USING GIS TECHNIQUES IN ANALYSIS OF STONE AGE SITES, MACRO LEVEL ANALYSIS OF LANDSCAPE STRUCTURES AND MICRO LEVEL ANALYSIS OF INTERNAL SITE STRUCTURE AND ORGANIZATION

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Abstract

In this paper the use of Geographic Information Systems (GIS) in analysis of landscape and intra-site organization is demonstrated. The archaeological material consists of Mesolithic sites in the county of Akershus in Norway.

This paper deals with the use of GIS techniques in the analysis of coastal Mesolithic sites in the Follo region south of Oslo. South-Eastern Norway has been subject to isostatic rise ever since the retreat of the ice 10 000 years ago. Around Oslo the land has been raised more than 200 meters and is still rising, although very little now. In south-eastern Norway there is no trace of eustatic sealevel rising, as is documented in south-western Sweden, western Norway and further north along the Norwegian coast. This means that older coastal sites always lie higher than younger ones and shore level dating is often applied when working with chronology. The Mesolithic of south-eastern Norway is divided into four phases, according to typology and heigth above sea-level (Mikkelsen 1975). The sites referred to in this paper mostly belong to phase 3 Nøstvet (7400–6300/5600 years BP), and some may be older, belonging to phase 2 (8300–7400 years BP).

The following examples will show how GIS can be used for the study of spatial distribution of sites in the landscape, and their connection to resources, in this case diabase dykes. Some of the excavated sites have been analysed with respect to spatial distribution of refuse and artefacts.

The Follo region lies in Akershus, between Oslo and Østfold county, fig. 1. During the last 10–15 years more than 250 new Mesolithic site have been located, due to intensive inventoring of this region in connection with zoning and building of new roads, railways etc. (Berg & Uleberg 1995). The locations of most sites have now been digitized, and are therefore available for analysis using GIS. Fig. 2 shows the distribution of sites. This and the follwing maps have been constructed using PCArcInfo and ArcInfo.

Most of the sites will according to heigth above sea-level belong to the Nøstvet phase of the Mesolithic, although there are some younger and very few older sites. This map reflects the zoning and building intensity in the region, more than prehistoric cultural reality. The long "chains" of sites along the lake Årungen, and in Vestby does not mean that these are the only sites around, but this is where right now new roads and railway lines are in the process of being built.

Fig. 3 gives a closer look at the northmost cluster of sites. Here the shore line 50 meters above sea-level has been included to give an idea of the differences in the landscape more than 6000 years ago. The classic Nøstvet site, from which the Nøstvet culture got its name at the beginning of the century is one of the sites among the clus-

