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Constructing a Reference Event List for NORESS

Florence Rivière-Barbier

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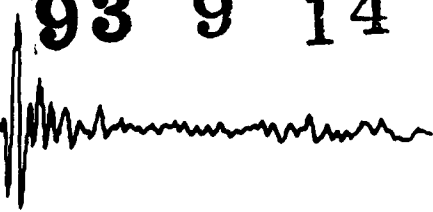
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Special Technical Report C93-06

August 25, 1993

Constructing a Reference Event List for NORESS

Florence Rivière-Barbier

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ATTN: Ms Lynne Adams

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Reference Event List of NORESS Report C93-06
Contract No. F29601-92-C-0005

ARPA/NMRO has carefully reviewed the subject scientific report submitted by Science Applications International Corporation under the subject contract, and certifies that this report contains no critical or sensitive data, information, or technology. As a result of this investigation, the report is approved for public release, distribution unlimited.

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Steven R. Bratt
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Nuclear Monitoring Research Office

REPORT DOCUMENTATION PAGE

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| | | | | |
|--|---|--|---|--|
| 1. AGENCY USE ONLY (Leave blank) | | 2. REPORT DATE August 5, 1993 | 3. REPORT TYPE AND DATES COVERED Special Technical Report | |
| 4. TITLE AND SUBTITLE Constructing a Reference Event List for NORESS | | | 5. FUNDING NUMBERS F29601-92-C-0005 | |
| 6. AUTHOR(S) Riviere-Barbier, Florence | | | 8. PERFORMING ORGANIZATION REPORT NUMBER C93-06 | |
| 7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Science Applications International Corporation Center for Seismic Studies 1300 N. 17th Street, Suite 1450 Arlington, VA 22209 | | | | |
| 9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) Advanced Research Projects Agency 3701 N. Fairfax Drive Arlington, VA 22203 | | | 10. SPONSORING/MONITORING AGENCY REPORT NUMBER | |
| 11. SUPPLEMENTARY NOTES | | | | |
| 12a. DISTRIBUTION/AVAILABILITY STATEMENT Approved for Public Release. Distribution Unlimited. | | | 12b. DISTRIBUTION CODE | |
| 13. ABSTRACT (Maximum 200 words) The method described in a previous report (C93-03) has been applied to a large data set of events recorded at NORESS. Groups of similar events have been defined and compared to mine locations when available. Events from the southern part of Norway showed larger variabilities in their signal than events located around ARCESS which lead to a larger percentage of number of groups including a smaller number of events. | | | | |
| 14. SUBJECT TERMS Data Set NORESS ARCESS Seismic Events Norway | | | 15. NUMBER OF PAGES 106 | |
| | | | 16. PRICE CODE | |
| 17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED | 18. SECURITY CLASSIFICATION OF THIS PAGE UNCLASSIFIED | 19. SECURITY CLASSIFICATION OF ABSTRACT UNCLASSIFIED | 20. LIMITATION OF ABSTRACT NONE | |

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1. INTRODUCTION

This report is summarizing part of a study using recordings of events from Scandinavia in order to construct a list of reference events for each of the Scandinavian arrays. The previous report (Rivière-Barbier, 1993) gives a thorough description of the procedure followed to define these reference events.

The results presented in this report were obtained using data recorded at the NORESS array. Figure 1 shows a map of Scandinavia on which were superimposed the different areas that were studied independently. Seventeen areas were studied using NORESS data: areas 26, 27, 31, 32, 33, 34, 46, 47, 48, 49, 50, 51, 52, 53, 62, 63 and 64.

Recordings on the vertical channel (sz) of the central element (NRA0) were used in the waveform comparison process. General information and the results of the processing are presented for each area in Appendix 1. Processing parameters are listed in Appendix 2. Lists of the mine locations from several sources, already provided in the previous report, are given in Appendix 3.

2. AREA DESCRIPTION

The area description follows the same pattern than in the previous report. The parameters used to characterize the areas are given below.

2.1. Latitude

Upper and lower latitude limits of the studied area are given in this field. For the part of Scandinavia described in this report, the lowest latitude is 56 degrees and the highest latitude is 66 degrees. Area sizes in latitude are 2 degrees. All latitudes given in this report are North of the Equator.

2.2. Longitude

Upper and lower longitude limits of the studied area are given in this field. For the part of Scandinavia described in this report, the smallest longitude is 4 degrees and the largest longitude is 24 degrees. Area sizes in longitude can vary from 1.5 degree to 6 degrees. Longitudes given in this report are East of the Greenwich meridian.

2.3. Number of events in IMS2

This is the number of events located within a particular area by the IMS and stored in the IMS2 database account at the time of the selection, January 31, 1993.

At that time, the database contained events that occurred between November 1990 and January 27, 1993.

2.4. Local magnitude range

The local magnitude range is used to select the events from a particular area. The range is used to obtain a representative data set of the area. The events were selected based

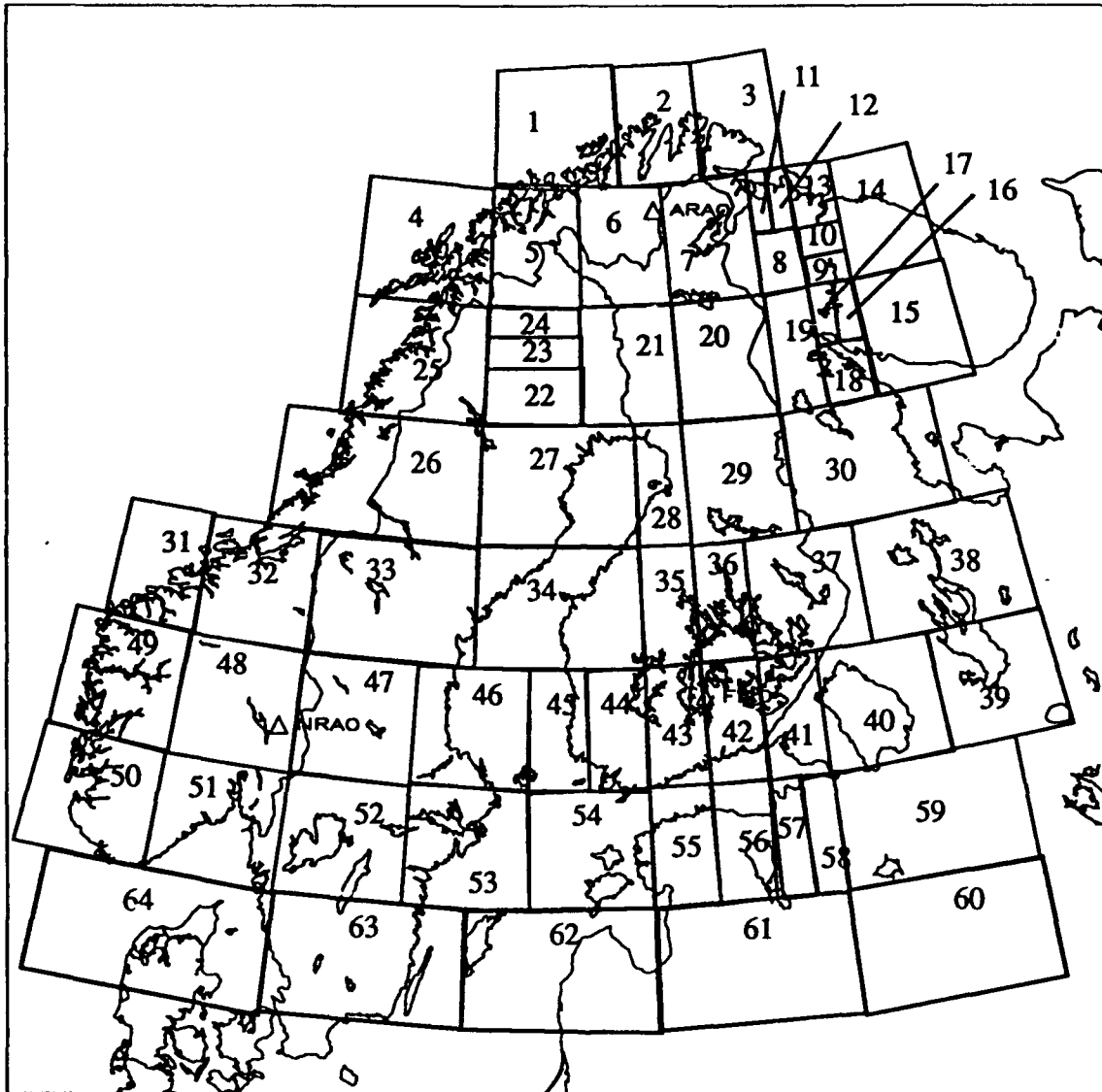


Figure 1: Map of Scandinavia showing the 64 areas that are being used to define a list of reference events for each array NORESS, ARCESS and FINESA. The arrays are represented by their central element: NRA0, ARA0, FIA0.

on decreasing magnitude in order to get the largest events. When no magnitude range is given, all events located in the area were used in the processing. This happened when too few large events were available for a given area.

2.5. Number of events within the magnitude range

This number is either equal to or lower than the number of events in the IMS data-

base. Not all events located by the IMS and whose locations are stored in the database have waveforms. Technical problems at the array, software and hardware failures, and misidentification by the expert system can lead to lost of waveforms.

2.6. Number of processed events

The number of processed events is, in most cases, smaller than the *number of events within the magnitude range*. A specific length of signal is required for the computation, and the waveform segment available on disk may not be long enough. Also, an event recording can be made of two waveform segments, a case that is not handled by the processing program.

2.7. Frequency range used to process the data

For each area, a frequency range is defined to filter the data. The high frequency corner is always set to 16.0 Hz. The low frequency corner varies from 2.0 to 3.5 Hz.

2.8. Processed signal length

The signal length needed for processing should include all phases and therefore, is distance dependent. The signal length is defined to contain the beginning of the first phase and the end of the last phase associated with the event. The total length includes the signal plus 1/8 of the signal length at each end since a 10% cosine taper is applied to the data.

2.9. Number of reference events

This gives the number of events that need to be used to identify most of the events located within a given area. The table listing these reference events gives the following information:

- the event number: related to the processing;
- the IMS orid: IMS event number in the database;
- the IMS arid: IMS number for the first phase associated with the event at the array;
- the IMS wfid: IMS waveform number, in this study only waveforms recorded at the central element of the array (NRA0) on the vertical channel (sz) were used;
- the threshold: lowest cross-correlation value between a given reference event characterizing a group and any event in this particular group. Below this value, events do not belong to the group represented by the reference event. When a reference event is defined for a group of only two events, no threshold value is given.
- the group: corresponds to the event classification using the cluster analysis method.

2.10. Reported mine locations

Scandinavia has a very large and important mining industry. The vast majority of the events recorded in the area are related to the mining activity either directly as mine blasts or indirectly like as induced events (tremors). In Appendix 3, lists of

the different mine locations are given. These lists have four main sources: SPOT photos, the bulletin published by the University of Helsinki, the Norwegian bulletin, and Joint Operations Graphic (JOG) maps from the American Defense Mapping Agency. The mine locations found on SPOT photos are the most reliable locations but the SPOT photos available cover only a small part of the studied area. The locations provided in the Helsinki bulletin have recently been updated based on SPOT locations and on information that the Finnish researchers have obtained directly from the mines. Based on these new locations, the Helsinki mine labelling changed after May 1991. This list is probably the most complete list for Scandinavia despite the fact that some large mines located outside of Finnish territory are missing. An attempt was made to map the old Helsinki mine labels with the new labels. This mapping is shown in the table giving the new Helsinki mine locations. The Norwegian bulletin gives a list of accurate mine locations located mostly in Norway. The JOG maps give accurate mine locations but they are not recent enough: some new mines may be missing and old mines may not be active any more. For each area, a table gives:

- the label: symbol used on the IMS maps,
- the location: latitude and longitude,
- the source of information.

2.11. Number of events found in the Helsinki bulletin

The bulletin published by the University of Helsinki provided extensive lists of events occurring in Scandinavia. Most of the mining events reported in this bulletin have a "manual location" which means that the Finnish analysts visually assigned these events to a particular mine. However, for this particular area, only events with an automatic location have been reported.

A software was used to match the events reported in the Helsinki bulletin with the studied events applying the following parameters:

- the distance between associated events should not be more than 1°,
- the difference in origin time should not be more than 20 seconds.

Forty-three events from the Helsinki bulletin were associated with an event from the IMS database. Five of them were identified as being "earthquakes" and five others as being "probably earthquakes".

For each area, a table listing the studied events that were found in the Helsinki bulletin based on the criteria described above gives:

- the event number: this number is related to the processing,
- the event orid: number identifying the event in the IMS database,
- the origin time: from the IMS origin table,

- the local magnitude: from the IMS origin table,
- the Helsinki location: either a latitude and longitude if the event was located automatically or a mine label if the event was located manually,
- the Helsinki identification: if the event was located manually, the label 'EXP' (for explosion) is used; if the event was identified as being a probable quarry blast, the label 'P. QB' is used; if the event was identified as being an earthquake, the label 'EARTH' is used; if the event was identified as being probably an earthquake, the label 'P.E.' is used. When the event was not identified in the Helsinki bulletin, no label is shown.
- the group: corresponds to the event classification using the cluster analysis method.

2.12. Events with the most reliable classification

For each area, events were sorted into groups based on their waveform similarities. A table gives the list of the events included in each group. Events with a too low signal-to-noise ratio and events that were mixed with other events on the same waveform (except when these events were very large and when they all belonged to the same group) were not included in this list. The table includes the following information:

- the event number: this number is related to the processing,
- the event orid: number identifying the event in the IMS database,
- the origin time: from the IMS origin table,
- the location: from the IMS origin table,
- the local magnitude: from the IMS origin table,
- the group: corresponds to the event classification using the cluster analysis method.

2.13. Remarks

For each area, comments are made about the events and their classification. Comparisons are made between mine locations and event locations. Any particular features seen on the data are reported.

2.14. Mine and event locations

A map showing the IMS event locations and the mine locations from the Norwegian bulletin, the Helsinki bulletin and the JOG maps are plotted for each area. This map allows the comparison between the different sets of mine locations mentioned above as well as the comparison between the event locations and the mine locations.

3. CONCLUSION

One-thousand-one-hundred-sixteen events were processed during this study. One hundred-eight reference events have been defined to represent the event types recorded at

NORESS for distances between 0 and 8 degrees. Among the studied event, five-hundred-seventy-seven events were reliably associated with a reference event and forty-three events were found in the Helsinki bulletin. Five of these events were identified as being "earthquakes" and five others as being "probably earthquakes". None of the remaining thirty-three events was identified as originating from a mine since they all had automatic locations.

About half of the events could not be sorted because either they had too low signal-to-noise ratios or they were unique. Proportionally to the total number of studied events, more reference events were needed to characterize events recorded at the NORESS array than at the ARCESS array. This confirms the large number of different signals recorded at the NORESS array.

As already noticed for the events located around the ARCESS array, several areas show clusters of events where no mine locations have been reported.

4. REFERENCES

- Rivière-Barbier, F. 1993. Constructing a Reference Event List for ARCESS. *Center for Seismic Studies Annual Technical Report C93-03*. March 1992-March 1993.
- Ryall, F. 1993. Analysis summary of IMS Reprocessed Data. Internal Report. *Center for Seismic Studies*.

APPENDIX 1



AREA 26

Latitude: 64 - 66°N

Longitude: 10 - 18°E

Local magnitude range: -

Number of events in IMS2: 27

Number of events within the magnitude range: 27

Number of processed events: 8

Frequency range used to process the data: 3 - 16 Hz

Processed signal length: 14s. before P, 134s. after P

Number of reference events: None

Reported mine locations:

Table 1: Mine locations for area 26

| Label | Latitude | Longitude | Origin |
|-------|----------|-----------|--------|
| N9 | 64.07 | 11.20 | Norw |
| N7 | 64.87 | 13.88 | Norw |
| N8 | 65.93 | 13.88 | Norw |

Number of events found in the Helsinki bulletin: None

Remarks:

- This area shows very little seismic activity.
- Most of these events are unique and the others have too low signal-to-noise ratios to be sorted.

Mine and event locations:

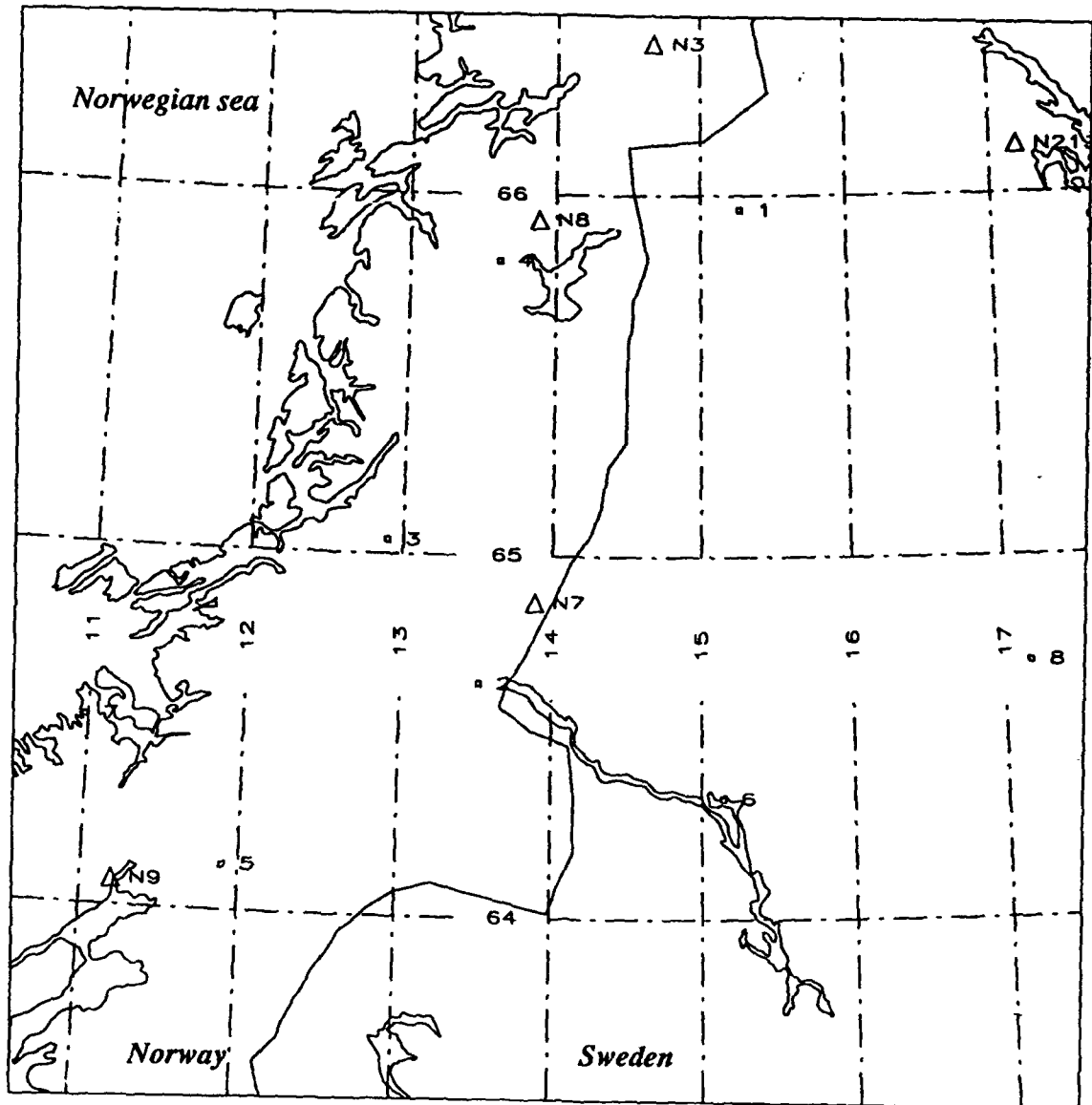


Figure 2: Mine and IMS event locations for area 26.

AREA 27

Latitude: 64 - 66°N

Longitude: 18 - 24°E

Local magnitude range: -

Number of events in IMS2: 54

Number of events within the magnitude range: 54

Number of processed events: 15

Frequency range used to process the data: 3 - 16 Hz

Processed signal length: 14s. before P, 139s. after P

Number of reference events: None

Reported mine locations:

Table 2: Mine locations for area 27

| Label | Latitude | Longitude | Origin |
|-------|----------|-----------|--------|
| N220 | 64.05000 | 20.71670 | Norw |
| N216 | 64.10000 | 19.58330 | Norw |
| N214 | 64.13329 | 18.56670 | Norw |

Number of events found in the Helsinki bulletin: 6

Table 3: Events found in the Helsinki bulletin for area 27

| Event # | IMS orid | IMS origin time | | IMS ml | HEL location | | HEL label | Group |
|---------|----------|-----------------|------------|--------|--------------|-------|-----------|-------|
| 1 | 11179 | 1/19/91 | 21:01:13.8 | 2.28 | 65.66 | 18.06 | PE. | ? |
| 10 | 327190 | 4/16/92 | 10:21:42.6 | 2.34 | 64.18 | 20.64 | EART | ? |
| 12 | 338193 | 9/4/92 | 21:58:07.5 | 1.46 | 65.89 | 22.00 | PE. | ? |
| 13 | 340554 | 9/28/92 | 14:48:53.5 | 1.42 | 65.01 | 21.34 | PE. | ? |
| 3 | 41532 | 9/23/91 | 19:20:28.3 | 3.15 | 64.58 | 21.40 | EART | ? |
| 4 | 301196 | 11/8/91 | 22:07:51.4 | 1.98 | 65.23 | 22.71 | PE. | ? |

Remarks:

- Most of these events show low signal-to-noise ratios or are unique events.
- The cluster seen on the map (Figure 3) consisting of events 6, 7, 8 and 9 corresponds to a group in the cluster analysis; but, their too low signal-to-noise ratios did not allow to verify this classification.

Mine and event locations:

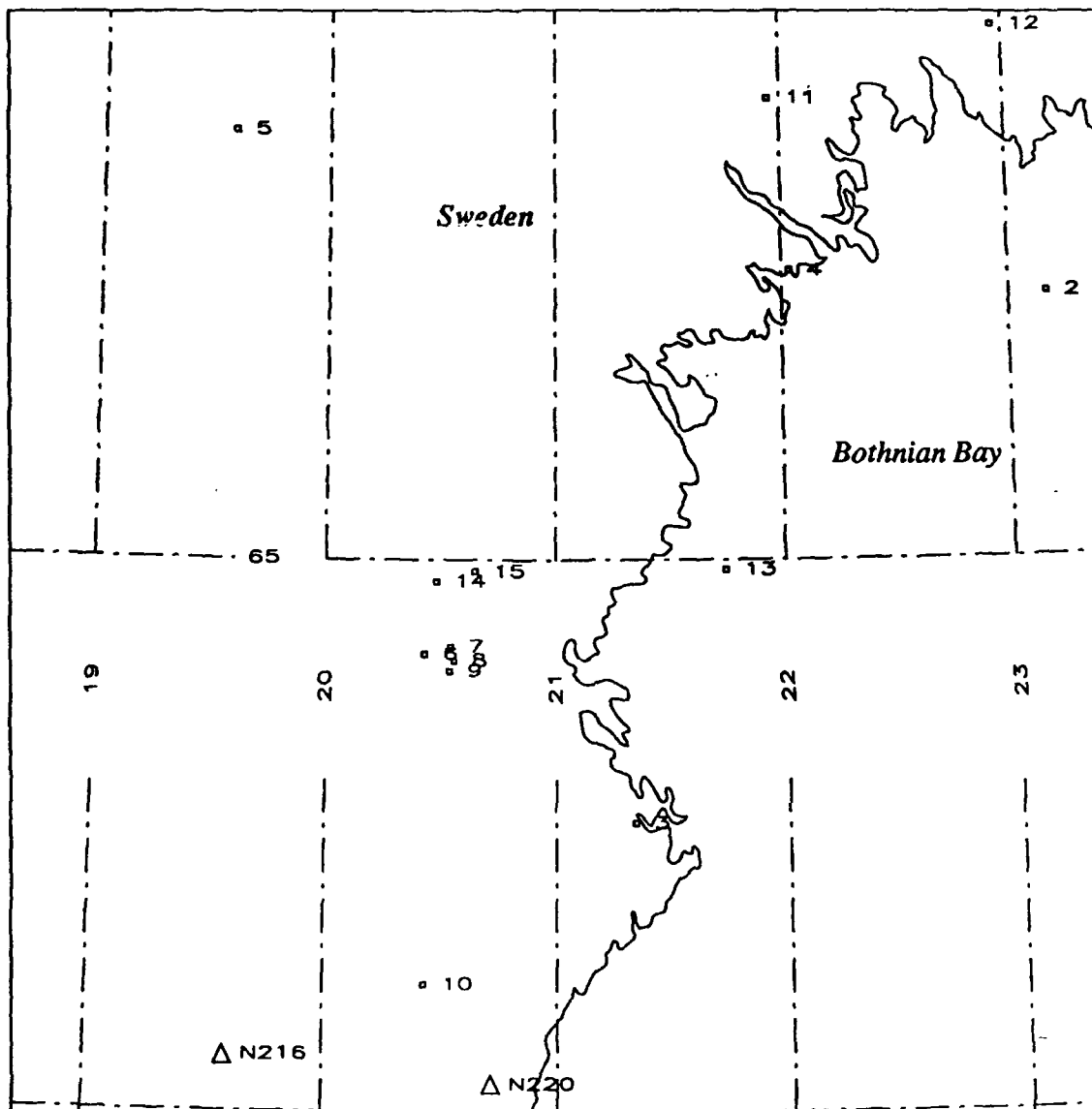


Figure 3: Mine and IMS event locations for area 27.

