AN ANALYSIS OF MAGNETIC SURVEYS AT THE FORT CLATSOP NATIONAL MEMORIAL, OREGON: THE SECOND SEASON

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INTRODUCTION

Fort Clatsop National Memorial near the town of Astoria, Oregon is the site of Fort Clatsop erected by Lewis and Clark in 1805. This site has been tested by excavation at various times. There is a reconstruction of the Fort at the Monument but the precise location of the Fort is not known. As part of the ongoing archaeological study of the Fort, a magnetic survey was conducted over part of the site area in 1996 (Weymouth, 1997). That survey covered about 600 square meters south-west and about 200 square meters north-east of the reconstructed fort. In 1997 another magnetic survey was carried out covering a little over 800 square meters north-east of the reconstructed fort and north of the area covered in 1996. About 33 square meters of this survey overlapped the 1996 survey. This is a report of the 1997 survey.

BACKGROUND

On November 7, 1805 the Lewis and Clark expedition reached the estuary of the Columbia River (Ferris, 1975). For several days, and in bad weather, they explored the north shore of the estuary for a suitable winter camp site. Finding the north shore inhospitable and lacking in game they crossed over to the south shore on November 26 and eventually on December 7 they located a site 3 miles up what is now known as the Lewis and Clark River. They started to build a fort Called Fort Clatsop after a local Indian tribe. It was a 50 feet by 50 feet enclosure with two rows of cabins inside facing each other. Although not finally completed until December 30 the men moved in on Christmas eve.

The Lewis and Clark expedition left Fort Clatsop March 23, 1806 for their return trip. The abandoned fort was all but gone by the 1850's. In 1856 a Mr. Shane, who built a cabin at the site, reported that there existed remains of two of the Lewis and Clark cabins. In June and July of 1948 Caywood conducted some exploratory excavations. He reported that there was evidence of "charcoal and then later some thin layers of orange-red burned earth and burned stones of about the size of baseballs and larger". These excavation units are indicated on the GIS maps produced by Keith Garnett (Garnett, 1996, 1997) (referred to here as the KG maps). Schumaker dug several trenches in 1956, 1957 and 1961. These are marked on the KG maps.

Today, in spite of several archaeological studies the exact location of the Fort is unknown. A replica of the fort was built on the site in 1955 by the Oregon Historical Society. In 1958 the National Park Service acquired the site and named it the Fort Clatsop National Memorial.

James Bell (Bell, 1990, 1996) conducted some radar surveys at the fort site in 1990. In 1996 (Bell, 1996) he conducted a more extensive survey over regions south-west and

north-east of the fort replica. These transects as well as areas of possibly significant reflections are marked on the KG maps.

MAGNETIC SURVEY METHODS

In general a magnetic survey consists in measuring the magnetic field of the earth a few centimeters above the surface on a grid of evenly spaced points. Slight differences in concentrations of weakly magnetic iron oxides beneath the surface can give rise to anomalies in the mapped data. Such concentration differences can have anthropogenic causes such as filled pits, fired or burned earth including bricks, intrusive walls and cellars or privies (see Weymouth, 1986).

There are two ways to measure the earth's field, total field or gradient. In the total field method the magnitude of the field, regardless of direction, is measured. In the gradient method the gradient of the field or the difference between two readings separated by a short vertical distance is measured. A gradiometer emphasizes near surface features and tends to cancel deeper of longer range features but the signals are slightly weaker than those of the total field method. It is best to use total field data for quantitative analysis of individual anomalies. All of the 1996 data were obtained using a Geoscan FM36 Fluxgate Gradiometer.

An area 20 m by 40 m was laid out north-east of the reconstructed fort in units of 10 m by 10 m blocks. Figure 1 is a layout of the blocks. These blocks were surveyed with two Geometric G856 total field proton magnetometers with a sensitivity of 0.2 nT, one placed on the grid points spaced 1/2 m by 1/2 m, the other positioned off the grid and fired simultaneously for diurnal correction. The G856 data were obtained with a crew under the supervision of Ken Karsmizki, Museum of the Rockies, Montana State University. The surveys were done on July 26, 27, 28 and 30, 1997. The rows and columns between the blocks were done twice, once for each block surveyed, thus producing 11 pairs of "common rows". An average and standard deviation was calculated for the difference between the corrected values of each member of a pair of common rows. The standard deviations give a measure of the operator "noise". The average of the standard deviations is 3.2 nT. This sets a lower limit for significant contour intervals.

A smaller block, Block A, was surveyed at the south end of the large area (see Figure 1) with a Geometric G858 cesium gradiometer operating continuously with a cycle time of 0.5 seconds and a sensitivity of 0.05 nT. The grid interval was 25 cm in the east direction and 20 cm in the north direction. The G 858 was also used to survey Blocks L and P in the main group. These latter surveys were discrete, not continuous, with a grid interval of 50 cm by 50 cm. The G858 data were obtained with a crew under the supervision of John Weymouth Since the L and P surveys did not add much to the G856 results these surveys will not be presented in this report. The software of the gradiometer provides not only the gradient but also separate values for the top and the bottom sensors. The bottom sensor values can be used for total field values uncorrectd for the diurnal variation.

RESULTS

The total field blocks

Figure 2 is a gray-scale map of the total field of all blocks but Block A. Figure 3 is a line contour map and Figure 4 is a shade map. In figure 3 linear anomalies associated with the Schumaker excavation trenches and current paths are marked. These trenches and paths are displayed on the KG maps. The shade map simulates sun from the west 45 degrees above the horizon.

There are several anomalies and groups of anomalies of interest. The largest anomaly at N33,E25 is clearly caused by iron, probably of recent origin and therefor of no interest. The anomalies of interest have been grouped in subregions as outlined on figure 5.

Region S

Region S contains a major anomaly as shown in Figure 6, a gray-scale map of the region. The anomaly is a normal one, that is the negative part is north of the positive part and the ratio of the positive part to the negative part is reasonable for a normal dipole anomaly. Figure 7 is a north-south profile along E23. This shows a magnitude of about 50 nT. The anomaly is not caused by a single piece of iron, although it could be caused by a collection of small pieces of iron or ruble and soil of higher magnetic susceptibility. It is either an extended source or a single source no deeper than 1.5 m. I suggest a privy for the source. Bell (Bell, 1990) ran radar traverses over this region. He recorded 4 echoes in the vicinity of the anomaly.

Region T

Region T also contains a major anomaly which is shown in Figure 8. In this case the negative part is north-east of the positive part suggesting a single piece of iron. Figure 9 is a profile along E32.5. If the source is a single piece of iron then it is about 1 Kg at a depth of about 1 m. At any rate it should be of archaeological interest. No radar traverses were run in this region.

Region U

Region U contains an interesting group of anomalies which are in the general area of where Shane's house may have been. Figure 10 is a gray-scale map of the region with a contour interval of 10 nT. Figure 11 is a profile along E 16.5 and Figure 12 along E17.5. It can be seen that the anomalies range from 20 to 50 nT and all seem to be normal dipole (non metal) type. The negative anomaly in the middle may be related to Schumaker's Trench 4 which runs through here. The individual anomalies either have somewhat extended sources or the source is less then a meter deep. In the case of the anomaly at N9.4, E14 the source is probably less than 50 cm deep. It is possible that some of these

anomalies are caused by storage pits or fire hearths or are related to footings of Shane's house. No radar traverses were run in this region.

Region V

During the survey of Block H it was realized that two anomalies were on the east edge of the block and thus the survey was extended into part of Block I. Figure 13 covers Region V in Blocks H and I. The lower region between the anomalies along E29, N9 to 11 and E30.5,N10 is where there was an excavation unit of Caywood (Caywood, 1948). Figure 14 is a profile along E 29 showing two of the anomalies. The anomaly at N15,E29 has a source that is less than a meter deep. On radar traverse was run in this region (Bell, 1990) which produced an echo near the negative anomaly.

Block A

Block A was surveyed with the Geometric G858 cesium gradiometer, providing both magnetic gradient and total field data. The south-north traverses were spaced 25 cm. The data along the traverses were collected continuously with a cycle interval of 0.5 sec providing a step of about 20 cm. Figure 15 covers Blocks C and D of the main group with Block A and the excavation unit 1996.2 in outline. Figure 16 is a map of the gradient data and Figure 17 is a map of the lower sensor data. Since Block A was covered in 19 minutes and the geomagnetic field was quiet during this time a diurnal correction was not necessary so the bottom sensor provides a total field map.

Region 2 of the 1996 survey (Weymouth, 1997) of Fort Clatsop overlaps the south end of the main blocks and Block A of the 1997 survey. It is interesting to note that all three sets of data show the same anomalies, both positive and negative except for the large anomaly at N-2.20,E19.25. This anomaly is caused by a large piece of iron very near the surface and is probably related to the excavation there. The extended anomaly in the G858 total field data along the north edge of Block A can be seen in the south-east corner of Block C of the G856 survey. This anomaly can also be seen in the 1996 data. In the gradient data, Figure 16 the anomaly is broken up. This is because gradient data resolves parts of larger anomalies more than does total field data. This anomalous region could be caused by a burning with concentrations at N1,E19 and N1.5,E16. There is a small dipole anomaly of about 5 nT at N-0.5,E17.5.

SUMMARY

An area of a bit over 800 square meters was surveyed with two G856 proton magnetometers with an addition 28 square meters covered by a G858 cesium gradiometer. All of the Schumaker excavation trenches as well as the modern paths can be seen in the data. Aside from one very large modern iron anomaly there are several individual anomalies and groups of anomalies that could be significant, particularly in Regions S, T, U and V. It is possible that some of these could be related to privies, storage pits, fire hearths or house footings.