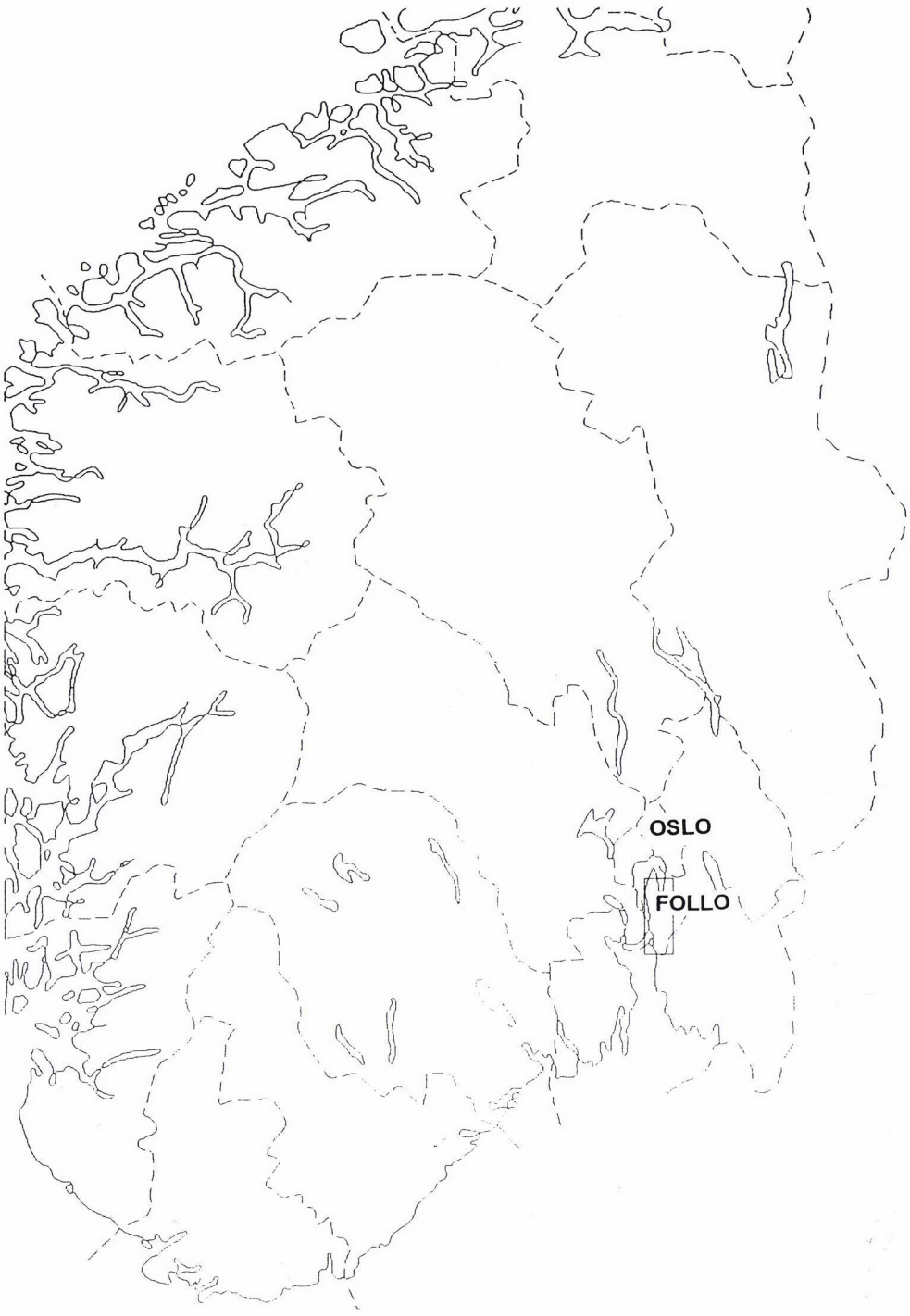


Fig. 1. The Follo Region.
Scale 1:250000

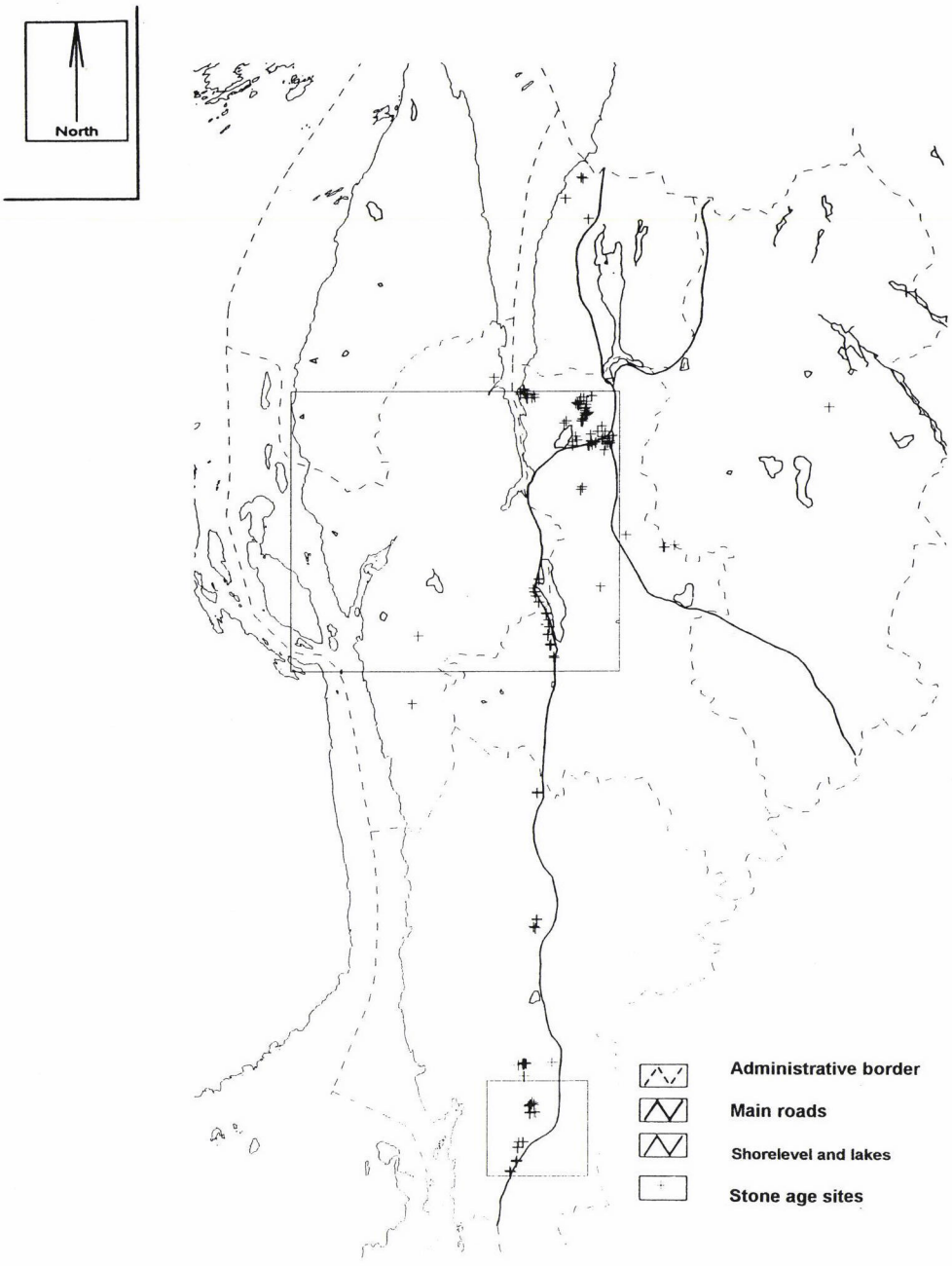


Fig. 2. Known Stone Age sites in Follo.
Scale 1:75000

ter marked "Sjøskogen". There is a very clear correlation between many of the Sjøskogen sites and the 50 meter shore line level. Sites are found at higher levels too, and a few lower than 50 meter, but the 50 meter level stands out. This kind of information is useful for both planners and archaeologists. For archaeologists this kind of map is

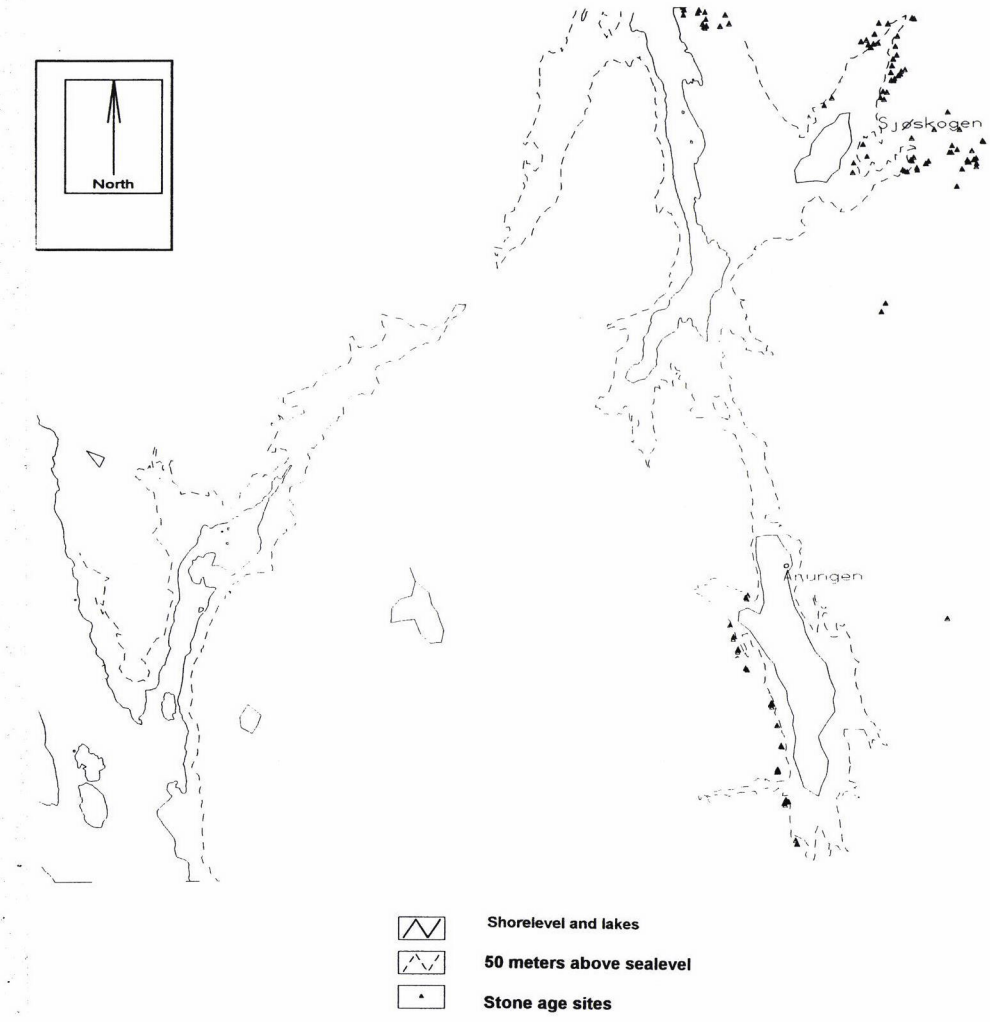


Fig. 3. The sites along lake Årungen and in Sjøskogen.
Scale 1:25000

one way of analysing the prehistoric landscape. A full analysis would demand more shore levels to show the developement over time. Another important aspect is the representativity of archeological sites. Since they most often are found by inventoring in connection with building plans this map also reflects the building intensity more than prehistoric cultural reality. The Sjøskogen area is probably more representative than the long chains of sites along lake Årungen since the whole area has been inventored intensively over the last ten years.

