that means that the sealevel rise is faster than the remaining uplift which, compared to the rest of Scotland, results in the uplift value being negative.

3.1.1 Topography, streams and outlets

'The central part of West Mainland consists of a wide, almost flat, open plain in which small, slaggish streams meander through a succession of low–lying, marshy hollows and shallow lochs. [...] This central portion is some 40 square miles in extend and is surrounded by a girdle of low hills which is breached on the south at the Bridge of Waith where the waters from the Loch of Stennes enter the sea through the channel known as The Bush. It is by this exit that the main drainage of the area is discharged, though

outlets for other streams rising on the inner slopes of the ridge of hills occur through the Binsgarth valley to Finstown, and by the way of the Lochs of Hundland and Boardhouse to the sea at Birsay.' (Wilson *et al.* 1935, 43)
'From the Bridge of Waith to the head of the valley above Finstown the ground rises gently to a height of about 110 ft. in a distance of about 4 miles and then falls away rapidly to soar level in a little over three–quarters of a mile. The present stream is only small and cannot in any way be responsible for the erosion of the Finstown valley. It rises in Syra Dale, flows southwards and along the foot of the hills to the Loch of Wasdale and then turns east to Finstown, The streams that flow down the outer side of the range of hills are ususally short and rapid and tend to run dry in fine weather. The more important are those that feed the Loch of Swannay, the Burn of Woodwick, the Burn of Sweenaley and the burns that empty into the Loch of Kirbister,' (Wilson *et al.* 1935, 44)

3.1.2 Bathimetry

It had been suggested that a landbridge once existed but there is no bathimetrical evidence unless historical shorelines were below todays by more than 70 m (s. Fig. 3.1). There might have been a connection to Scandinavia and Scotland during glaciation, though (s. Section 3.4).
Concerning lost islands of the North Sea that might have been exposed during the Mesolithic, the Miocene volcanism in the central North Sea could explain certain simple spikes in echo sounder traverses (Fig. 3.2).
Looking at magnetic and gravimetric anomalies, one finds associated shallow topography W of Orkney (Fig. 3.3).

3.1.3 Geology

The Orkney Islands comprise some 376 square miles, are located N of Caithness, Scotland and there are 90 islands counted, 28 of which are inhabited. The ground is mostly low–lying (except for Hoy) and the hill girdle seldom exceeds 200 ft. (W Mainland). Most of the coastline is precipitous and on the western seaboard is formed by vertical cliffs, often exceeding 100 ft. The beds are often folded into gentle anticlines and synclines with axes trending between NNW and NNE.
The **Granite–Schist Complex** is found in the vicinity of Stromness, near Yesnaby and Graemsay with the Middle Old Sandstone laid on top.
The **Lower Stromness Flags** are basal breccias, conglomerates and sandstones and purely local deposits. When traced away from the old land surface on which they rest, they pass laterally into the normal flagstones of the group. They comprise of blue, grey and ochreous–weathering beds with occurences of calcareous sandstone that is limy in character and some yield fragmentary fish remains (Wilson and Knox 1936, 271-2).
The **Sandwick Fish–Bed** is a well–bedded flagstone that is dark, limy and contains over

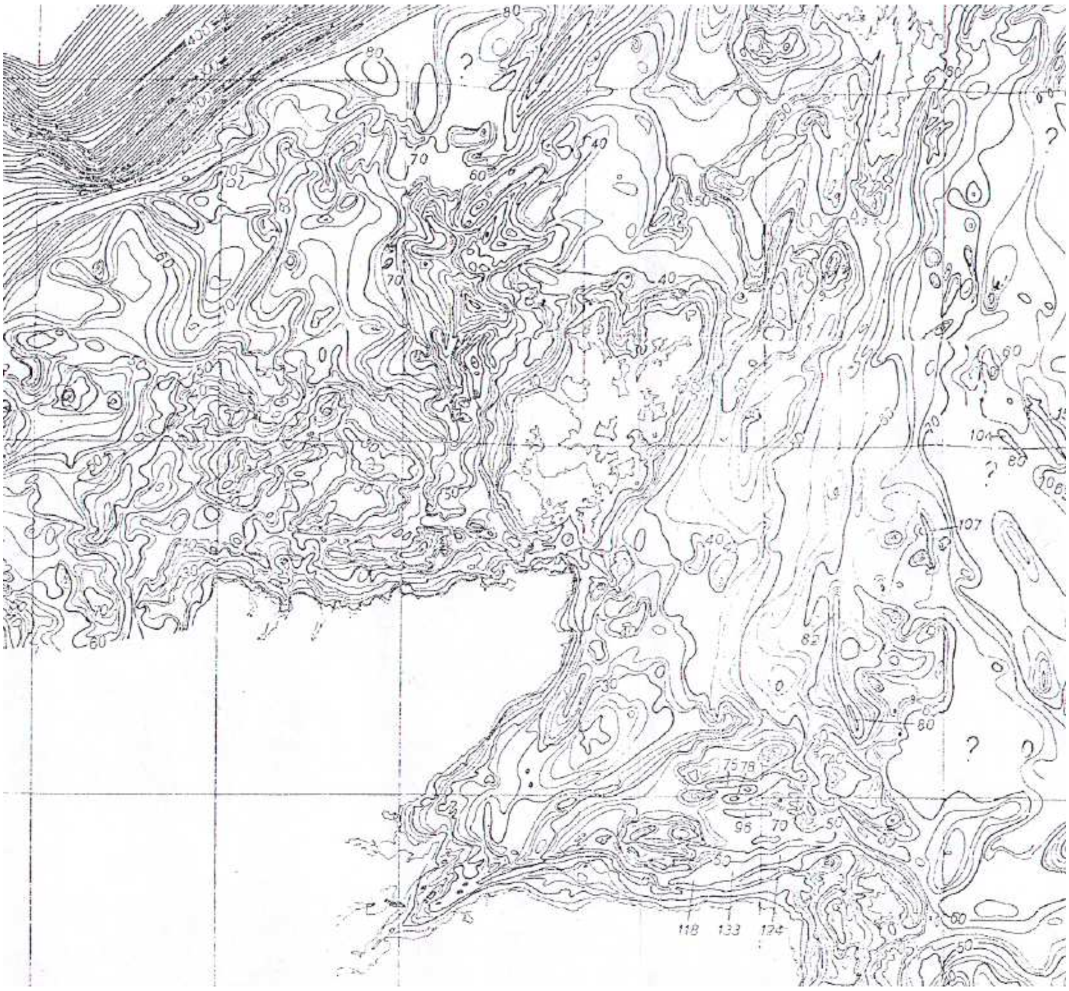


Figure 3.1: *Bathimetrical sea chart of the Pentland Firth, Orkney and Shetland Waters (Flynn 1973, Fig. 2a).*

21 species.

The **Upper Stromness Flags** are indistinguishable from the lower Stromness Flags and overly the Rousay Flags.

Rousay Beds are a 5000 ft. in thickness group with a pebbly sandstone bed of 300 ft., fossils and alternating bands of hard and soft flags and occurences of fossiligerous limy bands (Rousay, Westray and Papa Westray) (Wilson and Knox 1936, 272).

The Orkney and Caithness **Lower Eday Sandstone** alternates between flaggy and sandy material and is different from the Rausay and Eday groups. It is current–bedded and often yellow with red and purple occurences and interbedded fish bands can be found in Flotta and South Ronaldsay (Wilson and Knox 1936, 272–3).

Eday Flags occur in Deerness (500 ft.), Eday and Sanday (30 ft.) and include a volcanic horizon between two fish–bands (Wilson and Knox 1936, 273).

The **Middle Eday Sandstone, the Eday Marls and Upper Eday Sandstone** occur in Eday, Sanday, South Ronaldsay and Flotta. They are red and there is a climatic difference to the Stromness and Rousay Flags. The conditions are generally similar to

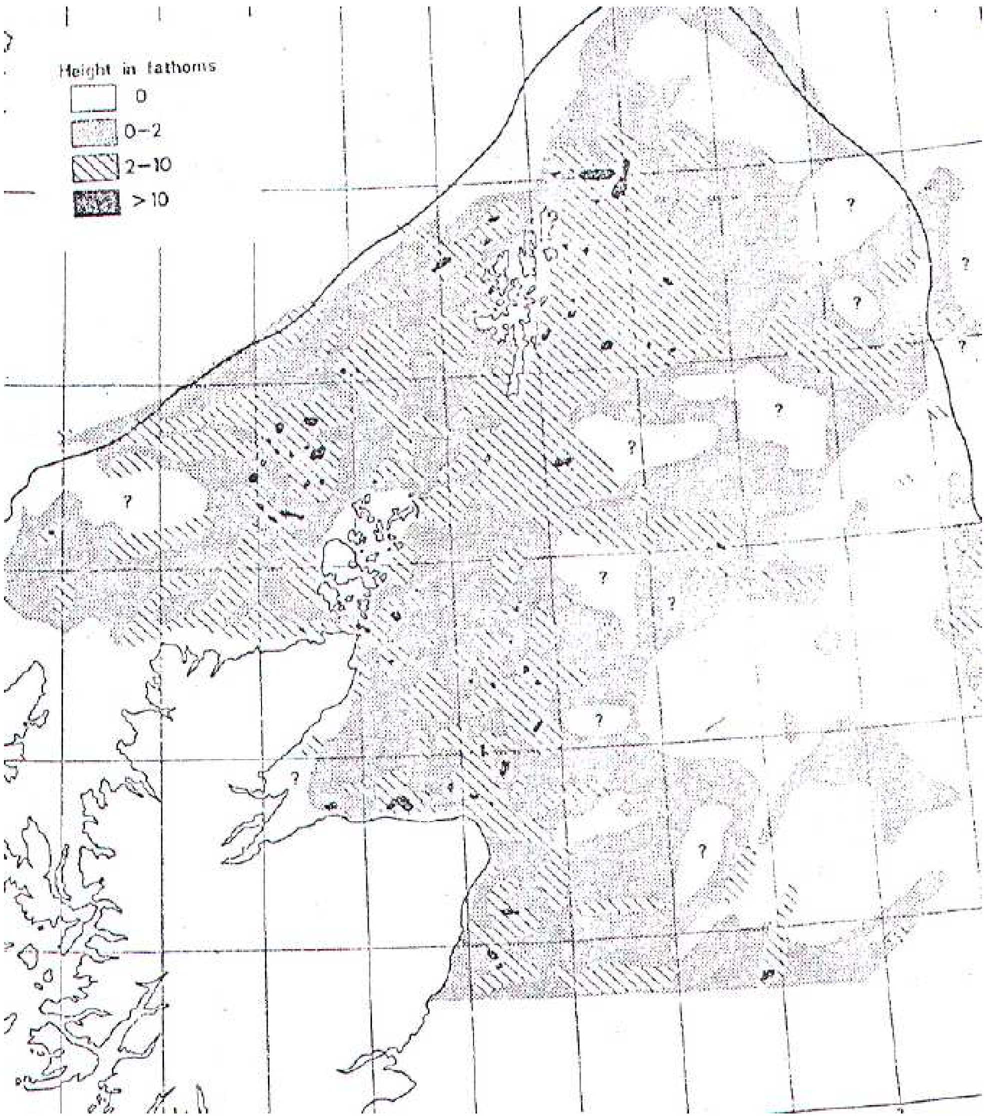


Figure 3.2: *Height of spike like features on echo traces in the northern North Sea (Flynn 1973, 52). Some spikes can be seen to the NW of Orkney Mainland and Rousay which could be volcanic masses.*

those in the Upper Old Red Sandstone times and they are sandy and marly bands which is lithologically identical to material from the Trias (Wilson and Knox 1936, 273).

The **Upper Old Red Sandstone** in Hoy overlies a sequence of earthmovements, a period of denundation during which 10 000 ft of strata were removed and Volcanic outbursts of explosive character with ashes overlay the lands surface along with a 200–300 ft. thick sheet of basic lava and a slaggy top of 50 ft. It was leyd down after another short period of denundation and is contemporary to the Dunnet Head Standstones in Caithness. Occurences vary in pink, red and yellow and are 3500 ft. thick (Wilson and Knox 1936, 273–4).

Over 200 **Intrusive Igneous Rock** dykes cross Orkney in various parts and directions.

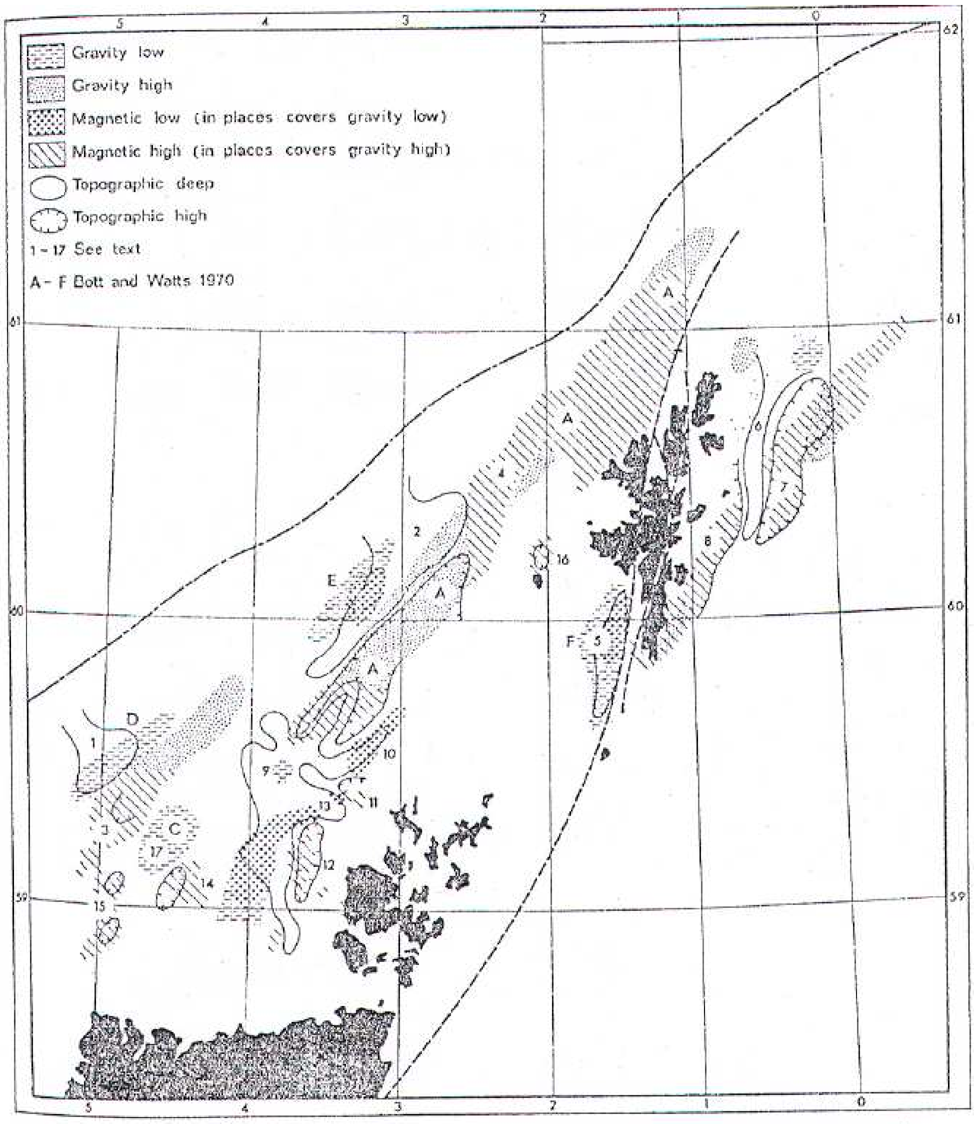


Figure 3.3: *Gravity and magnetic anomalies in relationship to seafloor morphology (Flynn 1973, 47). Peaks in gravity and magnetic values seem to be correlated with topographic high seafloors NW of Orkney.*

Few are some inches while others are over 12 ft. in thickness and of camptonitic, monchiquitic or bostonitic composition and some are filled with fresh olivine, small interstitial augites and laths of felspar (ash and basic igneous material) (Wilson and Knox 1936, 274).

3.1.4 Holocene glaciation

The Holocene or Flandrian is the period from 10000 BC until today and the paleoenvironmental conditions can be described as glacial to interglacial transitory. The settlement pattern of the Mesolithic period will have a correlation with the location of moranes and lake basins and therefore relates to succeding settlement patterns of the Neolithic and so on while tsunamis and floods disturb these patterns along the ancient shoreline. The first evidence comes from a borhole of glaciomarine sediments as early as 850 ka ago. It was located 125 km E of Orkney but it was most certainly covered by ice sheets during the Anglian or Elsterian glaciation, commencing around 440 ka, although no glacial sediments of this age are known from Orkney but from the Outer Hebrides and Shetland (Fig. 3.4). The Scottish and Scandinavian ice sheets may have been confluent in the northern North Sea. Interglacial conditions in the Elsterian deposited temperate marine fauna into deep meltwater channels while Orkney was probably covered with ice again, afterwards until the Coal Pit Formation, correlated with the paleomagnetic Blake Event of 105–115 ka, which represents the last, Eemian interglacial in the northern North Sea, although there was an early Weichselian ice cover recorded on Shetland which would be coinciding with another paleomagnetic, the Laschamo event. The advance of the Late Weichselian ice sheet into the N marks the last phase of glaciation of the North Sea. A raised cobble beach is exposed in the N of Hoy at 6–12 m above present sea level and it rests on the inner margin of a marine abrasion ramp. The maximum of the late Devension glaciation was reached 24 ka ago and retreated until the preceeding maximum from around 18 ka ago. The Wee Bankie Formation in the central North Sea some tens of kilometres offshore Stonehaven terminates eastward into a zone of sea–bed ridges interpreted as end moraines and marks an eastern limit of grounded ice alongside with the Bosies Bank Moraines and the Fladen Ground that appears to have been covered prior to 22 ka ago. The West Shetland shelf shows similar evidence with morainal banks some 100–12 km NE of Orkney and glaciomarine sediments near St. Kilda between 22 and 15.3 ago. The ice retreated around 14.8 ka ago to the present Buchan coast and moved backwards into SE. Apparently Scandinavian erratics are found on Orkney and Shetland which would imply that the ice sheet had been Scandinavian. An Example is the Savill Boulder on Sanday. On Hoy there is evidence of local glaciation with small accurate end moraines at Dwarfie Hamars and Enegars Corrie which are contemporary to the Loch Lomond Stadial (Fig. 3.5).

The following mild climate allowed for a sparse vegetation of dwarf shrub heath and arctic–alpine communities to grow on West Mainland. After 11 ka with the onset of the Loch Lomond stadial, arctic conditions established with erosion of soils around small basins and herb–dominated species indicating disturbed conditions until after 10 ka ago grassland communities returned and the rates of erosion declined at the beginning of the Holocene (Hall 1996, 4–15).

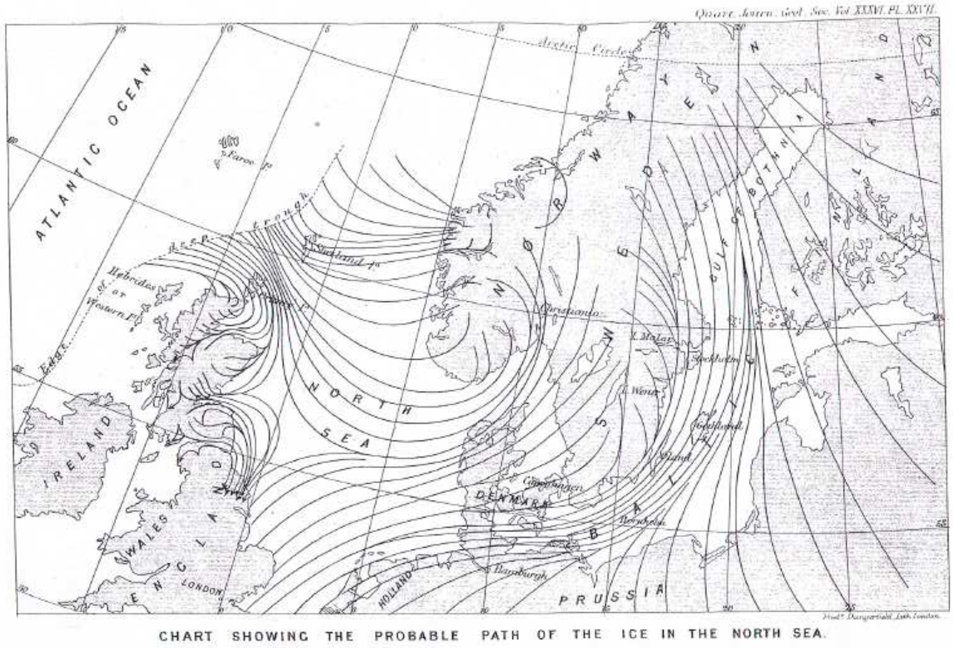


Figure 3.4: *Probable path of the ice in the North Sea (Peach and Horne 1880, pl. xxvii).*

3.1.5 Holocene sea-level changes and tsunamis

From the lower Wick river valley in Caithness on mainland Scotland a sequence of peat growth interrupted by a tsunami event and the maxima of two sea–level transgressions is known. Together with the general isostatic uplift data (Wilson *et al.* 1935, 6, Smith *et al.* 1996, 17) for the whole of Scotland which gives a negative uplift for Orkney (at the borders of glaciation, the pressure effects on the land–mass are minimal and hence, negative in the whole picture) plus an estimated rise of the sea–surface of c. 1-2 mm/a. Summarizing all information we can draw the following picture for Orkney:

The evidence of the lower Wick river valley has an accumulation of peat at c. 8500 radiocarbon years BP starting at -4 m OD which would be offshore and at least -8 m OD for Orkney. The past glacial peat–growth is then interrupted by an event, caused by the breakup and slide of Ice in the northern sea, which reached the height of at least 3.4 m OD in Caithness and is called the second Storegga slide tsunami at c. 7100 radiocarbon years BP. The height of the wave will probably have been less for Shetland and similar for Orkney, due to the shallowness of the sea levels around the isles and the proximity to Caithness.