REFERENCES

Bell, James W.

1990 Report of the Geophysical Survey of Fort Clatsop National Monument, Astoria, Oregon.

1996 Personal communication and recorded on GIS maps, Garnett, 1996

Caywood, Louis R.

1948 The Exploratory Excavation of Fort Clatsop. Oregon Historical Quarterly, Vol. 49, #3, pp. 205-210

Ferris, Robert G., Ed.,

1975 Lewis and Clark, Historic Places Associated with Their Transcontinental Exploration (1804-06). United States Department of the Interior, National Park Service, The National Survey of Historic Sites and Buildings, Volume XIII, pp. 193-196.

Garnett, Keith

1996 GIS Maps of Fort Clatsop.

1997 GIS Maps of Fort Clatsop

Weymouth, John W.

1986 Geophysical Methods of Archaeological Site Surveying. In Advances in Archaeological Method and Theory, vol. 9, edited by Michael B. Schiffer, pp. 311-395. Academic Press, Orlando, Florida.

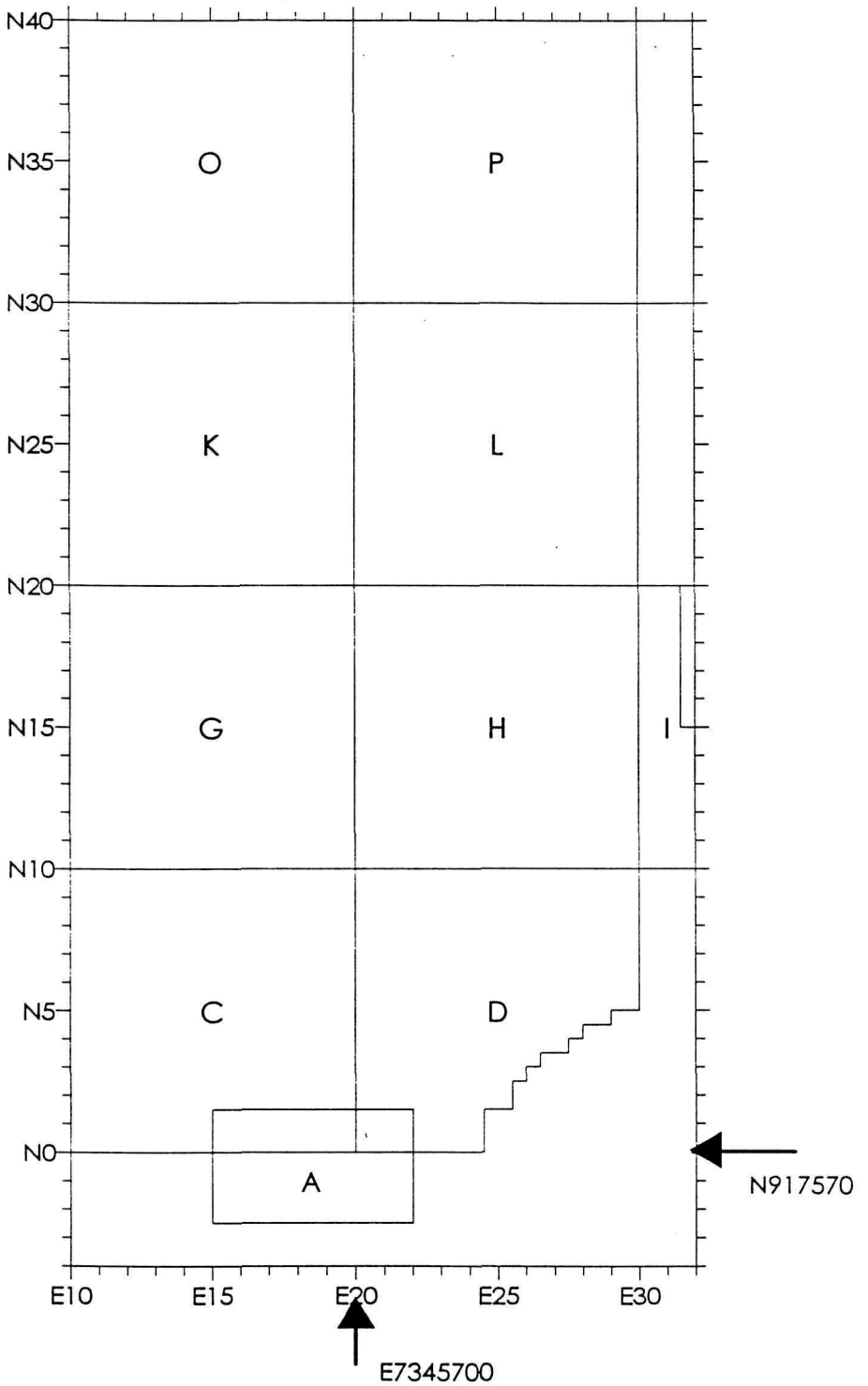

Figure 1: Block layout for magnetic surveys, Fort Clatsop, 1997

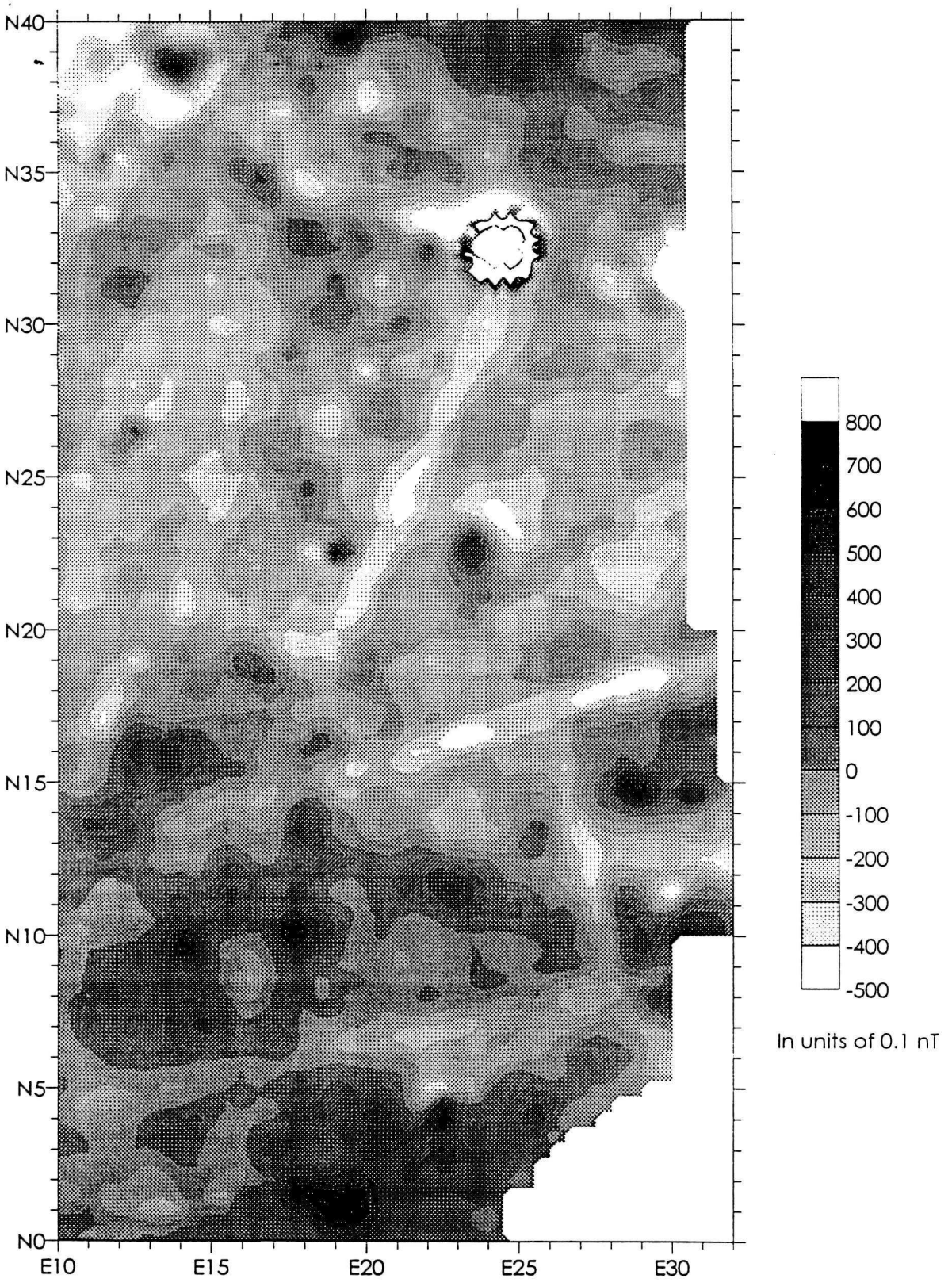

Figure 2: Fort Clatsop magnetic map, 1997. Contour interval 10 nT, clipped at +/- 50 nT.