The "chain" of sites along lake Årungen reflects inventoring due to upcoming road building. Four of these sites will be destroyed by road construction and have therefore been excavated in 1996. The highest site lies close to 70 meters above sea-level and should according to the chronological schema be older than the Nøstvet phase. The map shows that during the time of occupation the lake Årungen was a rather narrow fjord. The sites lie in small coves and inlets opening up towards the fjord. Since

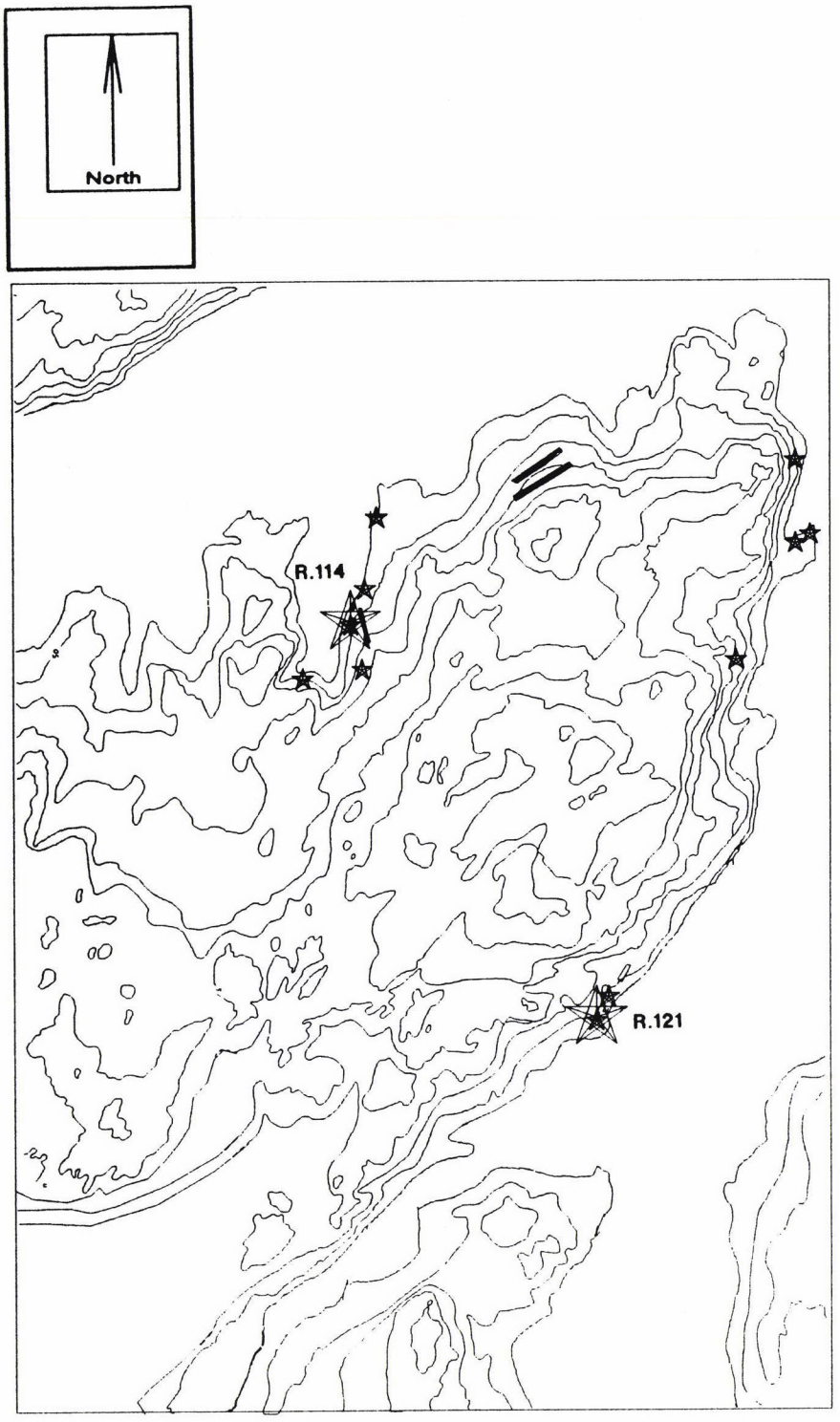


Fig. 4. Sites and diabase dykes in Vestby.
Shore level 45 m above sea-level Scale 1:5000