The following peat accumulation in the valley continued but is overlain by two culminated maxima of post glacial marine transgression horizons at 1.5 m OD and 2.4 m, peaking first c. 6000 radiocarbon years BP and second c. 4500 radiocarbon years BP. The last, third period of continuing transgression started c. 1200 BP and is still in progress. The isostatically corrected evidence lies in submerged depths of 6–8 and 4–6 m off shore the Orkney Islands (Smith *et al.* 1996, 16-8).

In contrast to the evidence from Caithness there is some data from the Shetland Isles,

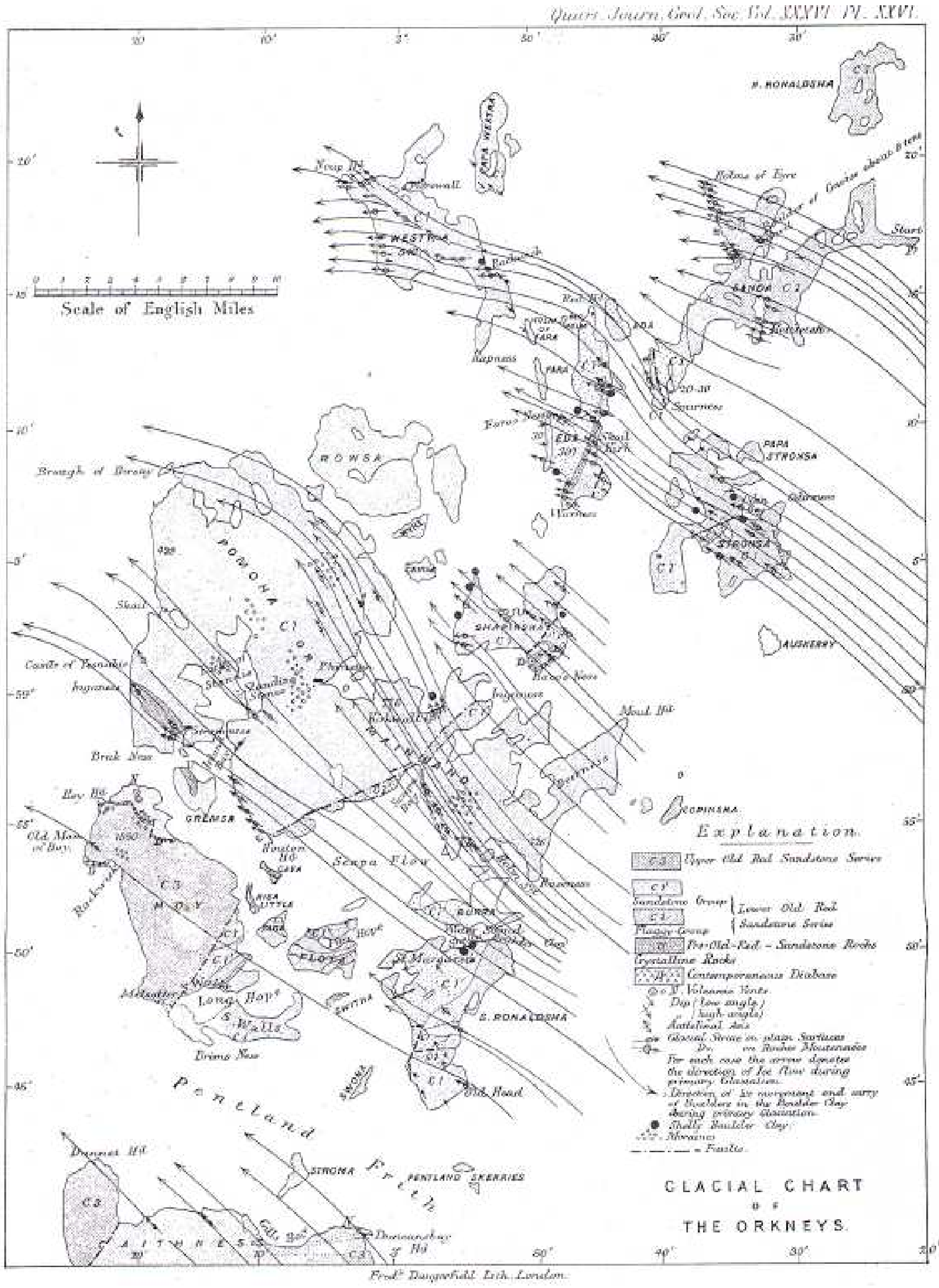


Figure 3.5: *Glacial chart of Orkney (Peach and Horne 1880, pl. xxvi).*

which point to an extreme flooding event around 5000-6000 radiocarbon years BP, reaching a height of 9 m above current Datum. This would coincide with the maximum of the continuing transgression, recorded in Caithness and imply that the tsunami wave, associated with the event, did not reach Caithness with decent strength. The event is interpreted as another Storegga Slide and would be preserved in the North of Orkney, whether off shore or on shore would depend of the energy loss rate with which the wave

must have travelled from Shetland to Orkney (Smith *et al.* 1996, 19). As waves lose energy on the land, while building up in shallow waters, the destruction of the Orkney coastlines might have reduced the waves energy enough to explain the lack of evidence of it in the Caithness stratigraphy.
Waves, traveling south from Orkney to Caithness might not have reached Scotland's coasts at all or would either be stratified OD if they where devastatingly high or now submerged and therefor a subject only to underwater archaeology. If the Shetland event that is recorded 9 m OD is projected backwards in time, the relative height of it at 6000 BP would have been about 15–20 m or more above the prehistoric Datum (assuming the isostatic uplift models to be correct) and is definitely an extinct level event class (the rushed abandonment of Skara Brae falls into this period). Obviously, the earliest known crannog in North Uist and the main period for crannog occupation, so far, for Scotland lie just in between the flooding maxima, in 'quiet' periods.

3.1.6 Climate and soils

Due to the bedrock geology, small confined basins are rarely found in Orkney and unlike Shetland and the Western Islets, blanket peat is not a dominant landscape feature. It occurs sporadically besides cropland, improved grazing and dry heathland Bunting 1996, 20).
The early Postglacial interglacial conditions show a transition from heathland to tall herb grassland which persisted from 10000 BP until 8000 BP (or 11500–8900 BP). The sequences are dated by the Saksunarvatn tephra layer correlation from 9100 BP which occurs mid–way through this period at Crudale Meadow and Quoyloo Meadow. The Mid–Postglacial shows *Betula–Corylus* woodland expanding around Qouyloo and Crudale around 8000 BP (8900 cal BP) and remain the dominant vegetation type in West Mainland until around 5000 BP (5600 cal BP). Declining times seem to vary between sites; Quoyloo Meadow shows increase in grasses and ferns around 6500 BP (7400 cal BP) and an increase in the microscopic charcoal curve with the return to woodland and the addition of *Quercus*, *Alnus glutinosa* and *Pinus sylvestris*.
Decline in woodland occurs in the late Postglacial around 5000 BP (5600 cal BP) with possible causes including autogenic factors and human–induced pressures such as grazing density, changing fire regime and direct clearance. Local variances are:

1. Autogenic processes in remote places

2. Transition from open to vegetated wetland with low density of grazing animals or accidental or deliberate burning

3. the Bay of Skaill formation deposition of a layer of blown sand in the region which led to tall herb grassland for approximately 230 years and was then replaced by pasture vegetation such as Plantago lanceolata

4. Active human contribution

Persistent woodland is found at Burn of Rusht in the west Mainland hills until peat initiation around 3400 BP (3700 cal BP) but the arboreal pollen percentages remain at twice the modern level on Rousay after the decline which indicates the persistence of few trees until the late Neolithic. Heathland and blanket peat developed in West Mainland from 3400–3000 BP (3700–3200 cal BP), sometimes preceeded by an increase in grazing indicators with a possible increase of shrubby taxa at Lesliedale Moss and spread of heath taxa samples, showing a decrease of human activity in the ditch fill at Maes Howe chambered cairn, while at Loch of Skaill human activity slightly increased at that time. Iron Age evidence is scant and suggests that the major impact of human activity occured shortly after the decline of woodland. Subsequent changes in the palaeoecological record are sparse, suggesting that landuse patterns remained constant while other aspects of human activity altered. There is no direct evidence of climatic changes although it was suggested (Keatinge and Dickinson 1979) to have been the reason for the blanket peat development (Bunting 1996, 20-9).

3.2 Sites

The following represents all information that was available during this work. The order roughly follows a NS axis, starting NW on Rousay as in table 1 with the exception of the sites in Shetland and North Ronaldsay. General information about the maps can be obtained where they first appear.

Loch of Brow, Shetland
One island is indicated in the Loch of Brow in Dunrossness in Shetland (RCAHMS 1892).

Loch of St. 'Tredwall'
There is one island, a chapel site in the Loch of St. Tredwell in Papa Westray (RCAHMS 1892).

Loch of Wasbister
The geological O. S. map of 1932 indicates the loch's area as overlying Boulder Clay and Rousay Flags, stretching from Scapa Taing in the West to Nousty Sand/Rough of Wasbister in the East (Wilson 1932).
Blaeu's atlas of Orkney and Shetland (Blaeu and Jansson 1654) shows one island (probably Burrian) in the Loch of Wasbister in North Rousay (Roousoy). The map symbol suggests a massive structure with no ecclesiastical attributes and there is no indication of a promontory, which is Bretta Ness.
A map sheet from 1753 shows both, the islet and the promontory in the Loch of Wasbister

on the island of 'Rowsa' (Rousay), one in the Loch of 'Swona' (Swannay) and one in a loch near Skaill Bay (probably Loch of Skaill). No other lochs exist on this sheet (Collins 1753).
In harsh contrast to any other source, the Admiralty Chart of an 1850's survey shows four islets in the Loch of Wasbister in Rousay and no islands in the Lochs of Harray and Stenness while the Lochs of Wasdale and Bosquoy are missing altogether. The Loch of Swannay shows one island (BHO 1850).
In contrast to the above situation, on the Royal Commission map of crofter holdings, one promontory is indicated (probably Bretta Ness) but no island (RCAHMS 1892) can be seen.
Mr. H. Marwick, in his 1923 report, claims that Bretta Ness and Burrian were brochs which were turned into chapels (Marwick 1924).
The geological O. S. survey map of 1932 shows one promontory and one islet in the NW of Rousay (Wilson 1932).
A map with place names shows one promontory and no island (Survey c. 1960).
Bretta Ness (HY 3972 3324) has long been known to be a chapel site (RCAHMS 1900) on a small promontory on the E side of the loch but there have been stones removed and placed on the margin of the loch (RCAHMS 1880). Hugh Marwick, the first of three Marwicks to research the site, had no interrelationship admits as to whether the gently rounded mound may be the remains of this chapel or if it was dedicated to St. Brittive, Bridget or Bride (Marwick 1924). In 1972 the site was visited by the Ordnance Survey again but no trace was found of the chapel. When Raymond Lamb visited the site another time in 1979 he could add nothig to the previous observations (RCAHMS 1982).
Exploratory excavations, on the other hand, investigated the chapel site on the E shore of Wasbister loch and revealled significant evidence of it being man–made and consisting of a mound of occupational debris and structural remains. It measures 30 m in diameter and 1.7 m in height and lies on a masonry platform set on a dumped mound of rubble stones, today [1984] underwater. There was a limited area excavation which concentrated on the stratigraphy of the later phases which exposed a single line of sizeable wall–footings, running EW and associated with building stone rubble and lime plaster while lacking evidence of medieval or general domestic refuse. There is a substantial and curving drystone wall at the W end of the mound, maybe related to the primary use of the site and secondary cellular buildings, apparently partially corbelled below the residual remains of unknown origin one of which survived in part due to it's reuse as a kiln. TL samples were taken and the finds collection comprises of Iron Age and 'Pictish' pottery iron slag, hipped bone pins, a variety of domestic objects of whalebone as well as small crucibles and mould fragments (Marwick 1984).
Despite this structural evidence, the site, when visited lately by a small team of underwater archaeologists, did not reveal it's structural identity and appeared to be natural in origin. The stones found along the footings of the mound were described as slipped down from the buildings and into the water with less amound of build–up than discovered around the positively classified site of Burrian Crannog in the same loch. This survey further mentiones a feature that was noted on an aerial photography, which, due to the weed cover, would deserve fuerther examinations 'earlier in the year' (Dixon and Forbes

2004).
Burrian (HY 395 334) (the name derives (Childe 1938) from old Norge 'borg–in'= the broch) was examined and has a large walled structure of unknown date on it, which is divided into two by a cross wall. The larger one is overgrown by salmon berry. The underwater examinations culminated in the discovery of a largely artificial appearing sub-structure, due to the appearance of the stones from which it is formed. There is also an enlcosure which follows the shoreline and the stones inside the water consist of large slabs which have been interpreted as differing from the material the enclosure was made of. Although the edge of the mound, where the stones meet the seabed, could not be found, due to weeds growing on the loch bed. Similar large slabs were used to build a substantial causeway that suddenly breaks off, just before reaching the present [2004] shore. A number of features along the shoreline and close to the causeway can be seen on an aerial photography, but again, no underwater evidence of such could be established (Dixon and Forbes 2004).

Loch of Swannay
The geological O. S. map from 1932 indicates Boulder Clay, Upper Stromness Flags in the East and in the West of the loch (Wilson 1932).
The 1753 map sheet of Greenville Collins shows one islet on the west shore of the Loch of 'Swona' (Swannay) (Collins 1753).
There is one island in the Admiralty Chart of 1850 (BHO 1850).
The Royal Commission shows three islands (RCAHMS 1892) in that loch.
There are three islets on the geological O. S. map in the Loch of Swannay (Wilson 1932).
Stoney Holm (HY 3113 2731) has a rectangular structure of some 37 ft by 23 ft on it, with a major axis lying ENE/WSW, which occupies most of the exposed surface. It is reduced to the foundation but in the SE corner the lowest course of masonry is preserved while elsewhere the outline is obscured. The wall–thickness cannot be detemined and there is no evidence of a causeway. Nevertheless wading to it is possible and easy (RCAHMS 1946).
In 1967 the vegetation and tumble obscured the structure very much and only the SE wall was visible, no classification was possible (RCAHMS 1967).

Loch of Hundland
Nothing is indicated in the loch on any map in the Orkney Library and Archives but there is evidence on modern O. S. maps.

Isbister
Boulder Clay and Lower Stromness Flags underly this loch (Wilson 1932).
There are two or three islets on the Royal Commission map (RCAHMS 1892).
On Wilson's map there are two 'Broughs' depicted on top of two islets (Wilson 1932).

Banks
Nothing is indicated in the loch on any map in the Orkney Library and Archives but there is evidence on modern O. S. maps.

Loch of Sabiston
The present terrace rests upon Boulder Clay and Lower Stromness Flags (Wilson 1932). There are two islets on the Royal Commission map (RCAHMS 1892) and two on Wilson's map (Wilson 1932).

Loch of Skaill
In the center of a loch near Skaill bay (probably the Loch of Skaill) is an islet near 'Urkister Sandwick Manse' on the Greenville Collins map of 1753 (citepgreenville1753).

Loch of Clumly
Geology comprises of Boulder Clay and Upper Stromness Flags (Wilson 1932).
There is one islet on the Royal Commission map (RCAHMS 1892) and one islet on Wilson's map (Wilson 1932).

Loch of Harray
The island named **'Lyermira'** (HY 29651807) is shown in the SE end with extensive surface usage on a 1902 O. S. map (RCAHMS 1902).

Loch of Stennes
The geological underground consists of Boulder Clay and lower Stromness Flags (Wilson 1932).
There is one islet on the Royal Commission map which is VoyA with reference to table 1 (RCAHMS 1892).
Wilson's map shows only one islet (probably VoyA) (Wilson 1932).

Loch of Bosquoy
The geology consists of Boulder Clay and Lower Stromness Flags (Wilson 1932).
No island is shown on the Royal Commission map, maybe because it was not surveyed with reference to the site in Loch Wasdale (RCAHMS 1892).
The parish name, Harray, either derives from tiar (icelandic) = high (high church = principal church) or Herad (icelandic) = bordered by high mountains (Fraser 1923, 34).
Wilson shows one islet on his map (Wilson 1932).

Loch of Wasdale
There are Upper Stromness Flags on the West and Rousay Flags on the East of the island (Wilson 1932).
No island is shown on the Royal Commission map (RCAHMS 1892). This probably

indicates that the site had never been surveyed since it is of fair height and would always have remained exposed.
After Fraser, the Firth parish derives its name from the norse fjord, bay of troutfishing. The Finns landed here in Prehistory (Fraser 1927, 51) and the Broch of Burness had a chapel but there are no traces but of the demolished broch. The islet in Loch Wasdale had a chapel but with so few inhabited houses in the neighbourhood, it seems not to have been a regular one. There are no traces of a graveyard, but the rich grass is indicative of human occupation, possibly by the earlier Picts and the later priests (Fraser 1923, 33 Fraser 1927, 54).
Interestingly, Wilson's map shows two islands in this loch, the second probably being a promontory in the NW (Wilson 1932).
The island (HY 34321473) is known to be a **chapel site** and is listed locally as HY31SW 8 but not online (RCAHMS).

Loch of Kirbister
The area around the loch consists of Boulder Clay and Upper Stromness Flags (Wilson 1932).
An 1813 map of Orphir parish very clearly depicts 'Groundwater' islet (Holm of Groundwater) on the East bank of the loch, with it's particularly elongated shape but no causeway is shown (Map 1813).
There is one islet, maybe two on the Royal Commission map, the first one being the **Holm of Groundwater** (HY 37190814, RCAHMS 1892).
Wilson shows 2 islets in this loch (Wilson 1932).

3.3 Related sites

3.3.1 Loch of Bosquoy

The Broch of Bosqouy lies on the E side of the loch and to the W Burrian Broch lies at the E shore of Loch Harray. There is another broch in marshy land to the S which is called Burrian in the meadows and which is unexplored. All three are know to be haunted by fairies. St. Mary's Marykirk in Grimeston township and St. Mary's at Kirkquoy with indications of burial ground are known to have been build by Cistercian monks from Eynhallow after the Reformation and there is another church, St. Michael, in Upperbrough. At the E shore of Loch Harray, at Horransquoy is another church, called Kirk of Keaton or Cleaton.
The crannog in the Loch of Bosquoy lies on a triangle that connects Burrian Broch on the W and Bosqouy Broch on the E with Upper Brough and Chapel on the S side (Fraser 1923, 33).
The distance between Marykirk in Russland, the chapel on the loch at Tenston, Sandwick, the chapel at Kirkness, Sandwick and back to Marykirk, Russland is 6080 ft (which is

exactly one nautical mile and equals $\frac{1}{60}$ of a degree of latitude on Earth). The three sites furthermore form an equilateral triangle (Fraser 1923, 35).
The distance between Bosquoy Broch and Nettletar Broch is 6080 ft.
The distance between Bosquoy Broch and Burrian, Netherbrough is 6080 ft as well.
More sites with 6080 ft. distance separation are Redland Broch and Burrian Hill (prehistoric errection), Upperbrough Broch and Marykirk Rusland, Redland Chapel and Settiscarth chapel as well as Marykirk, Rusland and Gullow Mound (Fraser 1923, 34).

3.3.2 Loch of Wasdale

The distance between the Broch near Oyce Bridge at Finstown and the chapel site in Loch Wasdale is also 6080 ft.

3.4 Discussion

3.4.1 Contemporary sites

The question as to what comprises a comparable site is frequently issued as being complicated while the question what a contemporary site might be would need answering, first. There is now evidence that crannogs were being build and inhabited as water–side dwellings. They were partially man made already during early inhabitation, but a considerable period for a crannog culture cannot be assumed, yet, although there is strong evidence that most crannogs that are known today have been found to be highly potential sites with dates into the late prehistoric period, with structural timbers from sampled sites starting around 400 BC while the vast majority was occupied around 300–500 AD (O'Sullivan 2000, 8,9; Dixon 2004, 52). Albeit, there is one exception which is Moynagh Lough crannog which showed multiperiodicy from the Mesolithic onwards (Bradley 1991). Is it because these excavations have to go deep enough? Is there a general lack of contextualisation of the sampled evidence of most later sites, that is, is a general underwater survey with few samples taken whenever there was access to a timber near the ground the correct way to establish a profound date and, henceforth, an insight in the chronology of the crannog evidence of scotland in the whole?
Clearly, no, we are not as of yet able to pretend that the contemporary site to a crannog is a late prehistoric site, but we are very well able to establish that a contemporary site to a late prehistoric site is a crannog, as they seem to have been a target of activity in that period.
The question is why this was so and if there can possibly be a similarity with earlier lake–side islet dwelling research strategy.
The monumentality of brochs and their imposing posture above the landscape, while at the same time looking impressively save and sheltering, are attributes that can easily

be attached to crannog impressionist experiences. There is, as well, another fact to be considered, the fact that they control the water supply. A broch without a barn or well or other freshwater access would not be able to support the inhabitants and their beasts and domestic animals and equally important is the freshwater reservoir of the lake in which the crannog is located. Tidal sites, however, have to be added to a different type, for there is the traveling aspect coming into play, which, again, signposts towards control over resources.
Are we looking for for an aspect like controlling sites, as a reason for the whole idea, then? How do souterrains relate to this scheme, can they offer a controlling and sheltering, a supplying aspect, or is it simply a fact that hydrophil people live on the lake while terraphil people live in or on the ground?
If control and supply are the terms with which the late prehistoric period was interwoven, than there is no suprise that order and specialization have finally lead to hirarchic symptoms and the medieval peasantship.