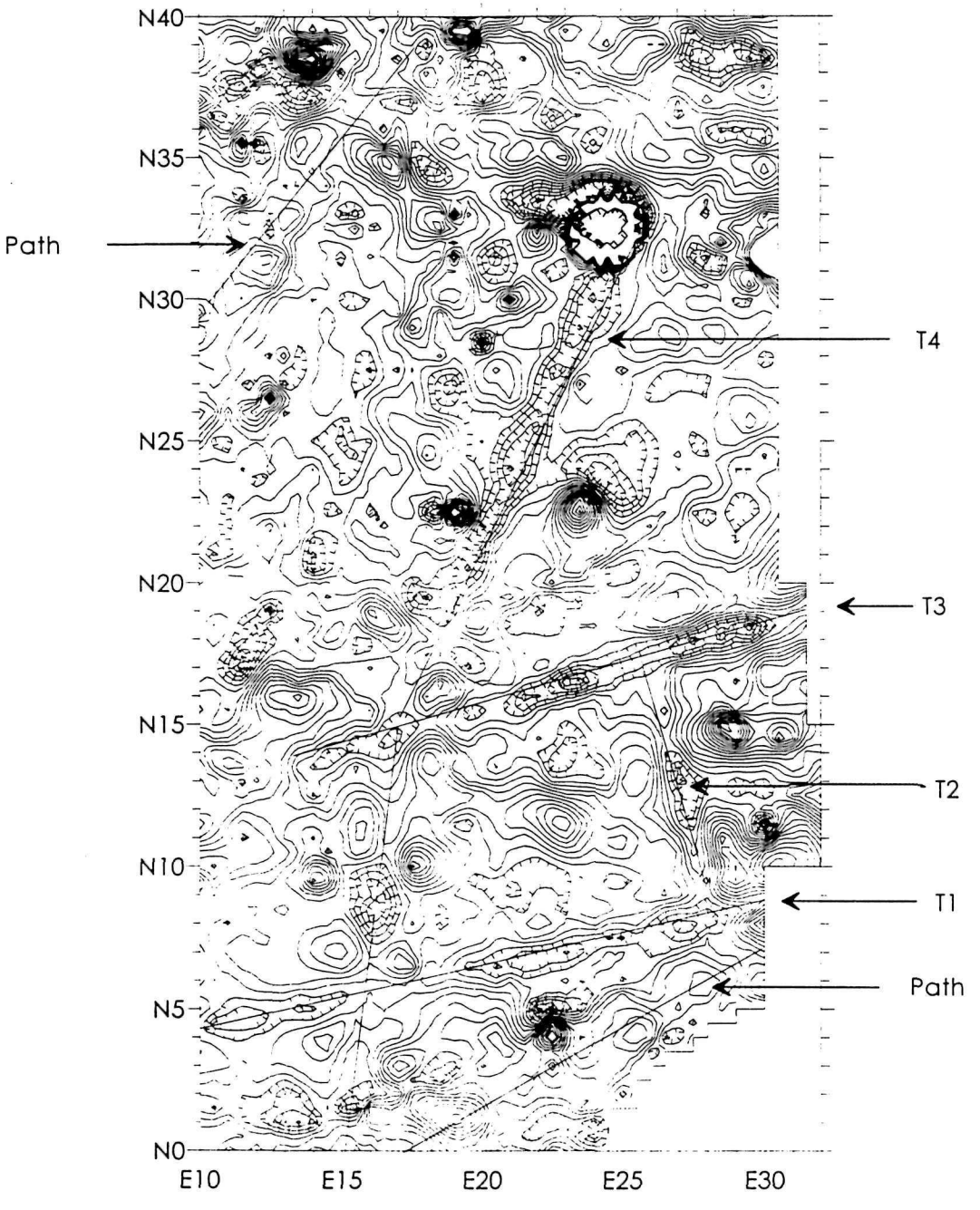

Figure 3: Fort Clatsop Magnetic map, 1997. Contour Interval 5 nT, clipped +/- 50. Paths and excavation trenches marked.

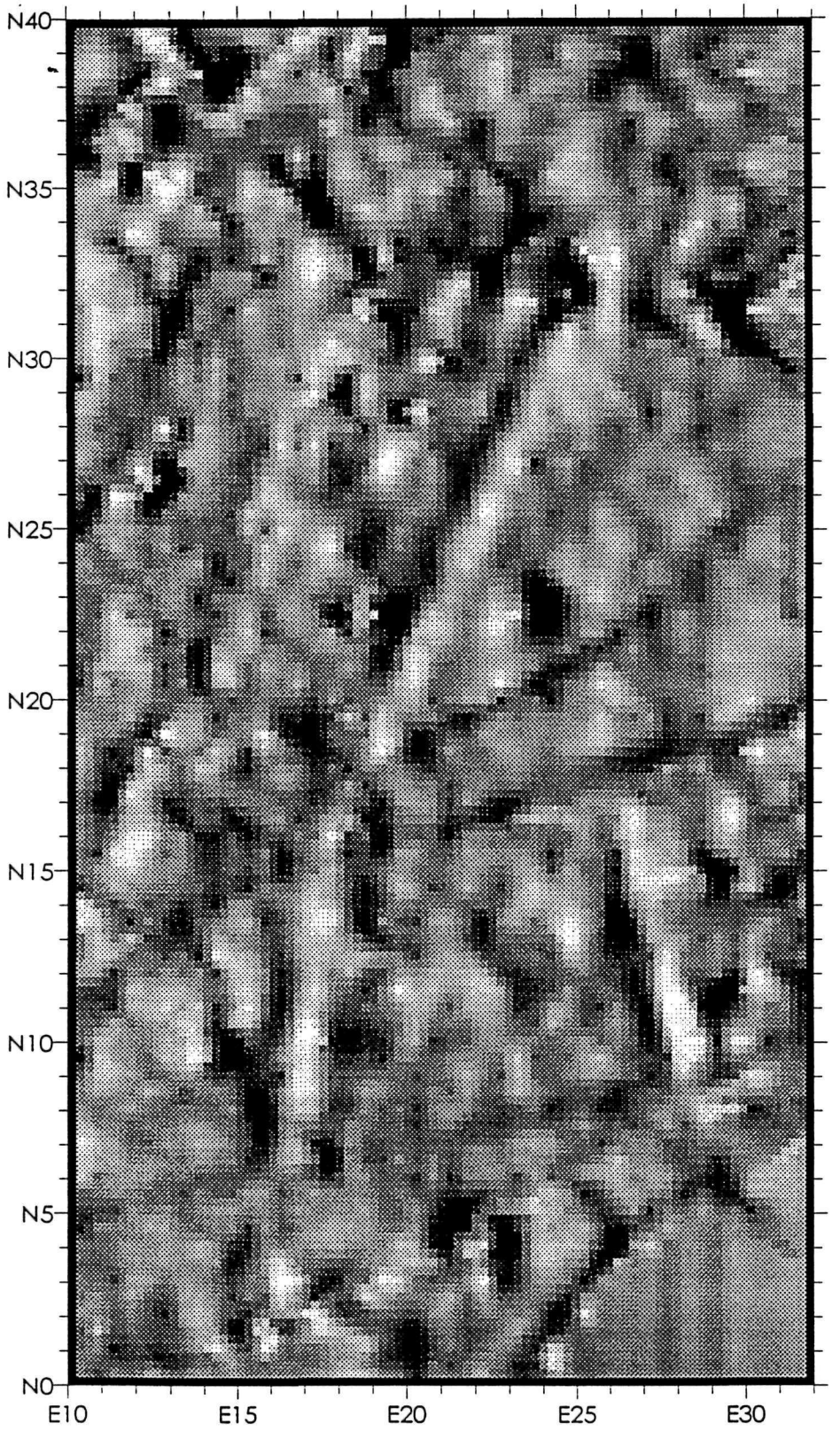

Figure 4: Fort Clatsop magnetic map, 1997. Shade map, sunshine from the west 45 degrees above the horizon