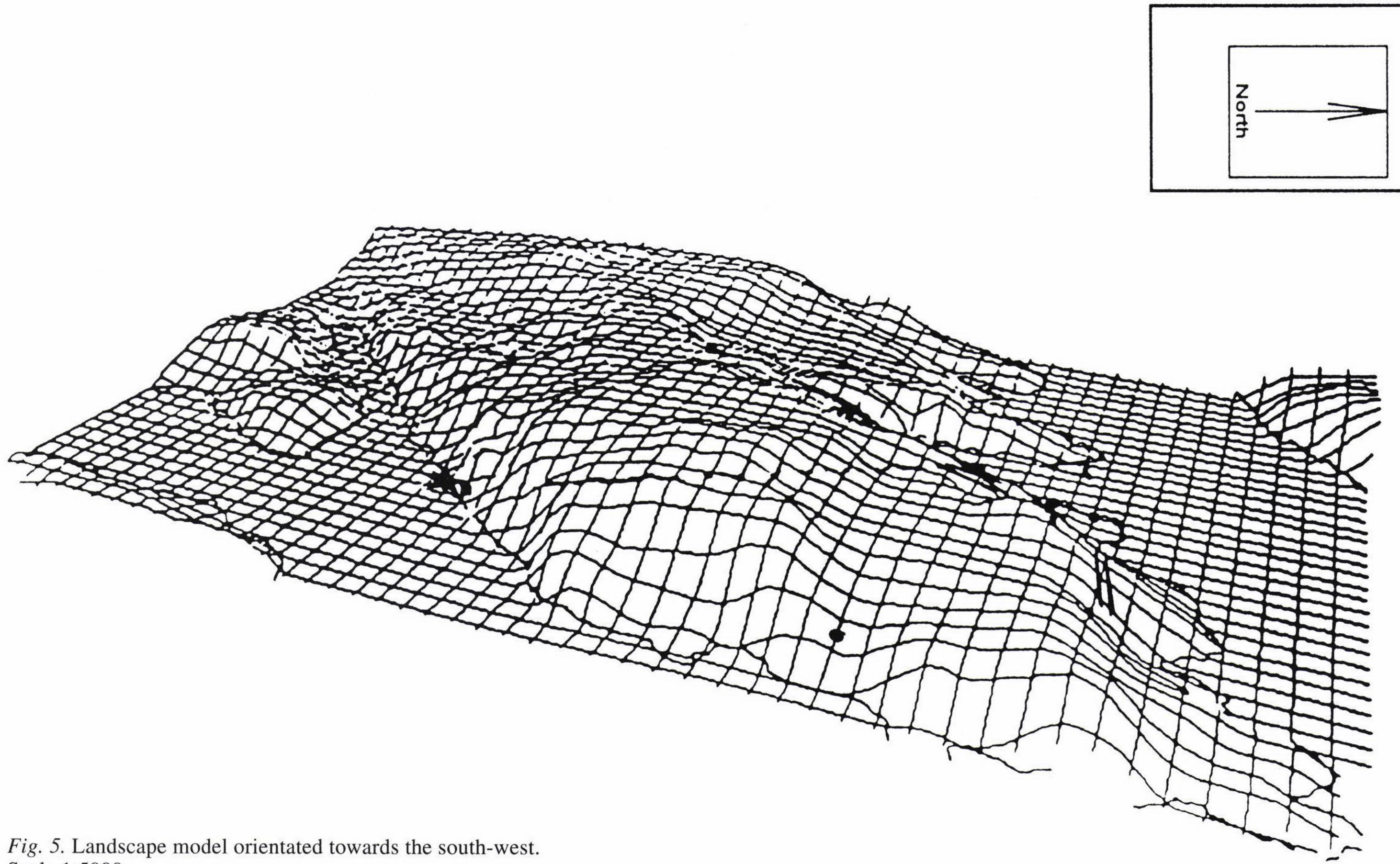
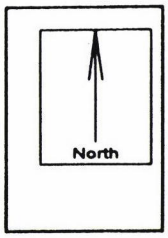


Fig. 5. Landscape model orientated towards the south-west.
Scale 1:5000



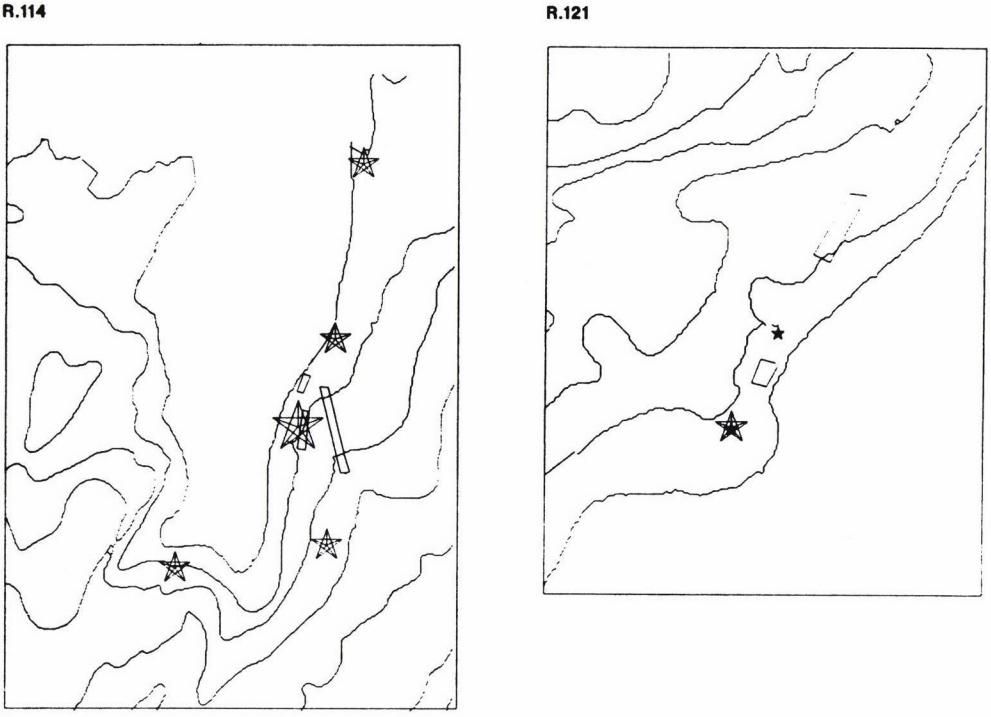


Fig. 6. Detailed maps of R.114 and R.121.
Scale 1:5000

these sites are still being excavated the micro level analyses of internal organization have not yet begun.