AREA 31

Latitude: 62 - 64°N

Longitude: 5 - 8°E

Local magnitude range: > 1.0

Number of events in IMS2: 147

Number of events within the magnitude range: 87

Number of processed events: 71

Number of events found in the Helsinki bulletin: None

Frequency range used to process the data: 2 - 16 Hz

Processed signal length: 7s. before P, 62s. after P

Number of reference events: 4

Table 4: Reference events for area 31

| Event # | IMS orid | IMS arid | IMS wfid | Threshold | Group |
|---------|----------|----------|----------|-----------|-------|
| 41 | 324452 | 1232237 | 1936695 | 0.80 | A |
| 68 | 342817 | 1501769 | 2807742 | 0.85 | B |
| 23 | 35150 | 883500 | 1123004 | 0.84 | C |
| 10 | 10235 | 613896 | 1375345 | 0.90 | D |

Reported mine locations:

Table 5: Mine locations for area 31

| Label | Latitude | Longitude | Origin |
|-------|----------|-----------|--------|
| NI | 62.04000 | 5.52333 | Norw |

Events with the most reliable classification:

Table 6: Sorted events for area 31

| Event # | IMS orid | Origin time | | IMS lat. | IMS lon. | IMS ml | Group |
|---------|----------|-------------|------------|----------|----------|--------|-------|
| 2 | 2510 | 11/23/90 | 13:12:44.1 | 62.2775 | 7.5712 | 1.32 | A |
| 3 | 10221 | 11/24/90 | 14:56:10.3 | 62.4044 | 7.2551 | 1.35 | A |
| 4 | 2599 | 11/26/90 | 07:24:23.9 | 62.2531 | 7.5407 | 1.16 | A |
| 6 | 4252 | 12/17/90 | 15:44:01.8 | 62.2936 | 7.2337 | 1.14 | A |
| 8 | 10047 | 1/31/91 | 13:53:55.0 | 62.4133 | 7.3089 | 1.28 | A |

Table 6: Sorted events for area 31

| Event # | IMS orid | Origin time | | IMS lat. | IMS lon. | IMS ml | Group |
|---------|----------|-------------|------------|----------|----------|--------|-------|
| 16 | 25992 | 6/8/91 | 15:24:53.9 | 62.5132 | 7.6565 | 1.57 | A |
| 19 | 28428 | 7/4/91 | 16:15:09.3 | 62.2090 | 7.4522 | 1.61 | A |
| 21 | 30469 | 7/19/91 | 15:11:41.1 | 62.2808 | 7.5615 | 1.50 | A |
| 24 | 34950 | 8/14/91 | 14:00:15.4 | 62.1604 | 7.1555 | 1.74 | A |
| 26 | 38297 | 9/5/91 | 22:36:51.7 | 62.3531 | 7.6692 | 1.82 | A |
| 28 | 40465 | 9/18/91 | 21:48:17.7 | 62.4236 | 7.3846 | 1.69 | A |
| 36 | 319378 | 2/19/92 | 18:09:00.7 | 62.3824 | 7.2756 | 1.36 | A |
| 40 | 325147 | 4/1/92 | 16:56:34.2 | 62.2890 | 7.2357 | 1.61 | A |
| 41 | 324452 | 4/10/92 | 14:47:22.3 | 62.2681 | 7.4835 | 1.64 | A |
| 42 | 325511 | 4/22/92 | 18:45:54.9 | 62.1992 | 7.4185 | 1.51 | A |
| 44 | 326152 | 4/26/92 | 20:21:20.8 | 62.3356 | 6.8153 | 1.61 | A |
| 46 | 328737 | 5/22/92 | 14:55:22.3 | 62.5628 | 6.7505 | 1.53 | A |
| 48 | 333003 | 6/25/92 | 20:35:04.5 | 62.3223 | 7.1887 | 1.60 | A |
| 51 | 335212 | 8/6/92 | 06:56:48.5 | 62.1975 | 7.7111 | 1.15 | A |
| 53 | 336596 | 8/21/92 | 14:58:43.4 | 62.3031 | 7.8807 | 1.31 | A |
| 56 | 338043 | 9/6/92 | 16:45:02.8 | 62.3541 | 7.8374 | 1.03 | A |
| 63 | 340702 | 10/3/92 | 14:42:21.9 | 62.2837 | 7.8288 | 1.27 | A |
| 45 | 328569 | 5/21/92 | 12:13:52.3 | 62.7966 | 6.7777 | 1.62 | B |
| 52 | 336459 | 8/20/92 | 11:50:06.9 | 62.7417 | 6.7152 | 1.63 | B |
| 59 | 340523 | 9/23/92 | 12:44:12.2 | 62.5318 | 7.6475 | 1.43 | B |
| 68 | 342817 | 11/5/92 | 12:38:26.0 | 62.2263 | 7.5716 | 1.25 | B |
| 23 | 35150 | 8/9/91 | 14:59:48.0 | 62.7840 | 7.6879 | 1.49 | C |
| 34 | 313740 | 1/18/92 | 05:57:29.6 | 62.2207 | 7.2037 | 1.57 | C |
| 10 | 10235 | 2/2/91 | 18:41:09.9 | 62.3782 | 5.9031 | 2.35 | D |
| 22 | 31976 | 7/28/91 | 20:14:29.3 | 62.2162 | 6.3369 | 1.14 | D |

Remarks:

- Half of these events have very low signal-to-noise ratios.
- The other half contains mostly events from group A whose locations spread over a large area. No mines have been reported close to these locations.

Mine and event locations:

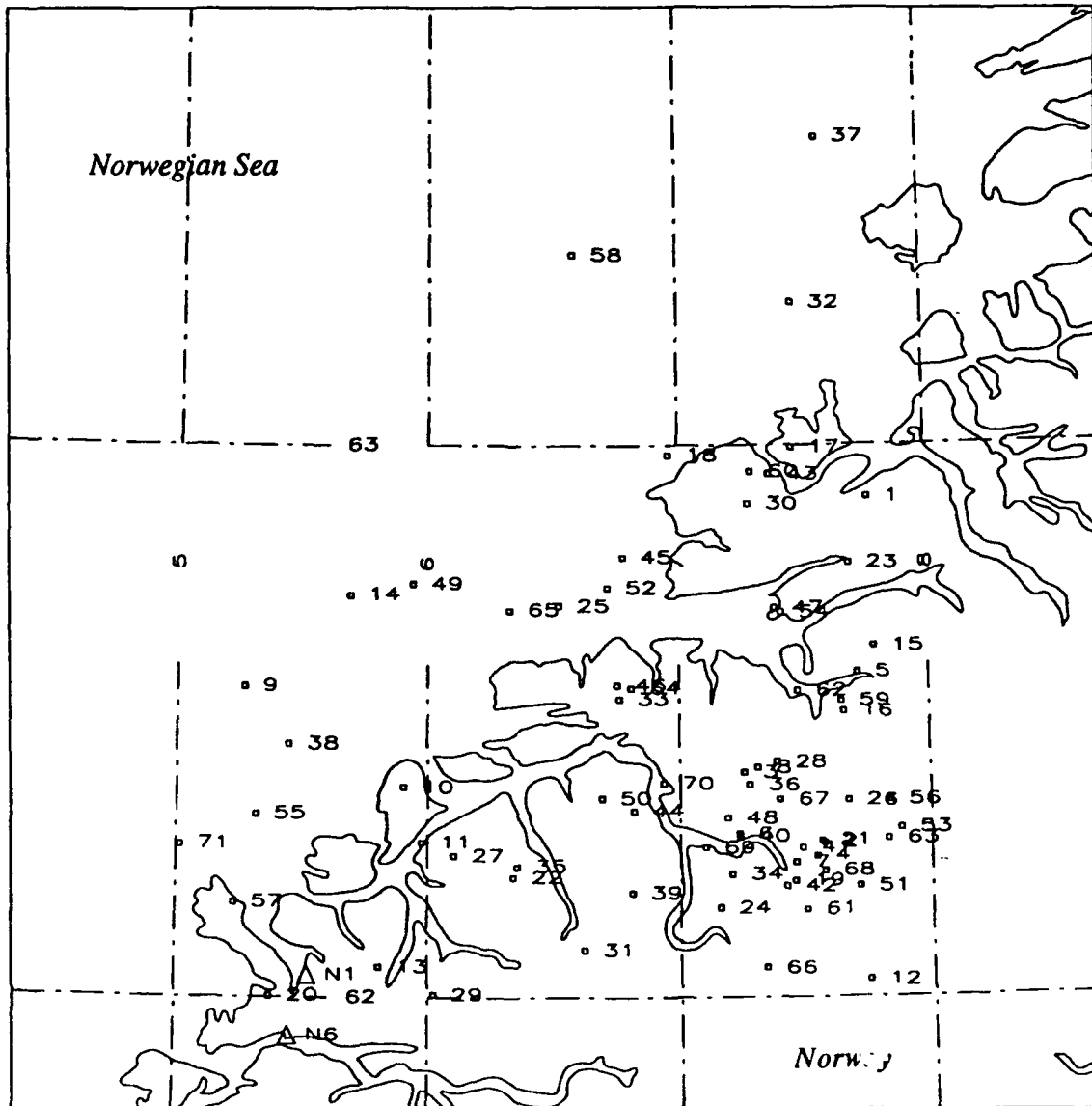


Figure 4: Mine and IMS event locations for area 31.

AREA 32

Latitude: 62 - 64°N

Longitude: 8 - 12°E

Local magnitude range: > 1.0

Number of events in IMS2: 305

Number of events within the magnitude range: 134

Number of processed events: 105

Frequency range used to process the data: 2 - 16 Hz

Processed signal length: 7s. before P, 62s. after P

Number of reference events: 11

Table 7: Reference events for area 32

| Event # | IMS orid | IMS arid | IMS wfid | Threshold | Group |
|---------|----------|----------|----------|-----------|-------|
| 23 | 16230 | 727130 | 554614 | 0.80 | A |
| 58 | 30943 | 857460 | 1004021 | 0.83 | B |
| 20 | 15714 | 717638 | 517697 | - | C |
| 57 | 30722 | 851430 | 989039 | 0.85 | D |
| 4 | 42123 | 542979 | 635977 | - | E |
| 11 | 13322 | 697403 | 447419 | - | F |
| 33 | 23076 | 790265 | 780690 | 0.88 | G |
| 99 | 341497 | 1469971 | 2767320 | 0.77 | H |
| 37 | 24467 | 799678 | 867558 | - | I |
| 89 | 336514 | 1402119 | 2582050 | 0.84 | J |
| 105 | 344551 | 1522192 | 2864049 | 0.85 | K |

Reported mine locations:

Table 8: Mine locations for area 32

| Label | Latitude | Longitude | Origin |
|-------|----------|-----------|--------|
| JOG10 | 62.04 | 10.82 | JOG |
| JOG11 | 62.10 | 10.21 | JOG |
| JOG12 | 62.10 | 9.80 | JOG |
| JOG13 | 62.11 | 9.82 | JOG |
| JOG14 | 62.11 | 9.90 | JOG |

Table 8: Mine locations for area 32

| Label | Latitude | Longitude | Origin |
|-------|----------|-----------|--------|
| JOG15 | 62.13 | 10.09 | JOG |
| JOG16 | 62.15 | 10.08 | JOG |
| JOG17 | 62.15 | 10.68 | JOG |
| JOG18 | 62.28 | 10.32 | JOG |
| JOG19 | 62.32 | 10.62 | JOG |
| JOG20 | 62.33 | 10.62 | JOG |
| JOG21 | 62.38 | 10.40 | JOG |
| JOG22 | 62.38 | 10.42 | JOG |
| JOG23 | 62.41 | 10.27 | JOG |
| JOG24 | 62.41 | 10.28 | JOG |
| JOG25 | 62.44 | 10.86 | JOG |
| JOG26 | 62.44 | 10.87 | JOG |
| JOG27 | 62.52 | 11.22 | JOG |
| JOG28 | 62.54 | 11.10 | JOG |
| JOG29 | 62.54 | 11.25 | JOG |
| JOG30 | 62.55 | 11.81 | JOG |
| JOG31 | 62.57 | 11.82 | JOG |
| JOG32 | 62.63 | 11.55 | JOG |
| JOG33 | 62.67 | 11.28 | JOG |
| JOG34 | 62.69 | 11.28 | JOG |
| JOG35 | 62.71 | 11.28 | JOG |
| JOG36 | 62.77 | 11.28 | JOG |
| JOG37 | 62.79 | 11.25 | JOG |
| JOG38 | 62.81 | 11.26 | JOG |
| JOG39 | 62.82 | 10.05 | JOG |
| JOG40 | 62.84 | 11.55 | JOG |
| JOG41 | 62.87 | 11.63 | JOG |
| JOG42 | 62.92 | 11.68 | JOG |
| JOG43 | 62.94 | 11.50 | JOG |

Number of events found in the Helsinki bulletin: None
Events with the most reliable classification:

Table 9: Sorted events for area 32

| Event # | IMS orid | IMS origin time | | IMS lat | IMS lon | IMS ml | Group |
|---------|----------|-----------------|------------|---------|---------|--------|-------|
| 17 | 14259 | 3/19/91 | 12:31:22.4 | 63.4953 | 9.3970 | 1.24 | A |
| 21 | 16827 | 4/3/91 | 07:16:53.7 | 63.7548 | 9.2443 | 1.60 | A |
| 23 | 16230 | 4/5/91 | 09:01:38.7 | 63.0640 | 8.8438 | 1.39 | A |
| 25 | 16891 | 4/9/91 | 11:19:57.9 | 63.2350 | 9.4245 | 1.31 | A |
| 26 | 17772 | 4/10/91 | 18:38:07.4 | 63.2591 | 9.6294 | 1.44 | A |
| 27 | 18752 | 4/18/91 | 07:22:42.4 | 63.4696 | 9.5131 | 1.53 | A |
| 31 | 19884 | 4/23/91 | 11:55:09.6 | 63.3922 | 9.3568 | 1.40 | A |
| 36 | 24571 | 5/30/91 | 12:15:04.2 | 63.6696 | 9.4185 | 1.67 | A |
| 38 | 25126 | 6/3/91 | 14:43:33.3 | 63.5047 | 9.4820 | 1.39 | A |
| 46 | 26136 | 6/12/91 | 17:52:02.1 | 63.2744 | 9.5871 | 1.37 | A |
| 75 | 301345 | 11/4/91 | 15:04:35.9 | 63.8362 | 9.6451 | 1.46 | A |
| 76 | 302993 | 12/18/91 | 14:05:34.4 | 63.6997 | 9.4698 | 1.57 | A |
| 41 | 25709 | 6/6/91 | 02:14:40.0 | 63.4018 | 8.9992 | 1.42 | B |
| 51 | 28749 | 7/2/91 | 19:32:05.5 | 63.6677 | 9.2719 | 1.44 | B |
| 53 | 29867 | 7/11/91 | 10:39:51.8 | 63.4345 | 9.1061 | 1.20 | B |
| 56 | 30614 | 7/16/91 | 15:09:57.3 | 63.5818 | 9.3324 | 1.15 | B |
| 58 | 30943 | 7/23/91 | 09:11:07.8 | 63.2602 | 9.3484 | 1.27 | B |
| 61 | 33460 | 8/2/91 | 15:42:44.4 | 63.6157 | 9.0001 | 1.50 | B |
| 63 | 34406 | 8/8/91 | 09:08:55.5 | 63.2902 | 9.0609 | 1.27 | B |
| 68 | 35047 | 8/15/91 | 17:47:55.4 | 63.4197 | 9.2668 | 1.28 | B |
| 70 | 37073 | 8/29/91 | 18:44:55.8 | 63.3012 | 8.9277 | 1.19 | B |
| 72 | 39663 | 9/11/91 | 16:27:31.1 | 63.2599 | 9.0554 | 1.27 | B |
| 73 | 39930 | 9/18/91 | 18:07:32.7 | 63.2313 | 8.4347 | 1.12 | B |
| 81 | 324155 | 3/25/92 | 15:42:31.9 | 63.3540 | 9.3956 | 1.17 | B |
| 12 | 13522 | 3/7/91 | 15:18:57.2 | 63.5109 | 9.4243 | 1.40 | C |
| 15 | 14396 | 3/13/91 | 14:42:09.0 | 63.2046 | 8.8618 | 1.27 | C |
| 16 | 15276 | 3/18/91 | 16:07:32.9 | 63.4951 | 9.1985 | 1.41 | C |

Table 9: Sorted events for area 32

| Event # | IMS orid | IMS origin time | | IMS lat | IMS lon | IMS ml | Group |
|---------|----------|-----------------|------------|---------|---------|--------|-------|
| 20 | 15714 | 3/27/91 | 09:51:41.0 | 63.3365 | 9.6751 | 1.51 | C |
| 22 | 16542 | 4/4/91 | 19:02:35.2 | 63.3251 | 9.1368 | 1.17 | C |
| 24 | 17329 | 4/8/91 | 15:10:35.8 | 63.2274 | 8.9803 | 1.28 | C |
| 28 | 18386 | 4/19/91 | 14:09:28.6 | 63.4639 | 8.3145 | 1.32 | C |
| 30 | 19758 | 4/22/91 | 19:05:02.2 | 63.3100 | 9.0492 | 1.26 | C |
| 32 | 19314 | 4/25/91 | 15:58:43.8 | 63.3341 | 9.2370 | 1.26 | C |
| 34 | 23536 | 5/24/91 | 10:48:06.7 | 63.2894 | 8.2568 | 1.29 | C |
| 35 | 23637 | 5/24/91 | 19:24:39.7 | 63.3163 | 8.9348 | 1.01 | C |
| 40 | 25301 | 6/3/91 | 20:40:15.5 | 63.3768 | 9.0798 | 1.29 | C |
| 47 | 26259 | 6/13/91 | 16:05:45.4 | 63.6499 | 8.8450 | 1.64 | C |
| 52 | 29490 | 7/9/91 | 19:53:13.1 | 63.7328 | 9.4723 | 1.50 | D |
| 54 | 29880 | 7/11/91 | 21:51:15.5 | 63.4808 | 9.1924 | 1.37 | D |
| 55 | 29966 | 7/16/91 | 13:48:14.2 | 63.3238 | 9.2981 | 1.30 | D |
| 57 | 30722 | 7/18/91 | 15:51:23.0 | 63.6993 | 9.4990 | 1.37 | D |
| 60 | 32312 | 7/30/91 | 13:17:42.1 | 63.3700 | 9.4297 | 1.29 | D |
| 4 | 42123 | 12/4/90 | 11:17:54.5 | 63.2156 | 11.0211 | 1.12 | E |
| 11 | 13322 | 3/6/91 | 15:22:06.6 | 63.3378 | 10.4514 | 1.17 | E |
| 5 | 42203 | 12/5/90 | 10:07:15.9 | 62.9914 | 8.3237 | 1.34 | F |
| 6 | 42262 | 12/6/90 | 10:42:45.7 | 62.8699 | 8.5054 | 1.30 | F |
| 33 | 23076 | 5/21/91 | 14:55:34.7 | 62.7600 | 8.6713 | 1.04 | G |
| 42 | 25990 | 6/8/91 | 14:24:38.4 | 62.8022 | 8.0360 | 1.27 | G |
| 39 | 25127 | 6/3/91 | 15:03:11.9 | 63.2008 | 10.5989 | 1.09 | H |
| 48 | 26559 | 6/17/91 | 17:16:35.0 | 63.2677 | 11.0273 | 1.05 | H |
| 65 | 35417 | 8/12/91 | 13:59:19.3 | 63.1807 | 10.9654 | 1.00 | H |
| 87 | 333068 | 7/3/92 | 11:31:33.5 | 63.2195 | 11.7209 | 1.03 | H |
| 90 | 337287 | 8/28/92 | 13:48:07.7 | 62.8906 | 10.8331 | 1.02 | H |
| 91 | 337566 | 9/1/92 | 12:21:04.2 | 63.3407 | 11.4751 | 1.13 | H |
| 93 | 337898 | 9/4/92 | 15:12:45.1 | 63.0940 | 11.3602 | 1.19 | H |
| 95 | 340547 | 9/23/92 | 15:22:26.6 | 63.1116 | 11.0033 | 1.19 | H |
| 99 | 341497 | 10/16/92 | 15:45:32.1 | 63.3674 | 11.4088 | 1.45 | H |

Table 9: Sorted events for area 32

| Event # | IMS orid | IMS origin time | | IMS lat | IMS lon | IMS ml | Group |
|---------|----------|-----------------|------------|---------|---------|--------|-------|
| 100 | 341497 | 10/16/92 | 15:45:32.1 | 63.3674 | 11.4088 | 1.45 | H |
| 37 | 24467 | 5/31/91 | 11:55:45.3 | 62.6956 | 10.5410 | 1.23 | I |
| 45 | 26064 | 6/12/91 | 16:42:59.5 | 62.6889 | 10.3887 | 1.00 | I |
| 13 | 13533 | 3/7/91 | 19:49:31.5 | 62.3631 | 9.3006 | 1.20 | J |
| 69 | 36745 | 8/28/91 | 18:44:45.5 | 62.1535 | 9.4477 | 1.65 | J |
| 89 | 336514 | 8/20/92 | 18:46:22.6 | 62.2988 | 9.4481 | 1.37 | J |
| 94 | 338572 | 9/11/92 | 18:47:25.0 | 62.1476 | 9.4034 | 1.13 | J |
| 97 | 341003 | 10/8/92 | 19:50:49.0 | 62.1118 | 9.4146 | 1.13 | J |
| 101 | 341508 | 10/16/92 | 19:42:29.7 | 62.1295 | 9.4369 | 1.20 | J |
| 1 | 1501 | 11/5/90 | 19:48:31.6 | 62.1338 | 9.4278 | 1.05 | K |
| 2 | 2672 | 11/16/90 | 19:42:52.3 | 62.1856 | 9.5278 | 1.04 | K |
| 3 | 10069 | 11/29/90 | 19:46:28.4 | 62.1950 | 9.3288 | 1.04 | K |
| 7 | 3527 | 12/10/90 | 19:49:07.3 | 62.1198 | 9.4047 | 1.18 | K |
| 8 | 314343 | 12/19/90 | 19:50:08.2 | 62.2152 | 9.1472 | 1.07 | K |
| 10 | 8464 | 1/22/91 | 19:51:39.0 | 62.3048 | 9.1366 | 1.29 | K |
| 14 | 14294 | 3/12/91 | 19:45:18.7 | 62.2959 | 9.2940 | 1.05 | K |
| 49 | 28964 | 7/4/91 | 18:43:24.3 | 62.4489 | 9.0456 | 1.12 | K |
| 64 | 35163 | 8/9/91 | 22:08:37.4 | 62.1405 | 9.4843 | 1.05 | K |
| 71 | 37722 | 9/3/91 | 18:47:13.0 | 62.2613 | 9.8207 | 1.02 | K |
| 74 | 41735 | 9/26/91 | 18:41:23.8 | 62.1319 | 9.3922 | 1.11 | K |
| 77 | 319330 | 2/18/92 | 19:43:04.8 | 62.3007 | 9.3076 | 1.02 | K |
| 84 | 325933 | 4/24/92 | 18:43:25.8 | 62.1619 | 9.5347 | 1.19 | K |
| 86 | 330386 | 6/12/92 | 18:45:16.5 | 62.1517 | 9.4967 | 1.39 | K |
| 96 | 340179 | 9/25/92 | 18:39:33.6 | 62.2494 | 9.9568 | 1.35 | K |
| 103 | 343116 | 11/9/92 | 19:46:13.0 | 62.2124 | 9.5659 | 1.06 | K |
| 105 | 344551 | 11/27/92 | 19:38:27.1 | 62.0900 | 9.4424 | 1.08 | K |

Remarks:

- Events from groups A, B, C and D are concentrated in an area located on the North-western part of the map (Figure 5) where no mines have been reported.
- Events from groups J and K form a tight cluster in the southern part of the map

whose location is the closest to a reported mine.