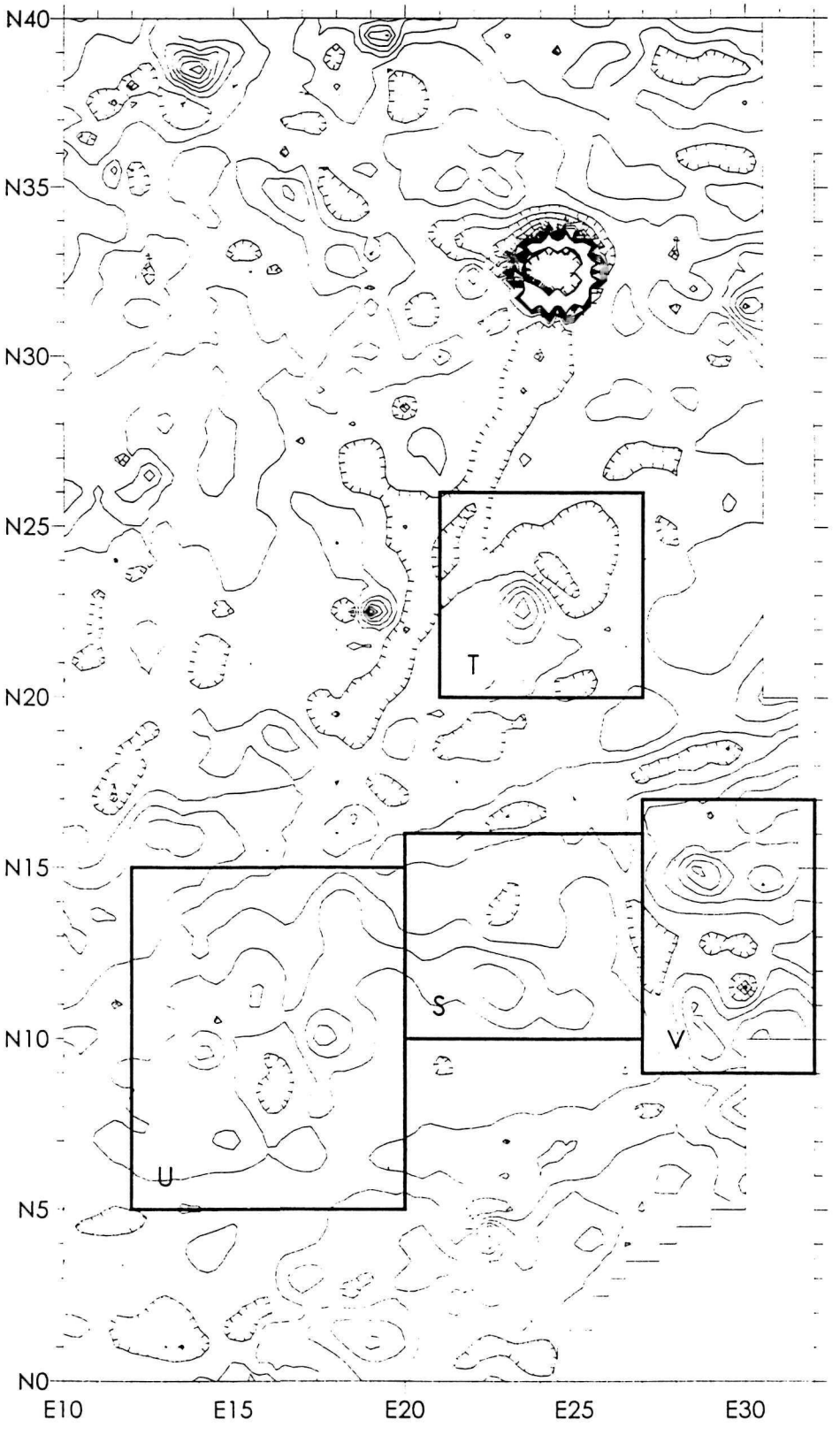

Figure 5: Fort Clatsop Magnetic Map, contour interval 20 nT, clipped +/-100, special regions marked.

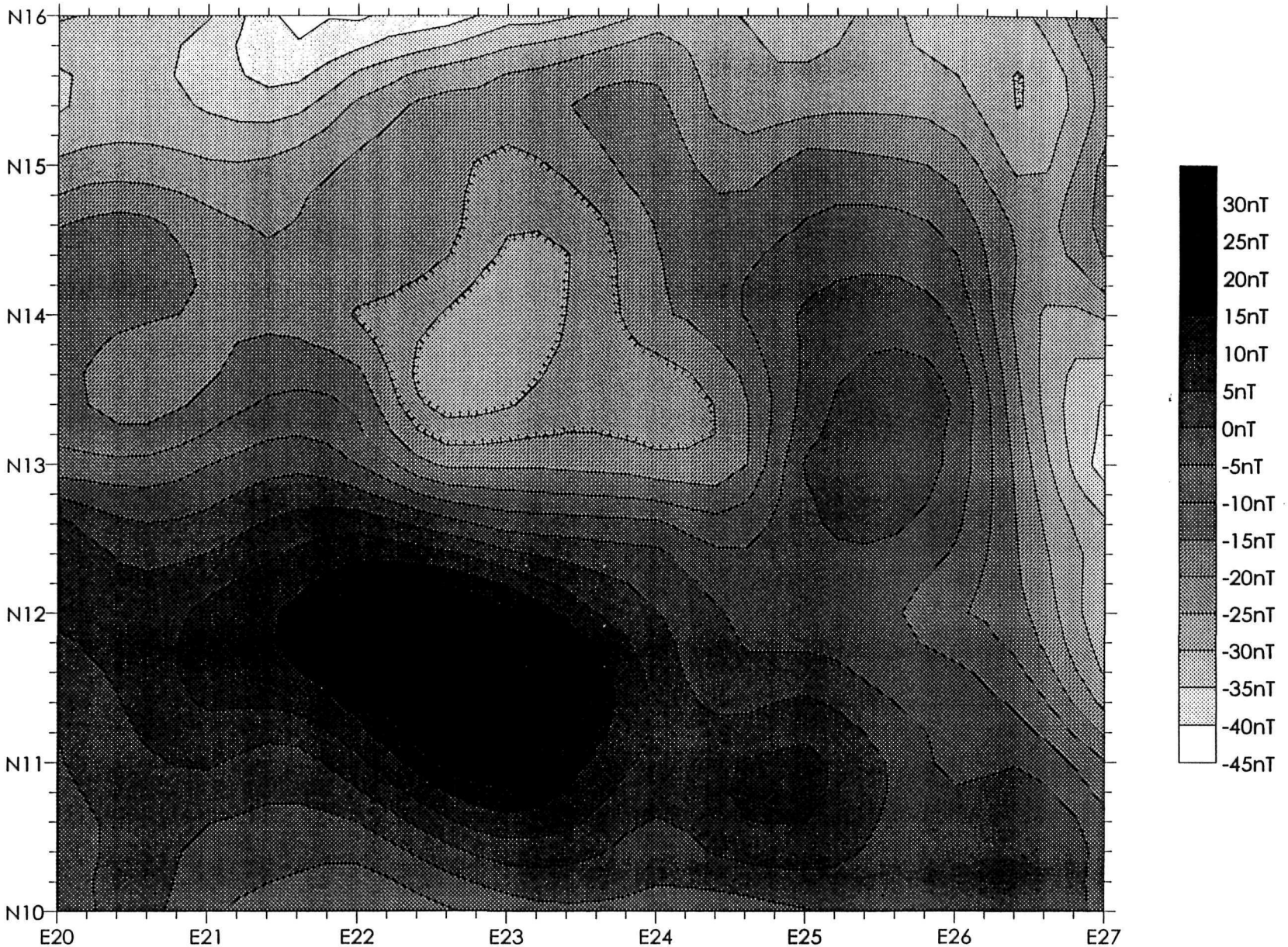

Figure 6. Fort Clatsop magnetic map, Region S.

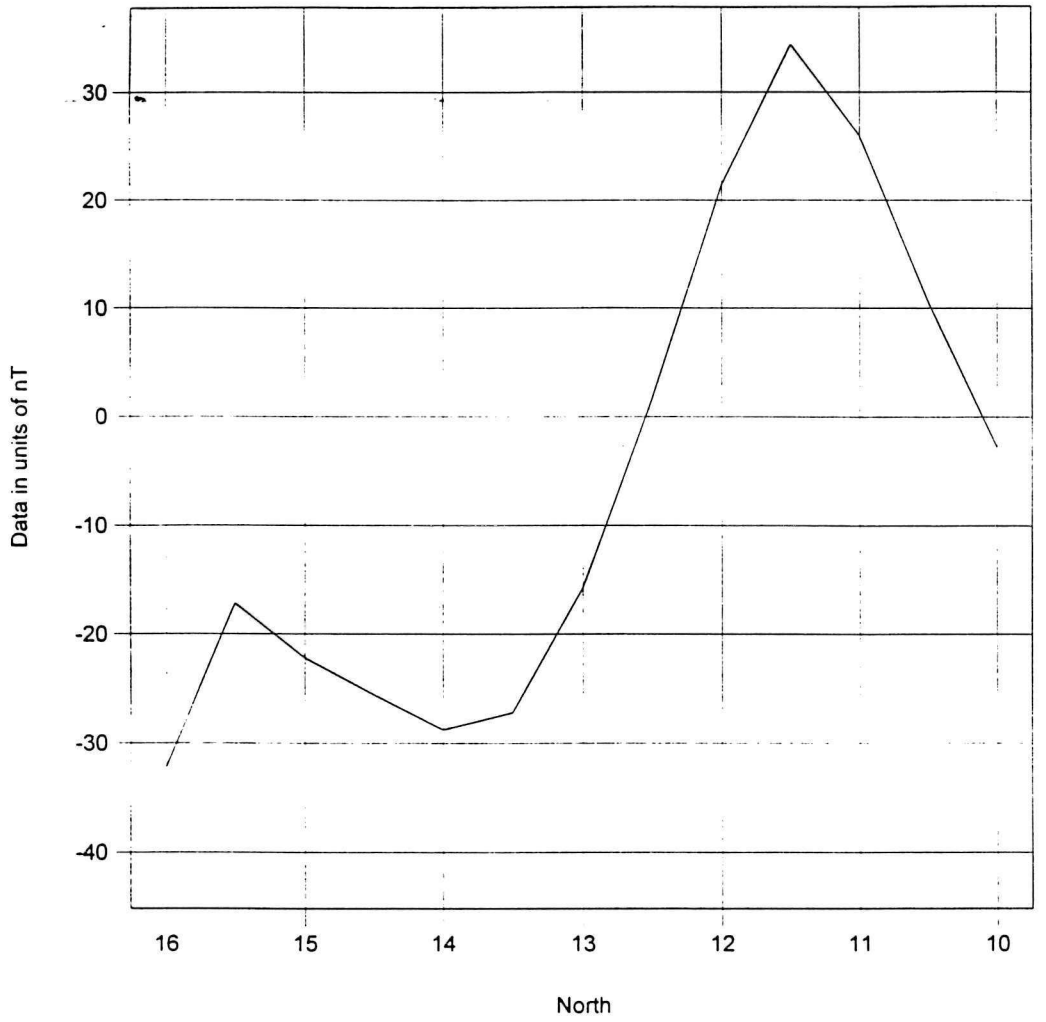

Figure 7: Fort Clatsop, Region S, magnetic profile on E23.