3.4.2 Origin

Maybe we should also ask why the idea came to an end, and what constitutes a crannog now. When rules and distribution are organized and well established in the capitals of our modern society, a crannog seems to be a retreat and not the dominant place it might once have been. The retreat–idea, and the defensive nature of crannogs, when nicely depicted on medieval maps (Morrison 1985), tends to be ideomatically attributed to these sites, while they were, close–up, defenseless. The power they impose is of purely subjective nature as they sit peacefully in their place. The only way out might have been the escape through the backdoor, which is, where we find nousts. They may well have been just part of a rather generous and quick transport system, though. Certainly so, as there is, at least in Orkney, evidence for the crannogs and brochs being the nodes of a landscape mesh that has the nautical mile as a measure. The people who knew this constant did know about the earth being a sphere, long before Columbus, what brings us back to the oldest of the human traditions, rafting, canoing and sailing. Therefore we shall have a look backwards in time and into the end of the ice ages, where strenght and power is always formed out of ice and water. These forcing times of ice and water, even today, leave us impressed and we should not be surprised to find a people that admires and respects the mighty power of water over a long period of time. Meanwhile, when the world is taken by the powers of the world wide web and the information that can be gathered from it in only a few hours, humankind is still in charge of storytelling and despite the fact that neolithic activity thrived on a good amount of rituality, it was also scientifically advanced. The only evidence of observations beforehand (but which date back hundrets of thousands of years) is the counting of the moonphases to set up calendars, the hunting scenes on cave walls, and the impressions of experiencing the own self, the human body and copies of it on the walls. The glaciation episodes and floods have left worldwide imprints on aboriginous stories and some might well tell of fear, while other might talk of admiration, or even adoration, of the powers of water. In terms of crannog builders it seems that we are dealing with the latter.

Chapter 4

Geophysical methodology

All investigations were carried out under the guidance of the English Heritage guidelines for Geophysical survey in archaeological field evaluation (EH 1995).
Furthermore all fieldwork was carried out by the author and with and under the guidance of the geophysical unit of Orkney College.

4.1 Survey

4.1.1 TRIMBLE

The survey instrument is a TRIMBLE of the newest kind. It connects to other TRIMBLEs, if they are in range and to GPS satelites and their corrections from base stations close enough (several hundreds of miles). The hand held device connects to the base station via radio signals and all surveyed data will be stored aligned to the WGS1984 and the National Grid (British Isles). Lines can be attributed to coordinates to connect them and incrementing of named points is automatic. The amount of information gained in a very short time and the resolution of a few cm is outstanding and dismisses any other method into the rubbish bin.

4.1.2 Grid/Topography

Grids should be small but generally 20 by 20 m to account for geophysical equipment setup. If possible, at this stage of research, the grid should remain on site for as long, as possible, as it might be necessary to return and get more data or use different techniques. Surface conditions have to be included in a strategy as wall faces and water restrict the layout.

4.2 Magnetic methods

4.2.1 Instruments

The magnetometric investigations where carried out with a Grad601-2 two–sensor flux gate gradiometer and a magnetic susceptibility MS2 coil from Bartington Instruments. Each of the Grad601-2 sensors has two cylindrical fluxgate magnetometers with vertical sensitivity in 1 m separation. The twin system is carried on a rigid frame, the data is logged and the resolution is 0.1 % at a range of 100–1000 nT (BI 2003), which means that the sensitivity is such that it will detect anomalies in the range from a few $\frac{1}{10}$s to a few $\frac{1}{100}$s of the earth's natural magnetic field (Christen 2005, 15) with a resolution of 0.1–1 nT.
The MS2 Magnetic Susceptibility System measures the dimensionless (as a proportionality factor) magnetic volume susceptibility χ which correlates the Magnetisation M of an object in a magentic field with the fieldstrength H. In one dimension it can be written as

$$M = \chi H$$

.
The instrument generates a magnetic field in Z (surface oriented system) orientation and then measures the value of χ_V in the magnetized volume in either SI (Système Internationale) or Gaussian cgs units which are related by $\chi_V^{\text{SI}} = 4\pi\chi_V^{\text{cgs}}$. Measurements in the range of $1 \cdot 10^{-6}$ cgs units have a duration of 1 s and there is no automated data logger, therefore measurements are written down by hand (BI 2008).

4.2.2 Theory

The earth's magnetic field can be approximated as a dipole field. In northern Europe the Z (vertical) component therefore is the strongest component and by measuring it's variation near and further away from locally buried anomalies, local differences in mean field strength can be identified. Since the vertical component is the main value modern survey instruments like fluxgate magnetometers are normally measuring the vertical component in an arrangement of constant distance from the ground. The upper fluxgate coil will measure the mean field with residual local information while the lower coil receives a much stronger signal from the locally buried anomaly which adds to the mean field strength in either positive or negative way, depending on the origin of the anomaly. The lower value will be substracted from the mean field strength to give a local gradient between the two coils. The method is therefore cheap and quick as no total station for mean field measurements is needed for normalization of strength variations (Telford *et al.* 1976, 114, 145).
Magnetisation occurs when material is heated above it's **Curie–Temperature** where magnetization is erased and during cooling the natural background field magnetization is stored. Even without the object having moved, the permanent magnetization (called

Thermoremancence) it contains will be different as time goes by, since the earth's field varies with time. The Curie point temperatures vary for different minerals but range around a few hundret °C. Baked clay hearths, kilns, and other features that involved great heat, along with igneous dikes will have these strong responses. Passively, with the earth's field used as an induction field, the susceptibility of magnetized material can be detected. The susceptibility is a measure of a substance's ability to magnetize and increases with both, reduction (burning) and fermentation (later oxidation) (Gaffney and Gater 2003, 37–9). The substances that are undergoing magnetization (ferrimagnetism) are typically iron, iron–oxides, magnetite, titanomagnetite and ilmenite, titanium and pyrrhotite (Telford *et al.* 1976, 119). Soils which lack these minerals will therefore not undergow mangetizing effects and will not produce contrasts in gradiometric data. Nevertheless, contrast will only be gained if the material with different magnetization is spatially divers, as a contiuous distribution of enhanced material will only add to the background and lack contrasting features as well. Pits or ditches filled with enhanced soil will show up as positiv anomalies while those filled with water will show up negative. Therefore, structures like small houses will have considerably distorted pictures as the information from the hearth, walls and ditches along the walls will interfer (Gaffney and Gater 2003, 38–9).

4.2.3 Setup

Gradiometric data was measured in traverses of 2 m width with a resolution of 4 samples per meter. The sensitivity was maximised although on site checks were always necessary.

4.3 E method: Resistivity

4.3.1 Instruments

The area resistance measurements are taken with a frame setup with electrodes and a Geoscan Research RM15 with integrated data logging capabilities (Gaffney and Gater 2003, 57). It can easily be set up for twin probe array survey and 4 probes can be mounted on the frame at the same time. For twin probe setup one probe is a potential electrode and one is a current electrode, the other two (one potential and one current) are located away from the grid in fixed position and their separation should exceed the separation on the frame. The frame can thus be used in three ways: three electrodes switching between the outer to have a 1 m distance setup or four elctrodes for 0.5 m separation setup or 1.5 m separation setup. The distance between the probes determines the investigation depth, in this way ranging between a few meters to centimeters, depending on the ground conditions (Gaffney and Gater 2003, 57–8).
The Electrical Imaging or Resistivity Imaging is undertaken with an automated system from the french company IRIS instruments, called SYSCAL Pro Switch. It offers 10

simultaneous channels for high speed readings, 48, 72 or 96 electrodes to be plugged in at separation distances of up to 10 m. The system is programmable and can be used for 3-D imaging. The array setup can be chosen freely and the electrodes undergo automated surface resistence checks before data sequence procedures (IRIS 2008).

4.3.2 Theory

Ohm's Law

$$U = RI$$

with *U* the potential difference, *R* the resistance and *I* the current provides a strong tool for subsurface investigations. Two electrodes (C_1 and C_2) insert a current into the ground and two potential electrodes (P_1 and P_2) measure the variation in potential between data points while the current is kept constant. The resulting dependency between *I* and *U* is the resistance *R* and can be plotted in 2D for one electrode separation. The setup of the electrodes is of main importance as it determines the dependency of resistivity and resistance on one hand while it determines the investigation depth on the other. The geometry of the setup gives a geometric factor for resistivity calculations but is of importance only if the resistivity is needed. To estimate structural depth and extend it is efficient enough to measure the spatial changes of *R*. The arrays differ in as much as possible but the potential electrodes are usually on a centerline with small separation while the current electrodes are further out. The currents then have to travel through whatever is in between and through the depths that are targeted by both, the current electrode separation and the potential electrode separation. The spacing of both have to be adjusted accordingly. This is due to the fact that currents follow trajectories that are not parallel to the surface but ellyptical to radial (Gaffney and Gater 2003, 28–31).
An example for a simple array from which others derive can be given as follows:

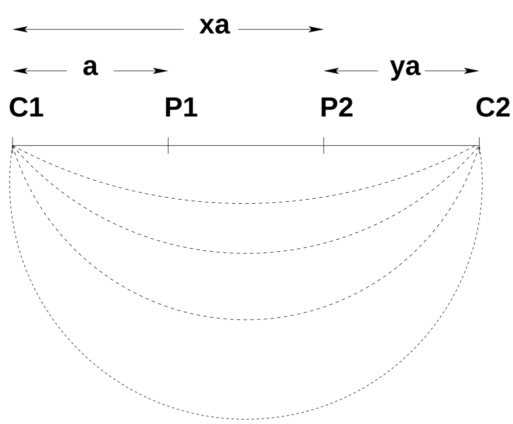


Figure 4.1: *Simple array for resistance survey*

The calculation then is

$$R = \frac{U}{I} = \frac{V_{P_1} - V_{P_2}}{I} \tag{4.1}$$

$$= \frac{\rho}{2\pi a} \underbrace{\left\{1 - \frac{1}{x} - \frac{1}{x+y-1} + \frac{1}{y}\right\}}_{GF} \tag{4.2}$$

with ρ = resistivity and *GF* the geometry factor. For the **Twin–Probe array** C_2 and P_2 are at 'infinity' (or $>$ 15–20 m), so $x \to \infty, y \cong 1 \Rightarrow R \cong \frac{\rho}{\pi a}$.
It is also important to keep in mind that the measured resistance is always an apparent resistance, since the currents travel through **all** layers. Only an inversion procedure and a model comparison will show values that approximate reality (Gaffney and Gater 2003, 28–34).
For the Vertical Electrical Sounding (VES), the pseudosections or the Electrical Imaging (EI) the theory is the same with the exception that the array is usually pre–chosen and cannot be changed by moving the electrodes. Rather than moving a frame over a surface there are electrodes inserted in lines of up to 96 for the SYSCAL instrument and then switched trough by the instrument. That means that one electrode at one time can be either C_1, C_2, P_1 or P_2. After the switch it can be either of the four, again, depending on the sequence that has been chosen. The depth information is gained by increasing the distance, therefore, the longer the line, the deeper the currents will have to travel. To obtain relevant results, the choice of the array is essential. The programming is automated and runs trough without human interference. Due to the curvature of the trajectory, the maximum depth is also a narrow region between the furthermost outward electrodes and therefore, the information gained is spatially located in this region. The resulting depth information is a triangular picture, turned upside down. If the lowest region is a horizontal layer, the length of the array has to be increased to implemet this layer into the center of the triangle. 3D matrices can be obtained by merging lines sections into a cube that can be sliced horizontally, if needed (Gaffney and Gater 2003, 34-5).

4.3.3 Setup

The Geoscan RM15 was set up for 1.5 m electrode separation every 1 m along traverses and was operated in twin–probe mode with C_2 and P_2 on a fixed point on the shore. The array in EI operations was always a **double–dipole**, as it is the most sensitve with the best spatial resolution up to a depth of a few meters. The electrode spacing was 1 m and was not decreased further, as the resolution, gained in this setup was good. The lengths of the sections was maximised to account for the island's extends and to receive as much information as possible. In the case of Wasdale Crannog, three instead of two transsections were laid out, partially because of its size, partially because of the wallface interrupting a possible layout crossing the center.

4.4 EM method: Ground Penetrating Radar (GPR)

4.4.1 Instruments

The TerraSIRch SIR system–3000 from Geophysical Survey Systems, Inc. is an antenna system of differing frequencies. The frequency of choice depends on the depth of investigation and is high for shallower surveys and small for deeper ones (GS 2003).
Normally, an instrument has got two antennae, one wheel and a handbar to pull it. One antenna sends a signal, the other will pick it up and the weel is connected to the aquisition sytem for linearity of spatial resolution along traverses. The operation of the input device is complicated as it offers a range of variables to be set. Generally, the best way to collect data is with maximum samples per scan unit which is defined by the weel the antenna is attached to. Practically, this means that no data is collected when the weel is static. After collection of one line, the line can be saved as a file which can be sorted into a 3D matrix as with EI. The horizontal slices of such a radar cube are called **time–slices** to account for the antenna signal's return travel time. The traveltime can be transformed into a pseudodepth information, if the mean expected dielectric constant (ϵ) of the soil is set. It is this constant that is responsible for the strength of the reflected wave. The initial wave is an electromagnetic signal with some modulation that can be chosen or not (default modulation). The wave will loose energy but not loose it's modulation when traveling through ground. The reflected wave will have the information stored in it's modulation that, when plotted along the traverse axis, allows features of differing ϵs to be picked up. Gain will be needed to visualize structures that have very week responses, if their ϵ is not very differnt from the background.

4.4.2 Theory

A pulse of electro–magnetic (EM) waves is transmitted downwards, reflected off interfaces and received back. The Reflection time is a measure of the distance travelled to the target and called two–way–time (TWT) (Mussett *et al.* 2000, 227). A time–distance graph is the standart plot like Fig. 4.2.
The resolution of a radar wave depends on its frequency because

$$v = f \cdot \lambda$$

where v is the travel velocity depending on the dielectrical property ϵ_r of the interface (rock, soil, voids, etc), f is the frequency and λ is the wavelength of the waves. The dielectric constant is the capacity of a material for storing a charge when an electric field is applied, relative to the same capacity in vacuum, and can be computed as

$$\epsilon_r = \frac{c^2}{v^2}$$

where $c = 3 \cdot 10^8 \frac{m}{s}$ is the velocity of the EM wave in vacuum.
If $f = const.$ then the wavelength changes when the material changes which results in a

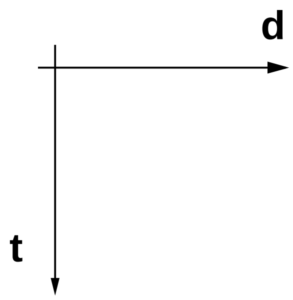


Figure 4.2: *Time–distance graph, schematic.*

time difference for the reflected signal. The data analysis follows that for reflection seismic waves as all parameters are following the same rules from this point on.
The transmitter has an antenna (aerial) that produces an extremely short pulse of waves (some nano seconds $\propto 10^{-9}s$). The pulses contain frequencies from 25 to 1000 MHz and the shorter the pulse is the higher the frequency. The smaller the frequency, the better the resolution but the shorter the investigation depth, as well. The receiver may be the antenna or a separate one on a trolley or sledge, close to the ground. The sledge is pulled along traverses with fairly smooth surfaces because of the small ground clearance.
The properties and hence, ϵ, the dielectrical constant of the material, are different for sediment or soil, rock, lithologic changes or changes in bulk density at stratigraphic interfaces like voids, tunnels or pipes. The types of discontinuities that are reflected are 1. air wave between aerial and receiver, 2. the direct ground wave, a reflection on the surface and 3. buried objects. A discontinuity reflects a wavelet of energy (positive or negative amplitude wave) back. Recorded is the composite of many wavelets from many depths in the ground that produce a series of reflections at one location. The composite created is called reflection trace (Fig. 4.3) and these composites are then plottet agains their position. The Time–distance graph then is the two–way–traveltime (TWT) on the vertical and the trace number or location on the horizontal axis (Fig. 4.4).
Strong reflections generate distinct black bands when their amplitudes overlap in the t–d plot, medial reflections produce gray bands (Mussett *et al.* 2000, 227–30).

4.4.3 Setup

A 270 MHz antenna was used for traverses along axae crossing the center of the crannogs. No timeslices were calculated because of the few available transsecs accross the crannogs surfaces. The sections were then viewed individually and processed to obtain information of structural differences.

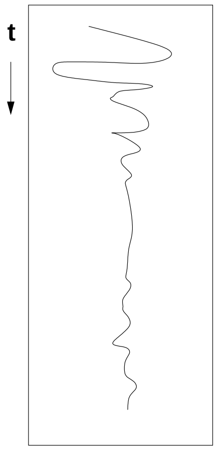


Figure 4.3: *Reflection trace, schematic.*

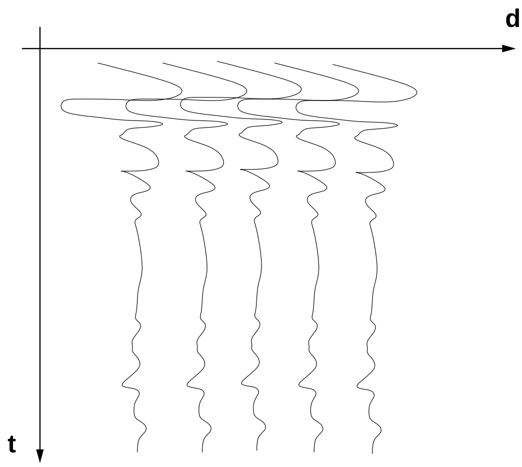


Figure 4.4: *Time–distance graph with two–way–traveltimes, schematic.*

4.5 Fieldwork

Site access is the most important thing to be arranged and turned out to be the hardest to achieve especially when the owner of the site may turn out to be entirely unaware of his/her ownership. After arrangements like car/vehicle hire the fieldwork can start, preferably after a dry period in mid/late spring. For the EI and RADAR equipment, dry to drizzly weather contitions are necessary as the equipment saturates with moisture in heavy rain. Therefore, fieldwork with sensitive equipment in Orkney cannot be considered a wise idea unless there is flexibility of chosen dates. Our team experienced a few weather conditions that made it necessary to sort out access again, which is important as crops and grazing can influence the surveys.
The weight of the equipment is another issue that plays a vital role when the loch's water level is not low enough to safely pass the causeway. When all conditions and variables meet contstructively, fieldwork can begin.

4.6 Software

The analysing software for gradiometric and resistance data was Geoplot (GEOSCAN 2008), the software for radar data was RADAN which comes with the instrument and the software for the EI was RES2DINV, an inversion procedure provided by the instrument's company, IRIS, as well as any other software, needed to program sequences or transform data.

Chapter 5

Results and analysis

5.1 Survey

The survey was carried out by Amanda Brend and Mary Saunders and the data was later used to generate 3D topographic models of the crannogs. Measurement were taken on top of stepping stones and boulders. Therefore, these appear as peaks although they had flat surfaces but as the survey was at this stage very rough, only one point was taken for these stones. The information gained this way is, nevertheless, strikingly informative.

5.1.1 Loch Wasdale Crannog

The Loch of Wasdale lies NW of Finstown and can be accessed from the Harray road (s. Fig. 5.1). The general appearance is that of a mound of stones with intact wall faces on either side of the former chapel (s. Appendix Fig. 6). A small chamber can be seen in the southern corner and it shows up nicely on the survey plots. The vegetation does not grow too high and the island is frequently grazed by cattle which wade through the shallow waters near the causeway. The causeway itself is sparsely laid out with few flat stones and some dipping ones. It does not have the appearance of a well–made and maintained connection and in winter it is completely submerged with strong surface currents. As the loch is at the slope of the surrounding mountains it quickly fills up with water after rainfall and so the causeway can become submerged and slippery overnight. The islet has an apron facing the causeway which is typical for a medieval site of ritual character as there is space for public events to be happening outside the rooms (Carruthers 2007). Generally, the islet is a substantial mound and the islet slopes into the loch bed rather smoothly (s. Fig. 5.2). What looks like a mound in the centre of the island was build by the owner's husband (McGray 2008) a while ago, presumably with stones quarried from the structural remains that are visible on the areal photography.