- The location of seismic activity does not correspond to the locations of the reported mines in this area.

Mine and event locations:

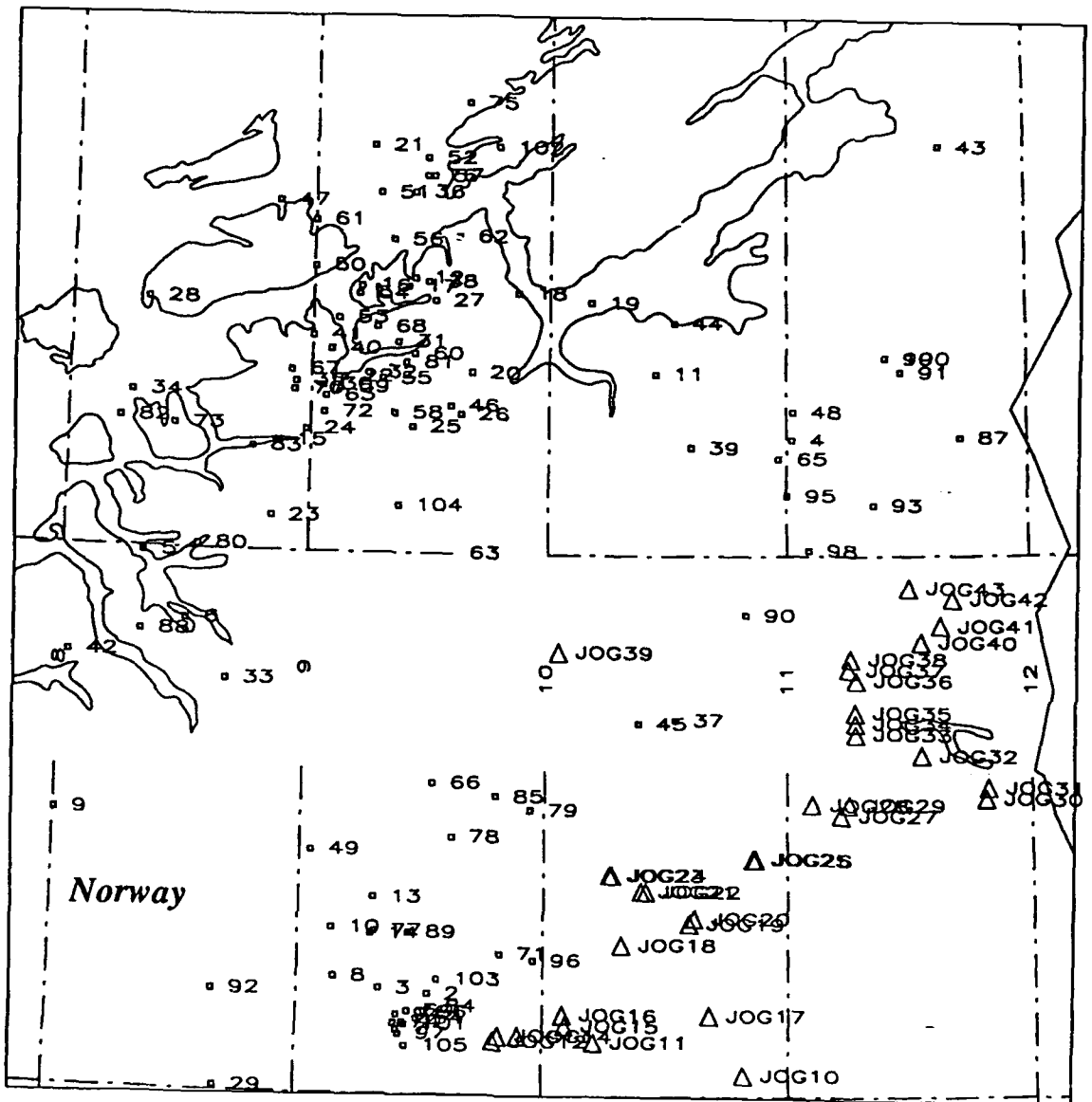


Figure 5: Mine and IMS event locations for area 32.

AREA 33

Latitude: 62 - 64°N

Longitude: 12 - 18°E

Local magnitude range: -

Number of events in IMS2: 43

Number of events within the magnitude range: 43

Number of processed events: 34

Frequency range used to process the data: 3.5 - 16 Hz

Processed signal length: 10s. before P, 90s. after.

Number of reference events: 1

Table 10: Reference events for area 33

| Event # | IMS orid | IMS arid | IMS wfid | Threshold | Group |
|---------|----------|----------|----------|-----------|-------|
| 7 | 15103 | 710967 | 498323 | 0.87 | A |

Reported mine locations: None

Number of events found in the Helsinki bulletin: 1

Table 11: Events found in the Helsinki bulletin for area 33

| Event # | IMS orid | IMS origin time | | IMS ml | HEL location | | HEL label | Group |
|---------|----------|-----------------|------------|--------|--------------|-------|-----------|-------|
| 17 | 302895 | 12/15/91 | 15:18:47.5 | 2.74 | 62.15 | 17.61 | EART. | - |

Events with the most reliable classification:

Table 12: Sorted events for area 33

| Event # | IMS orid | IMS origin time | | IMS lat | IMS lat | IMS ml | Group |
|---------|----------|-----------------|------------|---------|---------|--------|-------|
| 5 | 14927 | 3/19/91 | 13:04:20.1 | 62.7520 | 17.9256 | 1.68 | A |
| 7 | 15103 | 3/20/91 | 10:55:56.0 | 62.7197 | 17.9496 | 1.57 | A |
| 8 | 15237 | 3/21/91 | 11:57:16.4 | 62.6679 | 17.9993 | 1.78 | A |

Remarks:

- Most of these events have very low signal-to-noise ratios and could not be sorted. However, the locations spread over the whole area which implies that most of these events are probably unique.
- A small group of three events corresponding to group A can be seen on the Eastern part of the map (Figure 6).

Mine and event locations:

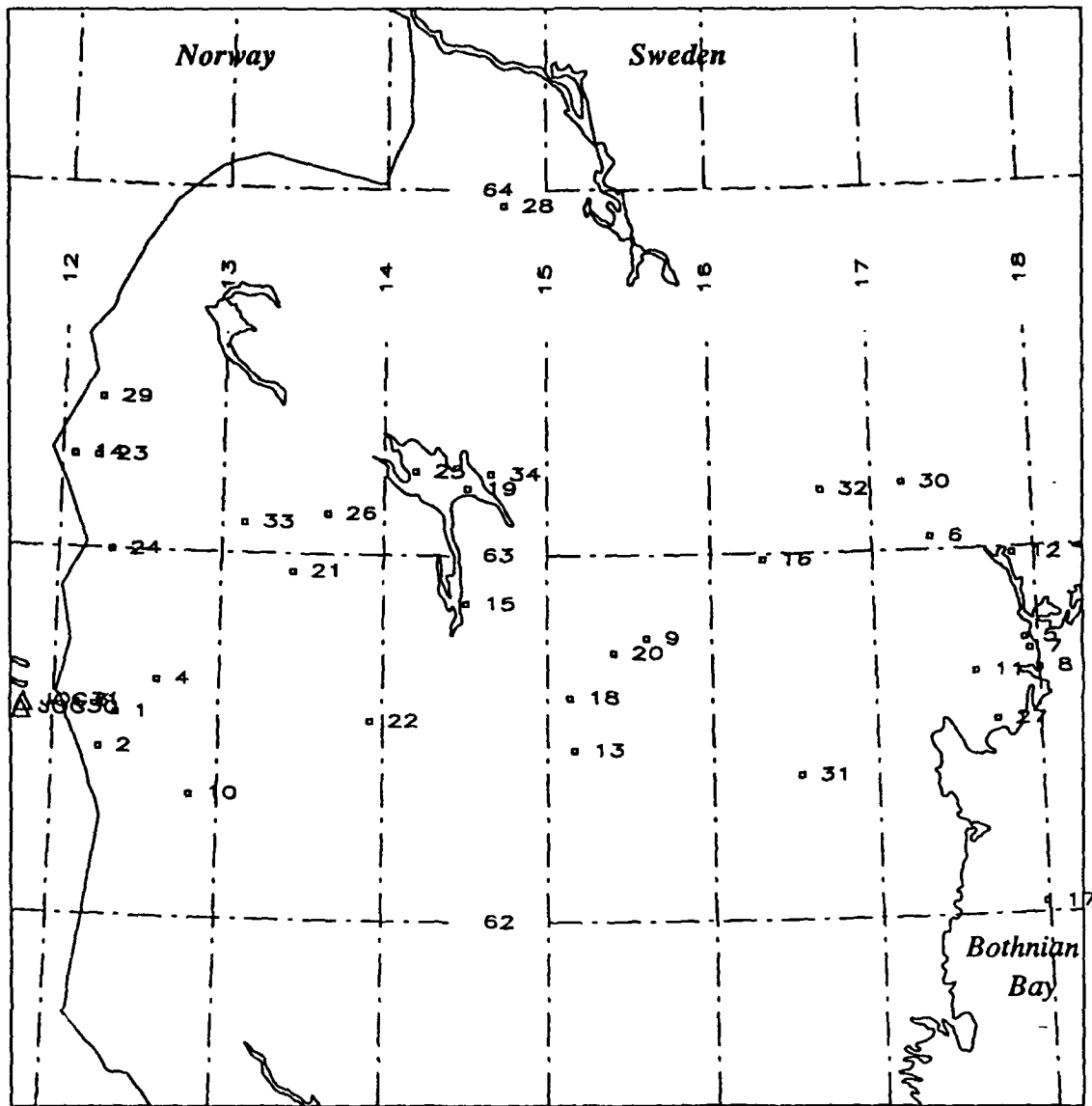


Figure 6: IMS event locations for area 33

AREA 34

Latitude: 62 - 64°N

Longitude: 18 - 24°E

Local magnitude range: > 1.0

Number of events in IMS2: 395

Number of events within the magnitude range: 83

Number of processed events: 9

Frequency range used to process the data: 3.5 - 16 Hz

Processed signal length: 14s. before P, 134s. after P

Number of reference events: None

Reported mine locations:

Table 13: Mine locations for area 34

| Label | Latitude | Longitude | Origin |
|-------|----------|-----------|--------|
| HM14 | 62.8 | 22.9 | Hels |
| HM20 | 62.7 | 23.2 | Hels |
| HM21 | 62.6 | 23.6 | Hels |
| N218 | 63.8667 | 20.2167 | Norw |
| N215 | 63.9167 | 20.1000 | Norw |
| N219 | 63.9167 | 20.3000 | Norw |
| N217 | 63.9333 | 20.0667 | Norw |

Number of events found in the Helsinki bulletin: 6

Table 14: Events found in the Helsinki bulletin

| Event # | IMS orid | IMS origin time | | IMS ml | HEL location | | HEL label | Group |
|---------|----------|-----------------|------------|--------|--------------|-------|-----------|-------|
| 1 | 25858 | 6/7/91 | 07:32:56.0 | 1.66 | 63.38 | 21.01 | - | - |
| 2 | 27857 | 6/27/91 | 11:44:55.0 | 1.61 | 62.82 | 22.89 | - | - |
| 3 | 300451 | 10/21/91 | 13:04:12.9 | 1.72 | 63.57 | 21.57 | - | - |
| 4 | 300450 | 10/21/91 | 13:05:20.5 | 1.72 | 63.60 | 21.33 | - | - |
| 5 | 300864 | 10/28/91 | 16:21:27.1 | 2.15 | 64.06 | 19.92 | P.E. | - |
| 8 | 330462 | 5/22/92 | 23:06:27.3 | 2.71 | 63.8700 | 21.32 | P.E. | - |

Remarks:

- Most of these events are located in the Bothnian Bay, including two events identified in the Helsinki bulletin as being "probably earthquakes".

Mine and event locations:

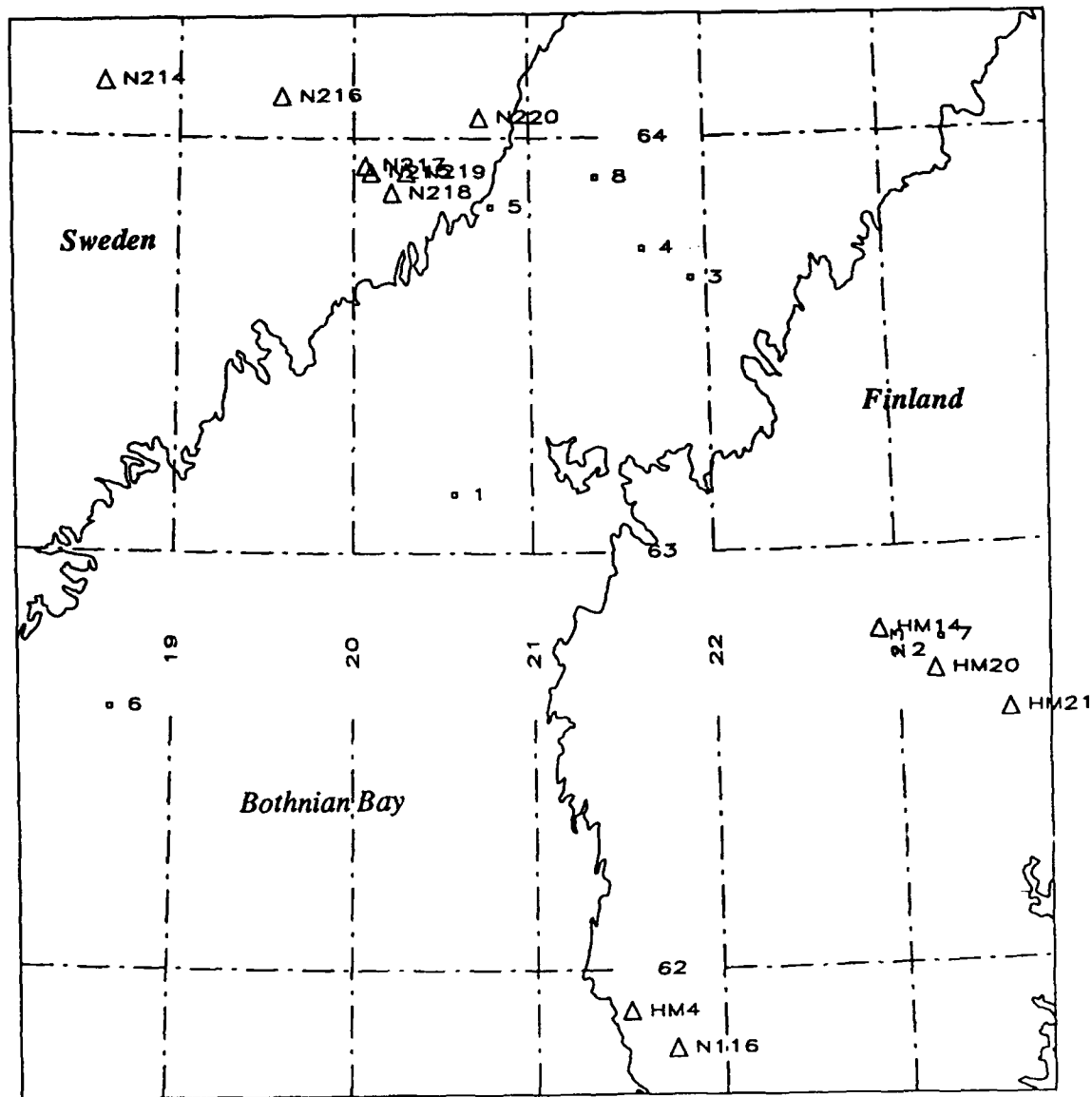


Figure 7: Mine and IMS event locations for area 34

AREA 46

Latitude: 60 - 62°N

Longitude: 16 - 20°E

Local magnitude range: -

Number of events in IMS2: 44

Number of events within the magnitude range: 44

Number of processed events: 31

Frequency range used to process the data: 3.5 - 16 Hz

Processed signal length: 9s. before P, 84s. after P

Number of reference events: None

Reported mine locations:

Table 15: Mine locations for area 46

| Label | Latitude | Longitude | Origin |
|-------|----------|-----------|--------|
| N202 | 60.120 | 17.520 | Norw |
| N204 | 60.185 | 16.115 | Norw |
| N203 | 60.200 | 16.130 | Norw |

Number of events found in the Helsinki bulletin: None

Remarks:

- The distribution of the event locations reflects the diversity of the signals and explains the absence of reference events.

Mine and event locations:

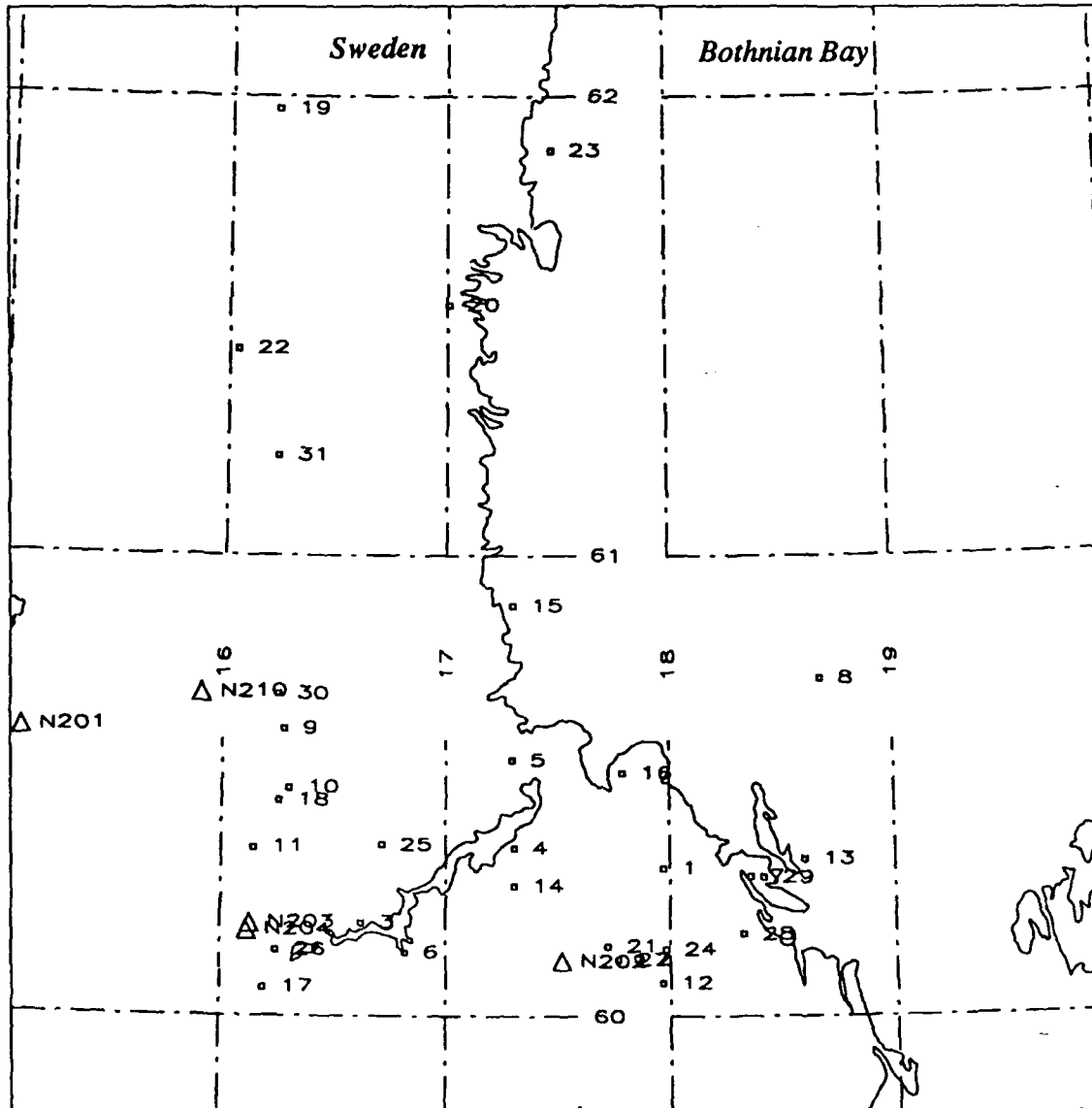


Figure 8: Mine and IMS event locations for area 46.