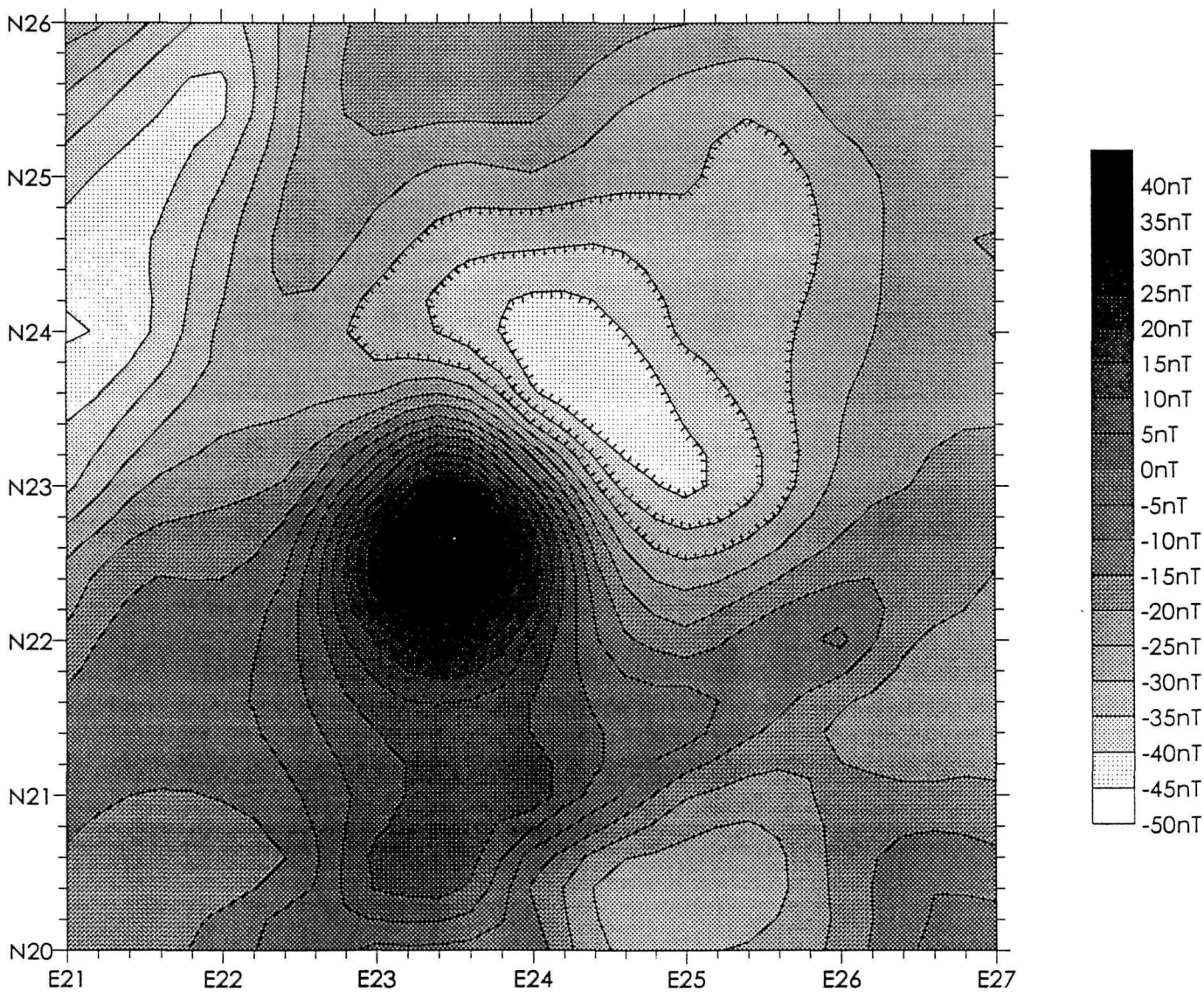

Figure 8: Fort Clatsop magnetic map, Region T.