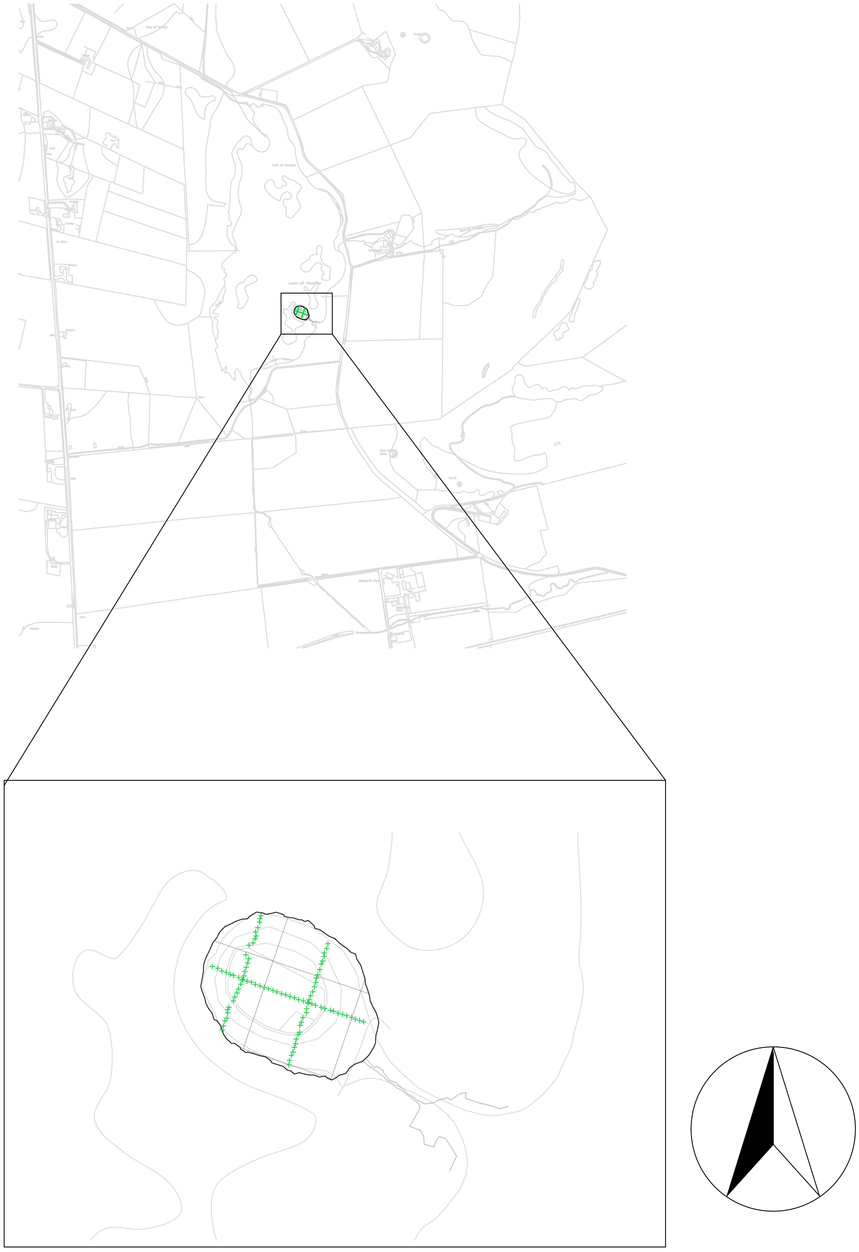


Figure 5.1: *Location of Loch Wasdale Crannog, parish Firth, Orkney (Digimap 2008).*

5.1.2 Loch Bosquoy Crannog

The Loch of Bosquoy lies in the NE of The Loch of Harray and SW of Dounby in Harray parish (s. Fig. 5.3). The crannog appears ideal and the nousts on its back are catching they eye intensly as does the fairly substantial causeway (s. Appendix Fig. 7). The islet itself is very flat but has several massive, mostly cubical boulders on it with a rather interesting example on its NW shoreline. This example is not cubical by has a triangular cross section while being almost 60 cm long. On the shore, close to one of the datum

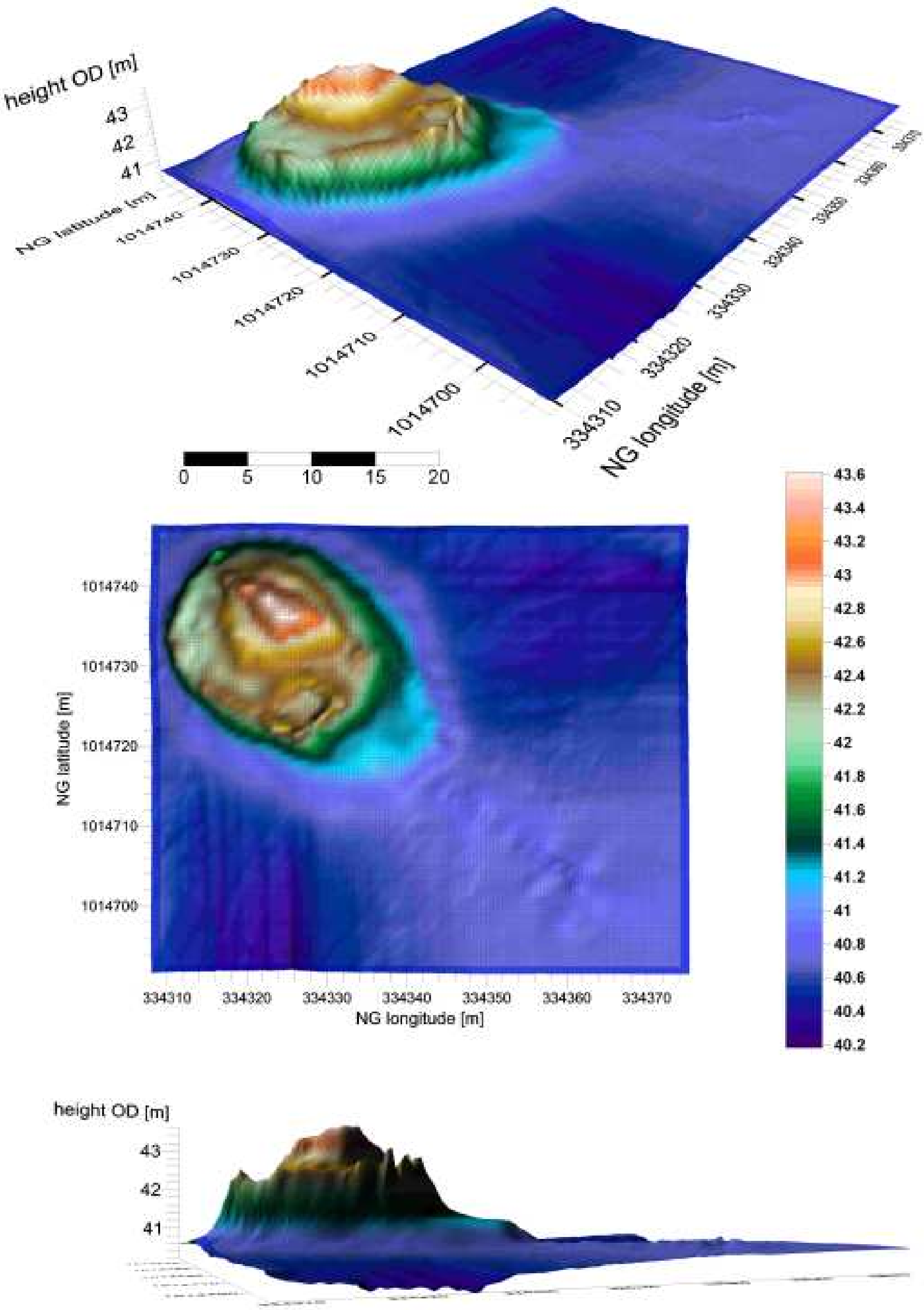


Figure 5.2: *Topographic model of Loch Wasdale Crannog in 3D.*

points, there is a very large stone slab lying flat on the ground. Its measurements are approximately 0.8 m x 1.2 m and there is no quarry in the area around the loch apart from the mound that formes the site of the Broch of Bosquoy, on the opposite site of the loch.

The islet is sitting on top of a mound of small stones and from the soreline, it descends rapidly into the lochbed, especially at the back, where two large nousts are still intact and slightly decentered from the geometry axis of islet, causeway and shoreline. The causeway is intact and substantially build of slabs that are lying in place like a pavement with orthostats marking the edges on both sides (s. Fig. 5.4).

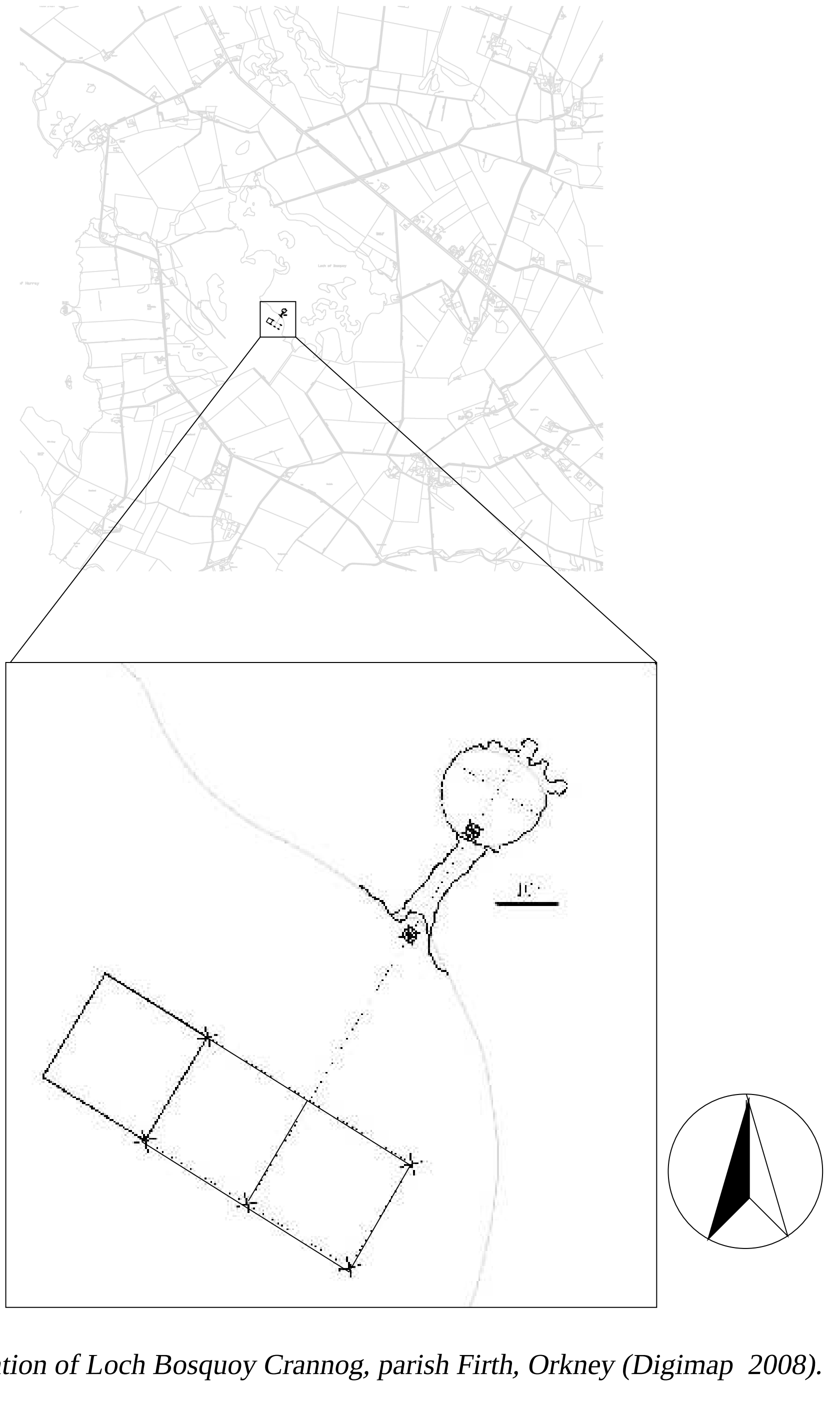


Figure 5.3: *Location of Loch Bosquoy Crannog, parish Firth, Orkney (Digimap 2008).*

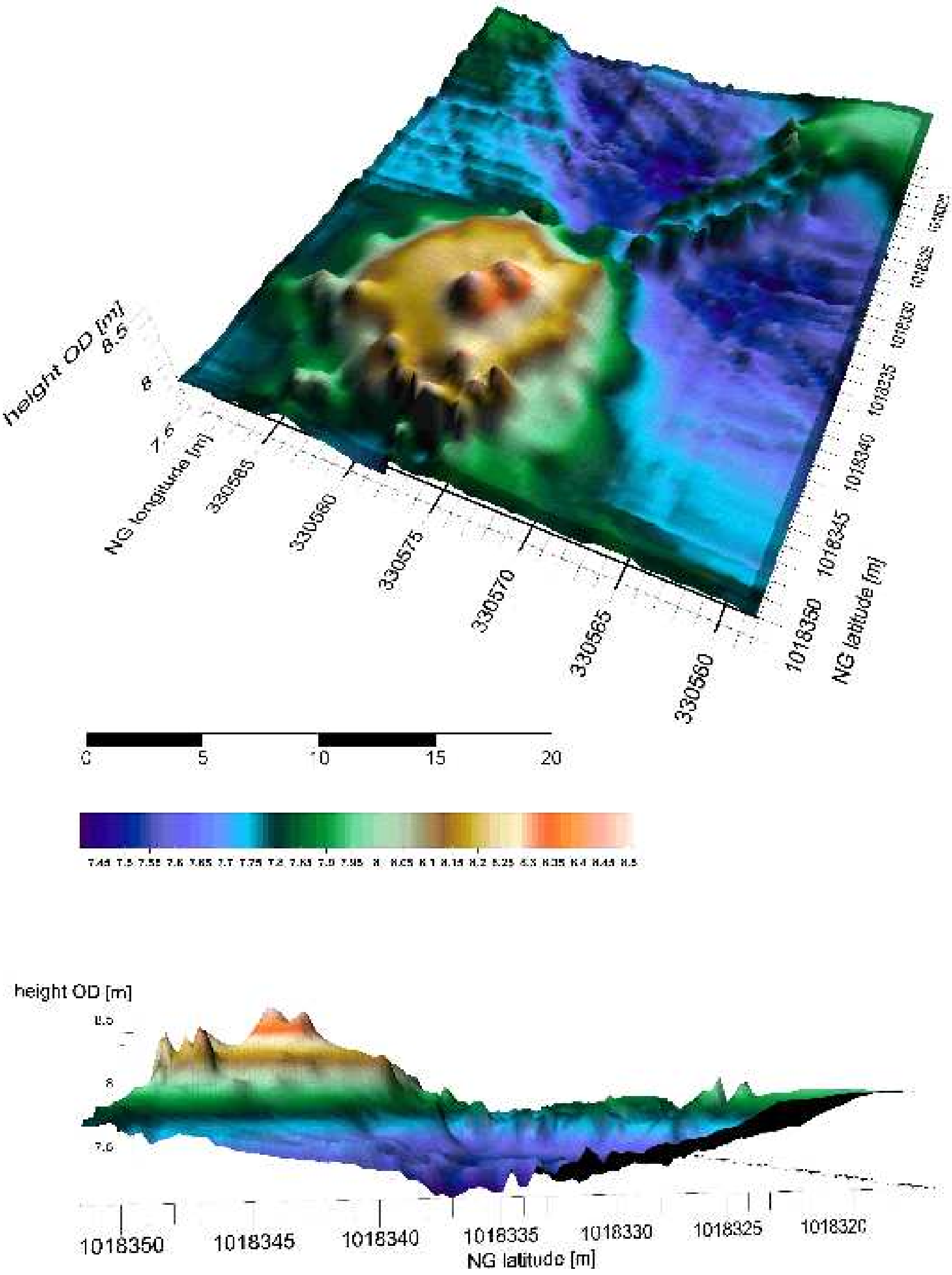


Figure 5.4: *Topographic model of Loch Bosquoy Crannog in 3D.*

5.2 Site plans

The grid was laid out according to the conditions and with respect to practicability. It was implemented in the survey data and then plotted with AUTO CAD. The plans in this section represent the underlying Ordnance Survey maps that are available online (Digimap 2008) and are coloured in grey. The overlying plans in black are plots of the actual shorelines at the time of the survey in June/July 2008. For orientation, EI layouts and grid lines along with GPR traverses are plotted in colour.

5.2.1 Loch Wasdale Crannog

The grid crossed the center of the crannog and was then enhanced into the S for the investigations on the related mounds (s. Fig. 5.5).

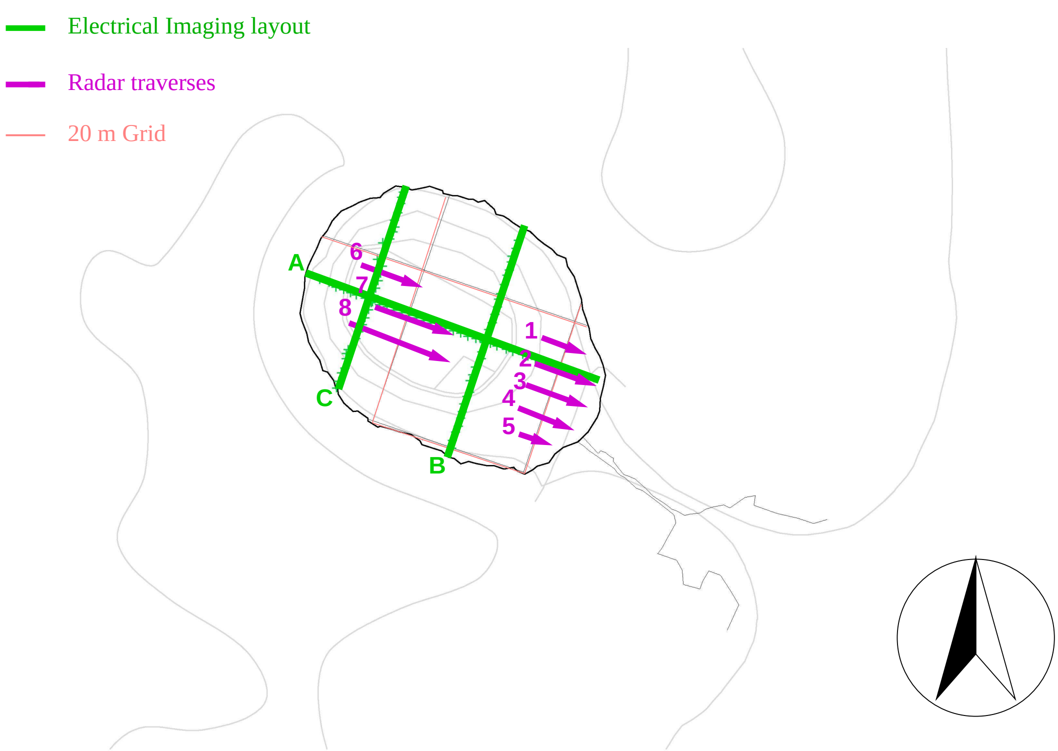


Figure 5.5: *Site plan and location of grid, EI and GPR on Loch Wasdale Crannog.*

5.2.2 Loch Bosquoy Crannog

The grid was laid out in parallel to the SW corner and the W shoreline that was roughly straight and from there advanced into the center that lay inside the walls. EI layout had to be done in such a way, that the lines of electrodes would neither rest on, nor cross over high walls, while for the radar instrument, it turned out to be impossible to centerly cross the N wallface and the choice was made to use two, rather than one traverse for the radar section in NS orientation. Furthermore, the extensions of the site are large and it was one of several considerations to get a radar section measurement nearer and further away from the shore for comparison of structural setups or features such as bedrock the crannog might sit on (s. Fig. 5.6), which is why another two traverses were chonsen in WE orientation.