AREA 47

Latitude: 60 - 62°N

Longitude: 12 - 16°E

Local magnitude range: 1.0

Number of events in IMS2: 272

Number of events within the magnitude range: 110

Number of processed events: 91

Frequency range used to process the data: 2 - 16 Hz

Processed signal length: 4s. before P, 39s. after P

Number of reference events: 8

Table 16: Reference events for area 47

| Event # | IMS orid | IMS arid | IMS wfid | Threshold | Group |
|---------|----------|----------|----------|-----------|-------|
| 3 | 42282 | 545254 | 639181 | 0.82 | A |
| 30 | 37296 | 924183 | 1200628 | 0.82 | B |
| 59 | 319726 | 1207183 | 1771113 | 0.84 | C |
| 57 | 302795 | 1010631 | 1504009 | 0.86 | D |
| 40 | 41425 | 959796 | 1274813 | 0.84 | E |
| 11 | 28037 | 820226 | 931865 | 0.92 | F |
| 15 | 28391 | 828812 | 944111 | 0.87 | G |
| 81 | 332016 | 1324336 | 2222884 | 0.90 | H |

Reported mine locations:

Table 17: Mine locations for area 47

| Label | Latitude | Longitude | Origin |
|-------|----------|-----------|--------|
| N207 | 60.10 | 15.00 | Norw |
| N201 | 60.62 | 15.10 | Norw |
| N210 | 60.70 | 15.90 | Norw |

Number of events found in the Helsinki bulletin: None

Events with the most reliable classification:

Table 18: Sorted events for area 47

| Event # | OMS orid | IMS origin time | | IMS lat | IMS lon | IMS ml | Group |
|---------|----------|-----------------|------------|---------|---------|--------|-------|
| 1 | 3004 | 11/21/90 | 13:46:49.8 | 60.1311 | 15.3008 | 1.16 | A |
| 3 | 42282 | 12/6/90 | 14:42:26.9 | 60.2175 | 15.3287 | 1.46 | A |
| 7 | 23390 | 5/23/91 | 12:58:53.6 | 60.7785 | 15.6215 | 1.32 | A |
| 20 | 28599 | 7/3/91 | 12:49:54.6 | 60.4589 | 15.4166 | 1.12 | A |
| 24 | 34925 | 8/14/91 | 11:35:12.4 | 60.2610 | 15.3440 | 1.18 | A |
| 60 | 320206 | 3/11/92 | 13:29:30.4 | 60.1714 | 15.2612 | 1.36 | A |
| 68 | 329110 | 5/27/92 | 10:38:29.7 | 61.0472 | 15.3701 | 1.17 | A |
| 87 | 341879 | 10/21/92 | 11:39:50.6 | 61.1989 | 15.3446 | 1.13 | A |
| 2 | 3093 | 12/4/90 | 13:03:52.8 | 60.4271 | 15.4105 | 1.12 | B |
| 4 | 4376 | 12/19/90 | 13:39:21.9 | 60.2553 | 15.3392 | 1.40 | B |
| 6 | 18168 | 4/18/91 | 08:56:31.3 | 60.9955 | 15.3597 | 1.04 | B |
| 30 | 37296 | 9/4/91 | 08:31:06.2 | 61.0303 | 15.2741 | 1.14 | B |
| 90 | 344341 | 11/26/92 | 11:25:42.1 | 61.1694 | 15.4875 | 1.16 | B |
| 5 | 17430 | 4/9/91 | 09:34:50.7 | 60.9651 | 15.3808 | 1.10 | C |
| 59 | 319726 | 3/4/92 | 11:06:43.0 | 61.0102 | 15.3852 | 1.10 | C |
| 64 | 327210 | 5/7/92 | 09:18:49.5 | 60.9830 | 15.3683 | 1.33 | C |
| 67 | 328433 | 5/20/92 | 14:00:28.7 | 61.0060 | 15.3720 | 1.11 | C |
| 69 | 330106 | 6/10/92 | 09:08:19.7 | 61.0085 | 15.1856 | 1.23 | C |
| 84 | 336291 | 8/19/92 | 08:54:29.9 | 61.0261 | 15.3019 | 1.20 | C |
| 88 | 342778 | 11/3/92 | 10:34:39.2 | 61.0936 | 15.4070 | 1.12 | C |
| 91 | 347161 | 1/5/93 | 09:41:39.7 | 61.0316 | 15.3004 | 1.02 | C |
| 57 | 302795 | 12/6/91 | 12:27:33.2 | 60.3073 | 15.8303 | 1.45 | D |
| 66 | 327908 | 5/15/92 | 09:32:13.0 | 60.0728 | 15.6417 | 1.02 | D |
| 89 | 343101 | 11/9/92 | 13:36:25.9 | 60.2572 | 15.8857 | 1.31 | D |
| 23 | 35243 | 8/10/91 | 07:58:49.9 | 60.5638 | 15.3543 | 1.13 | E |
| 40 | 41425 | 9/29/91 | 10:59:38.7 | 60.7755 | 15.3188 | 1.08 | E |
| 55 | 301532 | 11/14/91 | 12:37:06.6 | 60.9911 | 15.3022 | 1.00 | E |
| 56 | 301912 | 11/21/91 | 10:29:10.5 | 60.9822 | 15.4179 | 1.03 | E |

Table 18: Sorted events for area 47

| Event # | OMS orid | IMS origin time | | IMS lat | IMS lon | IMS ml | Group |
|---------|----------|-----------------|------------|---------|---------|--------|-------|
| 58 | 302686 | 12/11/91 | 08:00:33.4 | 60.9863 | 15.3465 | 1.01 | E |
| 61 | 320361 | 3/12/92 | 11:05:17.0 | 61.0543 | 15.3888 | 1.36 | E |
| 8 | 27706 | 6/17/91 | 13:29:59.8 | 61.5062 | 13.7830 | 1.52 | F |
| 9 | 27661 | 6/18/91 | 08:24:58.0 | 61.5178 | 13.9398 | 1.36 | F |
| 10 | 27952 | 6/18/91 | 12:45:10.5 | 61.5884 | 13.8180 | 1.49 | F |
| 11 | 28037 | 6/25/91 | 16:45:16.5 | 61.5420 | 13.8613 | 1.49 | F |
| 12 | 28324 | 6/26/91 | 14:30:17.7 | 61.4896 | 13.9075 | 1.49 | F |
| 14 | 27438 | 6/27/91 | 14:00:33.8 | 61.4740 | 13.9816 | 1.54 | F |
| 16 | 28020 | 7/1/91 | 14:00:05.8 | 61.5161 | 13.8931 | 1.52 | F |
| 18 | 28714 | 7/2/91 | 14:00:23.8 | 61.5444 | 13.8976 | 1.43 | F |
| 27 | 36697 | 8/28/91 | 09:29:50.6 | 61.4751 | 13.9248 | 1.38 | F |
| 36 | 41589 | 9/25/91 | 07:46:53.2 | 61.5585 | 14.0371 | 1.48 | F |
| 38 | 41689 | 9/26/91 | 09:44:47.6 | 61.6377 | 13.6103 | 1.49 | F |
| 41 | 300083 | 10/1/91 | 09:03:40.8 | 61.5026 | 13.8868 | 1.48 | F |
| 42 | 300096 | 10/1/91 | 13:00:17.2 | 61.4871 | 13.8676 | 1.36 | F |
| 43 | 300136 | 10/2/91 | 10:30:03.7 | 61.4223 | 13.8122 | 1.44 | F |
| 45 | 300454 | 10/21/91 | 13:30:03.3 | 61.5278 | 13.9385 | 1.45 | F |
| 46 | 300474 | 10/21/91 | 17:01:10.2 | 61.4714 | 13.8611 | 1.41 | F |
| 48 | 300634 | 10/22/91 | 14:00:14.0 | 61.4806 | 14.0205 | 1.52 | F |
| 49 | 300637 | 10/22/91 | 17:45:13.9 | 61.5579 | 13.7215 | 1.54 | F |
| 50 | 300861 | 10/28/91 | 14:30:03.2 | 61.6715 | 13.6322 | 1.45 | F |
| 51 | 300876 | 10/29/91 | 09:00:31.4 | 61.4382 | 14.0326 | 1.46 | F |
| 52 | 300886 | 10/29/91 | 12:30:01.3 | 61.4972 | 13.7930 | 1.54 | F |
| 53 | 300899 | 10/29/91 | 14:48:00.3 | 61.4306 | 13.9299 | 1.55 | F |
| 70 | 330661 | 6/16/92 | 09:00:03.8 | 61.4971 | 13.9021 | 1.46 | F |
| 71 | 330884 | 6/17/92 | 08:59:46.5 | 61.4944 | 13.8319 | 1.38 | F |
| 72 | 330931 | 6/17/92 | 13:30:08.1 | 61.4781 | 13.8870 | 1.47 | F |
| 73 | 330980 | 6/18/92 | 08:59:54.1 | 61.5160 | 13.8661 | 1.46 | F |
| 74 | 331304 | 6/22/92 | 13:29:53.0 | 61.5151 | 13.8992 | 1.46 | F |
| 75 | 331366 | 6/23/92 | 09:06:34.6 | 61.6681 | 13.7965 | 1.43 | F |

Table 18: Sorted events for area 47

| Event # | OMS orid | IMS origin time | | IMS lat | IMS lon | IMS ml | Group |
|---------|----------|-----------------|------------|---------|---------|--------|-------|
| 77 | 331496 | 6/24/92 | 09:00:07.1 | 61.6547 | 13.7685 | 1.56 | F |
| 78 | 331583 | 6/25/92 | 09:00:09.6 | 61.4658 | 13.8716 | 1.55 | F |
| 79 | 331899 | 6/29/92 | 12:00:01.7 | 61.4819 | 13.8264 | 1.32 | F |
| 80 | 331994 | 6/30/92 | 09:30:29.3 | 61.5306 | 13.8540 | 1.38 | F |
| 82 | 332169 | 7/2/92 | 07:05:19.8 | 61.4618 | 13.7778 | 1.34 | F |
| 83 | 332183 | 7/2/92 | 09:05:08.4 | 61.5278 | 13.9221 | 1.30 | F |
| 13 | 27842 | 6/27/91 | 09:29:58.3 | 61.5724 | 13.8323 | 1.51 | G |
| 15 | 28391 | 7/1/91 | 09:29:49.5 | 61.4759 | 13.8875 | 1.50 | G |
| 17 | 28564 | 7/2/91 | 09:29:56.5 | 61.4779 | 13.9309 | 1.49 | G |
| 19 | 28592 | 7/3/91 | 09:30:21.0 | 61.5030 | 13.7669 | 1.38 | G |
| 21 | 28282 | 7/3/91 | 14:30:21.8 | 61.5463 | 13.8288 | 1.36 | G |
| 22 | 28937 | 7/4/91 | 09:29:51.8 | 61.4820 | 13.9215 | 1.41 | G |
| 25 | 36905 | 8/27/91 | 13:45:01.5 | 61.4479 | 13.8925 | 1.06 | G |
| 26 | 36912 | 8/27/91 | 17:29:51.0 | 61.5059 | 13.8042 | 1.18 | G |
| 28 | 36735 | 8/28/91 | 14:29:51.5 | 61.5162 | 13.7898 | 1.47 | G |
| 29 | 37692 | 9/3/91 | 10:14:50.7 | 61.5523 | 13.7802 | 1.32 | G |
| 31 | 37366 | 9/4/91 | 14:00:02.8 | 61.4724 | 13.7358 | 1.29 | G |
| 32 | 38161 | 9/5/91 | 09:45:01.1 | 61.5241 | 13.8125 | 1.26 | G |
| 34 | 41264 | 9/23/91 | 11:29:7.9 | 61.5324 | 13.8737 | 1.47 | G |
| 35 | 41529 | 9/23/91 | 16:00:14.3 | 61.5328 | 13.8973 | 1.51 | G |
| 37 | 41659 | 9/25/91 | 14:59:55.2 | 61.5309 | 13.9606 | 1.43 | G |
| 39 | 41726 | 9/26/91 | 13:53:14.7 | 61.4908 | 13.8912 | 1.34 | G |
| 44 | 300152 | 10/2/91 | 15:00:17.5 | 61.5757 | 13.6974 | 1.54 | G |
| 47 | 300529 | 10/22/91 | 10:00:12.0 | 61.5952 | 13.6760 | 1.53 | G |
| 54 | 300916 | 10/30/91 | 09:15:07.8 | 61.5933 | 13.7689 | 1.34 | G |
| 81 | 332016 | 6/30/92 | 11:33:51.7 | 60.9237 | 14.9131 | 1.12 | H |
| 86 | 339558 | 9/22/92 | 13:28:01.5 | 61.0327 | 14.8778 | 1.39 | H |

Remarks:

- Events from groups G and H are located North of the map (Figure 9) forming a tight cluster of events.

- Another cluster is located on the eastern part of the map and consists of events from groups B and C.
- None of these clusters is located close to one of the three reported mines.

Mine and event locations:

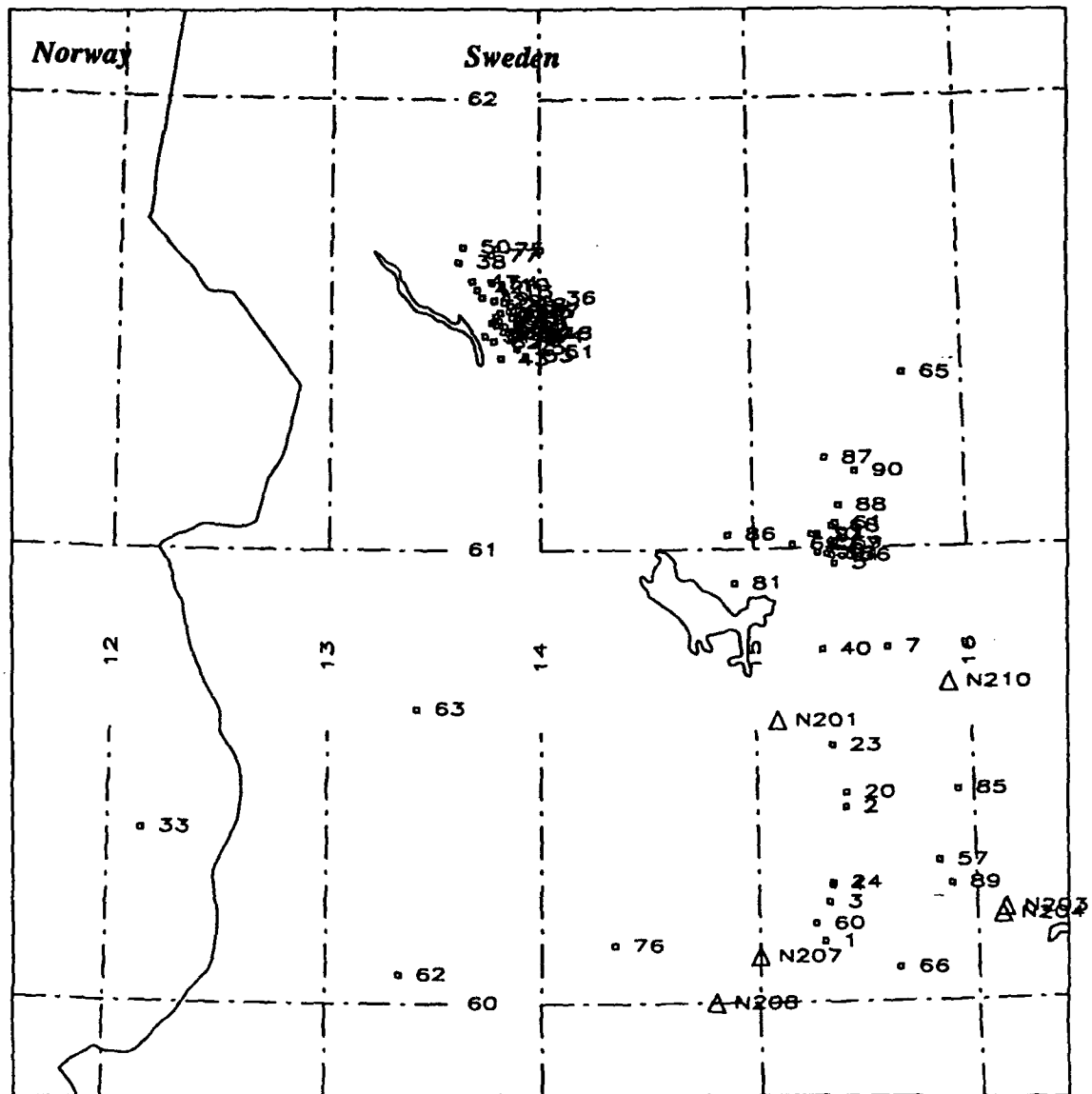


Figure 9: Mine and IMS event locations for area 47.

AREA 48

Latitude: 60 - 62°N

Longitude: 8 - 12°E

Local magnitude range: 0.8

Number of events in IMS2: 808

Number of events within the magnitude range: 133

Number of processed events: 109

Frequency range used to process the data: 2 - 16 Hz

Processed signal length: 4s. before P, 34s. after P

Number of reference events: 17

Table 19: Reference events for area 48

| Event # | IMS orid | IMS arid | IMS wfid | Threshold | Group |
|---------|----------|----------|----------|-----------|-------|
| 16 | 24385 | 797972 | 817722 | 0.83 | A |
| 54 | 312991 | 1030806 | 1605961 | 0.84 | B |
| 75 | 326308 | 1237047 | 1996500 | 0.90 | C |
| 46 | 301900 | 1007830 | 1467526 | - | D |
| 63 | 316161 | 1193338 | 1723863 | 0.83 | E |
| 21 | 26053 | 809671 | 901791 | - | F |
| 12 | 22723 | 784915 | 766053 | 0.87 | G |
| 109 | 345726 | 1536489 | 2886318 | 0.85 | H |
| 41 | 301216 | 1005791 | 1410322 | - | I |
| 91 | 334304 | 1328018 | 2275159 | 0.87 | J |
| 96 | 336330 | 1401620 | 2487487 | 0.82 | K |
| 39 | 300941 | 1003333 | 1348130 | - | L |
| 87 | 331611 | 1320677 | 2203294 | 0.86 | M |
| 6 | 7911 | 596037 | 427058 | - | N |
| 71 | 323262 | 1228970 | 1876932 | 0.82 | O |
| 9 | 19495 | 756378 | 709602 | 0.83 | P |
| 2 | 3215 | 530595 | 593995 | - | Q |
| 7 | 11084 | 619680 | 1375873 | - | R |

Reported mine locations:

Table 20: Mine locations for area 48

| Label | Latitude | Longitude | Origin |
|-------|----------|-----------|--------|
| N13 | 60.74 | 11.02 | Norw |

Number of events found in the Helsinki bulletin: 1

Table 21: Events found in the Helsinki bulletin for area 48

| Event # | IMS orid | IMS origin time | | IMS ml | HEL location | | HEL label | Group |
|---------|----------|-----------------|------------|--------|--------------|-------|-----------|-------|
| 88 | 333032 | 6/30/92 | 15:04:38.3 | 2.05 | 60.88 | 11.44 | PE. | - |

Events with the most reliable classification:

Table 22: Sorted events for area 48

| Event # | IMS orid | IMS origin time | | IMS lat | IMS lon | IMS ml | Group |
|---------|----------|-----------------|------------|---------|---------|--------|-------|
| 8 | 18722 | 4/15/91 | 15:02:41.4 | 61.2648 | 10.5470 | 0.85 | A |
| 11 | 22203 | 5/13/91 | 19:06:09.2 | 61.1453 | 10.4847 | 1.31 | A |
| 13 | 22725 | 5/14/91 | 19:10:19.4 | 61.1784 | 10.6462 | 1.02 | A |
| 15 | 24176 | 5/28/91 | 18:03:40.4 | 61.2074 | 10.6158 | 1.20 | A |
| 16 | 24385 | 5/29/91 | 19:09:37.1 | 61.0957 | 10.6542 | 1.32 | A |
| 18 | 25754 | 6/6/91 | 15:00:05.8 | 61.2133 | 10.4028 | 1.49 | A |
| 20 | 25897 | 6/7/91 | 13:00:11.7 | 61.2539 | 10.5088 | 0.94 | A |
| 25 | 28613 | 7/3/91 | 18:14:58.6 | 61.2528 | 10.4618 | 1.24 | A |
| 26 | 28954 | 7/4/91 | 13:13:45.9 | 61.2170 | 10.5436 | 1.12 | A |
| 28 | 29375 | 7/10/91 | 13:32:42.9 | 61.1259 | 10.7449 | 0.84 | A |
| 42 | 301552 | 11/15/91 | 15:17:56.3 | 61.4586 | 10.2080 | 0.84 | A |
| 43 | 301917 | 11/21/91 | 10:37:09.2 | 61.1874 | 10.5110 | 1.13 | A |
| 45 | 302028 | 11/27/91 | 14:01:39.7 | 61.2248 | 10.5023 | 1.09 | A |
| 48 | 302193 | 12/9/91 | 14:03:59.6 | 61.1600 | 10.7332 | 1.08 | A |
| 49 | 302751 | 12/5/91 | 14:05:13.0 | 61.2747 | 10.4371 | 0.91 | A |
| 50 | 302574 | 12/11/91 | 11:56:52.3 | 61.3662 | 10.2765 | 1.08 | A |
| 57 | 312784 | 1/14/92 | 14:05:31.0 | 61.0408 | 10.3954 | 0.98 | A |

Table 22: Sorted events for area 48

| Event # | IMS orid | IMS origin time | | IMS lat | IMS lon | IMS ml | Group |
|---------|----------|-----------------|------------|---------|---------|--------|-------|
| 58 | 313666 | 1/16/92 | 14:14:07.3 | 61.1599 | 10.2926 | 0.81 | A |
| 19 | 25872 | 6/7/91 | 10:58:56.6 | 60.3179 | 11.1898 | 0.81 | B |
| 29 | 32920 | 7/31/91 | 12:14:59.1 | 60.2087 | 11.0730 | 0.84 | B |
| 32 | 38259 | 9/5/91 | 17:18:21.0 | 60.2730 | 11.1342 | 1.22 | B |
| 33 | 40185 | 9/17/91 | 17:04:12.4 | 60.2728 | 11.1299 | 0.86 | B |
| 35 | 41662 | 9/25/91 | 15:46:11.3 | 60.2775 | 11.1581 | 0.91 | B |
| 37 | 300633 | 10/22/91 | 13:10:26.1 | 60.3078 | 11.1631 | 1.13 | B |
| 38 | 300936 | 10/30/91 | 12:46:36.5 | 60.3375 | 11.2087 | 0.91 | B |
| 40 | 301232 | 11/12/91 | 13:04:28.3 | 60.2556 | 11.1215 | 0.85 | B |
| 47 | 302317 | 11/26/91 | 12:21:33.1 | 60.3486 | 11.1826 | 0.84 | B |
| 52 | 302599 | 12/13/91 | 12:48:58.0 | 60.3770 | 11.2389 | 1.13 | B |
| 53 | 302903 | 12/16/91 | 12:05:42.7 | 60.3612 | 11.2149 | 0.91 | B |
| 54 | 312991 | 12/30/91 | 12:23:23.1 | 60.3296 | 11.1668 | 1.11 | B |
| 55 | 313130 | 1/13/92 | 12:32:17.6 | 60.3150 | 11.3130 | 0.89 | B |
| 60 | 315381 | 1/31/92 | 13:53:03.8 | 60.3160 | 11.1681 | 0.99 | B |
| 61 | 315664 | 2/3/92 | 13:16:31.6 | 60.3387 | 11.1807 | 0.94 | B |
| 64 | 317816 | 2/20/92 | 12:18:38.7 | 60.3369 | 11.1646 | 0.97 | B |
| 74 | 326190 | 4/27/92 | 09:55:57.1 | 60.3427 | 11.1999 | 0.93 | C |
| 75 | 326308 | 4/28/92 | 11:24:09.7 | 60.3612 | 11.2132 | 1.23 | C |
| 76 | 326918 | 5/4/92 | 11:13:10.6 | 60.3373 | 11.1984 | 0.92 | C |
| 78 | 328207 | 5/18/92 | 12:24:22.8 | 60.3710 | 11.2074 | 1.13 | C |
| 79 | 329137 | 5/27/92 | 13:33:34.8 | 60.3681 | 11.2077 | 0.98 | C |
| 81 | 329653 | 6/3/92 | 10:59:26.3 | 60.3431 | 11.1912 | 0.96 | C |
| 46 | 301900 | 11/28/91 | 12:52:49.9 | 60.1047 | 10.3421 | 0.89 | D |
| 56 | 312179 | 1/13/92 | 14:07:19.5 | 60.2132 | 10.1051 | 0.82 | D |
| 63 | 316161 | 2/19/92 | 14:46:46.1 | 60.3624 | 9.4056 | 1.04 | E |
| 66 | 319293 | 2/25/92 | 13:32:15.1 | 60.3930 | 9.4451 | 0.90 | E |
| 68 | 320556 | 3/13/92 | 13:39:13.9 | 60.3932 | 9.4593 | 1.09 | E |

Table 22: Sorted events for area 48

| Event # | IMS orid | IMS origin time | | IMS lat | IMS lon | IMS ml | Group |
|---------|----------|-----------------|------------|---------|---------|--------|-------|
| 21 | 26053 | 6/10/91 | 12:42:38.7 | 60.0366 | 10.7580 | 0.87 | F |
| 77 | 327524 | 5/11/92 | 14:12:46.6 | 60.0206 | 10.7158 | 0.80 | F |
| 12 | 22723 | 5/14/91 | 12:35:00.7 | 60.1372 | 11.7534 | 0.92 | G |
| 23 | 27663 | 6/18/91 | 09:08:35.1 | 60.1750 | 11.7781 | 1.02 | G |
| 3 | 4358 | 12/19/90 | 12:40:34.8 | 60.8386 | 9.3781 | 0.96 | H |
| 62 | 315818 | 2/18/92 | 15:29:29.1 | 60.9518 | 9.3670 | 1.06 | H |
| 109 | 345726 | 12/17/92 | 13:54:20.7 | 60.9401 | 8.8375 | 1.12 | H |
| 41 | 301216 | 11/14/91 | 10:46:09.7 | 61.8894 | 8.9904 | 1.19 | I |
| 59 | 315282 | 1/30/92 | 13:50:07.0 | 61.6813 | 9.5791 | 1.16 | I |
| 72 | 325494 | 4/22/92 | 15:16:10.2 | 61.0467 | 8.8891 | 0.88 | J |
| 89 | 332511 | 7/6/92 | 17:34:17.2 | 61.0597 | 8.9298 | 1.09 | J |
| 91 | 334304 | 7/13/92 | 17:18:52.0 | 61.0516 | 8.8627 | 0.88 | J |
| 93 | 334710 | 7/30/92 | 13:13:26.5 | 61.0602 | 8.8865 | 0.85 | J |
| 10 | 21003 | 5/7/91 | 12:53:22.6 | 60.0095 | 10.9706 | 0.86 | K |
| 96 | 336330 | 8/19/92 | 12:32:16.1 | 60.0085 | 10.9927 | 1.34 | K |
| 106 | 344302 | 11/25/92 | 15:57:09.1 | 60.0100 | 11.0593 | 0.86 | K |
| 39 | 300941 | 10/30/91 | 15:15:44.0 | 61.1108 | 9.2431 | 1.06 | L |
| 99 | 337682 | 9/2/92 | 14:19:45.5 | 61.0778 | 8.9359 | 0.96 | L |
| 67 | 320403 | 3/12/92 | 15:08:14.8 | 60.5412 | 8.2409 | 1.09 | M |
| 87 | 331611 | 6/25/92 | 12:47:30.4 | 60.5272 | 8.2797 | 0.90 | M |
| 103 | 341856 | 10/22/92 | 14:17:29.6 | 60.4436 | 8.4587 | 0.91 | M |
| 6 | 7911 | 1/24/91 | 14:08:33.2 | 60.0090 | 10.9210 | 1.23 | N |
| 14 | 23980 | 5/24/91 | 11:12:20.1 | 60.9566 | 10.6360 | 0.87 | N |
| 70 | 323059 | 3/31/92 | 08:46:51.2 | 60.5130 | 10.6285 | 0.91 | O |
| 71 | 323262 | 3/31/92 | 16:46:29.5 | 60.5183 | 10.6570 | 1.45 | O |
| 101 | 338792 | 9/14/92 | 12:05:54.0 | 60.4640 | 10.6949 | 1.50 | O |
| 9 | 19495 | 4/26/91 | 15:46:15.4 | 60.8702 | 11.0126 | 0.90 | P |
| 27 | 28963 | 7/4/91 | 18:03:34.0 | 60.8483 | 11.0473 | 0.92 | P |

Table 22: Sorted events for area 48

| Event # | IMS orid | IMS origin time | | IMS lat | IMS lon | IMS ml | Group |
|---------|----------|-----------------|------------|---------|---------|--------|-------|
| 44 | 301948 | 11/21/91 | 15:15:53.9 | 60.9175 | 11.0433 | 1.34 | P |
| 2 | 3215 | 11/20/90 | 15:04:38.7 | 60.9266 | 11.0344 | 0.93 | Q |
| 34 | 40436 | 9/18/91 | 11:43:04.4 | 61.7796 | 9.8422 | 1.27 | Q |
| 7 | 11084 | 2/5/91 | 13:18:01.7 | 60.1915 | 10.5819 | 0.80 | R |
| 83 | 329701 | 6/3/92 | 14:07:22.6 | 60.1090 | 10.2355 | 0.89 | R |

Remarks:

- In this area, several groups include only two or three events.
- Two clusters of events can be seen on the map (Figure 10). One is located North of the Mojsa lake and consists of events from group A while the other cluster is located south of the lake and includes events from groups B and C.
- The single reported mine is located in the middle of the lake and the closest cluster of events (group P and Q) is about 20 km away.