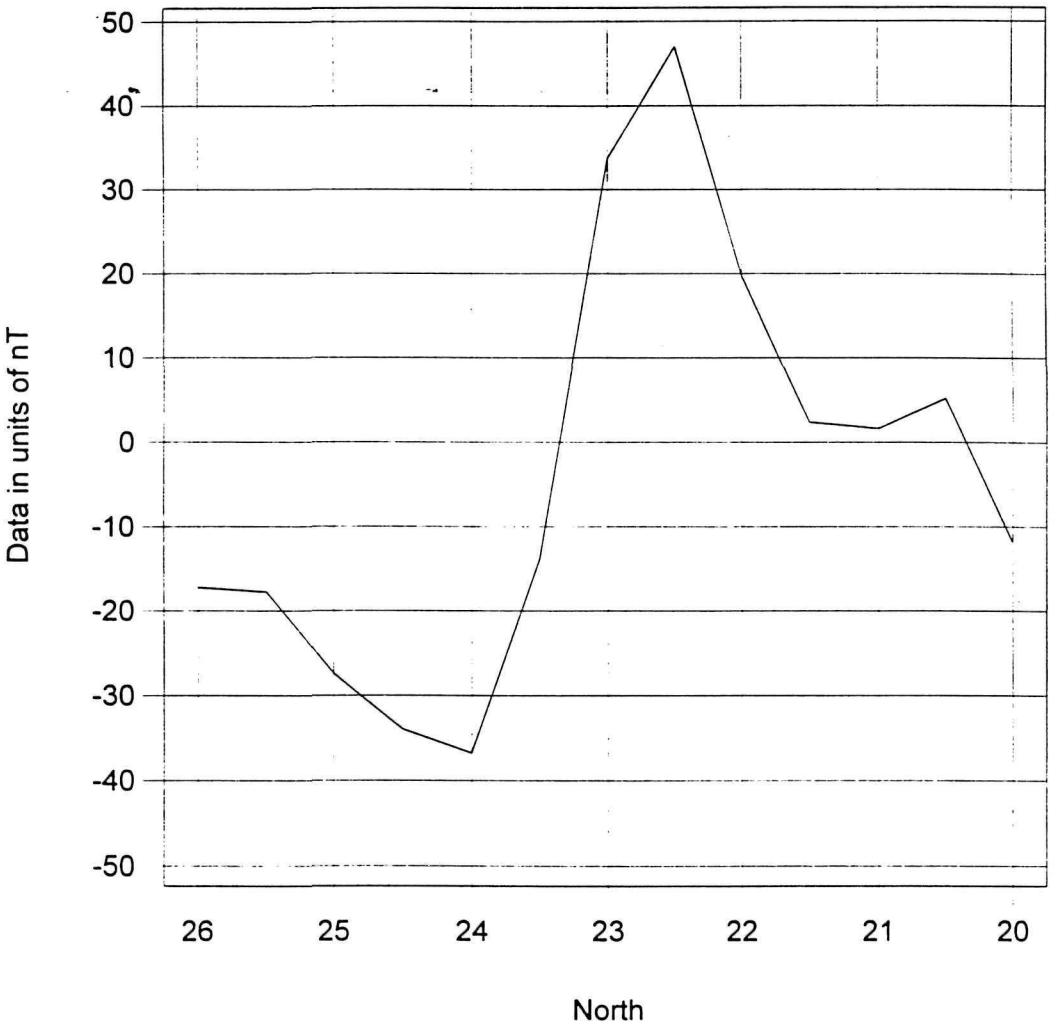

Figure 9: Fort Clatsop, Region R, magnetic profile on E23.5

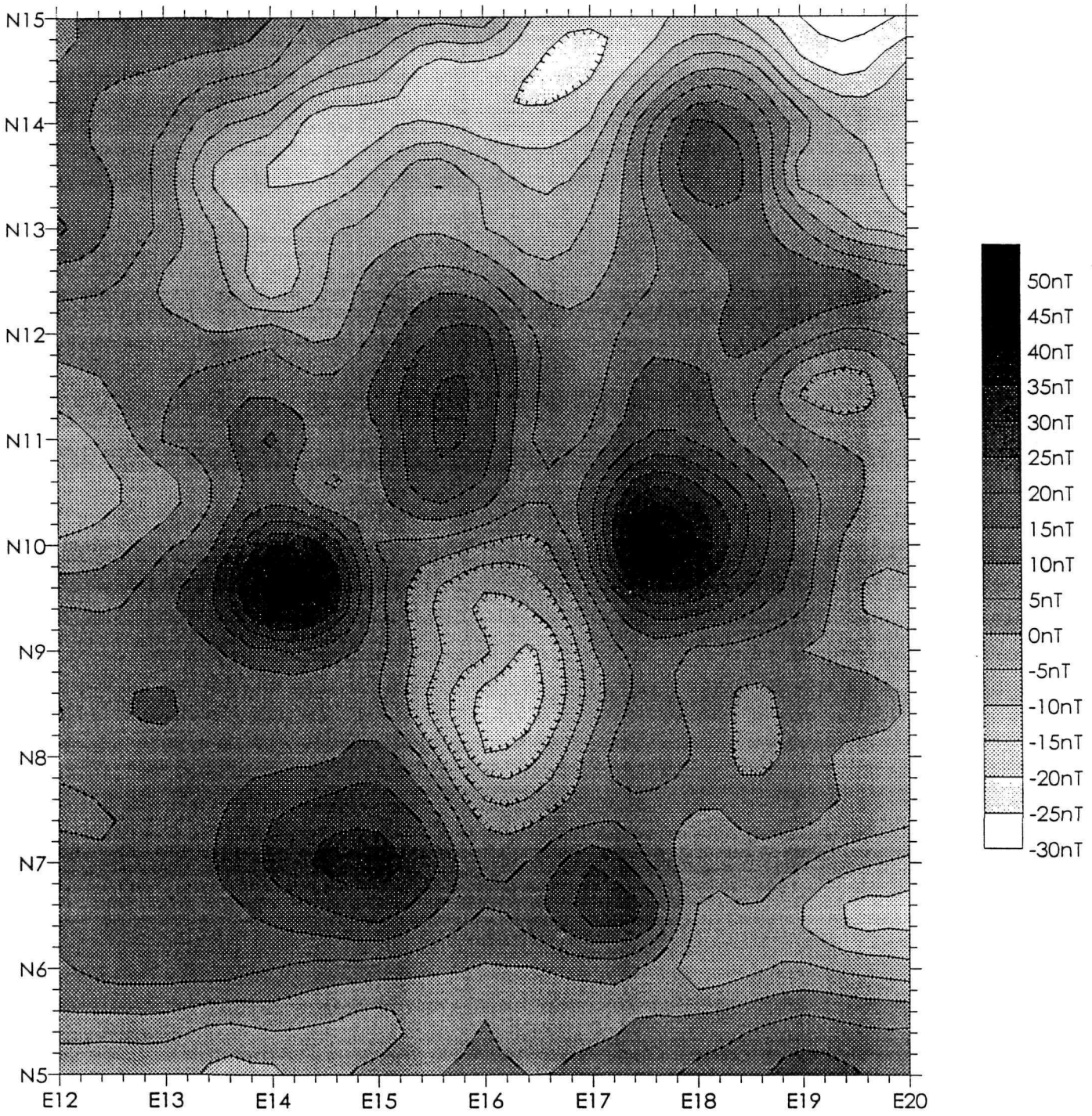

Figure 10: Fort Clatsop magnetic map, Region U.

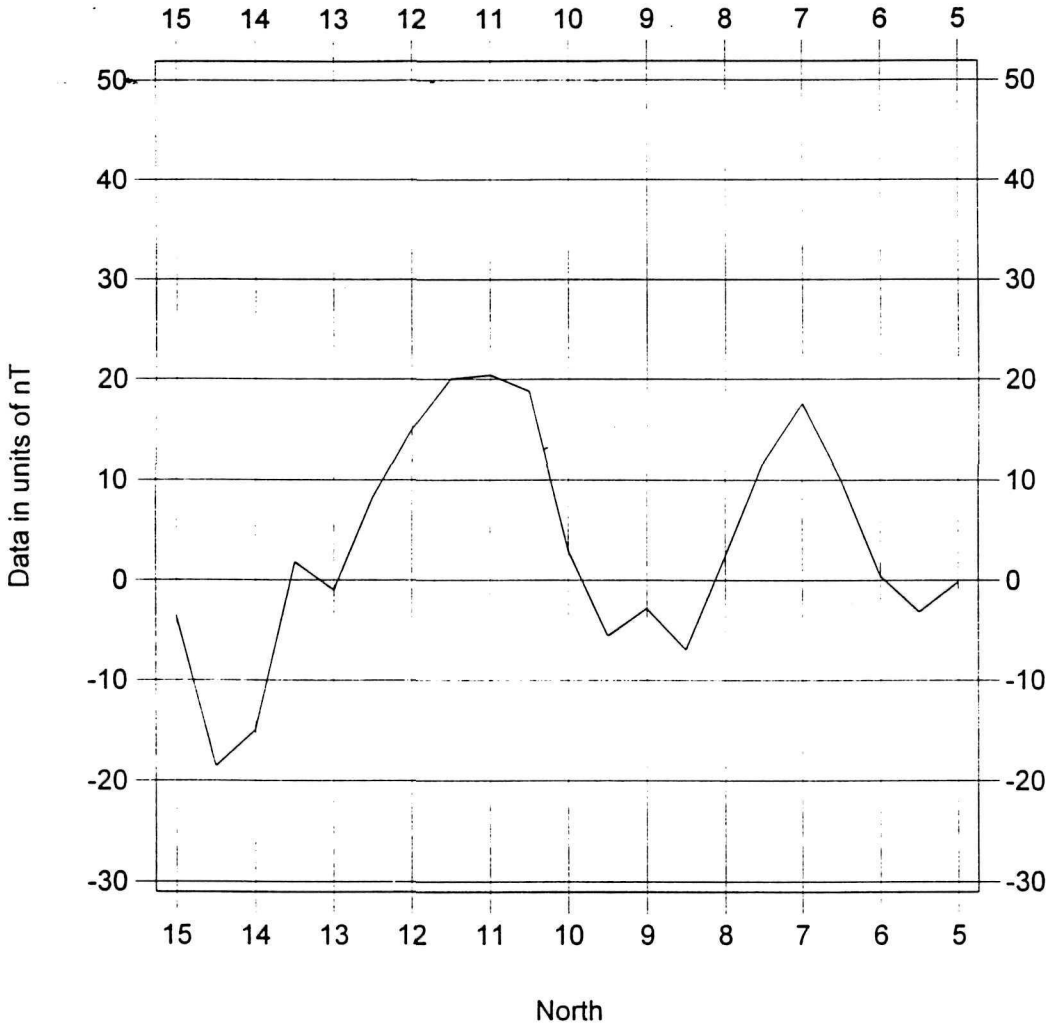

Figure 11: Fort Clatsop, Region U, magnetic profile on E15.5

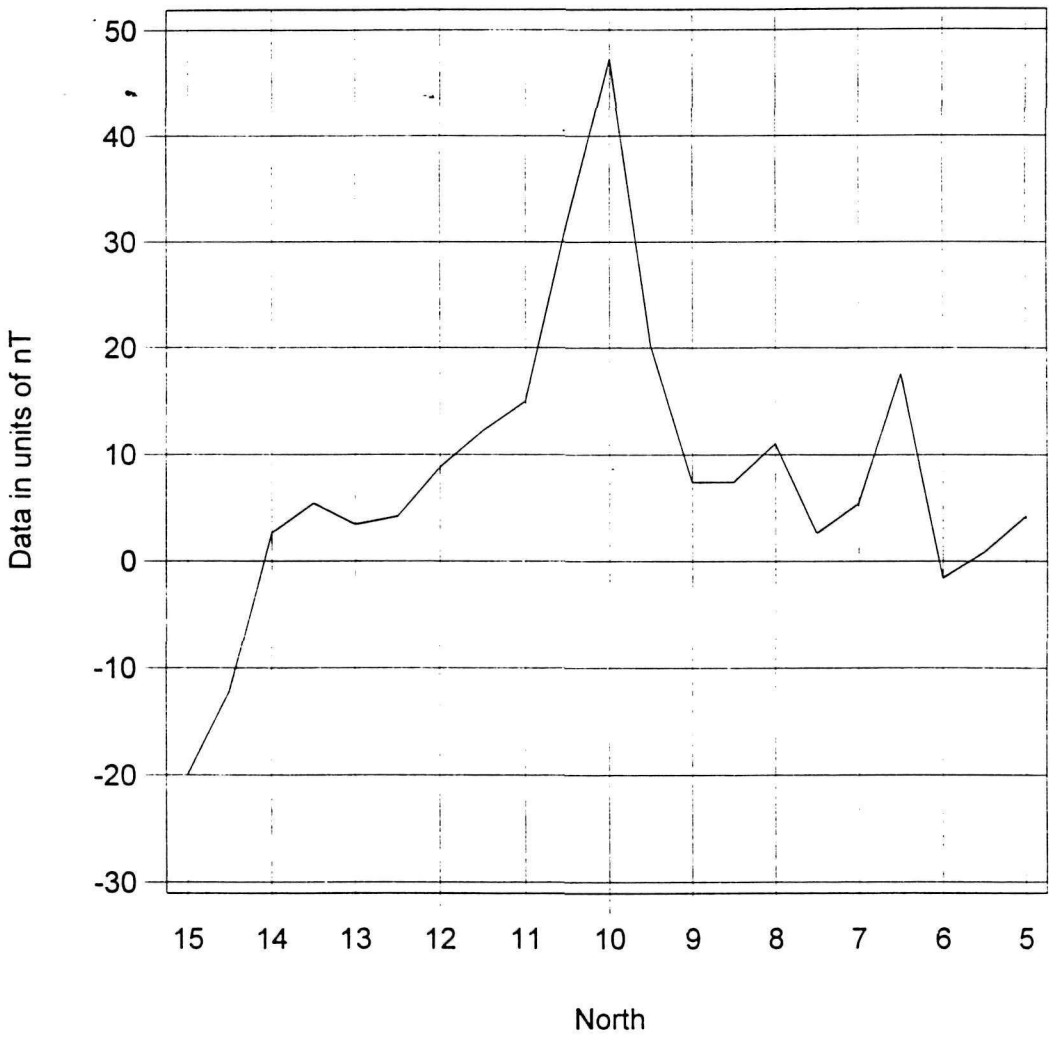

Figure 12: Fort Clatsop, Region U, magnetic profile on E17.5.