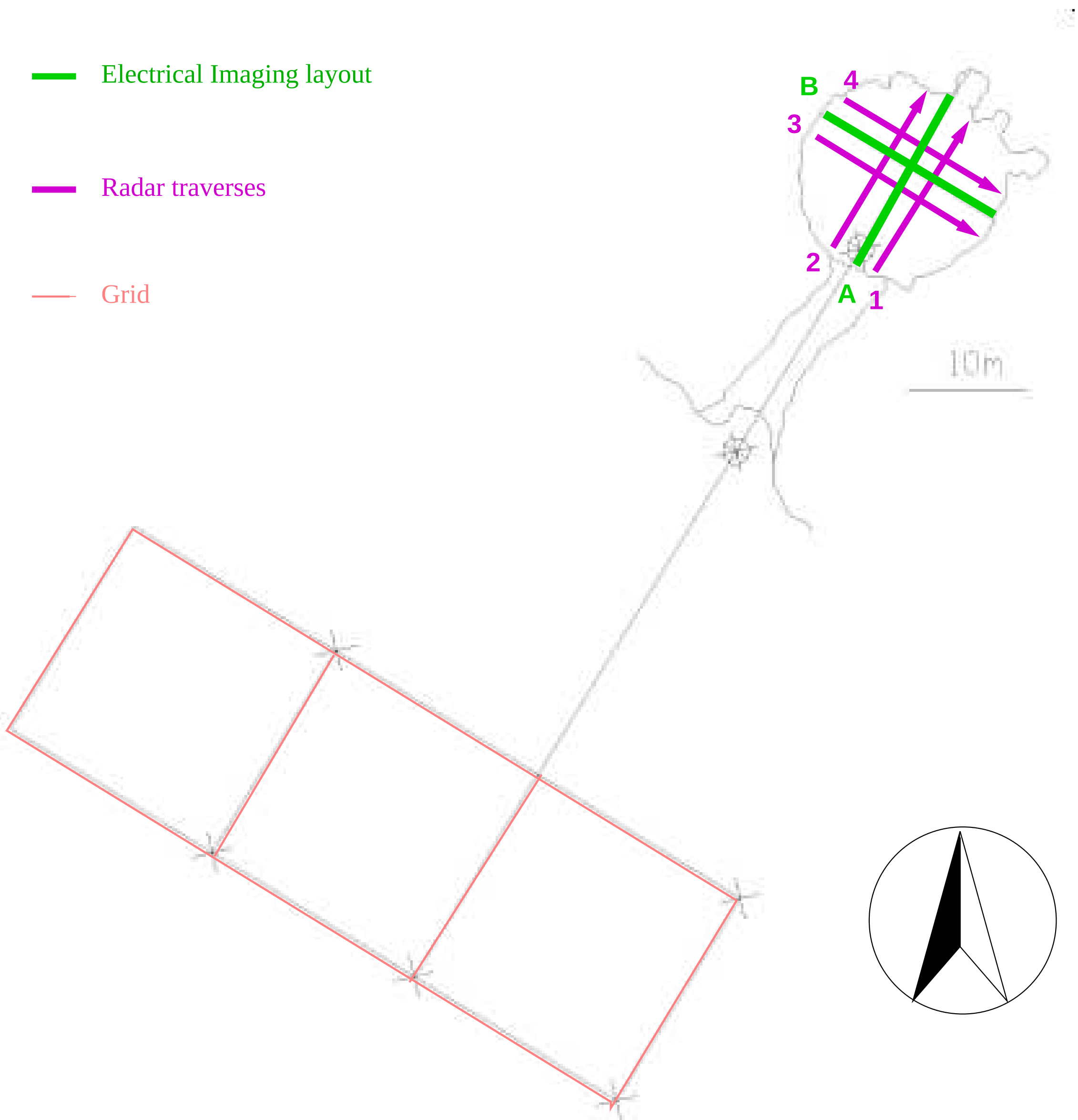


Figure 5.6: *Site plan and location of grid, EI and GPR on Loch Bosquoy Crannog*

5.3 Magnetics

The topography and surface cover restricted the gradiometer surveys in such a way, that the islands could not be completely or not at all targeted. The data from Loch Wasdale, fortunately, represents the only gradiometer data, that has ever been measured on an island of that size. The wallfaces and slopes introduced an advanced risk so that not all slopes could be measured. Meanwhile, although a complete survey is not essential for the outcome of this approach, there was no data taken from Loch Bosquoy which was due to the suface cover with reeds up to a height of 1.5 m.Nevertheless, three grids were measured on–shore under difficult conditions to investgate the associated structures near an on the burnt mound. Shortly after the survey the islet was grazed and all cover was trampelt down but there was no time left to go back to the site in this season. Instead, the important points crossing the on–shore situation and some point on the crannog were investigated with the MS2 coil. The method was valid enough to check for major activity changes in the complex of the crannog and the on–shore burnt mound and neighbouring buildings.

5.3.1 Loch Wasdale

The gradiometry data clearly showes activity associated with soil magnetic property enhancement which could be domestic (s. Fig. 5.7). The enhancement was expected to be distributed across the island, but is strikingly well defiend, so that the extend of domestic activity can be assumed to have stopped near the walls. Whatever happend to the waste, it was not dumped outside the walls and along the shoreline. The grid can be seen on Fig. 5.5.

5.3.2 Loch Bosquoy

Gradiometer data from Loch Bosquoy was taken on–shore on three distinct mounds, not far from the causeway. It can be assumed that the two smaller mounds on the W are houses of small size while the third structure peaks in very high readings which is typical for kilns, burnt mounds and similar places of great heat. The mound, that shows up on the plot (s. Fig. 5.8) could be made of highly burnt stones and the buildings seem to have had hearths, as well. This is mirrored in the data from the MS2 coil that read susceptibilities of 30 units (SI) on top of the mounds and values in the range of unenhanced, natural soil like 5 and 8 units (SI) in between. The readings are, from W to E:
30, 5, 25/40, 8, 213. The last reading is from top of the possible burnt mound feature while the crannog gave values of 3 and 4.
The causeway is in line with the largest feature, the possible burnt mound, not with the other structures. The grid can be seen on Fig. 5.6.

5.4 Resistivity

Surface conditions made it impossible to do any resistivity survey on–shore or on the islet of Loch Bosquoy. The data from Loch Wasdale, nevertheless is very informative and shows the typical values for a domestic site (s. Fig. 5.9). The grid can be seen on Fig. 5.5.

5.5 Electrical Imaging

5.5.1 Loch Wasdale Crannog

Contact between the electrodes and the ground was not easily achieved as the island with its substantial mound of loose rubble and collapsed wallfaces often consists of voids on which topsoil is laid down so that the surface looks compact. It is, in fact, not the case, and shows up in the data, as well. The deeper the investigation and the weaker the signal due to secondary conditions on site, the smaller is the model accuracey. Therefore, RES2DINV, the inversion program offers a detailed information plot of model block sensitivity after inversion calculations which helps to understand and interpret the data and control the model's weeknesses (s. Fig. 5.10. The outline of the lines layout can be seen on Fig. 5.5.
The final result with topographical corrections shows wallfaces of substantial extent and thickness and possibly bedrock coming through the images of lines A and B (s. Figs 5.11, 5.12).
The section C is the one further away from the shore and crosses wallfaces of less substantial thickness (s. Fig. 5.13.

5.5.2 Loch Bosquoy Crannog

The Electrical Images of Loch Bosquoy Crannog are very different from those from Loch Wasdale, at a first look. On a second look they are similar in a way, as the mound of debris and rubble, that the island in Loch Wasdale is formed of, has different electrical properties, while the part of it, that lies near or in submerged depths, looks strikingly similar. The humidity of the soil, or even water in void of rubble, provides a highly conductive environment where wall faces do not show up, even though they are there. It is obvious that there are limits to this method. Despite the humidity, though, bedrock of extremely high restistivity can clearly be seen as the base for the islet. Fascinatingly enough, the bedrock extends into the loch but not towards the shore. It therefore provides an indication of more stable underground where the island is, and considering lower water levels,

if this was marshland, the position of the island would have been the safest, not the area on the shore, close to it.
The outline of the lines layout can be seen on Fig. 5.6.

5.6 Ground Penetrating Radar

The radar data for both sites differed when first looked at, as well, but with some gain, the data from Loch Wasdale Crannog started to look different. The vegetation there was quite high and uneven, and even the surface wave did not return with normal intensity. After gaining, the information showed massive features of variations of dielectrical properties, possibly rubble. The thickness of the rubble varied between 0.5 and 2 m pseudodepth but is generally thick and overall present, underneath the apron as well as in the center. The thickness of this rubbly layer (it is almost flat with similar thickness) on Loch Bosquoy Crannog was around 0.5 – 1 m. Traverses are planned on Figs 5.5 and 5.6.

5.6.1 Loch Wasdale Crannog

The images show data after surface response correction, gain, and spatial filtering which removed random background disturbances. The lower, darker part has not been gained as it is reflections of second order, which can be seen in some cases where it clearly shows a mirror image of the upper structures. Although wallfaces or pits cannot be seen, it does indicate the extend of structural remains which is possibly equivalent to the structural mass of the mound (s. Figs 5.16 and 5.17).

5.6.2 Loch Bosquoy Crannog

The data was corrected with surface responses, slightly gained as in this case the signal was strong and had only to be shaped a bit, and spatially corrected for reduction of random noises. The layer of structural remains is similar to the rubble the Wasdale data might represent but is thinner. If this, indeed, is a structural layer made of stones, voids and refuse, it cannot be seen on the EI pseudosection which is then a sideeffect of them being waterlogged. Obviously, the surface of the water is not, what the radar is picking up, as it is too complex and too deep, since the whole ground was moisturous, especially around the shoreline where vegetation declined and the amount of water could easily be seen between rocks and stones. The radar traverses started and ended right on top of the clearly waterlogged shoreline. The wallface, that showed up on the EI cannot clearly be seen but might be too close to the surface (s. Fig. 5.18).

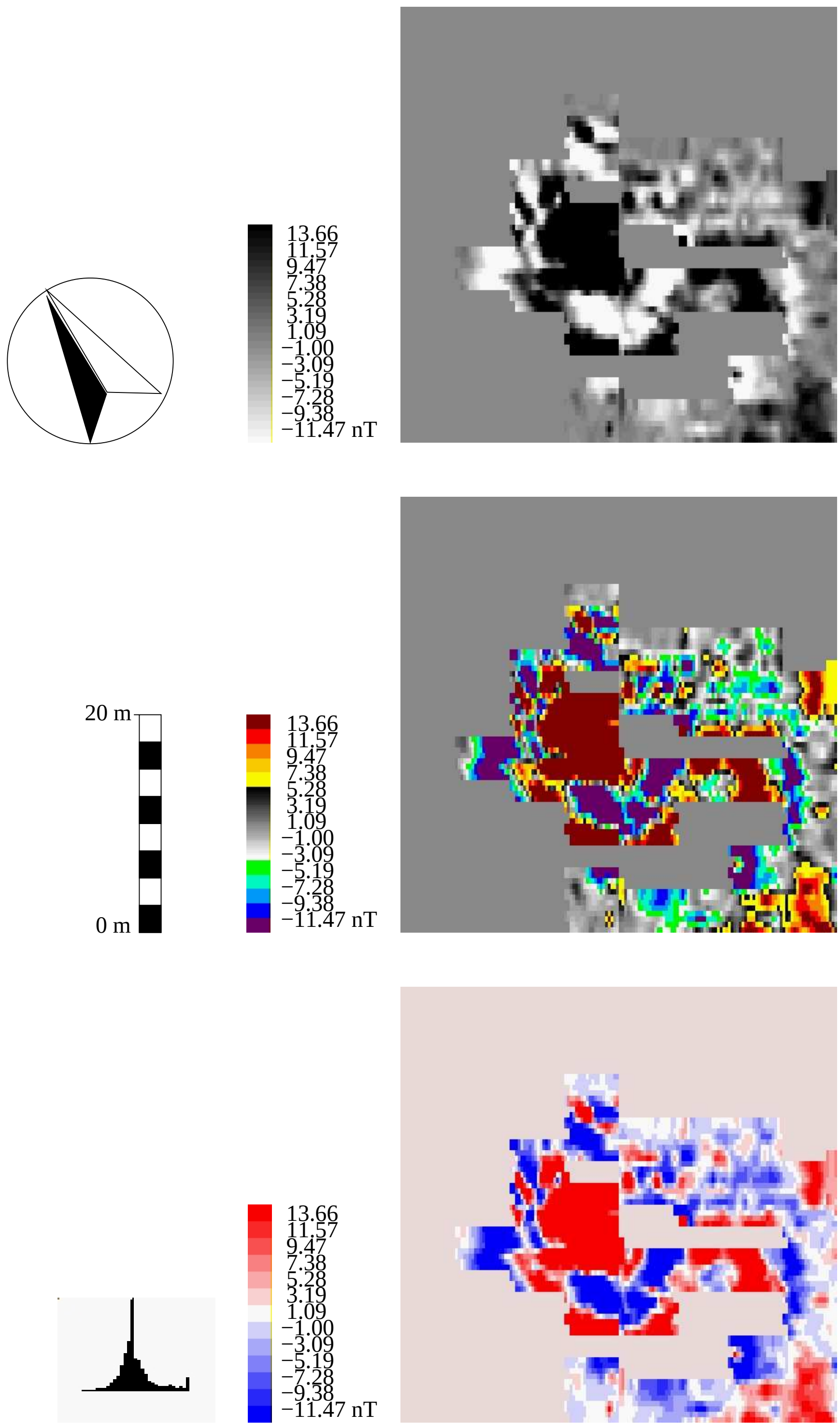


Figure 5.7: *Gradiometer data from Loch Wasdale Crannog (s. Fig. 5.5). Deposition of enhanced soils in the central region.*

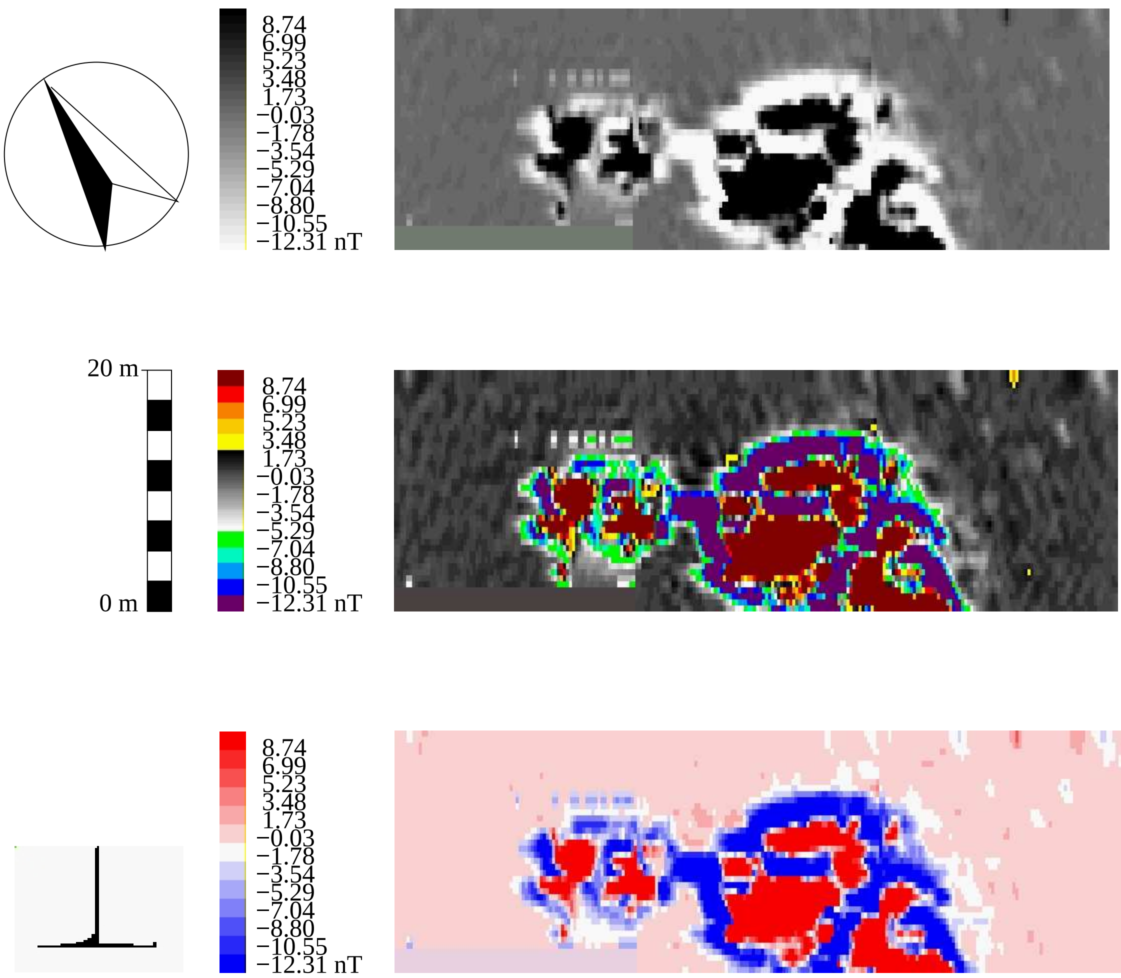


Figure 5.8: *Gradiometer data from Loch Bosquoy Crannog (s. Fig. 5.6). The large structure seems to comprise of two departments.*

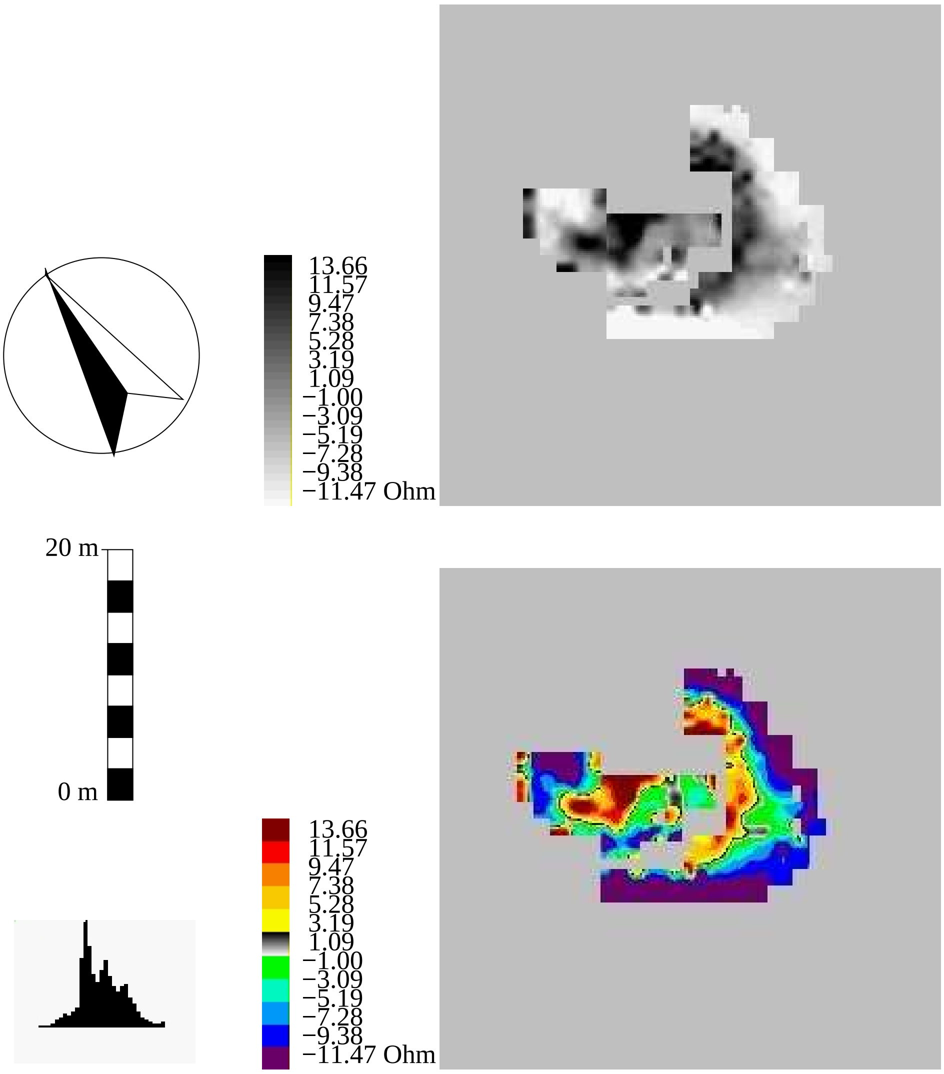


Figure 5.9: *Resistivity data from Loch Wasdale (s. Fig. 5.5). The values represent apparent resistance, not resistivity which does not affect the general tendency.*

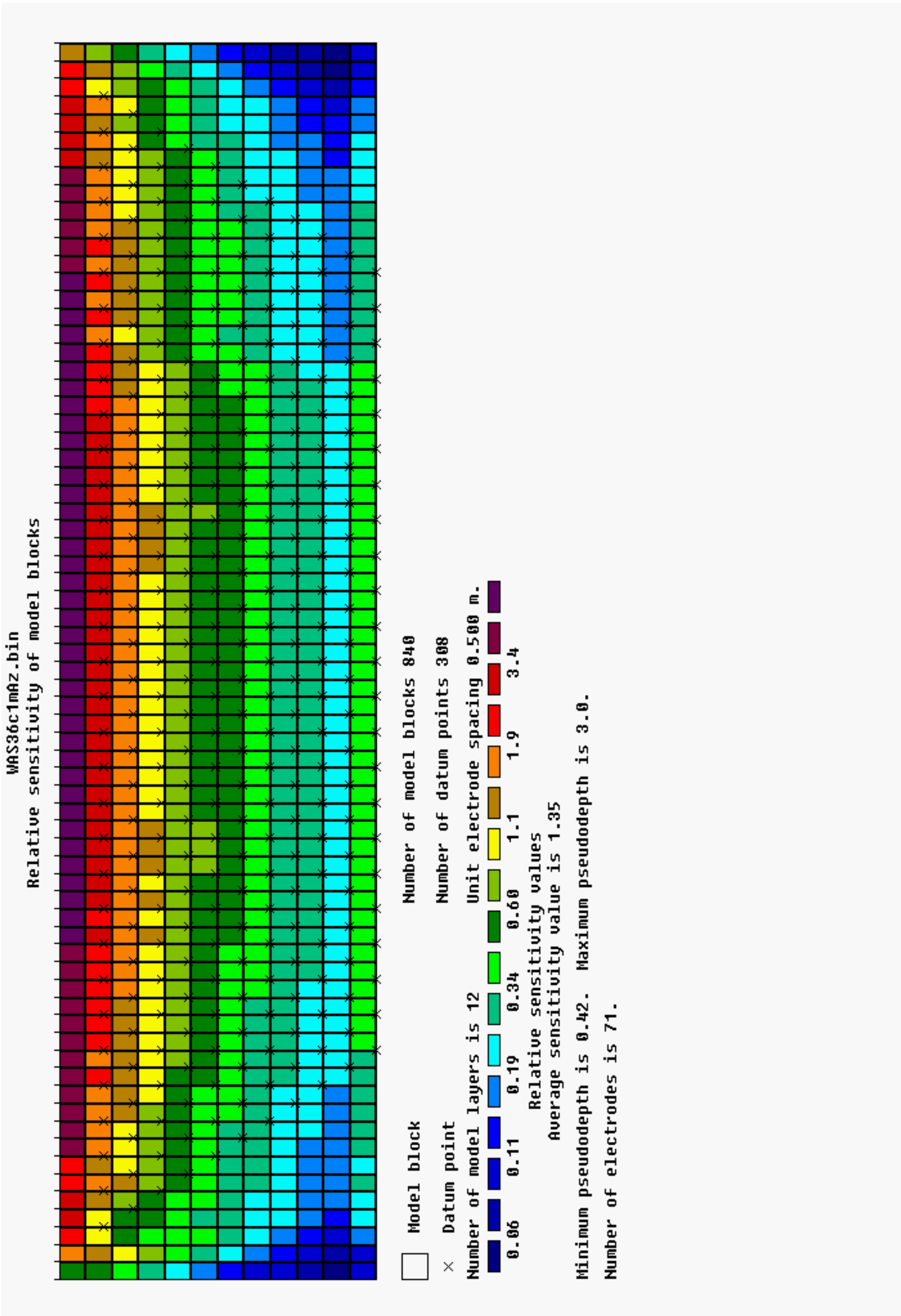


Figure 5.10: *Modelsensitivity of model blocks with depth for Loch Wasdale Crannog layout A (s. Fig. 5.5).*