In 1993 eleven sites in Vestby were excavated since they would be destroyed by the construction of new motorway and new railway lines. Heigth above sea-level varies from 62 to 41 meters. All the sites except the lowermost at 41 m belong typologically to the Nøstvet phase. The one exception belong to the following phase 4. This is also the only site which could be dated by ^{14}C, the rest can only be dated by typology and heigth above sea-level (Berg 1995).

None of the sites contained cultural layers. Most of them seem to have been occupied a fairly short time, and the activites performed must be inferred from the artefact types and the spatial distribution of artefacts and refuse.

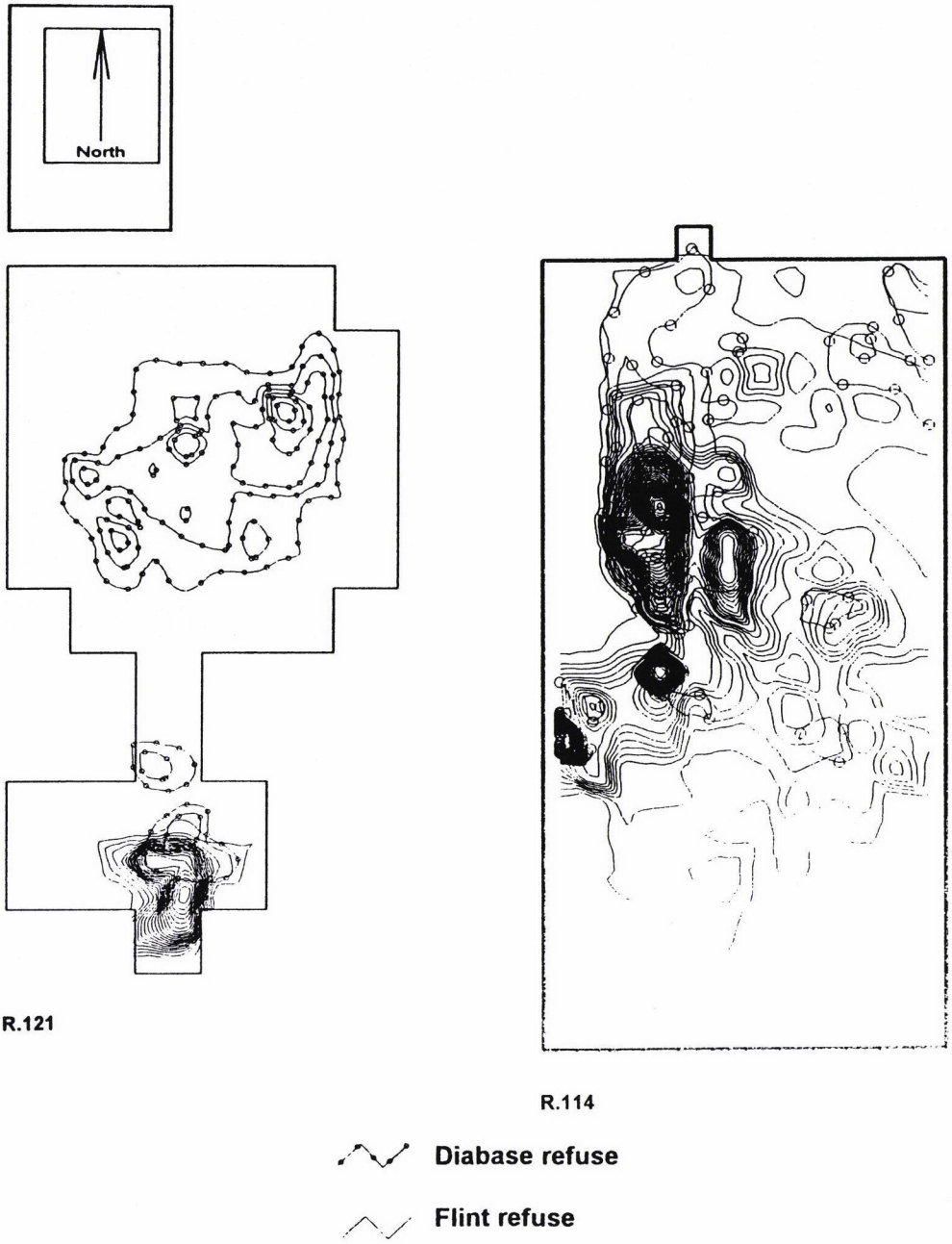


Fig. 7. The spatial distribution of diabase and flint refuse on R.121 and R.114.