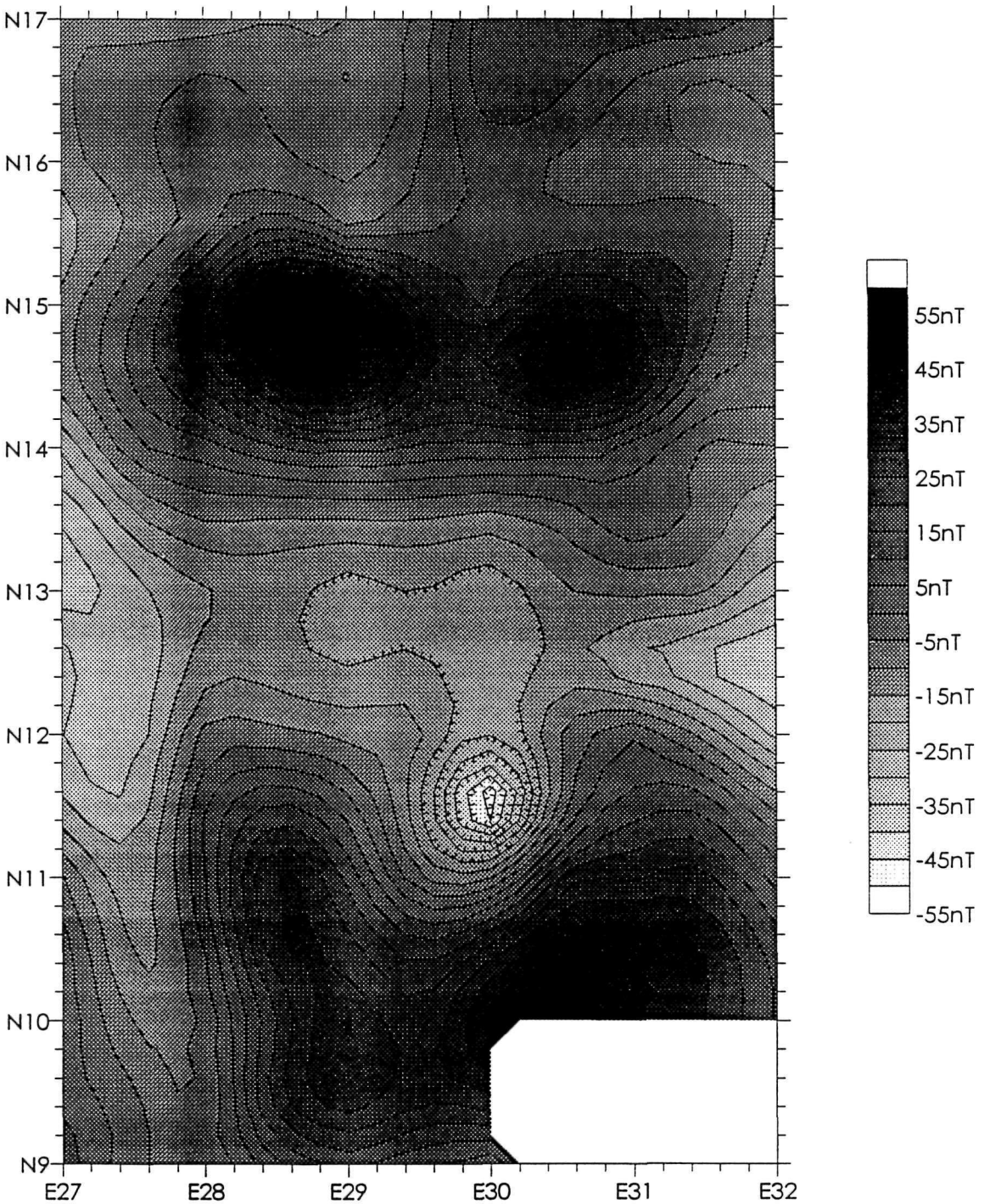

Figure 13: Fort Clatsop magnetic map, Region V.

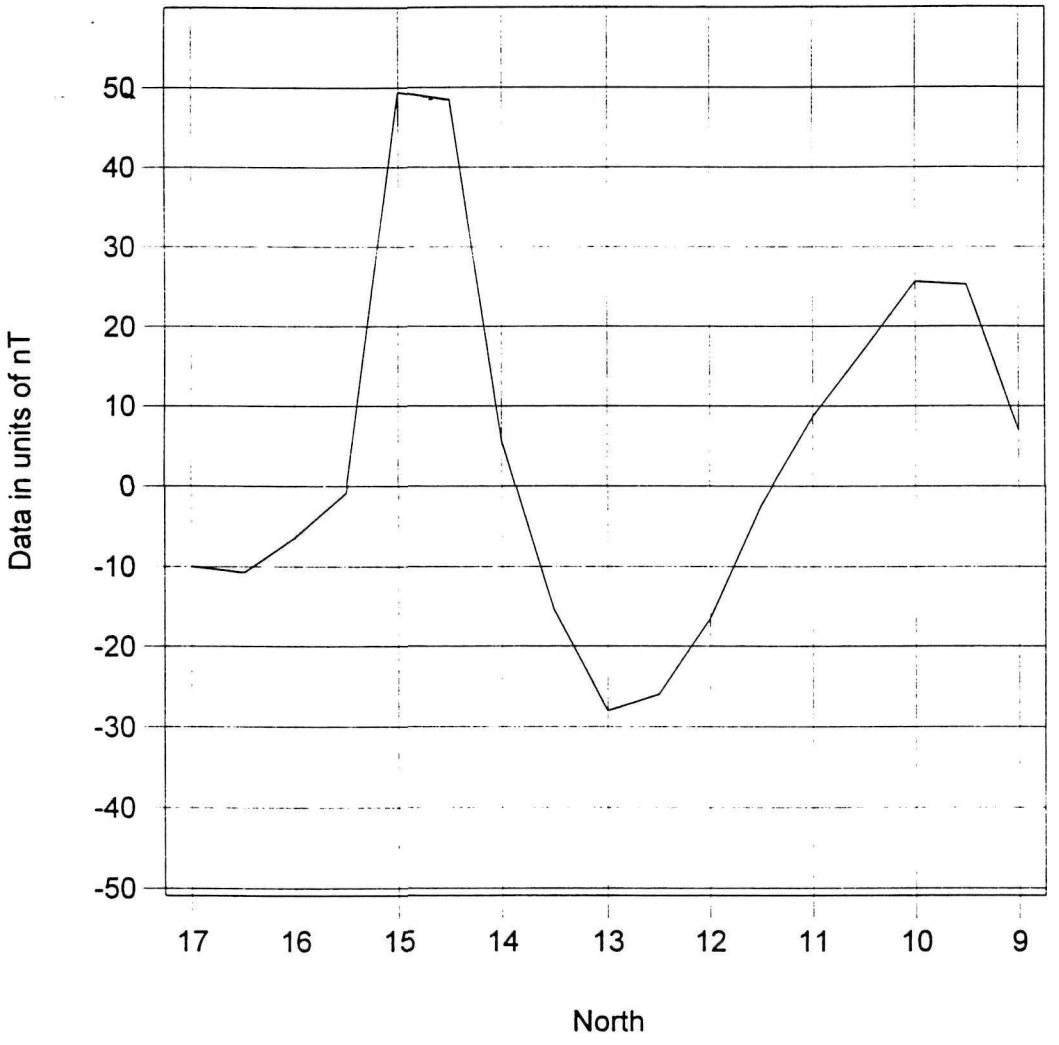

Figure 14: Fort Clatsop, Region V, magnetic profile on E29.