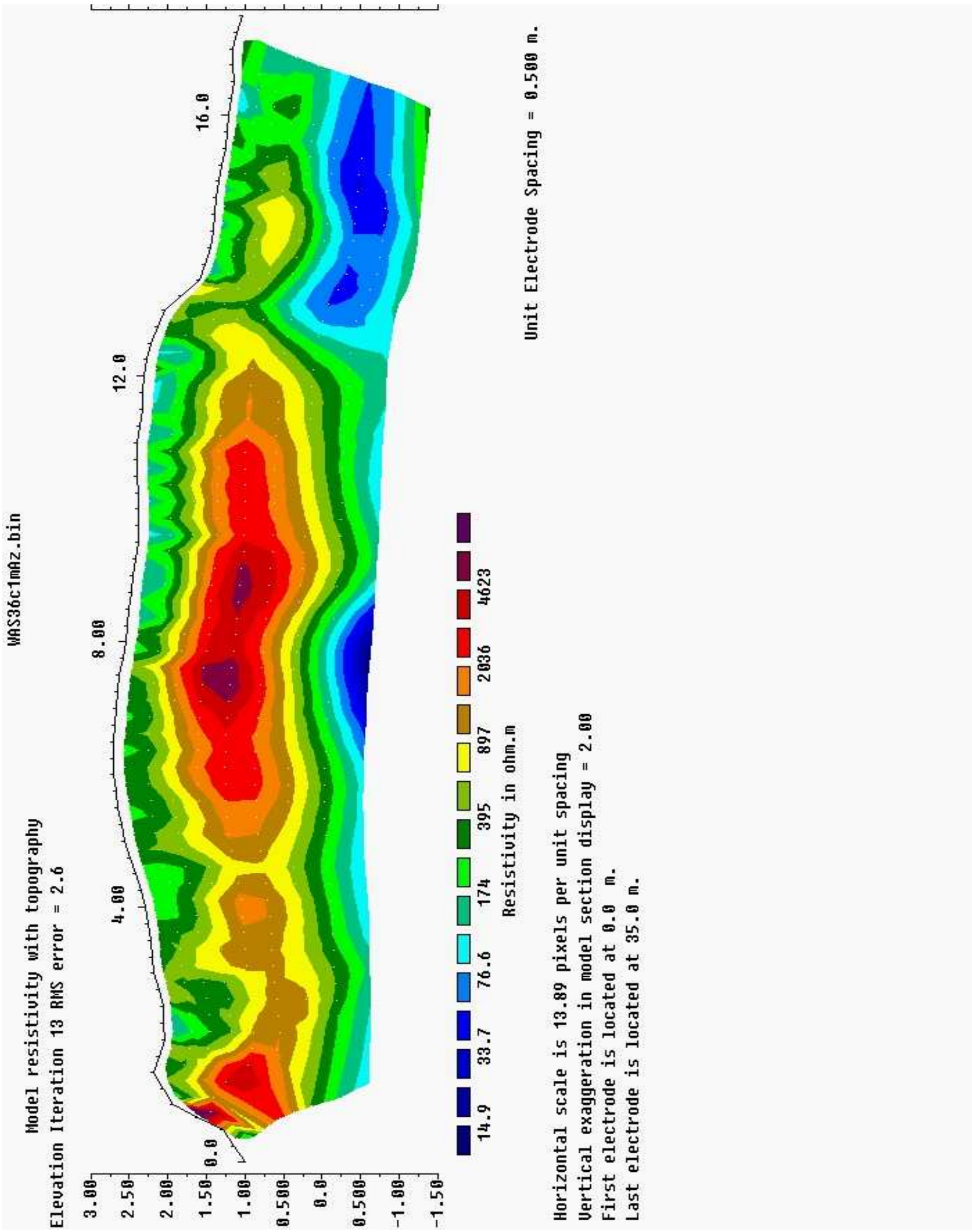


Figure 5.11: *Electrical Imaging pseudosection A (s. Fig. 5.5), Loch Wasdale Crannog; Electrode spacing is 1 m with 36 electrodes crossing the long axis of the islet. The causeway is to the right and the left hand side faces the loch.*

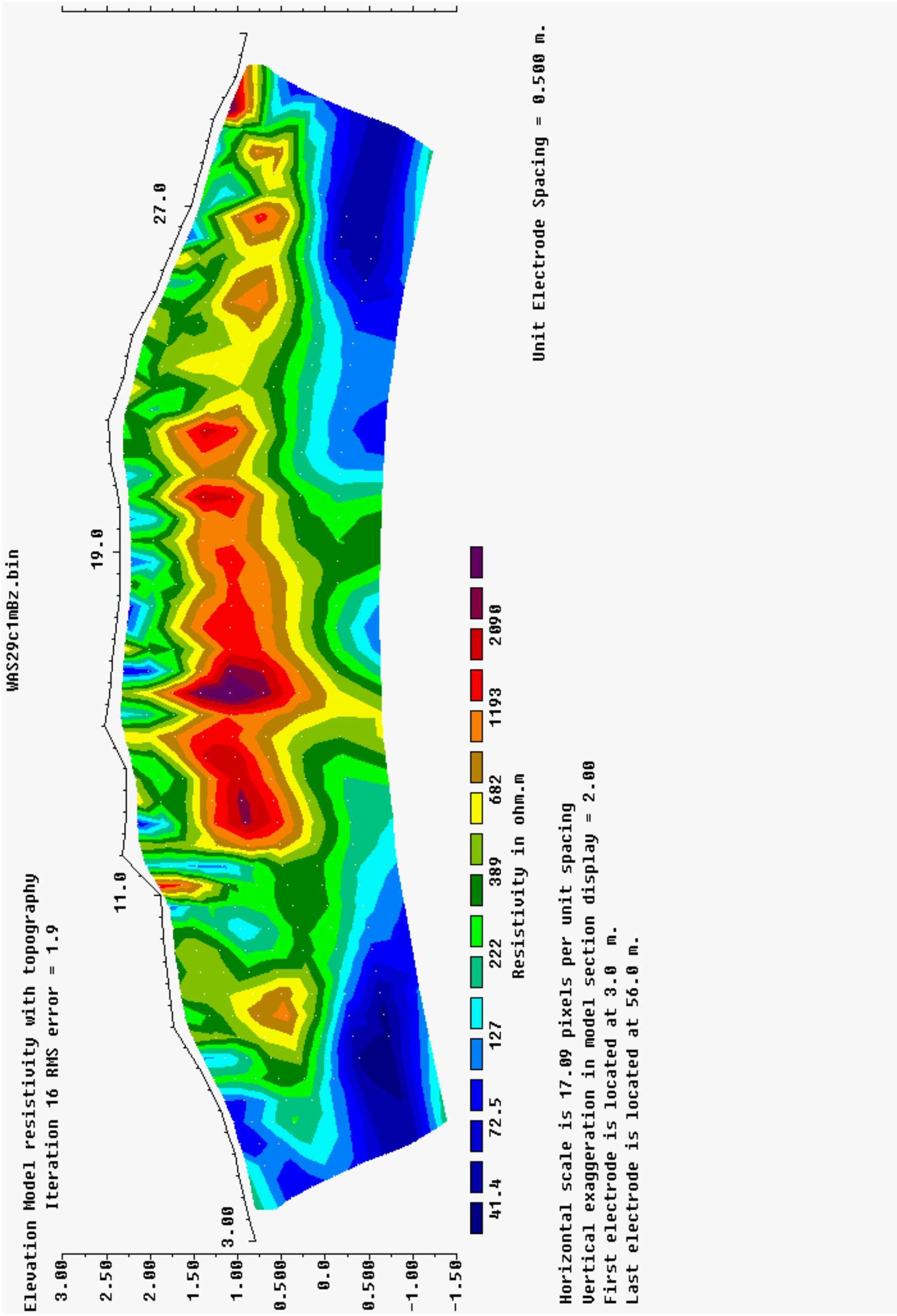


Figure 5.12: *Electrical Imaging pseudosection B (s. Fig. 5.5), Loch Wasdale Crannog; Electrode spacing is 1 m with 29 electrodes crossing the short axis of the islet on the side close to the shore. One datum point was exterminated due to bad contact near the wall on the left.*

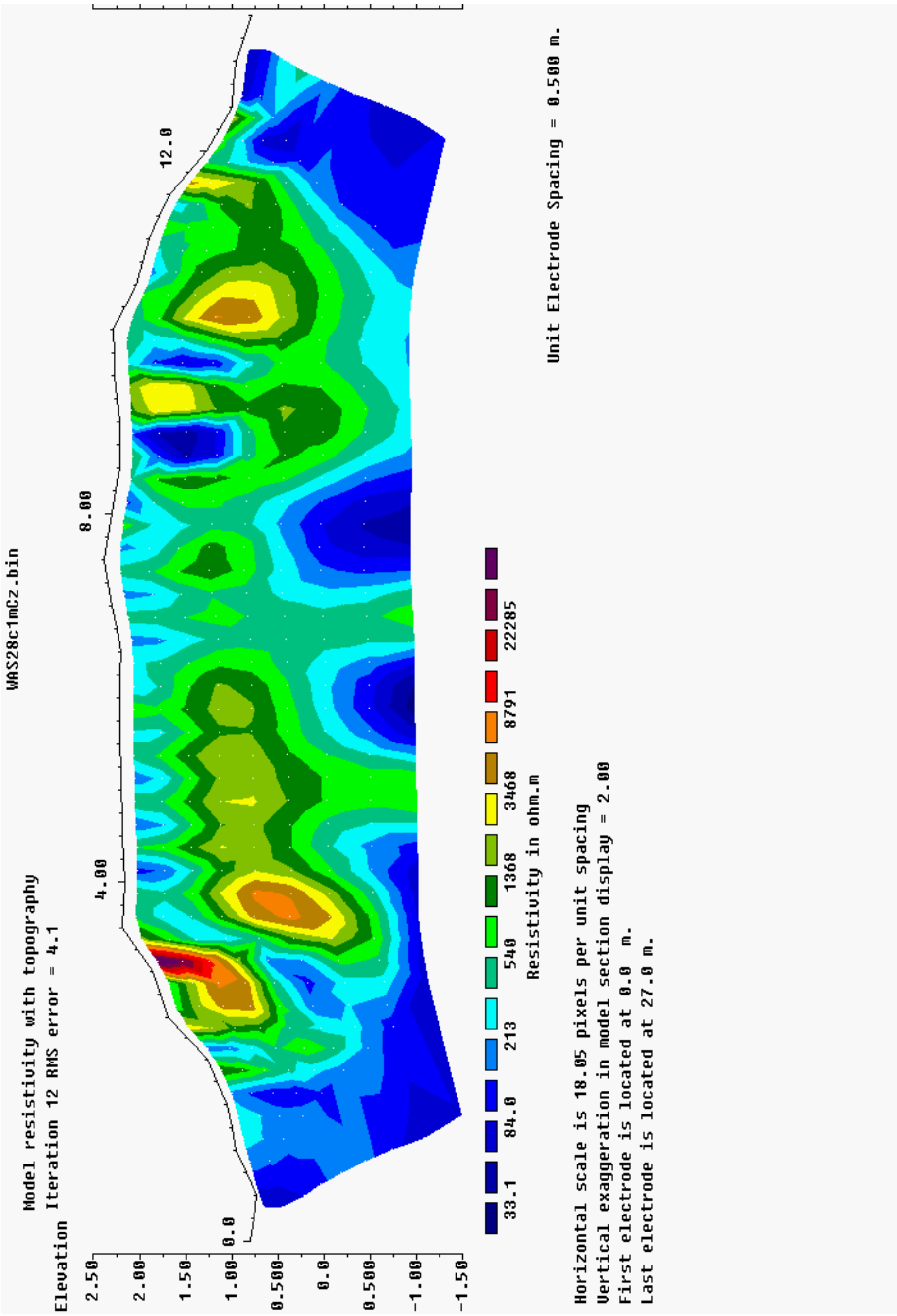


Figure 5.13: *Electrical Imaging pseudosection C (s. Fig. 5.5), Loch Wasdale Crannog; Electrode spacing is 1 m with 28 electrodes crossing the short axis of the islet on the side further away from the shore.*

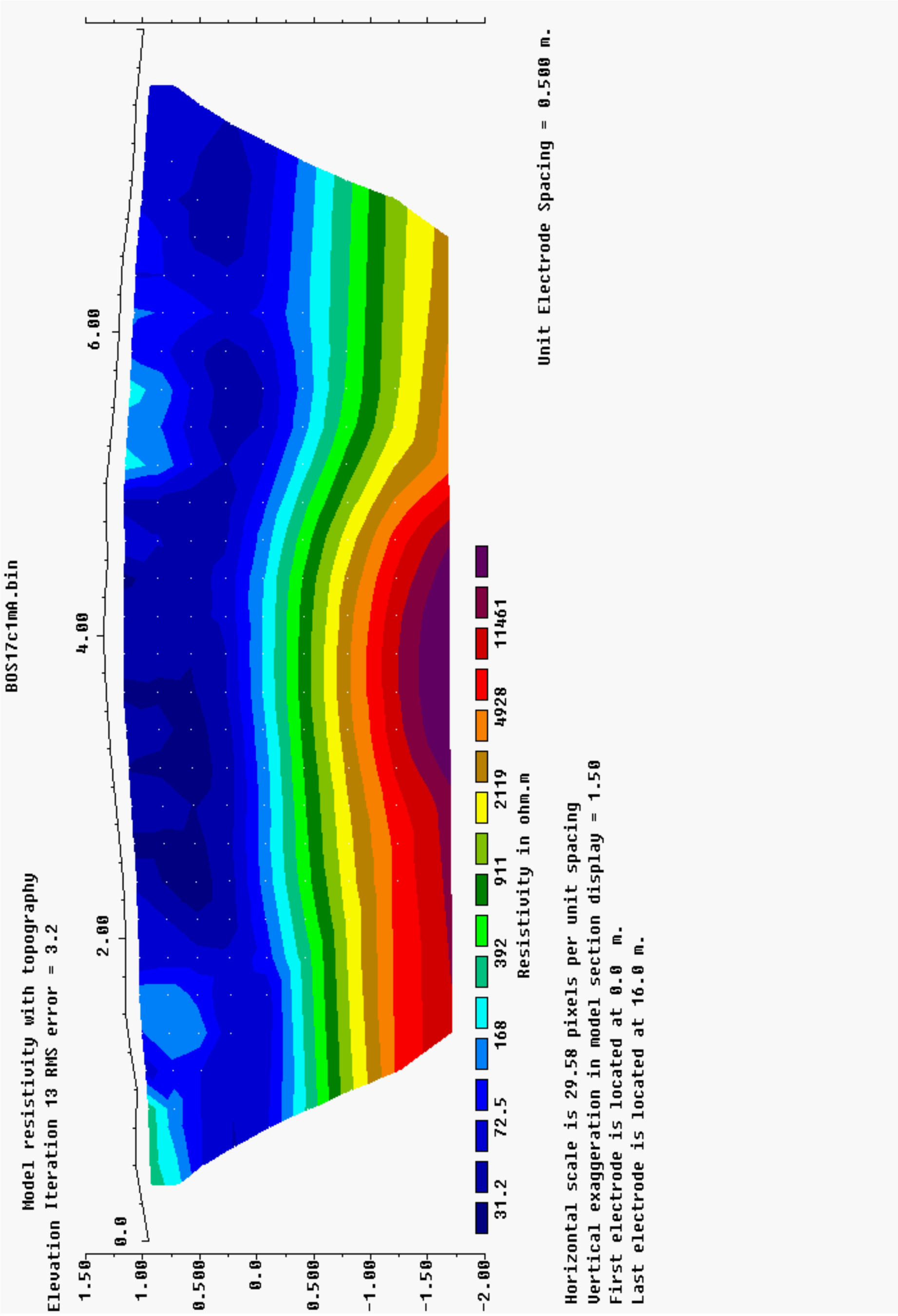


Figure 5.14: *Electrical Imaging pseudosection A (s. Fig. 5.6), Loch Bosquoy Crannog; Electrode spacing is 1 m with 17 electrodes crossing the short axis of the islet, in line with the causeway. The causeway is to the right and the left hand side faces the loch. Possible bases of walls can be seen in the surface layer; despite the presents of stone paving it does not show up, probably due to the level of moisture of the soil that is only about 30-40 cm above the water mark.*

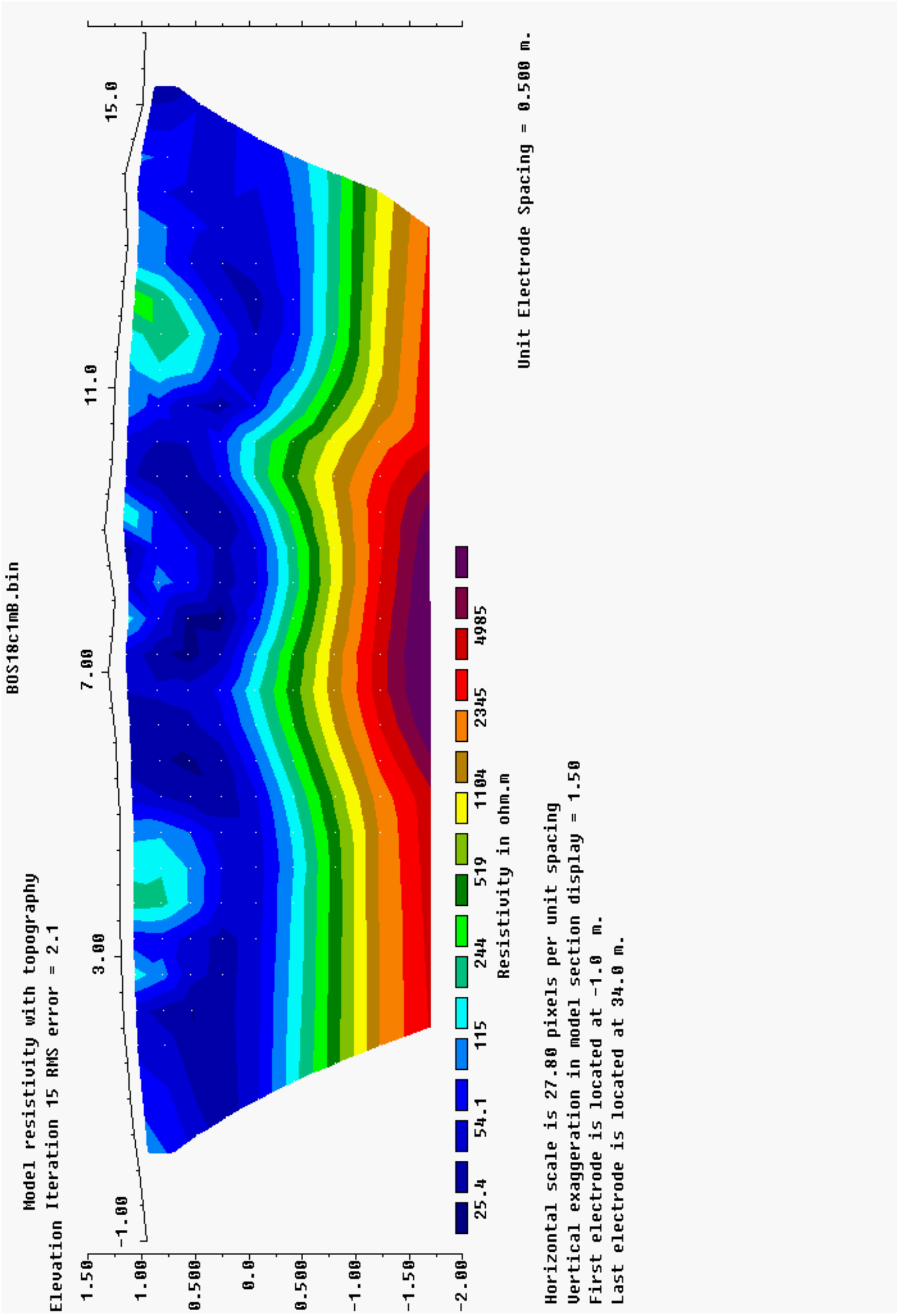


Figure 5.15: *Electrical Imaging pseudosection B (s. Fig. 5.6), Loch Bosquoy Crannog; Electrode spacing is 1 m with 18 electrodes crossing the long axis of the islet diametral to the causeway axis. Possible bases of walls can be seen in the surface layer; despite the presents of stone paving it does not show up, probably due to the level of moisture of the soil that is only about 30-40 cm above the water mark.*