Mine and event locations:

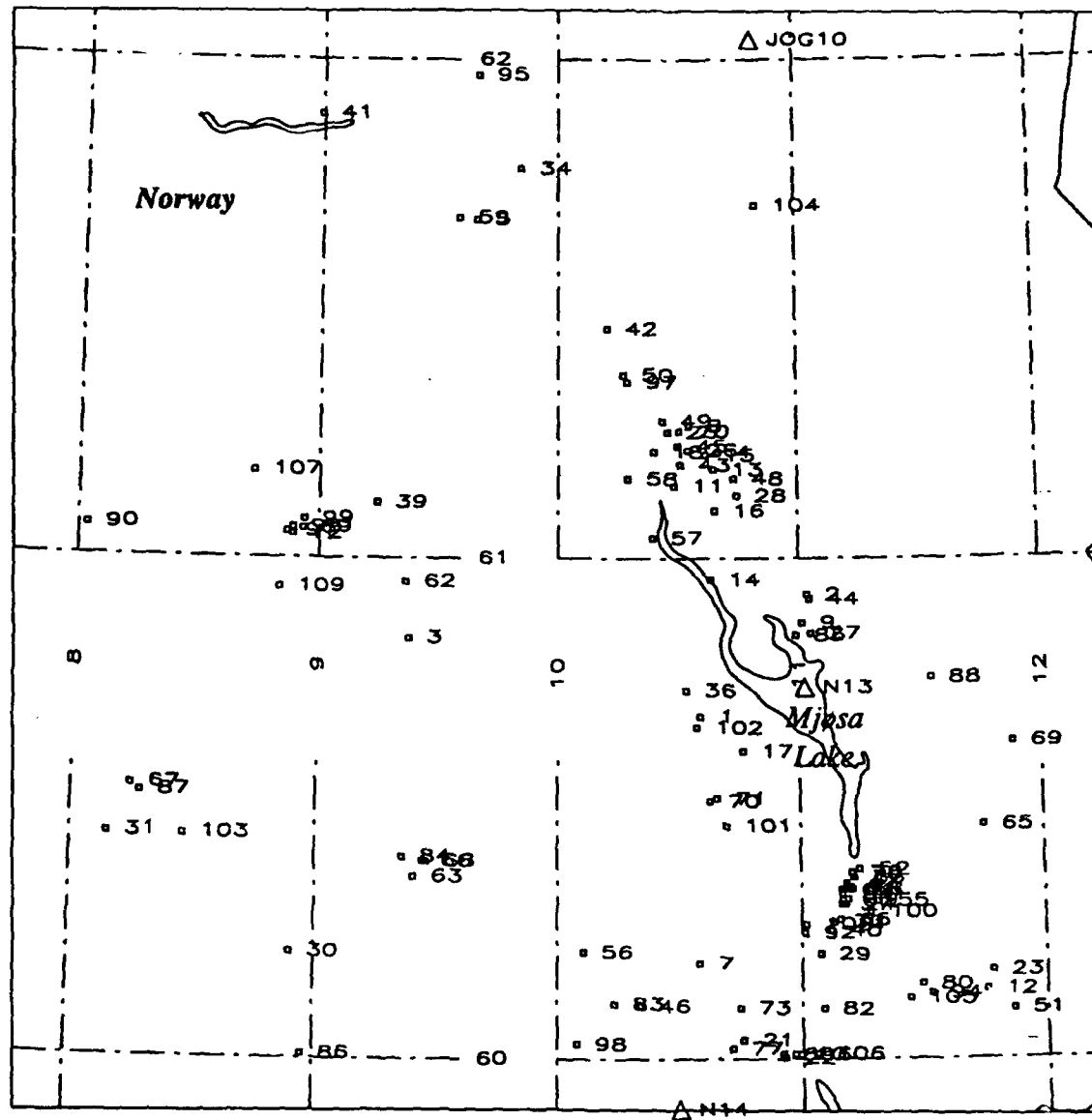


Figure 10: Mine and event locations for area 48.

AREA 49

Latitude: 60 - 62°N

Longitude: 4 - 8°E

Local magnitude range: 1.3

Number of events in IMS2: 776

Number of events within the magnitude range: 118

Number of processed events: 65

Frequency range used to process the data: 2 - 16 Hz

Processed signal length: 9s. before P, 84s. after P

Number of reference events: 9

Table 23: Reference events for area 49

| Event # | IMS orid | IMS arid | IMS wfid | Threshold | Group |
|---------|----------|----------|----------|-----------|-------|
| 45 | 300707 | 1002337 | 1327622 | 0.80 | A |
| 46 | 300944 | 1003344 | 1348208 | 0.89 | B |
| 29 | 28372 | 831799 | 951563 | 0.88 | C |
| 27 | 28712 | 830227 | 950378 | 0.88 | D |
| 3 | 3631 | 552649 | 647620 | 0.86 | E |
| 18 | 18167 | 741218 | 613183 | 0.83 | F |
| 34 | 32174 | 862924 | 1022270 | 0.83 | G |
| 10 | 6146 | 575954 | 686263 | 0.81 | H |
| 58 | 326329 | 1237126 | 1997553 | 0.92 | I |

Reported mine locations:

Table 24: Mine location for area 49

| Label | Latitude | Longitude | Origin |
|-------|----------|-----------|--------|
| NYG | 60.39 | 5.34 | - |
| N6 | 61.93 | 5.45 | Norw |

Number of events found in the Helsinki bulletin: None

Events with the most reliable classification:

Table 25: Sorted events for area 49

| Event # | IMS orid | IMS origin time | | IMS lat | IMS lon | IMS ml | Group |
|---------|----------|-----------------|------------|---------|---------|--------|-------|
| 45 | 300707 | 10/24/91 | 10:46:04.7 | 60.1515 | 5.1360 | 2.32 | A |
| 52 | 315350 | 1/31/92 | 07:51:00.8 | 60.2130 | 5.0142 | 1.71 | A |
| 42 | 300386 | 10/17/91 | 15:10:32.0 | 60.4794 | 5.2585 | 1.70 | B |
| 46 | 300944 | 10/30/91 | 16:00:17.1 | 60.2789 | 5.2426 | 1.66 | B |
| 47 | 300989 | 10/31/91 | 16:04:03.6 | 60.5342 | 5.2724 | 1.42 | B |
| 23 | 24550 | 5/30/91 | 06:44:44.5 | 60.1704 | 5.4371 | 1.41 | C |
| 29 | 28372 | 7/4/91 | 06:16:59.8 | 60.2589 | 5.5065 | 1.35 | C |
| 37 | 34532 | 8/15/91 | 06:16:29.9 | 60.5990 | 5.3826 | 1.38 | C |
| 27 | 28712 | 7/2/91 | 13:19:47.1 | 60.6093 | 5.1922 | 1.56 | D |
| 39 | 40069 | 9/17/91 | 11:59:25.8 | 60.4941 | 5.8726 | 1.33 | D |
| 3 | 3631 | 12/13/90 | 11:09:25.8 | 60.5859 | 5.8890 | 1.48 | E |
| 43 | 300279 | 10/18/91 | 11:11:45.9 | 60.5934 | 5.9078 | 1.50 | E |
| 13 | 8892 | 1/25/91 | 11:25:08.6 | 60.3465 | 5.3310 | 1.32 | F |
| 14 | 15238 | 3/18/91 | 11:27:36.3 | 60.5287 | 5.8266 | 1.37 | F |
| 17 | 18187 | 4/15/91 | 06:49:03.3 | 60.4220 | 5.3083 | 1.50 | F |
| 18 | 18167 | 4/18/91 | 08:32:24.3 | 60.4938 | 5.3891 | 1.51 | F |
| 19 | 19364 | 4/26/91 | 06:55:49.7 | 60.4041 | 5.4070 | 1.55 | F |
| 21 | 23910 | 5/24/91 | 07:33:26.2 | 60.5902 | 5.8406 | 1.33 | F |
| 34 | 32174 | 7/26/91 | 13:02:57.7 | 60.2731 | 4.7349 | 1.32 | G |
| 54 | 321596 | 3/3/92 | 18:17:05.1 | 60.3429 | 5.2801 | 1.49 | G |
| 7 | 9529 | 12/24/90 | 06:47:33.6 | 61.4041 | 7.7012 | 1.43 | H |
| 8 | 6037 | 1/5/91 | 19:00:30.6 | 61.3750 | 7.5478 | 1.30 | H |
| 9 | 6091 | 1/6/91 | 06:29:14.4 | 61.2178 | 7.4486 | 2.24 | H |
| 10 | 6146 | 1/6/91 | 13:38:11.0 | 61.4131 | 7.5681 | 1.95 | H |
| 11 | 6173 | 1/6/91 | 22:14:43.3 | 61.3342 | 7.6043 | 1.59 | H |
| 35 | 32251 | 7/27/91 | 14:03:16.3 | 61.2058 | 7.5104 | 1.35 | H |
| 58 | 326329 | 4/28/92 | 17:12:58.2 | 61.1056 | 7.6509 | 1.67 | I |
| 61 | 327535 | 5/11/92 | 18:12:01.4 | 61.1541 | 7.5860 | 1.58 | I |

Remarks:

- Many of these events could not be sorted because they were unique.
- Events from groups A through G have locations surrounding the NYG mine.
- Events from groups H and I are located in the East part of the map (Figure 11).

Mine and event locations:

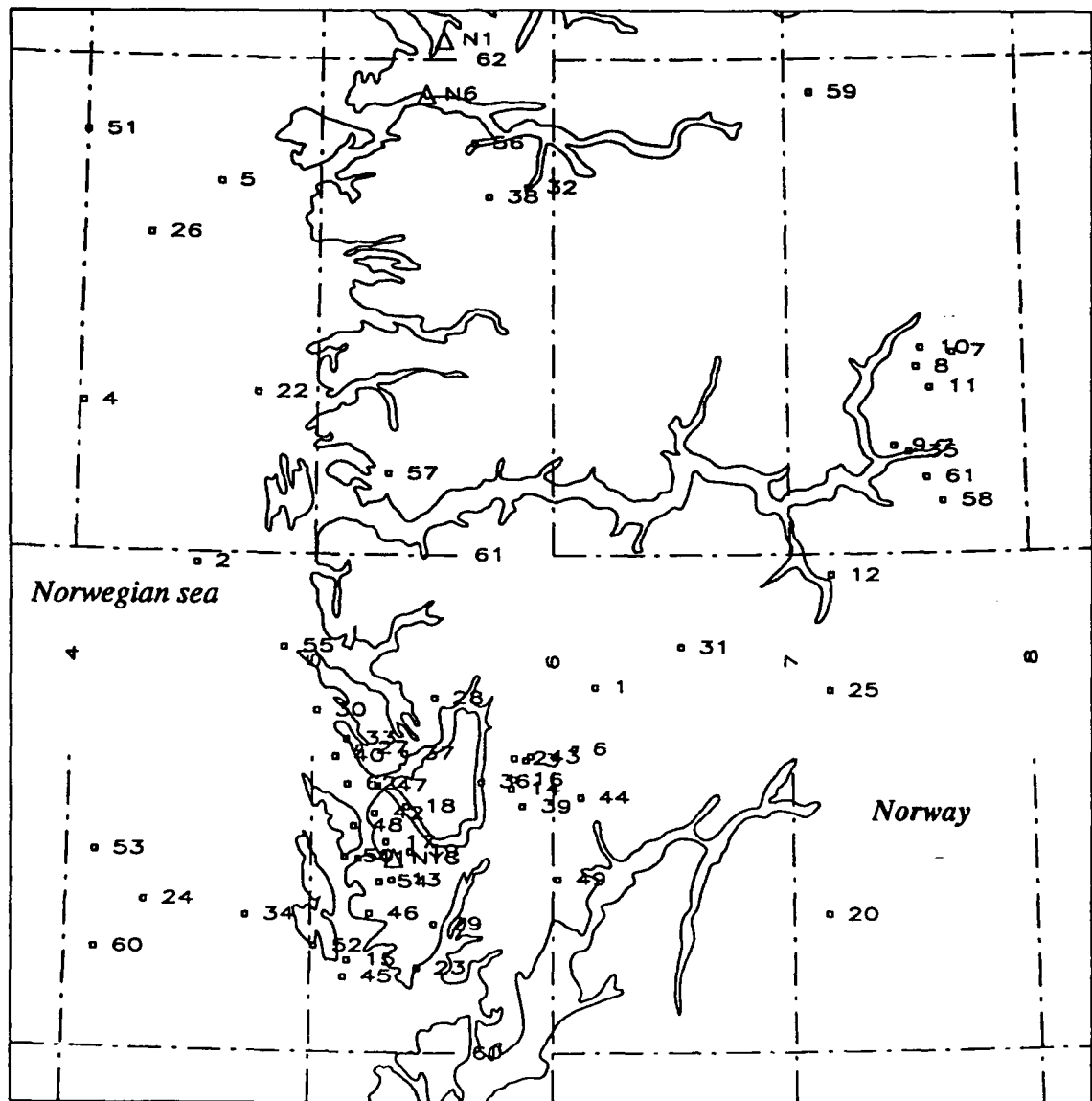


Figure 11: Mine and IMS event locations for area 49

AREA 50

Latitude: 58 - 60°N

Longitude: 4 - 8°E

Local magnitude range: 1.2

Number of events in IMS2: 211

Number of events within the magnitude range: 91

Number of processed events: 72

Frequency range used to process the data: 2 - 16 Hz

Processed signal length: 9s. before P, 79s. after P

Number of reference events: 8

Table 26: Reference events for area 50

| Event # | IMS orid | IMS arid | IMS wfid | Threshold | Group |
|---------|----------|----------|----------|-----------|-------|
| 9 | 19279 | 743789 | 620572 | 0.81 | A |
| 1 | 5810 | 526465 | 629104 | 0.83 | B |
| 28 | 29378 | 839737 | 967769 | 0.81 | C |
| 46 | 321701 | 1207027 | 1780431 | 0.83 | D |
| 52 | 325740 | 1233128 | 1948119 | 0.93 | E |
| 12 | 23028 | 787106 | 784305 | 0.83 | F |
| 14 | 23305 | 791205 | 798675 | 0.86 | G |
| 39 | 300612 | 1001966 | 1322012 | 0.86 | H |

Reported mine locations:

Table 27: Mine locations for area 50

| Label | Latitude | Longitude | Origin |
|-------|----------|-----------|--------|
| TIT | 58.23 | 6.43 | - |
| N15 | 58.30 | 6.40 | Norw |
| BLA | 59.31 | 6.95 | - |

Number of events found in the Helsinki bulletin: 4

Table 28: Events found in the Helsinki bulletin for area 50

| Event # | IMS orid | IMS origin time | | IMS ml | HEL location | | HEL label | Group |
|---------|----------|-----------------|------------|--------|--------------|------|-----------|-------|
| 40 | 300858 | 10/28/91 | 13:14:33.7 | 2.75 | 59.94 | 5.92 | EARTH. | - |
| 62 | 336035 | 8/6/92 | 07:32:41.3 | 3.15 | 59.89 | 6.15 | EARTH. | - |
| 65 | 337933 | 8/28/92 | 18:37:52.4 | 2.63 | 59.82 | 6.70 | P.E. | - |
| 53 | 325774 | 4/14/92 | 13:10:07.3 | 3.38 | 59.52 | 5.91 | EARTH. | E |

Events with the most reliable classification:

Table 29: Sorted events for area 50

| Event # | IMS orid | IMS origin time | | IMS lat | IMS lon | IMS ml | Group |
|---------|----------|-----------------|------------|---------|---------|--------|-------|
| 4 | 3272 | 11/22/90 | 14:15:12.4 | 58.0550 | 6.6666 | 1.80 | A |
| 9 | 19279 | 4/19/91 | 13:14:21.0 | 58.2182 | 6.6725 | 1.56 | A |
| 10 | 19480 | 4/26/91 | 13:15:07.3 | 58.2166 | 6.8521 | 1.42 | A |
| 11 | 22647 | 5/14/91 | 13:13:06.3 | 58.2967 | 6.5724 | 1.55 | A |
| 22 | 27869 | 6/27/91 | 13:14:43.4 | 58.1097 | 6.7534 | 1.55 | A |
| 1 | 5810 | 11/15/90 | 15:09:40.3 | 58.8092 | 6.4591 | 1.56 | B |
| 8 | 9397 | 1/29/91 | 14:34:25.1 | 58.7170 | 6.4150 | 1.58 | B |
| 26 | 28961 | 7/4/91 | 16:34:53.1 | 59.1513 | 6.3919 | 1.42 | B |
| 35 | 37561 | 9/5/91 | 18:56:13.4 | 58.8931 | 6.5559 | 1.21 | B |
| 18 | 24514 | 5/27/91 | 17:18:21.9 | 58.6667 | 6.4038 | 1.45 | C |
| 28 | 29378 | 7/10/91 | 14:10:01.0 | 59.0038 | 6.1310 | 1.49 | C |
| 29 | 29377 | 7/10/91 | 14:10:10.9 | 58.5148 | 7.1255 | 1.39 | C |
| 58 | 330690 | 6/16/92 | 03:44:29.1 | 59.5419 | 5.7205 | 2.04 | C |
| 46 | 321701 | 3/6/92 | 14:18:10.7 | 58.3074 | 6.5518 | 1.54 | D |
| 47 | 325682 | 3/26/92 | 14:37:17.5 | 58.2612 | 6.6775 | 1.54 | D |
| 50 | 323688 | 4/3/92 | 13:13:20.1 | 58.2073 | 6.8003 | 1.64 | D |
| 66 | 337975 | 9/1/92 | 13:13:46.5 | 58.4587 | 6.2956 | 1.54 | D |
| 52 | 325740 | 4/14/92 | 12:46:12.0 | 59.4967 | 6.0187 | 2.60 | E |
| 53 | 325774 | 4/14/92 | 13:10:07.3 | 59.4524 | 5.8739 | 3.38 | E |
| 54 | 325775 | 4/14/92 | 13:23:01.7 | 59.5417 | 6.1037 | 1.41 | E |

Table 29: Sorted events for area 50

| Event # | IMS orid | IMS origin time | | IMS lat | IMS lon | IMS ml | Group |
|---------|----------|-----------------|------------|---------|---------|--------|-------|
| 12 | 23028 | 5/17/91 | 05:32:45.0 | 59.9871 | 6.9344 | 1.51 | F |
| 36 | 39525 | 9/13/91 | 22:32:09.7 | 59.7945 | 6.9761 | 1.29 | F |
| 14 | 23305 | 5/22/91 | 14:14:09.1 | 59.6391 | 6.6143 | 1.21 | G |
| 19 | 24341 | 5/29/91 | 15:07:05.0 | 59.6045 | 6.3414 | 1.79 | G |
| 21 | 27303 | 6/26/91 | 16:11:12.9 | 59.7000 | 6.5212 | 1.34 | G |
| 39 | 300612 | 10/22/91 | 11:08:37.4 | 58.9134 | 6.1506 | 1.57 | H |
| 41 | 300674 | 10/30/91 | 08:34:24.5 | 59.1868 | 6.7418 | 1.31 | H |

Remarks:

- The majority of these events could not be sorted because they were unique.
- One event identified in the Helsinki bulletin has being an earthquake belongs to group E. This group consists of three events that occurred on the same day (4/14/92) within a very short period of time.

Mine and event locations:

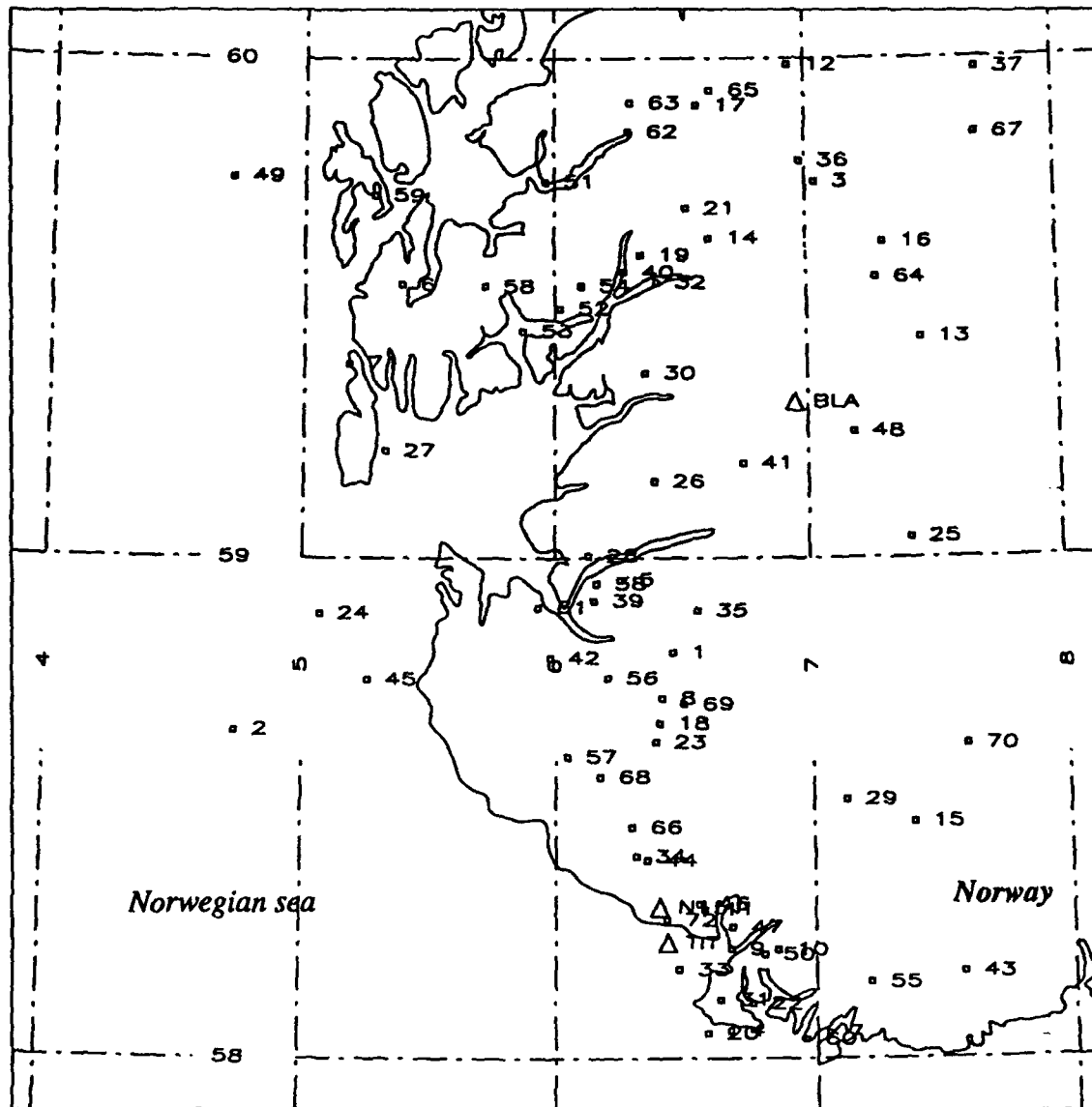


Figure 12: Mine and IMS event locations for area 50.