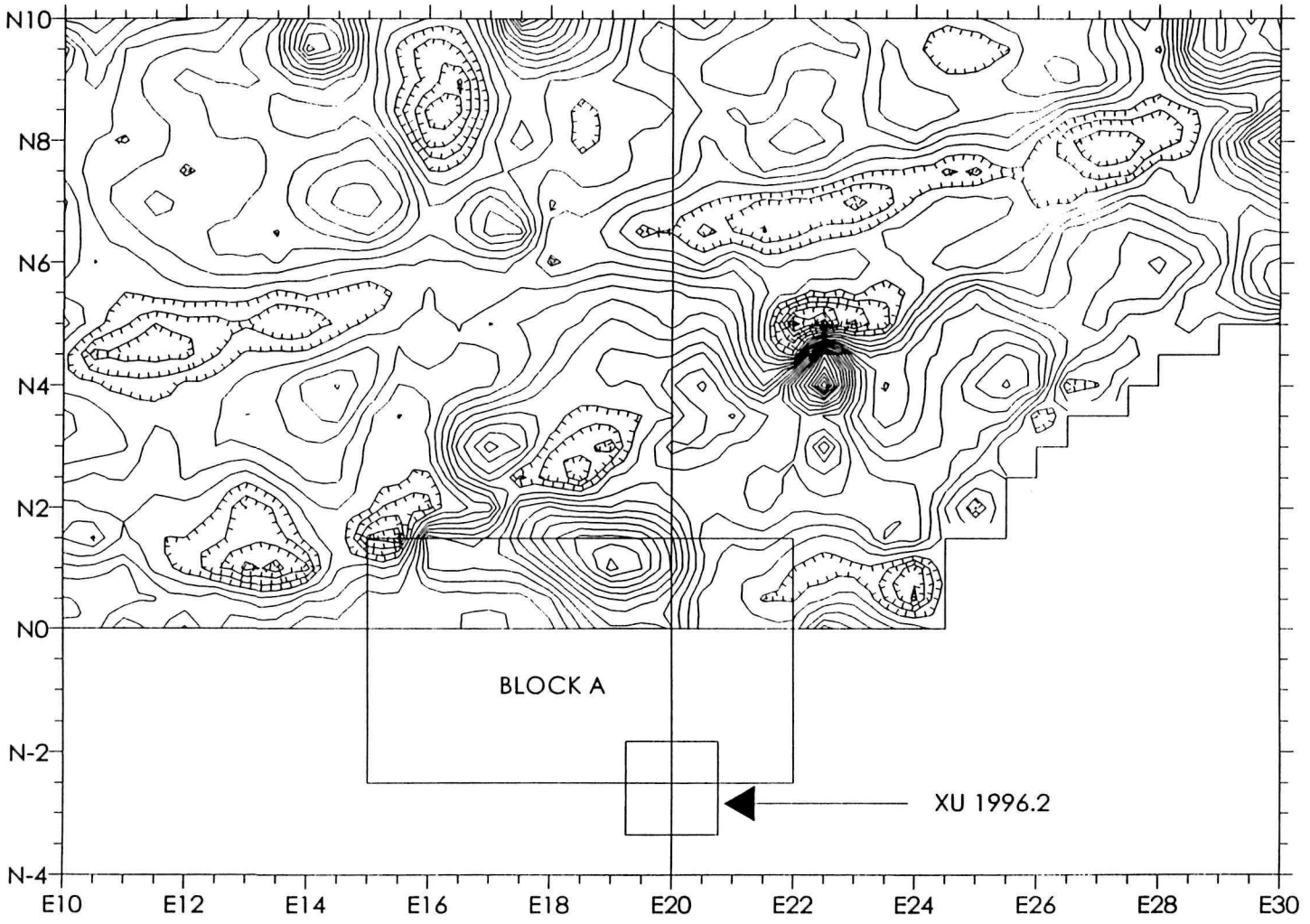

Figure 15: Fort Clatsop magnetic map, Blocks C and D with Block A and XU 1996.2 in outline. Contour interval 4 nT.

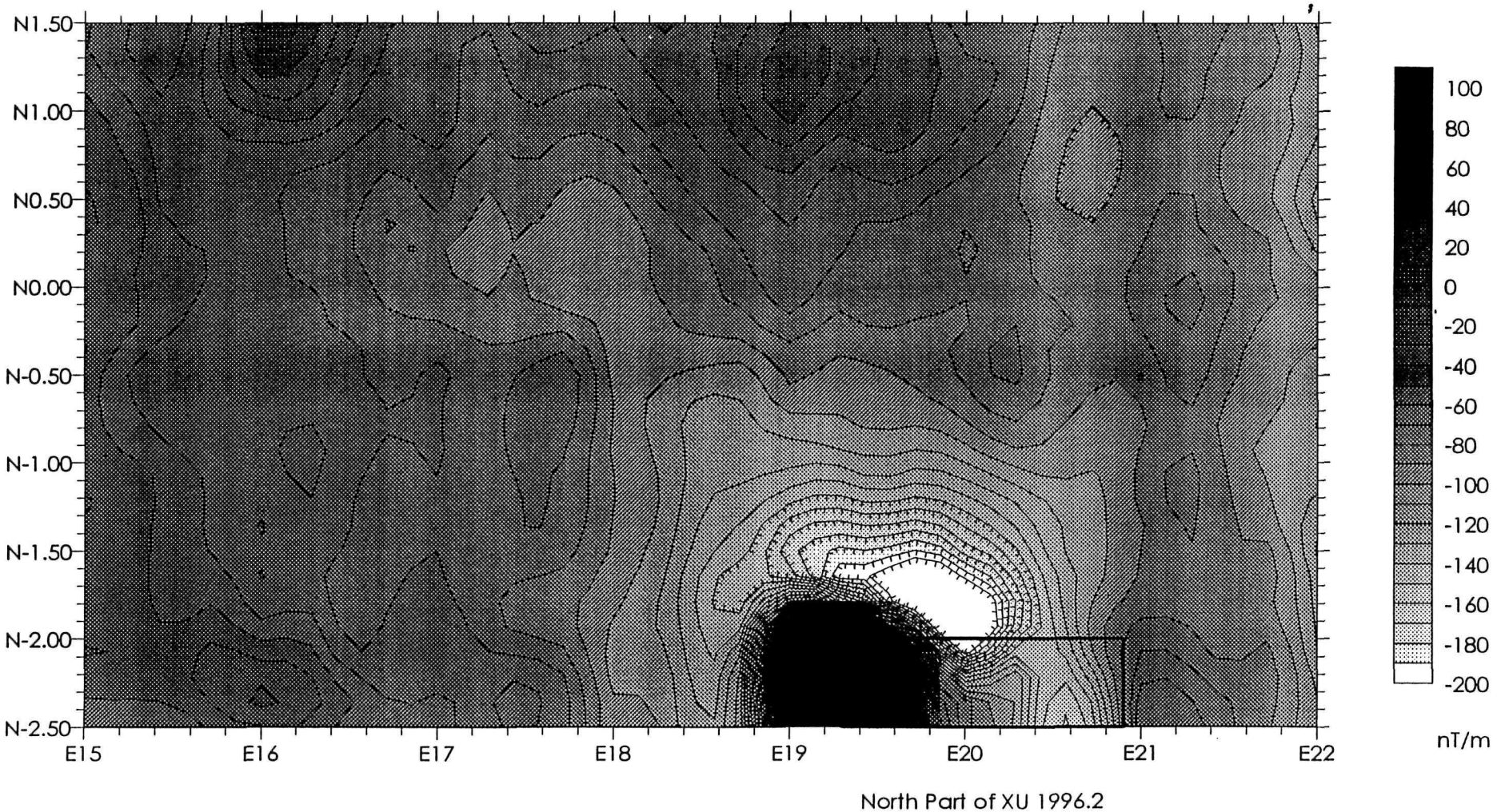

Figure 16: Fort Clatsop, Block A, cesium gradiometer map. Contour interval 10 nT/m.

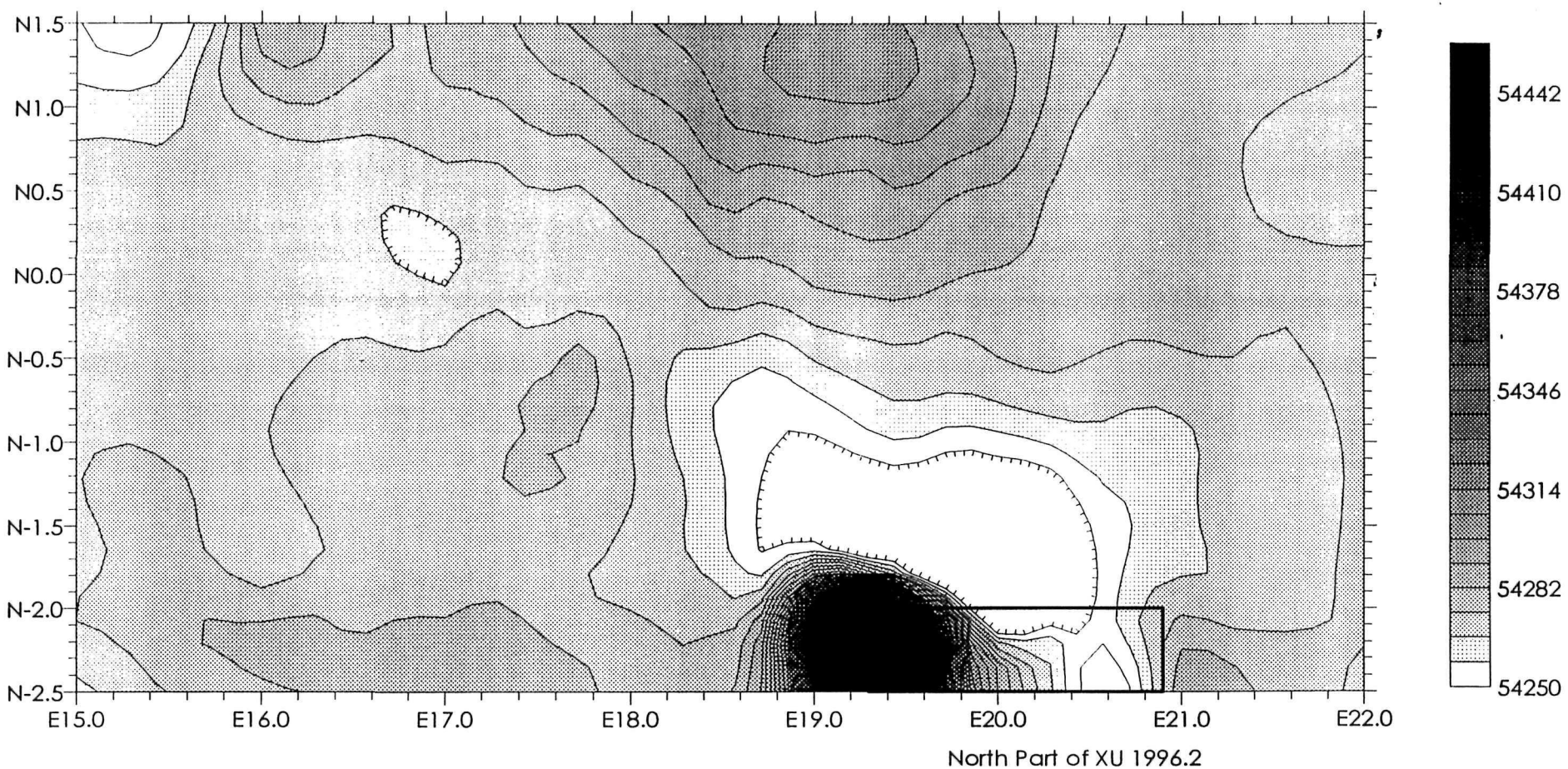

Figure 17: Fort Clatsop, Block A, total magnetic field map (bottom sensor, cesium gradiometer), contour interval 8 nT.