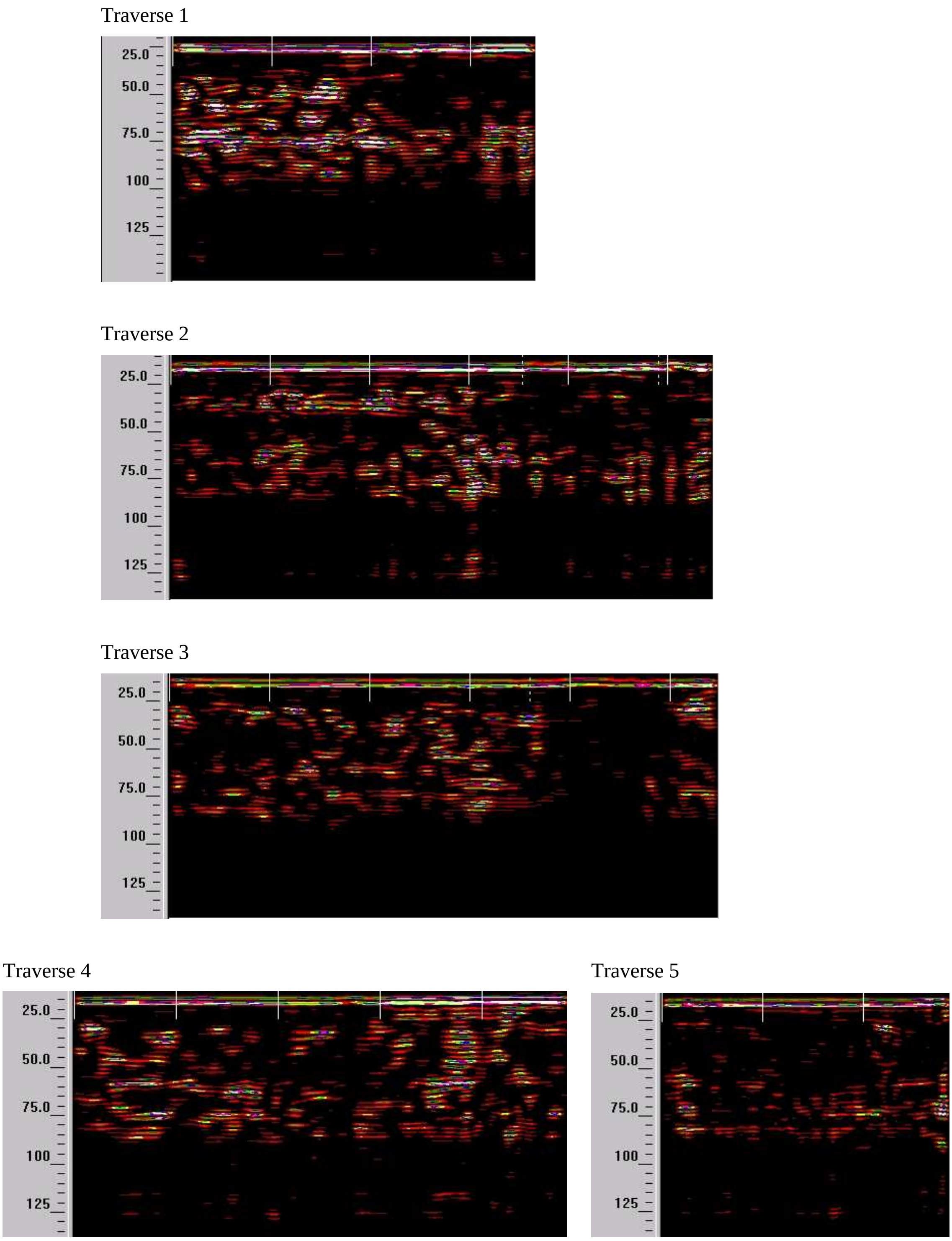
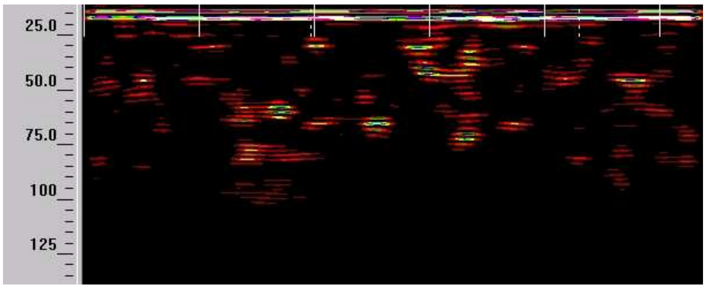
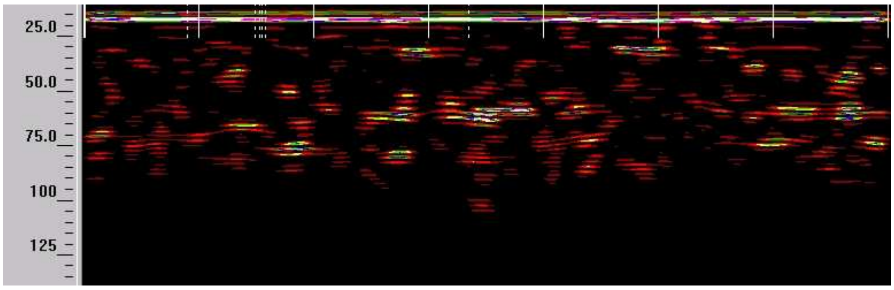


Figure 5.16: *GPR soundings on Loch Wasdale Crannog, part A (5.5). These sections cross the apron towards the causeway on the right, which might be the reason why the near–surface structural remains break up; the apron close to the causeway was very muddy and low–lying (s. Fig. 5.1).*

Traverse 6



Traverse 7



Traverse 8

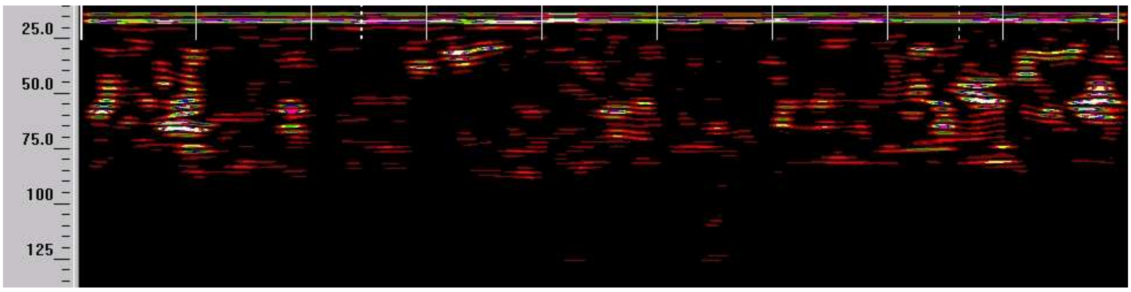
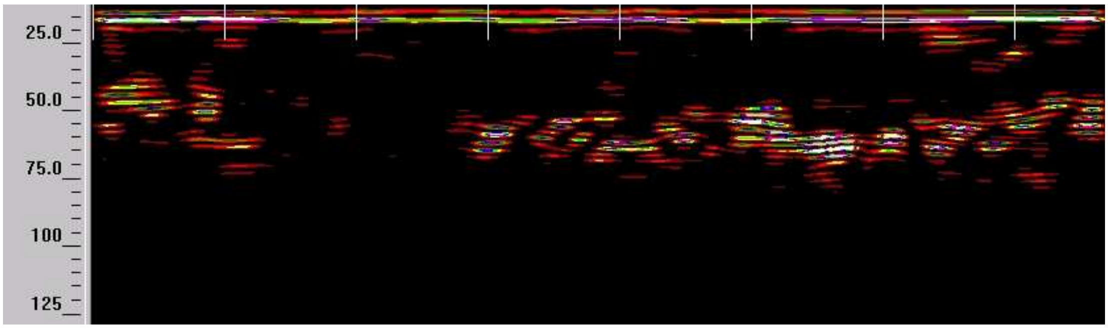
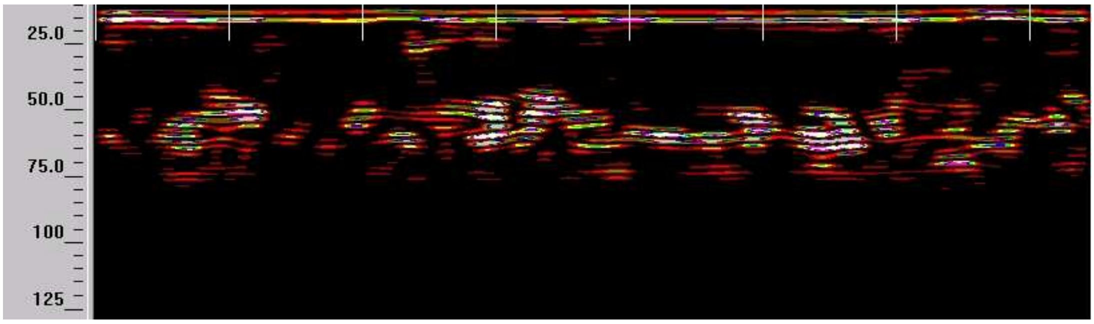


Figure 5.17: *GPR soundings on Loch Wasdale Crannog, part B (5.5). Traverse 8 has two features that might represent the walls of interiour compartments, the one to the right is clearly visible in the survey data (s. Fig. 5.1).*

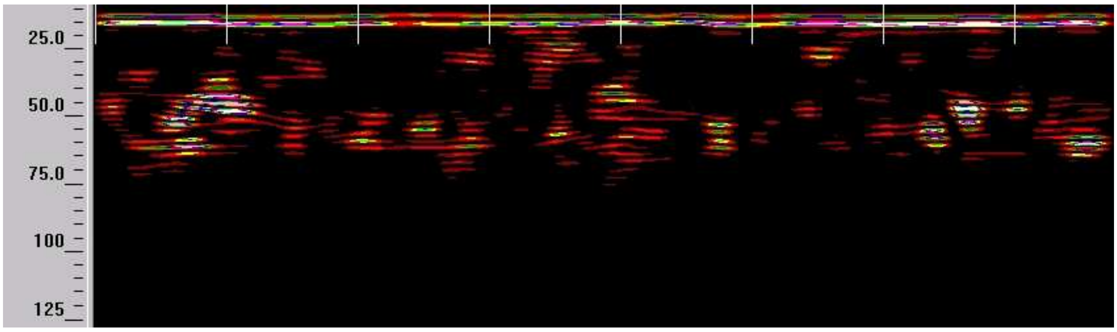
Traverse 1



Traverse 2



Traverse 3



Traverse 4

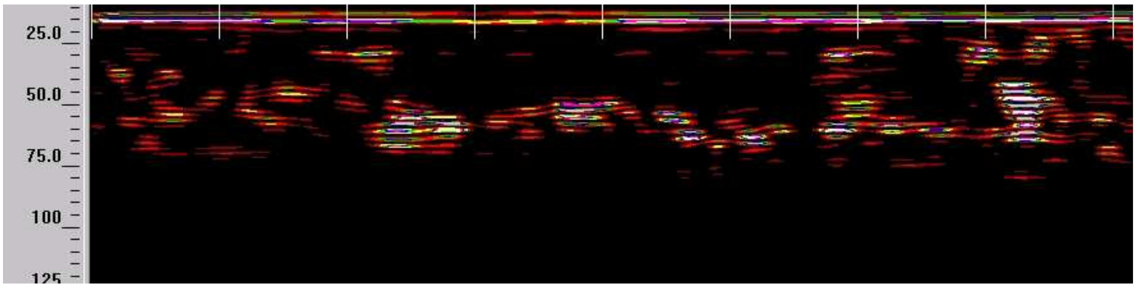


Figure 5.18: *GPR soundings on Loch Bosquoy Crannog (5.6). Traverses 1 and 2 lead away from the shore, so the causeway is on the left, the loch and nousts are to the right. The pictures should be similar as traverses 1 and 2 are in parallel with separation of 1.5 m. Traverses 3 and 4 cross the island diametral to 1 and 2, are in parallel with separation 1.5 m, and should therefore be similar. Possible wallfaces can be seen in traverse 4, which is further away from the shore than traverse 3.*

Chapter 6

Interpretation and discussion

6.1 On continuity

Continuity in the light of death, loss and abandonment of the home must have stricken the people in the high phase of crannog construction in Ireland and Scotland (O'Sullivan 2000, 8, 9) as islets, still being exposed in the loch's water's, must have reminded people at the turn to later prehistory of eternity, as the re-use and continuing occupation of some of the more in detail–investigated sites of hundreds up to thousands of years indicate (Dixon 2004, 31). The visibility of earlier lake-side structures in contrast to the quarried, and eventually disappeared, settlements of the Neolithic targets the observers attention gradually, especially when the observer is successively getting involved into the re-evocation of ancient rites and lifestyles. The point here is that the small quantity of excavations on Crannogs does not allow us to date them into a specific period by looking at the generally unstratified sampling evidence, which is mainly pointing to the early Iron Age in Scotland, while being slightly later in Ireland (Cavers 2006, 389-90). It merely allows us to register the widespread fashion of Crannog occupation in that period and we might await the exposure of earlier stratigraphy with contextualized samples pointing to earlier and earliest periods of human domestic or ritual activity. As long as not all Crannogs are identified and structurally and contextually examined, nothing is known and no assumptions for earlier phases can be made. Although this seems to be a lot of work it is not impossible to imagine it to be done in various ways, as Crannogs are, and will always be, easier to be found and identified than any other structure. Why is it that it still appears to be such a difficult task and why is there so much controversy about the structural evidence. It might essentially be because there are structural differences even in a single period of construction. The re–use of a structurally specific site might structurally overly and differ that much that it seems difficult to distinguish between the two phases, as deposits can become almost completely washed away by tidal, wind, and current forces. These phases might then be interpreted as a site with a peculiar way of construction, while, in reality, they are different constructional methods, relating to completely different traditions. Following Armit (Armit 1992b, 16) 'the rigid adherence to typological classification can often lead to the discussion becoming too specific to be constructive, with classifications introduced to rationalise interpretations rather than as tools for study. The analysis of artificially segregated groups can lead to a form of tunnel-vision when the validity of the classification system in defining exclusive groups is too readily assumed.' The classification emerging from such assumptions can create a system of classes that is not just incomprehensive but also misleading. With better insight one might find that in future times this leads to a different approach that incorporates all other theories and manages them comprehensively to allow assumptions to be made. One might then find that a site under examination fits very much into the structural presumptions made before the trial. Curiously, reality is not that kind but it certainly justifies the attempt. Typologically, crannogs should not exclude island duns, island brochs, roundhouses, 'stone mounds and other submerged and partly submerged sites, superficially resembling brochs and duns but of earlier date', etc. as it has been done in the past (Dixon 2004, 21-3, RCAHMS 2008), as they might well be later structural remains on top or inside earlier contexts and are most certainly part of the structural and contextual remains of the site as a whole. Equally, radiocarbon-dated samples taken from such sites cannot allow the sites to become classified with exclusion but certainly indicate an earliest date, but do not account for the character of the site. Therefore, assumptions made towards the distribution of crannogs in different periods of settlement or monumental patterns are to be taken with care, especially when the dating evidence comes from a site that lacks excavation data or even from a third party snorkelling activity and similar retrieval activities.

Whether or not structural evidence and dates are of major concern, artificial island dwellings remain a continuous idea as those islands all around the globe and in Lake Titicaca in particular, suggest (s. Appendix Figs 8 and 9, Wikipedia 2008c). The people of the 'swimming islands of Lake Titicaca' call themselves 'Uros', a pre–Inka tribe and build their islands out of a sort of reed which rules their lives as a medicine, as well Wikipedia 2008g). Maintenance of the fast rotting swimming islands is achieved by continuous floor levels of shilf maths that are continuously being layed out, especially after rainfall. The interconnected islands are fixed to the ground by being roped onto timbers which are rammed into the lake ground and they are strikingly similar to the swimming Aztek mega city of Tenochtitlan in the Mexico City valley (s. Appendix Fig. 10). Stability is gained through renewed rooting that gives further uplift and the whole group of islands can be moved, if necessary. The shilf boats they make represent the only water craft that is typical for ancient egypt, out of egypt and the oldest, largest and holiest of the lake island, the 'Isla del Sol' was the first to emerge out ot the floods when sun and moon where reborn in the lake and has an aligned neolithic stone circle and altar as well as later monasteries and pilgrim's guest houses on it, with underwater finds related to the Tihuanaco period (Wikipedia 2008b. The Father and Mother of the idea might not be clear in any case but major sideeffects are the watery resource and the retreat from 'land society', therefore, it must be assumed that those who dwell on the lake must like, even admire, or moreover adore the element. This links them with peoples from the desert as water, to them, is the most important thing in their lifes, it merely *is* life, while people from Indonesia avoid the lake sides and the coast, because for them, who have plenty,

water is not even precious, to be near it means social decline.
It has to be assumed then, that there is a good probability that the builders of artificial islands are more likely to come from a dryer environment then the British Isles, as they are today.

6.2 On Geophysics

The geophysical results are promising as they show that indeed investigations using Gradiometry, Resistivity, EI and GPR are possible methods of investigation on crannogs. This is certainly not true for some sites which are submerged or have no surface cover. The GPR seemed to work well, even on the probably waterlogged remains of Loch Bosquoy Crannog, while EI does not seem to pick up structural waterlogged remains. Nevertheless, the intersting result is that both sites were build on natural bedrock, although the evidence from Loch Wasdale is not overwhelmingly strong. The general trend in Scotland that crannogs often appear to have been build on natural elevations (s. Chapter 2) can also be found in Orkney.
The results from magnetic susceptibility measurements are not convincing, as the structural evidence of Loch Bosquoy Crannog implies activity on the island. The reason for a lack of enhancement of the topsoil there still needs to be found but it is suggestive whether loch silt could have been deposited on the island during flood periods and submergence. The submerged state of the island can be seen on its aerial photographies in the Orkney Records (s. Appendix Figs 4 and 5).
The submergence of the entire causeway of Loch Wasdale Crannog can be seen on aerial photographies in the Orkney Records and is today a seasonal state (s. Appendix Figs 1, 2 and 3).

6.3 On Water

The environmental analysis shows *where*, the geophysical *how* crannogs where build in Orkney. It is now but just a small step to extract the information gained in the landscape study of a small community and project the outcomes into a wider context. The community of the Orkney Islands is, for this matter, and ideal place of study for intersocial, environmental and landcape perceptionist approaches. The speciality within is the long–lasting general lack of biogenic building materials which have formed the development of entirely stone build structures of all kinds, impressively peaking in the presence of the highest density of brochs in Scotland. From the crannog point of view, the structural evidence that is to be expected here, certainly will follow the same path, and from the amount of very potential sites, the conclusion must be drawn, that there is likely to be more, if Orkney is, at the very least, **similar** in crannog density to the rest of Scotland. Any likewise, the crannogs found here will be, like the ones in the Hebrides (Armit 1998, 2003; Holley 2000), entirely made of stone, refuse and rubble, either sitting on natural bedrock or on silty beds (s. Appendix Fig. 11). Again, how to distinguish between stone and rubble is the task of the excavator. As the results from the radar survey suggest, the rubble is likely to be identified but did, in both cases, not succeed a depth of 2 or so meters. In both cases, again, the bedrock seemed to show up further down with an intersecting phase of high conductive material, either waterlogged or otherwise conducting, but certainly in between. If this is to be considered natural silt over bedrock than the settlement or occupation sequence **can** reach down to this phase, providing it is as old as the tree cover of the Orkney Islands. Water level rises and flooding will have forced the inhabitants to build up the floorlevel or abandon the site. Maybe the site was rebuild despite the rise of the water, with the necessity to retain a way of life that was considered precious or special. Maybe the need to control the resource of water as a means of supply for men and animal was stronger than the effort drain. In transitory phases the floor might have been paved only while in a next stage, with the lack of piles for exposed floorlevels, similar ways in stone might have been found. The existence of a burnt mound in visual context with the causeway of the islet in the Loch of Bosquoy (aligned with the axis of the causeway) is an indicater of correlation between these site types but the lack of domestic evidence in the surface layer of the islet is a mystery that yet awaits explanation. With the abandonment of the site that could have been earlier than the burnt mound build up (s. section 6.4) the surface that is exposed today has been transformed long ago and might well consist of lochbed silts that flooded the islet, which's elevation is currently no more than 30 cm in average above the loch water level. The structural remains on the islet would then have provided a quarry for the burnt mound and it's accompanying houses and the lack of domestic indicators in the islet's surface layers is a pointer towards an early age. The state of preservation of the noust at the backside, on the other hand, is in contrast to that theory and would then be a later addition. The other explanation would be the rare find of a non–domestic site.