Fig. 4 shows the location of 10 sites. The land above the 45 meter line above sea-level forms an island with several inlets. The sites lie in small coves and inlets facing a broad, but shallow fjord. In this map known diabase dykes have been included.The cluster of four sites in the north-eastern part of the island have not been excavated since they are located outside the building area for new road and railway. The rest of

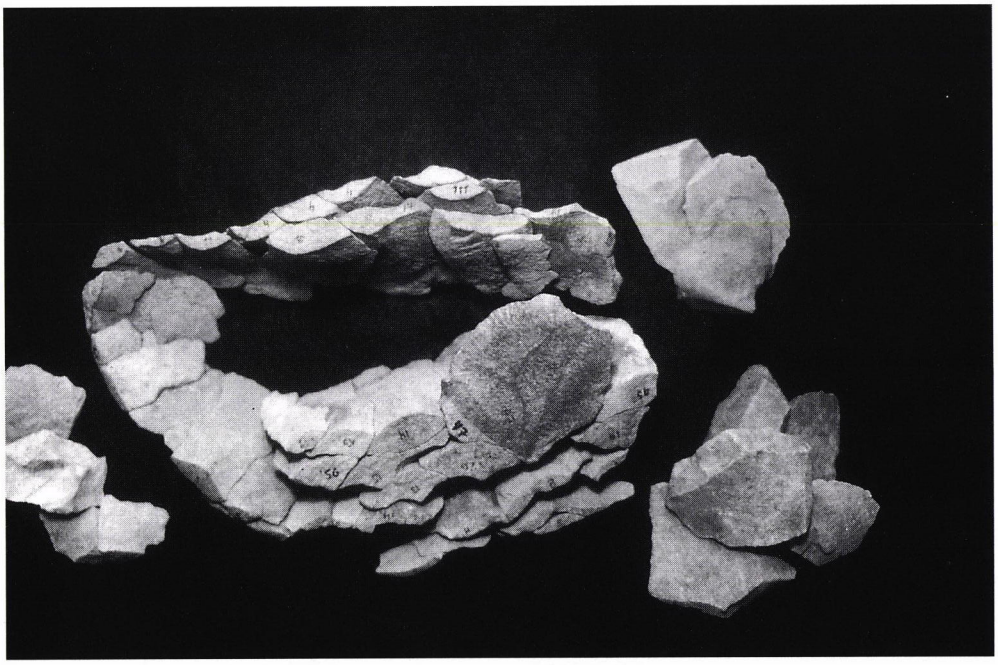


Fig. 8. Negative axe from refitted flakes R.121, together with some flakes from R.114

the sites have been totally or partially excavated and some of the results from two of them will be used in to demonstrating micro-level analysis of internal site structure.

The site named R.114 is marked with a bigger star and contained a large amount of diabase refuse including a number of blanks for Nøstvet axes/adzes. The site lies directly over a diabase dyke. R.114 is interpreted as a production site utilizing the diabase dykes which is protruding from the bedrock here. The main product is Nøstvet axes and maybe other types of axes. On the eastern part of the island R.121 is likewise marked with a bigger star. This site contained a small number of diabase flakes and four finished Nøstvet axes.

Another kind of view of the same landscape is shown in fig. 5. This landscape model was created using the TIN module of ArcInfo, and shows the landscape contours with heigths and depressions. It is based on the same map as the preceding figure and has been oriented so that the island is now seen towards the south-west.

The maps in fig. 6 show details of the sites in relation to the shore line and the location and directions of diabase dykes near R.114. A couple of dykes were found near R.121, but these are not diabase dykes. They consist of amphibolite, and due to the internal structure of the rock this amphibolite variety cannot be utilised in axe production.

The spatial distribution of artefacts and refuse were constructed from the find catalogue database. Fig. 7 show the distribution of diabase and flint flakes on R.114 and R.121. Finds were catalogued by units of $^1/_4$ m^2 and mechanical layers of 5 cm intervals. Files were exported to ArcInfo, and there one can construct distribution maps layer by layer, or by total amount. One may also choose between different artefact categories, such as flakes, and different raw materials, like flint or diabase. The maps were constructed using the TIN-module of ArcInfo, and shows the spatial distribution of diabase and flint flakes.