AREA 51

Latitude: 58 - 60°N

Longitude: 8 - 12°E

Local magnitude range: 1.3

Number of events in IMS2: 2951

Number of events within the magnitude range: 117

Number of processed events: 91

Frequency range used to process the data: 2 - 16 Hz

Processed signal length: 4s. before P, 39s. after P

Number of reference events: 13

Table 30: Reference events for area 51

| Event # | IMS orid | IMS arid | IMS wfid | Threshold | Group |
|---------|----------|----------|----------|-----------|-------|
| 67 | 327247 | 1270477 | 2027514 | 0.86 | A |
| 8 | 6248 | 576825 | 687814 | - | B |
| 17 | 13753 | 702380 | 470500 | - | C |
| 32 | 25792 | 809643 | 901674 | 0.87 | D |
| 20 | 16009 | 724976 | 551779 | 0.91 | E |
| 79 | 330091 | 1289383 | 2151604 | 0.69 | F |
| 11 | 7910 | 596036 | 427058 | 0.90 | G |
| 38 | 31435 | 857830 | 1005365 | 0.86 | H |
| 53 | 302078 | 1008790 | 1471111 | - | I |
| 54 | 302108 | 1009345 | 1498471 | - | J |
| 65 | 324823 | 1233497 | 1952649 | 0.83 | K |
| 45 | 300255 | 1001025 | 1306517 | - | L |
| 46 | 300570 | 1002426 | 1327973 | 0.81 | M |

Reported mine locations:

Table 31: Mine locations for area 51

| Label | Latitude | Longitude | Origin |
|-------|----------|-----------|--------|
| JOG1 | 59.65 | 9.68 | JOG |
| JOG2 | 59.66 | 9.65 | JOG |
| JOG3 | 59.66 | 9.69 | JOG |

Table 31: Mine locations for area 51

| Label | Latitude | Longitude | Origin |
|-------|----------|-----------|--------|
| JOG4 | 59.67 | 9.68 | JOG |
| JOG5 | 59.68 | 9.68 | JOG |
| JOG6 | 59.69 | 9.54 | JOG |
| N16 | 59.75 | 10.77 | JOG |
| JOG7 | 59.76 | 9.81 | JOG |
| JOG8 | 59.77 | 9.52 | JOG |
| JOG9 | 59.79 | 9.50 | JOG |
| N14 | 59.90 | 10.50 | JOG |

Number of events found in the Helsinki bulletin: 1

Table 32: Events found in the Helsinki bulletin for area 51

| Event # | IMS orid | IMS origin time | | IMS ml | HEL location | | HEL label | Group |
|---------|----------|-----------------|------------|--------|--------------|-------|-----------|-------|
| 58 | 319339 | 2/19/92 | 06:39:32.9 | 3.26 | 59.31 | 11.04 | EART. | - |

Events with the most reliable classification:

Table 33: Sorted events for area 51

| Event # | IMS orid | IMS origin time | | IMS lat | IMS lon | IMS ml | Group |
|---------|----------|-----------------|------------|---------|---------|--------|-------|
| 25 | 19013 | 4/18/91 | 13:51:03.9 | 58.9260 | 9.7221 | 1.31 | A |
| 40 | 33825 | 8/5/91 | 13:10:18.8 | 59.0028 | 10.0863 | 1.55 | A |
| 50 | 301435 | 11/7/91 | 13:19:28.3 | 58.9366 | 9.7306 | 1.35 | A |
| 59 | 319412 | 2/21/92 | 11:42:00.4 | 58.9388 | 9.9167 | 1.49 | A |
| 67 | 327247 | 5/7/92 | 13:45:49.7 | 58.9934 | 9.7389 | 1.38 | A |
| 85 | 336488 | 8/20/92 | 13:45:20.3 | 58.9472 | 9.8357 | 1.31 | A |
| 86 | 337678 | 9/2/92 | 13:44:30.2 | 59.0275 | 9.8510 | 1.30 | A |
| 8 | 6248 | 1/7/91 | 14:02:02.7 | 58.8679 | 9.8202 | 1.33 | B |
| 23 | 18266 | 4/15/91 | 13:04:23.6 | 58.8153 | 9.9493 | 1.38 | B |
| 17 | 13753 | 3/11/91 | 15:03:15.8 | 58.8596 | 10.3410 | 1.32 | C |
| 41 | 34939 | 8/14/91 | 12:22:14.1 | 58.9038 | 10.3491 | 1.35 | C |
| 32 | 25792 | 6/10/91 | 12:14:07.0 | 59.1971 | 10.0937 | 1.38 | D |

Table 33: Sorted events for area 51

| Event # | IMS orid | IMS origin time | | IMS lat | IMS lon | IMS ml | Group |
|---------|----------|-----------------|------------|---------|---------|--------|-------|
| 51 | 301085 | 11/8/91 | 14:05:55.2 | 59.1506 | 10.1973 | 1.49 | D |
| 63 | 322540 | 3/26/92 | 13:29:14.1 | 59.1888 | 10.3303 | 1.45 | D |
| 20 | 16009 | 4/2/91 | 13:36:47.9 | 59.1769 | 10.3070 | 1.37 | E |
| 24 | 17823 | 4/16/91 | 13:30:14.2 | 59.1449 | 10.0849 | 1.36 | E |
| 30 | 22405 | 5/15/91 | 13:20:10.7 | 59.1576 | 10.0653 | 1.58 | E |
| 36 | 28266 | 7/3/91 | 13:44:02.0 | 59.1971 | 10.1693 | 1.37 | E |
| 27 | 19846 | 4/25/91 | 12:42:03.1 | 58.0422 | 11.6992 | 1.40 | F |
| 28 | 19205 | 4/25/91 | 12:46:44.4 | 58.1012 | 11.5961 | 1.35 | F |
| 79 | 330091 | 6/10/92 | 08:14:02.5 | 58.1837 | 11.3522 | 1.64 | F |
| 80 | 330095 | 6/10/92 | 08:42:47.1 | 58.1982 | 11.3444 | 1.53 | F |
| 89 | 341050 | 10/5/92 | 10:56:57.8 | 59.6430 | 10.8735 | 1.30 | F |
| 11 | 7910 | 1/24/91 | 14:08:24.5 | 59.8635 | 10.9134 | 1.48 | G |
| 26 | 19835 | 4/23/91 | 07:51:03.4 | 59.4207 | 10.8337 | 1.30 | G |
| 34 | 27283 | 6/26/91 | 12:59:16.9 | 59.6396 | 10.9148 | 1.30 | G |
| 39 | 32265 | 7/30/91 | 07:53:24.2 | 59.4696 | 10.8745 | 1.53 | G |
| 38 | 31435 | 7/23/91 | 12:24:33.3 | 59.6047 | 10.0305 | 1.31 | H |
| 84 | 330326 | 6/12/92 | 08:11:11.6 | 59.5250 | 10.3874 | 1.30 | H |
| 53 | 302078 | 11/29/91 | 12:57:29.4 | 59.3138 | 10.1831 | 1.34 | I |
| 60 | 319265 | 3/3/92 | 15:45:52.8 | 59.2574 | 10.4462 | 1.46 | I |
| 54 | 302108 | 12/4/91 | 11:57:03.9 | 59.7048 | 8.8727 | 1.41 | J |
| 64 | 325146 | 4/1/92 | 16:28:09.5 | 59.8269 | 8.8559 | 1.52 | J |
| 65 | 324823 | 4/15/92 | 13:26:15.9 | 59.4284 | 11.6903 | 1.36 | K |
| 82 | 330258 | 6/11/92 | 17:17:36.9 | 59.4936 | 11.6659 | 1.44 | K |
| 88 | 339866 | 9/24/92 | 09:09:50.4 | 59.4598 | 11.6698 | 1.39 | K |
| 45 | 300255 | 10/17/91 | 13:36:30.9 | 59.3053 | 10.8961 | 1.32 | L |
| 66 | 327129 | 5/6/92 | 12:17:56.4 | 59.2731 | 10.8684 | 1.41 | L |
| 5 | 10215 | 11/26/90 | 14:26:09.0 | 58.6072 | 9.5349 | 1.35 | M |
| 46 | 300570 | 10/24/91 | 13:36:22.8 | 58.0335 | 8.8670 | 1.60 | M |
| 57 | 313175 | 1/10/92 | 13:02:35.2 | 58.0410 | 8.7790 | 1.53 | M |
| 78 | 330522 | 5/29/92 | 09:54:36.1 | 58.2122 | 9.0034 | 1.54 | M |

Remarks:

- Several clusters of events can be seen on the map (Figure 13), but none of them are located close to the reported mines.
- Most of the events are located either on the coast or off-shore.

Mine and event locations:

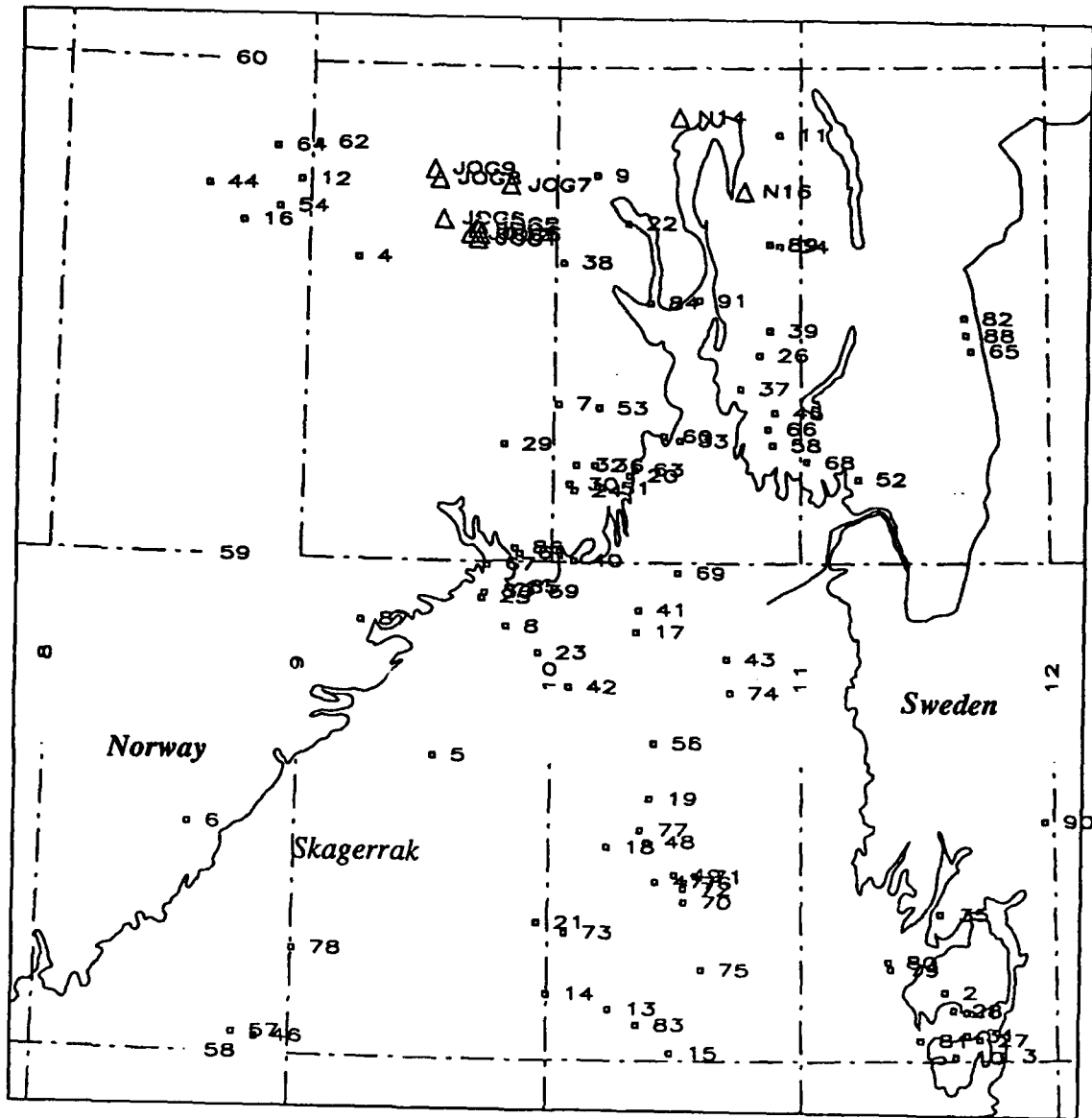


Figure 13: Mine and IMS event locations for area 51.

AREA 52

Latitude: 58 - 60°N

Longitude: 12 - 16°E

Local magnitude range: 1.0

Number of events in IMS2: 334

Number of events within the magnitude range: 101

Number of processed events: 78

Frequency range used to process the data: 2 - 16 Hz

Processed signal length: 6s. before P, 56s. after P

Number of reference events: 8

Table 34: Reference events for area 52

| Event # | IMS orid | IMS arid | IMS wfid | Threshold | Group |
|---------|----------|----------|----------|-----------|-------|
| 13 | 24861 | 799689 | 867597 | 0.83 | A |
| 47 | 328215 | 1277382 | 2063889 | 0.80 | B |
| 26 | 38270 | 926604 | 1206053 | 0.83 | C |
| 40 | 322856 | 1226347 | 1842861 | 0.83 | D |
| 53 | 332998 | 1320290 | 2200141 | 0.83 | E |
| 65 | 338519 | 1430127 | 2661360 | 0.9 | F |
| 71 | 341818 | 1481923 | 2777829 | 0.98 | G |
| 17 | 28176 | 824733 | 939764 | - | H |

Reported mine locations:

Table 35: Mine locations for area 52

| Label | Latitude | Longitude | Origin |
|-------|----------|-----------|--------|
| N205 | 58.80 | 15.10 | Norw |
| N206 | 59.30 | 15.40 | Norw |
| N209 | 59.70 | 14.10 | Norw |

Number of events found in the Helsinki bulletin: None

Events with the most reliable classification:

Table 36: Sorted events for area 52

| Event # | IMS orid | IMS origin time | | IMS lat | IMS lon | IMS ml | Group |
|---------|----------|-----------------|------------|---------|---------|--------|-------|
| 10 | 14202 | 3/12/91 | 13:53:16.0 | 58.6379 | 12.3285 | 1.13 | A |
| 13 | 24861 | 5/31/91 | 12:01:46.6 | 58.6829 | 12.3158 | 1.25 | A |
| 22 | 32778 | 7/31/91 | 09:39:02.7 | 58.7156 | 12.4115 | 1.06 | A |
| 47 | 328215 | 5/18/92 | 14:41:14.0 | 58.1590 | 12.0917 | 1.45 | B |
| 57 | 335088 | 8/4/92 | 14:19:50.8 | 58.1456 | 12.0189 | 1.25 | B |
| 67 | 339450 | 9/21/92 | 13:35:02.9 | 58.0294 | 12.1153 | 1.49 | B |
| 7 | 13218 | 3/6/91 | 12:35:35.6 | 58.7789 | 12.5328 | 1.27 | C |
| 21 | 32103 | 7/29/91 | 12:13:18.1 | 58.9303 | 12.4282 | 1.27 | C |
| 23 | 33538 | 8/8/91 | 05:03:38.0 | 58.8371 | 12.4835 | 1.10 | C |
| 25 | 38145 | 9/4/91 | 17:29:18.0 | 58.9544 | 12.4741 | 1.49 | C |
| 26 | 38270 | 9/5/91 | 18:16:44.1 | 58.7730 | 12.4014 | 1.43 | C |
| 30 | 40950 | 9/26/91 | 07:47:17.8 | 58.9146 | 12.2083 | 1.10 | C |
| 34 | 302787 | 12/6/91 | 11:40:21.8 | 58.7899 | 12.3920 | 1.42 | C |
| 38 | 324264 | 3/19/92 | 14:53:18.8 | 58.7905 | 12.3839 | 1.35 | C |
| 45 | 327128 | 5/6/92 | 12:08:45.4 | 58.7946 | 12.0103 | 1.23 | C |
| 48 | 328325 | 5/19/92 | 14:20:25.5 | 58.6247 | 12.6884 | 1.11 | C |
| 49 | 328948 | 5/25/92 | 17:36:04.6 | 58.8731 | 12.3135 | 1.18 | C |
| 54 | 332051 | 6/30/92 | 18:22:41.8 | 58.8569 | 12.5348 | 1.11 | C |
| 74 | 342796 | 11/3/92 | 15:16:54.5 | 58.8499 | 12.4011 | 1.19 | C |
| 75 | 343811 | 11/17/92 | 14:19:50.2 | 58.8281 | 12.3672 | 1.33 | C |
| 15 | 26049 | 6/10/91 | 11:28:02.4 | 58.7655 | 12.1139 | 1.00 | D |
| 27 | 39293 | 9/10/91 | 12:10:56.1 | 58.8230 | 12.3024 | 1.02 | D |
| 32 | 300897 | 10/29/91 | 14:26:08.3 | 58.7269 | 12.1535 | 1.23 | D |
| 40 | 322856 | 3/23/92 | 16:27:13.5 | 58.7376 | 12.4634 | 1.54 | D |
| 44 | 326933 | 5/4/92 | 13:51:42.1 | 58.6498 | 12.4711 | 1.38 | D |
| 52 | 330359 | 6/12/92 | 11:57:05.6 | 58.9199 | 12.4318 | 1.18 | D |
| 60 | 335775 | 8/13/92 | 17:26:26.0 | 58.8233 | 12.2892 | 1.57 | D |
| 6 | 11208 | 1/18/91 | 12:53:09.8 | 58.8309 | 12.5740 | 1.31 | E |

Table 36: Sorted events for area 52

| Event # | IMS orid | IMS origin time | | IMS lat | IMS lon | IMS ml | Group |
|---------|----------|-----------------|------------|---------|---------|--------|-------|
| 53 | 332998 | 6/24/92 | 17:21:03.9 | 58.8782 | 12.1242 | 1.07 | E |
| 55 | 334943 | 7/15/92 | 16:12:36.6 | 58.9836 | 12.1245 | 1.10 | E |
| 20 | 32084 | 7/26/91 | 05:43:15.8 | 58.8009 | 12.2301 | 1.08 | F |
| 63 | 337867 | 9/4/92 | 11:46:50.1 | 58.8951 | 12.4444 | 1.17 | F |
| 65 | 338519 | 9/10/92 | 19:33:57.2 | 58.8442 | 12.2616 | 1.16 | F |
| 56 | 333891 | 7/20/92 | 17:48:17.4 | 59.2977 | 12.1080 | 1.15 | G |
| 71 | 341818 | 10/22/92 | 06:25:44.5 | 59.2187 | 12.2287 | 1.73 | G |
| 73 | 342604 | 11/2/92 | 06:26:47.2 | 59.2752 | 12.4912 | 1.65 | G |
| 17 | 28176 | 6/28/91 | 10:32:55.2 | 58.1032 | 13.8678 | 1.26 | H |
| 39 | 322848 | 3/23/92 | 12:13:37.7 | 58.2852 | 13.8933 | 1.12 | H |

Remarks:

- The events located South-West of the Vanörn Lake have too low signal-to-noise ratios to confirm the results of the cluster analysis that grouped them. Only two events (group H) could be sorted.
- Events from group C, D, E and F have tight locations on the west side of the Vanörn Lake.

Mine and event locations:

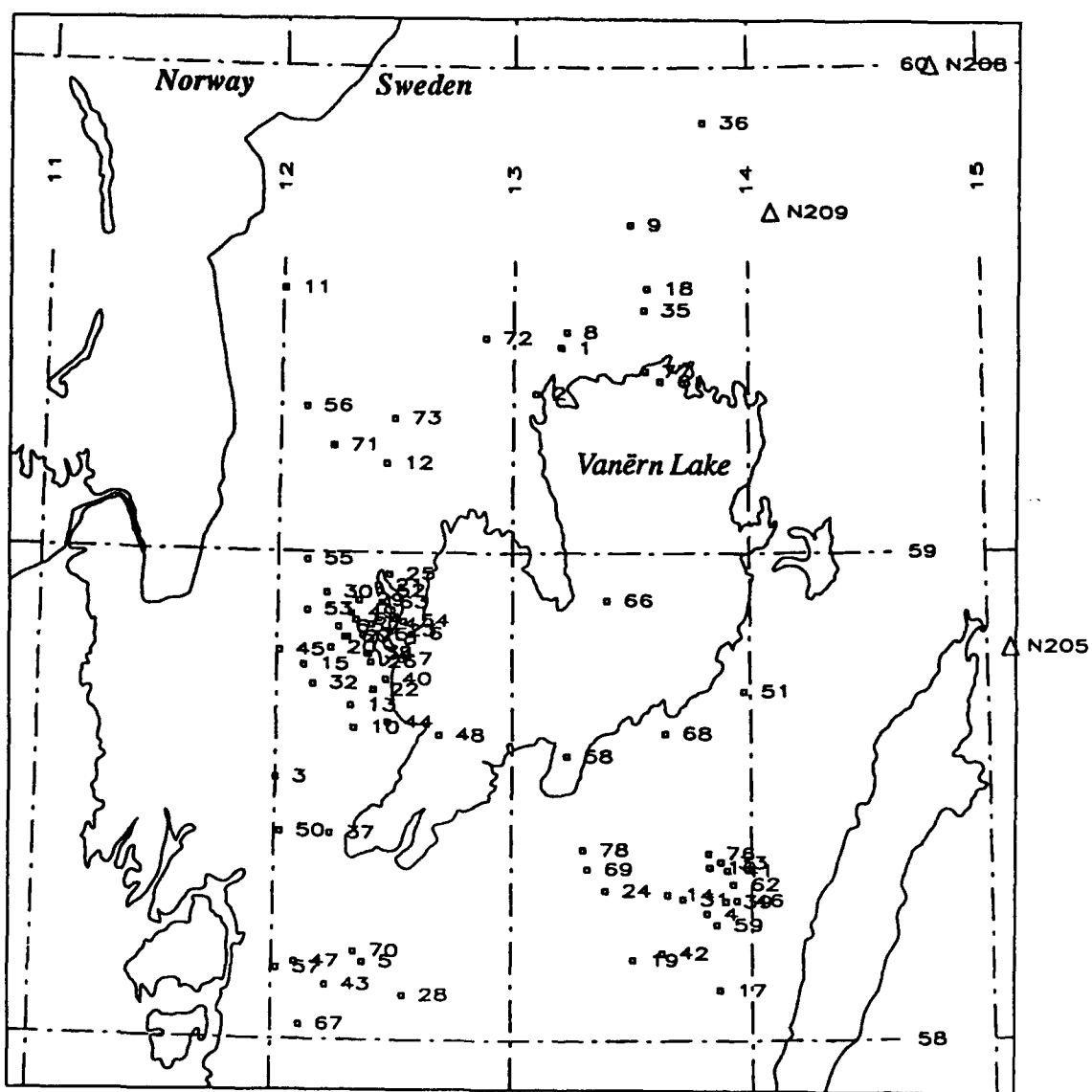


Figure 14: Mine and IMS event locations for area 52.