6.4 On logboats and burnt mounds

Robert Mowat describes in his book, 'The Logboats of Scotland', how recent studies suggest burnt mounds to be structures for steam–bathing, rather than for cooking, since excavations in Birmingham revealed a total absence of animal bone or artefacts associated with cooking or settlement. Whether this was their primary or secondary use, however, dating evidence from Orkney burnt mounds ranges from 500 to 1700 BC, but the most intrigueing find was a logboat re–used as cooking–trough during excavation of one of a group of seven burnt mounds at Curraghtarsna, Co. Tipperary, Ireland. 'The trunk had been split down its length to form the base and two sides before end–plates formed from unworked tree–trunks were pressed into place.' (Mowat 1996, 146–7). Another example was found on the edge of a former lake at Branthwaite near Workington, which was a split and damaged section of a 'hollowed canoe with a carefully in set back board' that dated to 1043$\pm$110 BC and had been converted into a trough. It's location was rather interesting, too, as it had sunk into the 'edge of the lake–bed where it was firmly wedged between four upright posts; further posts were found flanking the trough which was interpreted as having been incorporated into the lower part of an **artificial platform**, the upper parts of which had been destroyed by fire. [...] The location is noted as not being a lake of navigable size, while lacustrine deposits were not revealed by geological sampling. The discovery is re–interpreted as that of a bothy and work–site of comparatively recent date, based on a perpetual supply of seepage–water for steeping or soaking, and a supply of poles. Skin–dressing, flax–retting and basket–making are all considered possible explanations.' (Mowat 1996, 148).

Suggesting the re–use of logboats in the absence of any trees for building troughs in Orkney, the crannogs or other lake–side sites that could be associated with the boat would certainly pre–date the burnt mound. Troughs can, nevertheless, easily be build out of large slabs of stone. The area around Loch Bosquoy, though, is lacking a natural quarry and the re–use of building material seems to be the method of choice. The only noted buildings close are the brochs Burrian at the E shore of Loch Harray and Bosquoy on the other side of the loch, but without excavation, not much can be said.

However, the burnt mounds or mounds of burnt stones constitute the most numerous class of antiquity in Orkney with over 200 known sites and another 200 in Shetland. The density of this site type therefore exceeds that of any other in Britain with the exception of the bronze age round barrow in some areas.

A mound of burnt stones is a low heap of fire-affected stones intermixed with backened earth, between 1.5 m height and 20 m width. Some have upright slabs and narrow cells, stone tanks and are close to the water, a stream or boggy ground and come in groups. The shape is irregular or horseshoe like in plan with the concave part facing the water (Huxtable *et al.* 1976, 5).

The excavation at Liddle Farm in South Ronaldsay revealed 200 m^3 of burnt stone, ash charcoal, the remains of a small oval house, 6 x 4 m solidly build of stone, a large hearth and a stone build trough. Very few artefacts and no bone and shell were found (Hedges 1974, 8) and it was dated to 900–500 BC (Hedges 1974, 10). Fluxgate gradiometry showes strong permanent magnetic effects and increased magnetic susceptibility as a result of heating which gives geophysical confirmation even when the site is entirely covered with vegetation (Hedges 1974, 8–9).

Hedges (Hedges 1974, 8) suggests the majority of burnt mounds was used for cooking but were primarily settlements because:

1. The large number of sites prevents specialization to be the case
2. No other types are known in Orkney for that period
3. Quality of construction is high

The limited use of pottery could relate to the absence of wood as fuel since cooking pots on peatfire would not survive the heat, that is, if the peat that was fired was of normal density, since cooking on lighter heat can still be achieved by burning low density peat from the top layer (Brundle 2008).

Chapter 7

Conclusion

An idea, that works as a theory for the moment, as in science, is as good as any other and for the moment, one finds that, regarding the end of the last glacial maximum (LGM), there is the general global experience of human struggle of finding possible settlement places. A struggle which was marked by the retreat of the ice, leaving moraines and freshwater basins and flowers behind and floods, immediately correlated with the break–up of large glaciers and their descent into the seas. This way, tsunami waves occurred in coastal regions, while mountain regions saw floods along newly formed rivers and lakes. In this water–driven environment of instability and nature appearing renewed, stability would have been of demand to humanity and continuity would have meant relaxation. The need to regain energy out of stability would have driven people to places with freshwater and hunting grounds closely related and where fuel and berries could easily be gathered.

Looking into the Orkney landscape, within arctic climate and its islands emerging out of the flood (local folklore has it that the island of Eynhallow was the last to be *reclaimed* from the sea), a place of stability in terms of micro climate, water levels, and a mixture of vegetation to grow, and supplied with plenty of perimetric mountains with their barns for freshwater supply, the central western Mainland would have been preferable. This is, where most of the possible crannogs are located, or, where most of the lochs have got islands.

Whether or not the tradition of artificial island dwelling is really old, seems to be clearer when we take a look at the evident fact that the way of life on a swimming reed–made island as in lake Titicaca would have saved people from the disasters of rapidly rising water levels correlated with floods, and provided freshwater and food the easiest way. Since fishing is not an essentially exhausting hunt with predictable dangers, while staying with the family at the same time, it would have provided the lake dwellers with much needed shelter and support. For a growing, isolated community, stability and closeness would have meant much and the rest is provided by fuel for cooking and warmth. Although there was a general lack of building material for log boats for connection with the ever changing shoreline, reed would always have been available, of which boats can easily be made which last at least for a season. For people, who would have been used to fishing, in the ice age, the lochs would have been the ideal environments, and they still

are, although today, with the advancement of underwater vegetation as a side effect of field fertilisation, the oxygen contents descent into levels, where fish cannot survive in former quantities.
However, the final goal of these observations is that one can find very old traditions being reflected in settlement and believe patterns throughout human activity and provided with this insight an assumption can be made.
This is that a site type, whether it might be a crannog, a natural island, or an unidentified island, is of such great archaeological potential that it might not just *hold* the information of times very long ago, but also *keeps* them in an amazingly well preserved state as is typical for waterlogged remains. As time goes by, simply due to the fact that the site type represents the very first of all possible settlement types, it may become inhabited again, when recurring floods and climates perturb settlement and supply patterns.
This theory of striking beauty and simplicity and merely represents a general rule that underlies all settlement patterns or, to speak with Einstein once again: "The most incomprehensive thing about the universe is that it is comprehensible." (Greene 2000, 385)
But as with all theories, this is but just one that works, maybe *because* the climate is changing and stability has become a desire, again. Maybe the romanticism idea of a castle and drawbridge, that is surrounded by water, emerged from the same need for stability in a climatically changing world, rather than from the need of defence, for retreat and/or shelter. The passing over the water surely implies a change of view, a passing into another world, another environment, or a different realm. Maybe the journey has to be undertaken for clarity and transformation into a different state. Then, the drawbridge would just be an addition to the water's very presence that is anyway going to provide the transforming means of transport. As a transporting entity it certainly possesses this power.
Whether the explanation of why they exist will be revealed to us by themselves is uncertain but the mystery of crannogs and the like is unbroken, even now, as it is water that surrounds them, that transforms them into a place of difference, and "as we collectively scale the mountain of explanation, each generation stands firmly on the shoulders of the previous, bravely reaching for the peak. Whether any of our descendants will ever take in the view from the summit and gaze out on the vast and elegant universe with a perspective of infinite clarity, we cannot predict." (Greene 2000, 387)

Outlook

For further research projects on crannogs, islands or islets, the environmental aspects are of crucial importance, as they can proof the ideas outlined in this work. The geophysical approach should be further developed and field strategies should be outlined by incorporating seasonal changes in crops activity, and other land use, since it was shown that, indeed, all methods used during the underlying fieldwork, were suitable and reliable, but strongly dependent on various surface conditions.

Gradiometer and Resistivity field surveys should include all of the exposed surface, though standard hazard and danger preventions are implicitly restricting the surveyed area.

In the special cases of Loch Wasdale and Loch Bosquoy, excavations should be undertaken for evaluation of the validity of the geophysically obtained data. This includes either underwater excavations or pumping systems to be involved at Loch Bosquoy Crannog, since it's extends reach a depth of 2 or 3 meters above bedrock, and are only a few tens of centimetres above the summer water mark. On the same location, the correlated structures on–shore should be further investigated, especially the burnt mount should be excavated and the trough should be examined as it might be that a log boat was re–used there, which would provide a relative date for the crannog.

All islands, listed in the appendix, should be surveyed and further researched, whether connected by causeways or not. A framework for carrying of equipment on boats should be outlined to access otherwise neglected sites with large potential for being undisturbed. These isolated sites represent a category of greatest value.

All research data, in general, should be published immediately and made accessible to the world wide community for comparison and interdisciplinary work.

Summary

With regards to the preliminary set aims and objectives (2.5), the following findings and outcomes where achieved:

Desk based site assessments and environmental aspects have set the framework for a new theory concerning crannog origin and meaning, geophysical investigations on crannogs have been carried out with findings that are offering a structural analysis, even without excavation. Unfortunately, the data could not be compared to any other because no comparable data was published (although there is information that some exist, such as GPR and EI on two Irish sites (Ovenden 2008), as well as a Resistivity survey at Llangorse, Powys (Redknap and Lane 1994, 191)). The sites have been compared to Scottish and international sites of similar character and the structural evidence to be expected in Orkney was discussed.

Practically, access to the sites has turned out to be an underestimated difficulty, but the strategies of application of geophysical methods turned out to be sufficient. The weather conditions are a priority in many aspects such as the level of submergence, the strength of the wind and rain, and the saturation effect on instruments, as well as is the unexpected intensity of the sun. Beneficial aspects will include the publication of the data immediately after fieldwork in the world wide web, the experiences gained in handling instrumentation and setup as well as the methods of analysis outlined in Chapter 5. Excavation strategies were discussed in the outlook and the general benefit of the first concrete strategy of investigation of such sites in Orkney and elsewhere is of crucial benefit as well as the fact, that the level of economy of the approach and the detail of the data is rather high, especially when compared to the costs of excavations. Nevertheless, Geophysics can not un–bury the past, but that is to some extend also true for excavations. Archaeologically, the drawback that Bretta Ness could not be accessed is a rather disturbing issue as it would have been of some importance for comparison of data with the information gained from excavations. On the other hand, the excavation report had not been published at the time of our fieldwork. The investigations have certainly revealed some interesting facts, even without the use of underwater archaeology. The next step would be to include such methods for a wider picture of the structural appearances. The environmental contexts have been studied to some extend and showed a clear relationship between freshwater, sheltered basins of micro climatic character and islands or crannogs in Orkney. Strategies for excavations are outlined in the outlook and can further be pushed forward with the data included in this work. The multiperiodicy of the two sampled sites could only be claimed for Loch Wasdale Crannog, where substantial mounds of debris showed up on GPR and EI sections, but generally, the appearance is substantial and not necessarily multiperiodic. After environmental comparison, the relation whith brochs is strikingly obvious, and can be stated as concerned with **control, supply** and **shelter**. Finally, a framework has been set for crannog studies in general, and for Orkney, with a list in the appendices and the approach taken in this work, in particular.

.1 List of sites

Site Name/Location	NG Ref	RCAHMS/NMR/OS N^{o}	Orkney records[HS]
(Bretta Ness/Loch Wasbister)	HY 39723325	HY33SE 12 (2004, WB2)	468
Burrian/Loch Wasbister – subst. CW	HY 395334	HY33SE 77 (2004, WB1)	466
Stoney Holm/Loch of Swannay	HY 31132731	HY32NW 6 (1946, 20)	1576
VoyA/Loch Stenness	HY 26031504	HY21NE 85 (2004, St1)	–
VoyB/Loch Stenness	HY 261149	NY21NE 1 (2004, St2)	–
Knowe of Burrian/Harray marshes	HY 30821680	(1946, 17–8)	1603[1431]
Further potential crannogs			
Park Holm/Loch Swannay	HY 31272695	HY32NW 5 (1946, 20)	1575[1362]
Various sites in Loch Hundland	HY 292254	–	– *
Loch Isbister – CW	HY 25722334	HY22SE 35 (1946, 16)	1726
Loch Banks	HY 27502340	–	–
Loch Sabiston	HY 29052243	–	–
A+B/Loch Sabiston – interconn. CWs	HY 29372199	HY22SE 10 (1946, 22)	1716[1372]
Loch Skaill	HY 245179	–	– *
Loch Clumly	HY 25681627	–	–
ST4/Loch Stenness	HY 26421411	–	–
Loch Bosquoy – subst. CW	HY 30501837	–	2928 !
Loch Wasdale – CW	HY 34321473	HY31SW 8 (1946, 227)	579
’Stepping Stones’/Loch Harray – CW	HY 28861958	–	**
Lyermira/Loch Harray	HY 29651807	–	–
Ess Ness	HY 29751658	–	–
Peedie Bushan/Loch Harray	HY 28501567	–	–
Big Bushan/Loch Harray	HY 28501508	–	–
’BockanA’/Loch Harray	HY 29031452	–	–
’BockanB’/Loch Harray	HY 29111452	–	–
Baa Holm/Loch Harray	HY 30871410	–	–
Stenny Holm/Loch Harray	HY 30701386	–	–
Loch Harray	HY 30851354	–	–
Loch Harray	HY 30701340	–	–
’near Barnhouse site’/Loch Harray	HY 31281265	–	–
Holm of Westquoy/Loch Kirbister	HY 36650772	–	–*
Holm of Groundwater/Loch Kirbister	HY 37190814	HY30NE 6 (1946, 177)	1444[1463]
Peerie Water (Mainland)	HY 33302720	–	–
Loch Brockan	HY 39471898	–	–
Roos Loch/Sanday	HY 658445	–	– *
Ancum Loch/North Ronaldsay	HY 762544	–	– *
Larger islands with natural shapes			
Muckle Holm/Loch Swannay	HY 31432748	–	–
Holm of Kirkness/Loch Harray –CW	HY 292189	–	–
Ess Holm/Loch Harray	HY 297164	–	–
’Reed Meadow’/Loch Harray	HY 286156	–	–
Ling Holms/Loch Harray	HY 288156	–	–
Sand Holm/Loch Harray	HY 29251405	–	–
Ling Holm/Loch Harray	HY 305143	–	–

Table 1: *List of crannogs and other potential islands in Orkney; Listed crannogs and other potential sites. Abbreviations are: NG Ref = National Grid Reference, RCAHMS = Royal Commission of Ancient Historic Monuments Scotland, NMR = National Monuments Record, OS = Ordnance Survey, CW = Causeway. *: Crowley 2008, 38, **: OS 1903 sheet XCIV.16, !: site location needs correction*

.2 Photographic register

Aerial photographies of Loch Wasdale Crannog can be found in the Orkney records at HY31(4), no 23, 24 and 25, the latter two showing wallfaces in 1964. North is approximately to the top of the view.

Figure 1: *Aerial photography of Loch Wasdale Crannog, Orkney Records at coordinates HY31(4), no 23.*

Figure 2: *Aerial photography of Loch Wasdale Crannog, Orkney Records at coordinates HY31(4), no 24.*

Figure 3: *Aerial photography of Loch Wasdale Crannog, Orkney Records at coordinates HY31(4), no 25.*

One aerial photography showing Loch Bosquoy Crannog and causeway submerged can be found in the Orkney records at 6–1a, no 3360. Although submerged, the causeway can still be identified from a different angle on picture no 3361. North is approximately to the top of the view.

Figure 4: *Aerial photography of Loch Wasdale Crannog, Orkney Records at 6–1a, no 3360.*

Figure 5: *Aerial photography of Loch Wasdale Crannog, Orkney Records at 6–1a, no 3361.*

The following two photographies show the sites of Loch Wasdale Crannog and Loch Bosquoy Crannog during fieldwork in Summer 2008.

Figure 6: *Loch Wasdale Crannog during fieldwork, summer 2008 (Christen 2008).*

Figure 7: *Loch Bosquoy Crannog during fieldwork, summer 2008 (Christen 2008).*

Lake Titicaca and it's swimming islands made of shilf and Tenochtitlan, the Aztek swimming island build around a rock in the Mexico city basin, which was then flooded and a lake at the time of the spanish invasion.

Figure 8: *The swimming shilf islands of the Uros people at lake Titicaca, Bolivia and Peru (Wikipedia 2008d).*

Figure 9: *Shilf boats of the Uros people at lake Titicaca closely resemble those in ancient Egypt (Wikipedia 2008f, EB 2008).*

Figure 10: *Tenochtitlan, the Aztek capital in Loch Texcoco during the arrival of the Spanish invaders in Mexico City Valley (Wikipedia 2008e).*

A reconstuction drawing of the earliest found Crannog by Alan R. Braby shows a post and wattle fencing on a stone made structure circumferencing several continuously rebuild houses in occupation by 3650 BC until 2600 BC (Armit 1998, 33–5). The site before excavations looks very similar to loch Bosquoy Crannog in Orkney.

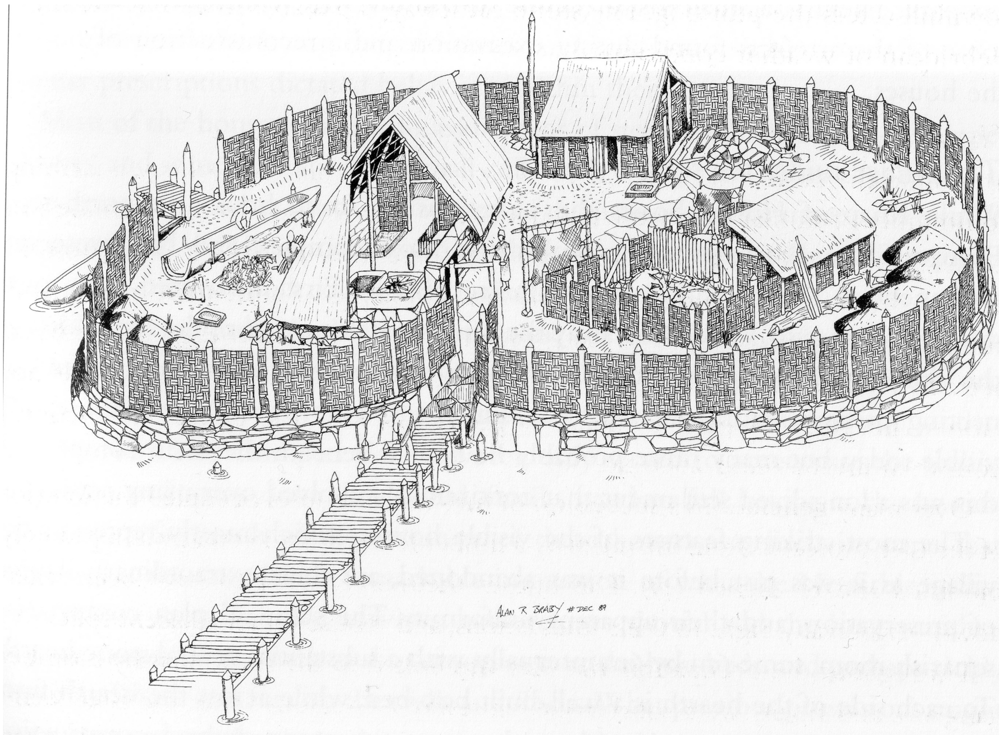


Figure 11: *The Neolithic Crannog Eilean Domhnuill, North Uist, reconstruction drawing by Alan R. Braby (Armit 1998).*

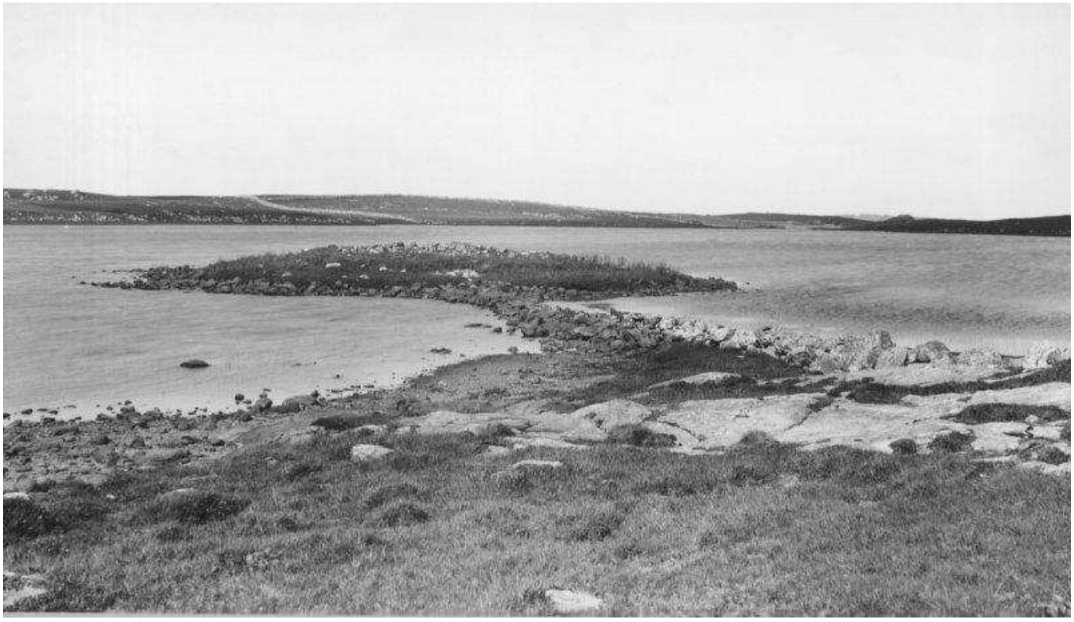


Figure 12: *The Neolithic Crannog Eilean Domhnuill, North Uist, before excavations (Scotland-sPlaces 2011).*

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