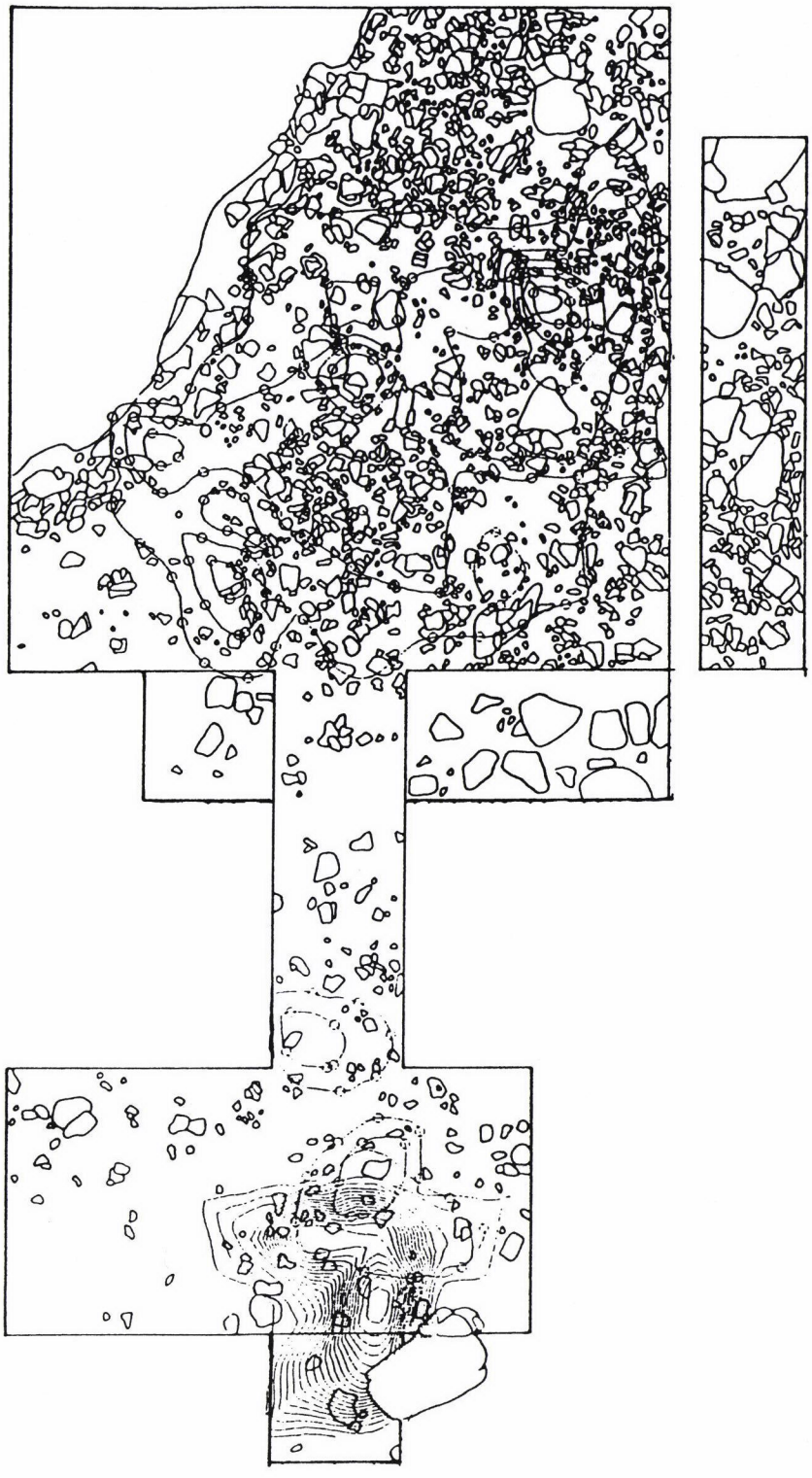


Fig. 9a. R.121. Plot combined with the distribution of natural stones.

Fig. 9b. R.121 aerial view towards the south. The stone probably used as a seat by the axemaker is clearly visible.

Fig. 10. A number of big and small flakes from R.114

Fig. 11. Diabase dyke protruding from the bedrock on R.114. This picture was taken after the works in the area had been completed and the site itself destroyed.

On R.121 the diabase refuse forms a single working area in the southern part of the site. Less than 200 flakes of diabase were found, and most of them could be refitted into a "negative" Nøstvet axe blank, fig.8. The loose flakes in the picture come from site R.114 and are included for comparison of rock structure. This negative did not fit with any of the four axes found at the site, indicating that the axe resulting from this production sequense was removed from the site and deposited elsewhere (Olstad 1995). In the case of the Nøstvet axe refitting as a method for studying the production process is possible, since it is a core axe with limited grinding performed on the edge. Most other axe and adze types cannot be refitted since they are finished with heavy polishing or pecking.

Combining the plot with a drawing of big and smaller stones on the site shows that the axemaker very probably sat on a stone facing north-west during the production, fig. 9a and 9b. The flint refuse is mainly concentrated in the northern part of the site, indicating a couple of working areas.

The spatial distribution of diabase flakes on R.114 shows a heavy concentration in the western part of the site. It is not possible to distinguish working areas for single axe production activities here. More than 30 000 flakes of diabase were recovered from this site. Some of them are shown in fig. 10.

The diabase found on R.121 very likely originated from the dykes on R.114, fig. 11. Based on visual analysis the rock composition, texture and structure of the diabase is similar. This leads to the conclusion that the raw material for the diabase axes was taken in the form of a lump from R.114 and used for production of at least one axe on R.121.

Conclusion

GIS techniques can be used in both macro and microlevel analyses of Stone Age sites. Find distribution maps can also be constructed using other kind of software, like CAD programs, but in these programs the ability to keep a database with information related to each entity on the map is restricted. With GIS one can navigate from an overview of the sites in a chosen area down to details about the excavation and analyses performed.

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