AREA 53

Latitude: 58 - 60°N

Longitude: 16 - 20°E

Local magnitude range: 1.2

Number of events in IMS2: 169

Number of events within the magnitude range: 128

Number of processed events: 98

Frequency range used to process the data: 3 - 16 Hz

Processed signal length: 12s. before P, 112s. after P

Number of reference events: 7

Table 37: Reference events for area 53

| Event # | IMS orid | IMS arid | IMS wfid | Threshold | Group |
|---------|----------|----------|----------|-----------|-------|
| 40 | 366134 | 1009382 | 1498627 | 0.78 | A |
| 21 | 18915 | 741334 | 613495 | 0.83 | B |
| 73 | 330238 | 1289884 | 2157106 | - | C |
| 94 | 344364 | 1503954 | 2832363 | - | D |
| 76 | 336034 | 1380051 | 2439166 | - | E |
| 45 | 302578 | 1010897 | 1515834 | 0.89 | F |
| 62 | 324579 | 1232679 | 1943397 | 0.88 | G |

Reported mine locations: None

Number of events found in the Helsinki bulletin: 21

Table 38: Events found in the Helsinki bulletin for area 53

| Event # | IMS orid | IMS origin time | | IMS ml | HEL locations | | HEL label | Group |
|---------|----------|-----------------|------------|--------|---------------|-------|-----------|-------|
| 5 | 7937 | 11/23/90 | 09:34:51.3 | 2.59 | 58.93 | 18.36 | - | - |
| 8 | 8455 | 11/27/90 | 10:42:35.7 | 2.26 | 58.80 | 17.44 | - | - |
| 10 | 8460 | 11/27/90 | 10:59:55.3 | 2.44 | 58.82 | 17.65 | - | - |
| 12 | 314140 | 12/12/90 | 15:27:27.0 | 3.04 | 59.83 | 16.79 | P.E. | - |
| 13 | 13226 | 3/6/91 | 13:22:25.1 | 2.23 | 58.22 | 17.81 | - | - |
| 17 | 17597 | 4/11/91 | 10:49:27.9 | 2.81 | 58.30 | 17.79 | - | - |
| 24 | 20066 | 4/27/91 | 07:11:03.5 | 2.44 | 58.95 | 17.83 | - | - |
| 25 | 20067 | 4/27/91 | 07:39:16.8 | 2.42 | 58.79 | 18.51 | - | - |

Table 38: Events found in the Helsinki bulletin for area 53

| Event # | IMS orid | IMS origin time | | IMS ml | HEL locations | | HEL label | Group |
|---------|----------|-----------------|------------|--------|---------------|-------|-----------|-------|
| 26 | 21864 | 5/3/91 | 07:44:42.9 | 2.37 | 58.57 | 18.55 | - | - |
| 29 | 21867 | 5/3/91 | 08:39:25.7 | 2.53 | 58.52 | 18.79 | - | - |
| 31 | 22774 | 5/15/91 | 08:24:25.4 | 2.38 | 58.31 | 17.86 | - | - |
| 36 | 39332 | 9/10/91 | 15:34:47.6 | 2.50 | 58.46 | 18.13 | - | - |
| 53 | 319297 | 2/18/92 | 12:02:04.8 | 2.19 | 58.98 | 18.34 | - | - |
| 54 | 320973 | 3/18/92 | 09:04:15.9 | 2.61 | 58.65 | 18.23 | - | - |
| 55 | 324871 | 3/26/92 | 11:26:27.7 | 2.44 | 58.37 | 18.11 | - | - |
| 56 | 324873 | 3/26/92 | 11:41:15.0 | 2.33 | 58.66 | 17.86 | - | - |
| 61 | 324575 | 4/13/92 | 08:27:44.4 | 2.20 | 58.99 | 18.48 | - | - |
| 66 | 328214 | 5/18/92 | 14:12:21.0 | 2.50 | 58.42 | 18.48 | - | - |
| 67 | 328236 | 5/18/92 | 19:21:18.2 | 2.68 | 58.55 | 18.02 | - | - |
| 71 | 330610 | 6/10/92 | 08:22:07.4 | 2.58 | 59.02 | 18.05 | - | - |
| 62 | 324579 | 4/13/92 | 08:45:14.3 | 2.79 | 59.04 | 18.55 | - | G |

Events with the most reliable classification:

Table 39: Sorted events for area 53

| Event # | IMS orid | IMS origin time | | IMS lat | IMS lon | IMS ml | Group |
|-----------------|----------|-----------------|------------|---------|---------|--------|-------|
| 19 | 366132 | 4/16/91 | 09:47:50.7 | 59.7229 | 18.7840 | 1.48 | A |
| 20 | 366133 | 4/16/91 | 13:33:55.8 | 59.0776 | 18.1447 | 1.86 | A |
| 40 | 366134 | 12/4/91 | 13:41:49.5 | 59.2385 | 18.1164 | 1.88 | A |
| 43 | 366135 | 12/5/91 | 09:49:35.1 | 59.2141 | 18.1048 | 1.93 | A |
| 63 | 366137 | 5/5/92 | 14:05:14.5 | 59.0500 | 18.1675 | 1.62 | A |
| 64 | 366138 | 5/6/92 | 08:01:11.3 | 59.1166 | 18.1437 | 1.63 | A |
| 65 | 366139 | 5/18/92 | 13:37:08.3 | 58.6058 | 18.8748 | 1.68 | A |
| 75 | 366147 | 8/4/92 | 15:18:23.5 | 59.0567 | 18.1374 | 1.64 | A |
| 77 | 366140 | 8/6/92 | 09:40:38.2 | 58.6289 | 18.6769 | 1.52 | A |
| 78 | 366141 | 8/18/92 | 16:09:01.4 | 59.4235 | 18.0653 | 1.62 | A |
| 79 | 366142 | 8/20/92 | 10:40:30.9 | 59.1910 | 18.2219 | 1.53 | A |
| 80 ^a | 366143 | 8/25/92 | 10:07:10.1 | 58.8805 | 18.3989 | 1.93 | A |

Table 39: Sorted events for area 53

| Event # | IMS orid | IMS origin time | | IMS lat | IMS lon | IMS ml | Group |
|---------|----------|-----------------|------------|---------|---------|--------|-------|
| 84 | 366144 | 8/25/92 | 11:33:06.5 | 59.0465 | 18.1836 | 1.61 | A |
| 21 | 18915 | 4/18/91 | 10:50:26.6 | 59.1549 | 18.2128 | 1.81 | B |
| 69 | 328496 | 5/21/92 | 09:35:32.1 | 58.5796 | 16.5494 | 1.33 | B |
| 90 | 339882 | 9/24/92 | 11:07:27.2 | 58.3267 | 18.5234 | 1.57 | B |
| 73 | 330238 | 6/11/92 | 13:44:14.1 | 58.2613 | 16.2042 | 1.64 | C |
| 96 | 344881 | 11/27/92 | 11:42:02.3 | 58.5463 | 16.2929 | 1.49 | C |
| 94 | 344364 | 11/17/92 | 17:20:54.2 | 59.0187 | 18.1528 | 1.72 | D |
| 95 | 343724 | 11/18/92 | 16:12:16.3 | 59.0553 | 18.1376 | 1.69 | D |
| 76 | 336034 | 8/5/92 | 12:27:25.9 | 59.5233 | 18.1432 | 1.38 | E |
| 85 | 337742 | 8/25/92 | 12:47:03.2 | 59.0458 | 18.1929 | 1.49 | E |
| 41 | 302306 | 12/4/91 | 14:02:41.4 | 59.5115 | 18.0304 | 1.69 | F |
| 42 | 302444 | 12/9/91 | 12:55:29.1 | 59.7364 | 18.1183 | 1.56 | F |
| 44 | 302785 | 12/6/91 | 11:34:21.7 | 59.3975 | 18.0929 | 1.64 | F |
| 45 | 302578 | 12/11/91 | 13:01:23.8 | 59.7783 | 17.8460 | 1.70 | F |
| 14 | 17575 | 4/11/91 | 10:02:21.7 | 58.9920 | 18.7157 | 2.50 | G |
| 18 | 17578 | 4/11/91 | 10:07:14.7 | 58.9610 | 18.6768 | 2.31 | G |
| 62 | 324579 | 4/13/92 | 08:45:14.3 | 59.1134 | 18.6381 | 2.79 | G |

a. Mixed event.

Remarks:

- Events from group A were carefully re-analyzed and the analyst found that most of them were originally poorly located (Ryall, 1993). Using only ARCESS and FINESA arrival information (azimuth and time), these event locations got tighter (except for event 19 which was recorded at NORESS only). Based on these new locations, the comparison with the azimuths determined at NORESS showed that the *P_n* azimuth was systematically about 18 degrees off while the *P_g* azimuth was consistent with these new locations. Surprisingly, one event, larger than the events from group A, which was located in the same area, did not show this particular feature. Its *P_n* azimuth at NORESS was consistent with the other phases.

Mine and event locations:

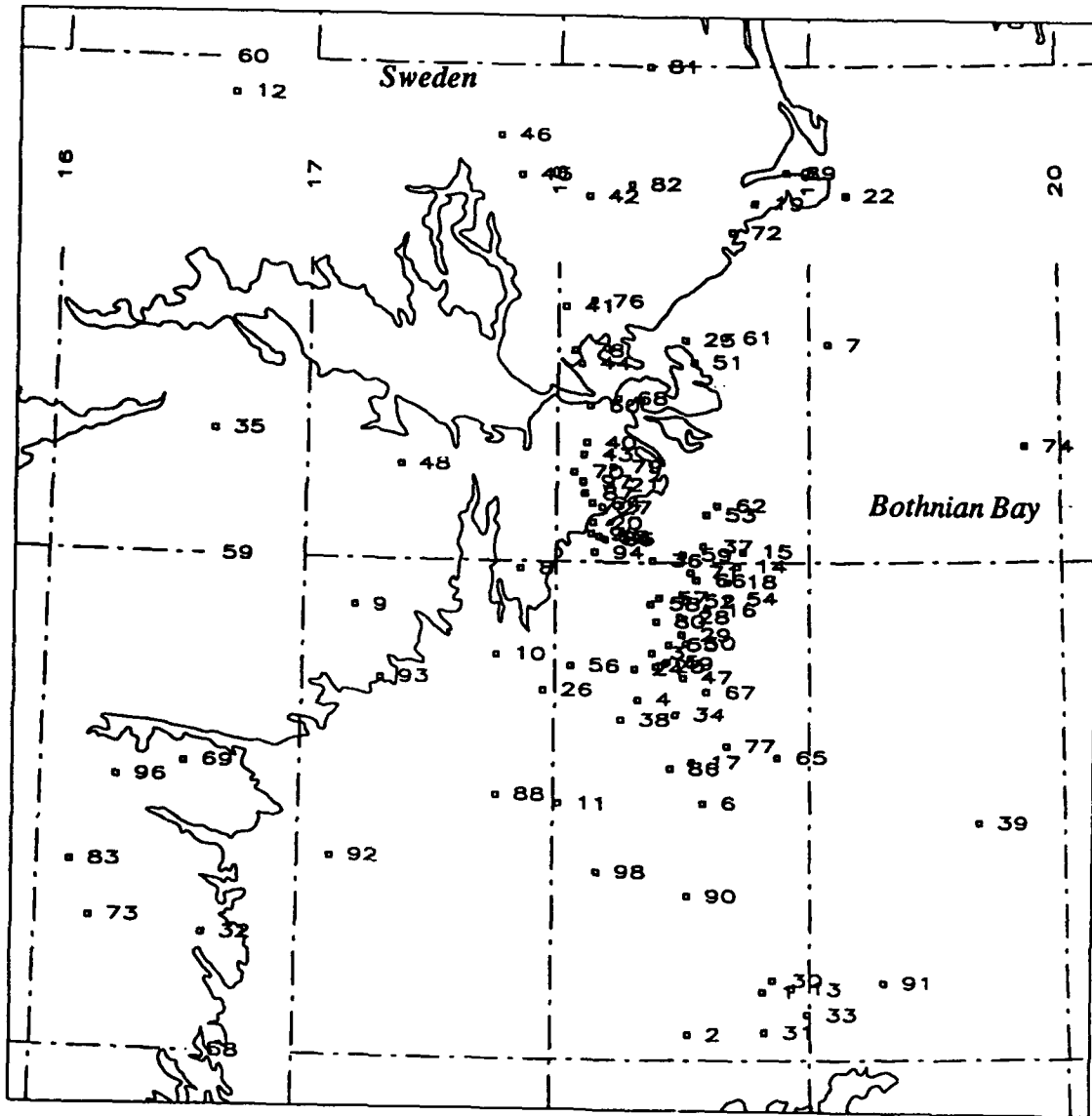


Figure 15: IMS event locations for area 53.

AREA 62

Latitude: 56 - 58°N

Longitude: 18 - 24°E

Local magnitude range: -

Number of events in IMS2: 117

Number of events within the magnitude range: 117

Number of processed events: 50

Frequency range used to process the data: 3 - 16 Hz

Processed signal length: 12s. before P, 107s. after P

Number of reference events: 3

Table 40: Reference events for area 62

| Event # | IMS orid | IMS arid | IMS wfid | Threshold | Group |
|---------|----------|----------|----------|-----------|-------|
| 41 | 331387 | 1292960 | 2195383 | 0.80 | A |
| 11 | 13717 | 699456 | 465190 | 0.81 | B |
| 8 | 4347 | 558102 | 1362115 | - | C |

Reported mine locations: None

Number of events found in the Helsinki bulletin: 8

Table 41: Events found in the Helsinki bulletin for area 62

| Event # | IMS orid | IMS origin time | | IMS ml | HEL location | | HEL label | Group |
|---------|----------|-----------------|------------|--------|--------------|-------|-----------|-------|
| 13 | 15731 | 3/27/91 | 13:13:52.1 | 2.76 | 57.83 | 19.10 | - | - |
| 49 | 339112 | 9/17/92 | 13:24:36.4 | - | 57.40 | 17.86 | - | - |
| 3 | 26213 | 11/27/90 | 12:52:09.0 | 2.56 | 58.15 | 18.06 | - | A |
| 25 | 39886 | 9/16/91 | 13:14:33.8 | 2.40 | 58.02 | 18.47 | - | A |
| 26 | 39889 | 9/16/91 | 13:17:23.4 | 2.65 | 58.28 | 18.52 | - | A |
| 40 | 331394 | 6/23/92 | 12:17:52.8 | 2.56 | 58.50 | 18.68 | - | A |
| 41 | 331387 | 6/23/92 | 12:36:11.2 | 2.60 | 58.40 | 18.69 | - | A |
| 42 | 331388 | 6/23/92 | 12:40:29.5 | 2.51 | 58.23 | 19.38 | - | A |

Events with the most reliable classification:

Table 42: Sorted events for area 62

| Event # | IMS orid | IMS origin time | | IMS lat | IMS lon | IMS ml | Group |
|---------|----------|-----------------|------------|---------|---------|--------|-------|
| 3 | 26213 | 11/27/90 | 12:52:09.0 | 57.5257 | 18.5924 | 2.56 | A |
| 25 | 39886 | 9/16/91 | 13:14:33.8 | 57.7868 | 18.9671 | 2.40 | A |
| 26 | 39889 | 9/16/91 | 13:17:23.4 | 57.9022 | 19.0654 | 2.65 | A |
| 40 | 331394 | 6/23/92 | 12:17:52.8 | 57.8428 | 19.5130 | 2.56 | A |
| 41 | 331387 | 6/23/92 | 12:36:11.2 | 57.5209 | 19.2025 | 2.60 | A |
| 42 | 331388 | 6/23/92 | 12:40:29.5 | 57.7262 | 18.9908 | 2.51 | A |
| 11 | 13717 | 3/8/91 | 14:38:17.3 | 56.9736 | 23.5002 | 1.93 | B |
| 16 | 16777 | 4/2/91 | 11:37:44.5 | 56.8348 | 23.7904 | 2.02 | B |
| 34 | 320015 | 3/5/92 | 14:15:52.0 | 57.2368 | 23.2869 | 1.93 | B |
| 35 | 320969 | 3/16/92 | 13:45:21.9 | 56.9393 | 23.6839 | 2.04 | B |
| 44 | 335515 | 7/24/92 | 13:49:55.2 | 56.9806 | 23.7871 | - | B |
| 8 | 4347 | 12/19/90 | 11:25:25.8 | 56.4821 | 22.3512 | 1.99 | C |
| 9 | 5206 | 12/22/90 | 10:35:41.0 | 56.4900 | 22.2748 | 1.98 | C |

Remarks:

- More than half of the events could not be sorted because of too low signal-to-noise ratios. Most of them are located in Latvia, East of the map (Figure 16).
- Events from group A are located off-shore of the Gotland Island.
- Events from group B are located in Latvia. No mines locations are been reported for this area.

Mine and event locations:

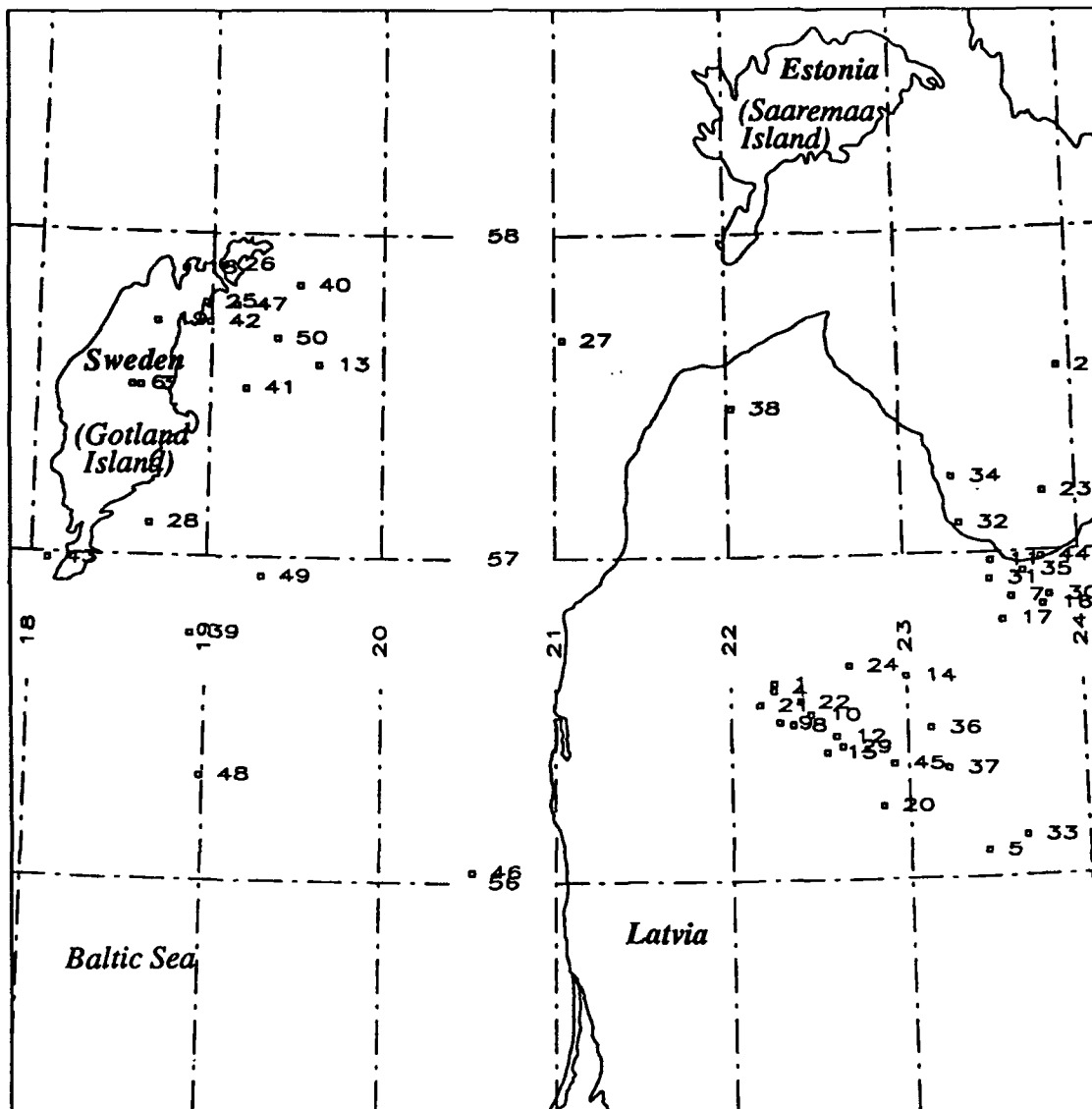


Figure 16: IMS event locations for area 62.

AREA 63

Latitude: 56 - 58°N

Longitude: 12 - 18°E

Local magnitude range: -

Number of events in IMS2: 62

Number of events within the magnitude range: 62

Number of processed events: 49

Frequency range used to process the data: 3 - 16 Hz

Processed signal length: 12s. before P, 107s. after P

Number of reference events: 4

Table 43: Reference events for area 63

| Event # | IMS orid | IMS arid | IMS wfid | Threshold | Group |
|---------|----------|----------|----------|-----------|-------|
| 40 | 340379 | 1458811 | 2725482 | 0.86 | A |
| 17 | 25690 | 804863 | 885111 | 0.82 | B |
| 7 | 14473 | 705485 | 486460 | 0.80 | C |
| 6 | 13630 | 704811 | 484255 | 0.81 | D |

Reported mine locations: None

Number of events found in the Helsinki bulletin: None

Events with the most reliable classification:

Table 44: Sorted events for area 63

| Event # | IMS orid | IMS origin time | | IMS lat | IMS lon | IMS ml | Group |
|---------|----------|-----------------|------------|---------|---------|--------|-------|
| 40 | 340379 | 9/29/92 | 14:18:47.6 | 56.9613 | 17.3405 | 1.66 | A |
| 41 | 341251 | 10/13/92 | 12:10:08.7 | 57.5232 | 15.8931 | 1.48 | A |
| 5 | 14198 | 3/12/91 | 15:16:07.1 | 57.4939 | 14.8966 | 1.66 | B |
| 15 | 23383 | 5/23/91 | 12:13:47.6 | 57.4323 | 14.4869 | 1.85 | B |
| 17 | 25690 | 6/5/91 | 14:48:27.0 | 57.4697 | 14.5920 | 1.73 | B |
| 23 | 38718 | 9/12/91 | 12:41:05.8 | 57.5766 | 15.5118 | 1.58 | B |
| 26 | 301249 | 11/12/91 | 15:19:59.9 | 57.3412 | 14.0818 | 1.65 | B |
| 35 | 328094 | 5/15/92 | 10:29:47.4 | 57.6010 | 14.7966 | 1.65 | B |
| 7 | 14473 | 3/14/91 | 12:59:02.2 | 57.5006 | 13.0834 | 1.21 | C |
| 38 | 338268 | 9/9/92 | 10:45:10.7 | 57.4306 | 12.9340 | 1.24 | C |

Table 44: Sorted events for area 63

| Event # | IMS orid | IMS origin time | | IMS lat | IMS lon | IMS ml | Group |
|---------|----------|-----------------|------------|---------|---------|---------|-------|
| 47 | 343346 | 11/13/92 | 12:55:35.3 | 57.4767 | 12.8758 | -999.00 | C |
| 6 | 13630 | 3/13/91 | 19:07:44.4 | 56.9882 | 12.3802 | 1.17 | D |
| 9 | 19709 | 4/22/91 | 13:35:54.8 | 57.8735 | 15.1142 | 1.34 | D |

Remarks:

- The event locations show two clusters in the North-western part of the map (Figure 17) whose events could not be sorted because of too low signal-to-noise ratios.
- The two events from group A are 108 km apart; one of them being located off-shore.

Mine and event locations:

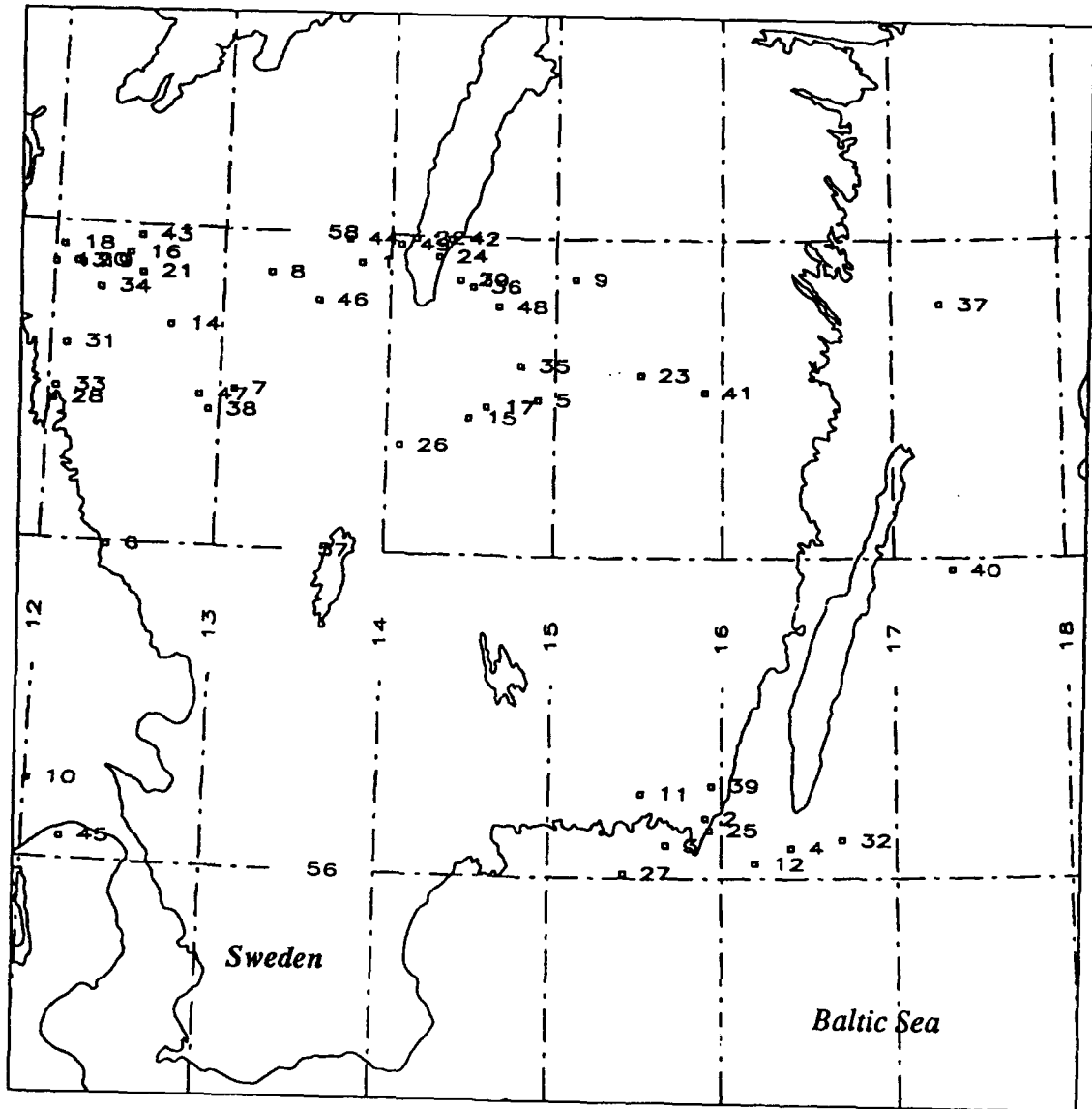


Figure 17: IMS event locations for area 63.

AREA 64

Latitude: 56 - 58°N

Longitude: 6 - 12°E

Local magnitude range: -

Number of events in IMS2: 142

Number of events within the magnitude range: 142

Number of processed events: 115

Frequency range used to process the data: 2 - 16 Hz

Processed signal length: 11s. before P, 96s. after P

Number of reference events: 11

Table 45: Reference events for area 64

| Event # | IMS orid | IMS arid | IMS wfid | Threshold | Group |
|---------|----------|----------|----------|-----------|-------|
| 45 | 27650 | 815271 | 927999 | 0.80 | A |
| 110 | 343709 | 1504199 | 2842572 | 0.70 | B |
| 21 | 15848 | 716194 | 523412 | 0.81 | C |
| 92 | 339186 | 1438767 | 2687688 | 0.89 | D |
| 77 | 330527 | 1285142 | 2091043 | 0.80 | E |
| 51 | 38630 | 929469 | 1212854 | 0.78 | F |
| 39 | 24372 | 795597 | 819387 | - | G |
| 60 | 301156 | 1005020 | 1397527 | 0.80 | H |
| 58 | 300990 | 1003549 | 1391941 | - | I |
| 97 | 340594 | 1459335 | 2734650 | 0.79 | J |
| 89 | 333015 | 1323633 | 2212996 | 0.79 | K |

Reported mine locations: None

Number of events found in the Helsinki bulletin: 1

Table 46: Events found in the Helsinki bulletin for area 64

| Event # | IMS orid | IMS origin time | | IMS ml | HEL location | | HEL label | Group |
|---------|----------|-----------------|------------|--------|--------------|------|-----------|-------|
| 73 | 328497 | 5/18/92 | 05:28:35.1 | 2.92 | 57.11 | 6.94 | P.E. | E |

Events with the most reliable classification:

Table 47: Sorted events for area 64

| Event # | IMS orid | IMS origin time | | IMS lat | IMS lon | IMS ml | Group |
|---------|----------|-----------------|------------|---------|---------|--------|-------|
| 17 | 15075 | 3/17/91 | 02:59:54.3 | 57.6691 | 6.7968 | 1.25 | A |
| 22 | 16324 | 4/1/91 | 16:11:07.2 | 57.2006 | 8.1062 | 1.27 | A |
| 33 | 21600 | 4/30/91 | 18:03:08.7 | 56.1290 | 11.8911 | 1.80 | A |
| 34 | 21599 | 4/30/91 | 18:03:22.3 | 56.3017 | 11.3407 | 1.54 | A |
| 37 | 22811 | 5/10/91 | 23:55:55.7 | 57.6129 | 6.7260 | 1.34 | A |
| 45 | 27650 | 6/18/91 | 02:45:34.2 | 57.4508 | 7.3407 | 1.55 | A |
| 50 | 34704 | 8/8/91 | 21:03:41.3 | 57.5904 | 6.9570 | 1.06 | A |
| 52 | 40688 | 9/20/91 | 15:55:59.8 | 57.8039 | 6.4939 | 1.34 | A |
| 66 | 321561 | 3/18/92 | 20:53:26.3 | 57.1663 | 8.5006 | 1.42 | A |
| 86 | 331415 | 6/20/92 | 21:44:12.9 | 57.4552 | 7.2628 | 1.77 | A |
| 105 | 342787 | 11/2/92 | 04:14:25.6 | 57.4435 | 7.5165 | 1.36 | A |
| 111 | 343814 | 11/18/92 | 22:19:27.1 | 57.4590 | 7.3308 | 1.48 | A |
| 112 | 344880 | 11/27/92 | 07:46:12.2 | 57.4799 | 7.4979 | 2.18 | A |
| 14 | 3120 | 11/5/90 | 21:52:52.6 | 57.8452 | 8.1242 | 2.17 | B |
| 8 | 313962 | 12/7/90 | 14:13:43.1 | 57.9726 | 7.2067 | 1.51 | B |
| 20 | 15284 | 3/21/91 | 14:12:02.5 | 57.9404 | 6.9363 | 1.73 | B |
| 36 | 22309 | 5/8/91 | 13:14:31.9 | 57.9952 | 7.0939 | 1.43 | B |
| 103 | 342487 | 10/30/92 | 14:15:41.6 | 57.8644 | 6.3830 | 1.49 | B |
| 110 | 343709 | 11/18/92 | 14:11:38.5 | 57.9378 | 6.0765 | 1.47 | B |
| 21 | 17583 | 4/10/91 | 08:03:52.3 | 57.7629 | 11.2689 | 2.14 | C |
| 106 | 343018 | 11/8/92 | 17:29:34.5 | 57.7937 | 8.7733 | - | C |
| 107 | 343333 | 11/13/92 | 10:56:48.1 | 57.9728 | 8.5523 | - | C |
| 70 | 325803 | 4/20/92 | 06:35:35.4 | 56.9995 | 7.2822 | 2.44 | D |
| 92 | 339186 | 9/17/92 | 00:16:18.1 | 57.1876 | 7.5203 | 2.09 | D |
| 114 | 347473 | 1/8/93 | 13:46:49.2 | 57.2859 | 7.8773 | 1.90 | D |
| 73 | 328497 | 5/18/92 | 05:28:35.1 | 57.0272 | 6.8502 | 2.92 | E |
| 75 | 328630 | 5/19/92 | 15:17:12.3 | 57.1190 | 6.0158 | 1.40 | E |
| 77 | 330527 | 5/23/92 | 17:12:34.8 | 56.9419 | 7.1445 | 1.50 | E |

Table 47: Sorted events for area 64

| Event # | IMS orid | IMS origin time | | IMS lat | IMS lon | IMS ml | Group |
|---------|----------|-----------------|------------|---------|---------|--------|-------|
| 51 | 38630 | 9/7/91 | 23:30:30.3 | 57.4472 | 7.8372 | 1.47 | F |
| 61 | 301486 | 11/10/91 | 08:16:55.3 | 57.3606 | 7.8960 | 1.47 | F |
| 85 | 331412 | 6/20/92 | 17:41:32.4 | 57.3189 | 7.7531 | 1.52 | F |
| 39 | 24372 | 5/27/91 | 09:04:57.3 | 57.6840 | 11.6445 | 1.61 | G |
| 40 | 24374 | 5/27/91 | 09:13:28.7 | 57.6508 | 11.5641 | 1.50 | G |
| 38 | 23470 | 5/22/91 | 13:17:38.7 | 57.5896 | 8.1491 | 1.43 | H |
| 60 | 301156 | 11/8/91 | 14:17:32.0 | 57.8668 | 6.5238 | 1.27 | H |
| 109 | 344363 | 11/17/92 | 15:56:58.5 | 57.1853 | 8.3760 | 1.08 | H |
| 58 | 300990 | 10/31/91 | 17:20:52.1 | 57.8265 | 8.7756 | 1.04 | I |
| 83 | 330694 | 6/16/92 | 09:05:24.1 | 56.8789 | 9.6951 | 1.72 | I |
| 29 | 20057 | 4/26/91 | 16:59:18.0 | 57.3838 | 10.2827 | 1.97 | J |
| 90 | 336039 | 8/7/92 | 08:08:06.4 | 57.4881 | 10.5152 | 1.49 | J |
| 94 | 340559 | 9/29/92 | 16:52:43.8 | 57.4369 | 10.1559 | 1.26 | J |
| 95 | 340591 | 10/1/92 | 13:08:20.9 | 57.7191 | 10.6970 | 1.58 | J |
| 97 | 340594 | 10/1/92 | 14:40:53.4 | 57.6482 | 10.4000 | 1.28 | J |
| 43 | 26007 | 6/11/91 | 06:42:04.0 | 57.3321 | 10.8044 | 1.26 | K |
| 82 | 330304 | 6/12/92 | 03:16:06.6 | 57.2494 | 9.0789 | 1.52 | K |
| 89 | 333015 | 6/28/92 | 08:55:05.5 | 57.7793 | 10.4574 | 0.93 | K |

Remarks:

- Most of the events occurring in this area are located off-shore.
- Within a group, event locations spread over large areas.
- Events from group G, H and I are located close to the Swedish coast along with 18 other events that could not be sorted because of their too low signal-to-noise ratios.

Mine and event locations:

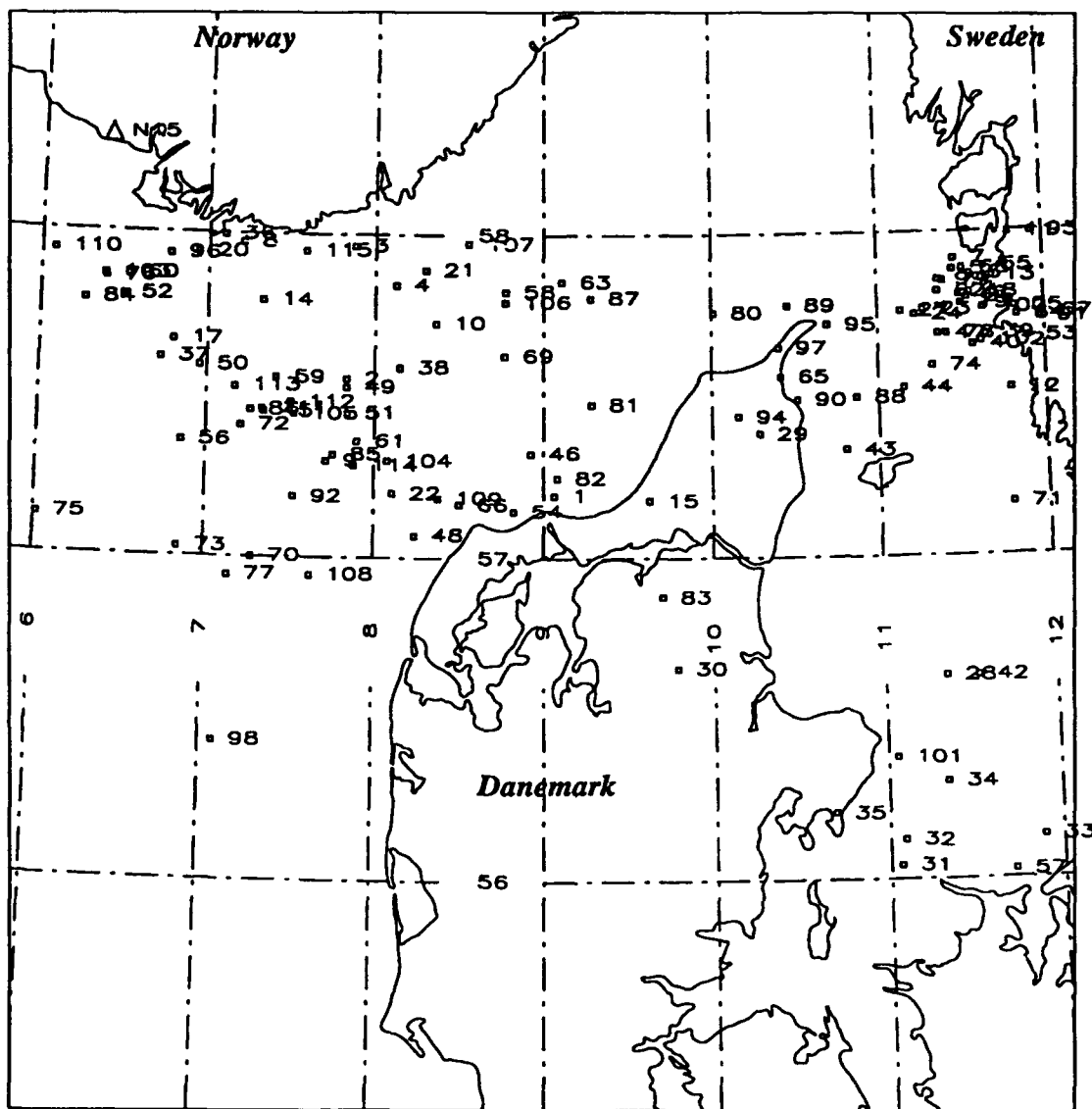


Figure 18: IMS event locations for area 64.

APPENDIX 2

The following table gives the list of the processing parameters used to perform the waveform comparison for each area. Lat1, Lat2, Lon1, and Lon2 give the limits of each area. Lfc and Hfc give the low frequency and the high frequency corner in Hz, respectively, used in the filtering. Sbf and Saf give, in seconds, the time before the first arrival and the time after the first arrival, respectively, defining the signal length.

Table 48: Processing parameters for NORESS data

| Area | Lat1 | Lat2 | Lon1 | Lon2 | Lfc | Hfc | Sbf | Saf |
|------|------|------|------|------|-----|------|-----|-----|
| 26 | 64 | 66 | 10 | 18 | 3.0 | 16.0 | 14 | 134 |
| 27 | 64 | 66 | 18 | 24 | 3.0 | 16.0 | 14 | 139 |
| 31 | 62 | 64 | 5 | 8 | 2.0 | 16.0 | 7 | 62 |
| 32 | 62 | 64 | 8 | 12 | 2.0 | 16.0 | 7 | 62 |
| 33 | 62 | 64 | 12 | 18 | 3.5 | 16.0 | 10 | 90 |
| 34 | 62 | 64 | 18 | 24 | 3.5 | 16.0 | 14 | 134 |
| 46 | 60 | 62 | 16 | 20 | 3.5 | 16.0 | 9 | 84 |
| 47 | 60 | 62 | 12 | 16 | 2.0 | 16.0 | 4 | 39 |
| 48 | 60 | 62 | 8 | 12 | 2.0 | 16.0 | 4 | 34 |
| 49 | 60 | 62 | 4 | 8 | 2.0 | 16.0 | 9 | 84 |
| 50 | 58 | 60 | 4 | 8 | 2.0 | 16.0 | 9 | 79 |
| 51 | 58 | 60 | 8 | 12 | 2.0 | 16.0 | 4 | 39 |
| 52 | 58 | 60 | 12 | 16 | 2.0 | 16.0 | 6 | 56 |
| 53 | 58 | 60 | 16 | 20 | 3.0 | 16.0 | 12 | 112 |
| 62 | 56 | 58 | 18 | 24 | 3.0 | 16.0 | 12 | 107 |
| 63 | 56 | 58 | 12 | 18 | 3.0 | 16.0 | 12 | 107 |
| 64 | 56 | 58 | 6 | 12 | 2.0 | 16.0 | 11 | 95 |

APPENDIX 3

The mine locations provided in this appendix cover more than the studied area. Distance 1 defines the distance to the ARCESS array in degrees and Distance 2, in kilometers. Mines are ordered by increasing longitude.

Table 49: SPOT mine locations

| Label | Latitude | Longitude | Distance 1 | Distance 2 | Azimuth |
|-------|----------|-----------|------------|------------|---------|
| SB8 | 59.230 | 24.235 | 10.36 | 1238.710 | 2.49 |
| SB1 | 59.242 | 24.329 | 10.35 | 1237.03 | 2.30 |
| SB11 | 59.243 | 27.833 | 10.38 | 1241.14 | 355.45 |
| SB9 | 59.269 | 27.732 | 10.35 | 1237.55 | 355.64 |
| SB10 | 59.306 | 27.626 | 10.31 | 1232.64 | 355.83 |
| SB7 | 59.325 | 27.272 | 10.28 | 1228.91 | 356.52 |
| SB6 | 59.327 | 27.070 | 10.27 | 1227.97 | 356.91 |
| SB12 | 59.364 | 28.365 | 10.29 | 1229.58 | 354.36 |
| SB14 | 59.369 | 28.527 | 10.29 | 1229.98 | 354.04 |
| SB13 | 59.370 | 28.428 | 10.28 | 1229.24 | 354.24 |
| SB2 | 59.407 | 24.591 | 10.18 | 1216.68 | 1.82 |
| SB5 | 59.446 | 26.486 | 10.14 | 1212.13 | 358.04 |
| SB16 | 59.482 | 29.930 | 10.27 | 1227.52 | 351.25 |
| SB15 | 60.019 | 29.742 | 9.72 | 1162.13 | 351.15 |
| SC3b | 60.581 | 29.064 | 9.11 | 1089.55 | 352.08 |
| SC3a | 60.599 | 29.073 | 9.10 | 1087.48 | 352.04 |
| SC2 | 60.699 | 29.178 | 9.01 | 1076.48 | 351.73 |
| SC1a | 60.747 | 28.836 | 8.93 | 1068.01 | 352.44 |
| SC1c | 60.749 | 28.854 | 8.93 | 1067.91 | 352.40 |
| SC1b | 60.753 | 28.846 | 8.93 | 1067.37 | 352.41 |
| SC0 | 60.816 | 28.711 | 8.86 | 1058.85 | 352.66 |
| SC4c | 60.843 | 28.989 | 8.85 | 1057.81 | 352.02 |
| SC4b | 60.849 | 28.979 | 8.84 | 1057.02 | 352.03 |
| SC4a | 60.851 | 28.991 | 8.84 | 1056.88 | 352.00 |
| SC19 | 60.852 | 30.096 | 8.93 | 1067.13 | 349.55 |

Table 49: SPOT mine locations

| Label | Latitude | Longitude | Distance 1 | Distance 2 | Azimuth |
|-------|----------|-----------|------------|------------|---------|
| SC6 | 60.951 | 29.175 | 8.75 | 1046.55 | 351.50 |
| SC7 | 60.961 | 29.312 | 8.75 | 1046.56 | 351.18 |
| SC8 | 60.969 | 28.880 | 8.72 | 1041.96 | 352.15 |
| SC9 | 60.974 | 29.054 | 8.72 | 1042.79 | 351.75 |
| SC10 | 60.985 | 29.275 | 8.73 | 1043.39 | 351.24 |
| SC5b | 60.999 | 29.026 | 8.70 | 1039.59 | 351.79 |
| SC5c | 61.005 | 29.043 | 8.69 | 1039.02 | 351.74 |
| SC5a | 61.008 | 29.016 | 8.69 | 1038.43 | 351.80 |
| SC11c | 61.120 | 29.902 | 8.65 | 1033.47 | 349.67 |
| SC11b | 61.132 | 29.823 | 8.63 | 1031.23 | 349.83 |
| SC11a | 61.133 | 29.845 | 8.63 | 1031.34 | 349.78 |
| SC12d | 61.199 | 29.727 | 8.55 | 1022.34 | 349.97 |
| SC12c | 61.201 | 29.731 | 8.55 | 1022.15 | 349.96 |
| SC12b | 61.204 | 29.727 | 8.55 | 1021.75 | 349.97 |
| SC12a | 61.208 | 29.727 | 8.54 | 1021.28 | 349.96 |
| SC13 | 61.270 | 29.804 | 8.49 | 1014.74 | 349.71 |
| SC14 | 61.604 | 31.283 | 8.31 | 993.565 | 345.82 |
| SC17 | 61.664 | 31.654 | 8.30 | 991.958 | 344.87 |
| SC15b | 61.666 | 31.144 | 8.24 | 984.421 | 346.04 |
| SC15a | 61.672 | 31.139 | 8.23 | 983.653 | 346.04 |
| SC16 | 61.691 | 31.274 | 8.23 | 983.321 | 345.70 |
| SC18b | 61.946 | 30.606 | 7.90 | 944.600 | 346.85 |
| SC18a | 61.952 | 30.575 | 7.89 | 943.502 | 346.92 |
| SD44 | 67.607 | 33.486 | 3.51 | 419.675 | 307.12 |
| SD43 | 67.645 | 32.912 | 3.31 | 396.102 | 308.34 |
| SD42 | 67.759 | 32.824 | 3.22 | 384.554 | 307.03 |
| SD41 | 67.803 | 32.781 | 3.18 | 379.824 | 306.53 |
| SD49 | 67.889 | 34.566 | 3.69 | 441.618 | 300.73 |

Table 49: SPOT mine locations

| Label | Latitude | Longitude | Distance 1 | Distance 2 | Azimuth |
|-------|----------|-----------|------------|------------|---------|
| SD40 | 67.893 | 33.029 | 3.20 | 382.702 | 304.46 |
| SD50 | 67.895 | 34.615 | 3.71 | 443.158 | 300.55 |
| SD47 | 67.916 | 34.385 | 3.62 | 432.924 | 300.75 |
| SD48 | 67.926 | 34.486 | 3.65 | 436.243 | 300.40 |
| SD46 | 68.006 | 34.697 | 3.68 | 439.762 | 298.89 |
| SD45 | 68.019 | 34.349 | 3.56 | 425.319 | 299.39 |
| SD39 | 68.040 | 33.229 | 3.18 | 380.626 | 301.68 |
| SD38 | 68.082 | 33.219 | 3.16 | 377.616 | 301.06 |
| SD37 | 68.112 | 32.986 | 3.07 | 366.807 | 301.20 |
| SD35 | 68.120 | 33.400 | 3.20 | 382.288 | 300.01 |
| SD36 | 68.133 | 33.162 | 3.11 | 372.289 | 300.40 |
| SD34 | 68.251 | 33.267 | 3.09 | 369.437 | 298.24 |
| SD33 | 68.268 | 33.403 | 3.13 | 373.830 | 297.65 |
| SD32 | 68.700 | 33.125 | 2.86 | 341.371 | 290.61 |
| SD31 | 68.791 | 33.146 | 2.83 | 338.543 | 288.84 |
| SD30 | 68.792 | 33.133 | 2.83 | 337.969 | 288.84 |
| SD29 | 68.872 | 33.025 | 2.76 | 330.521 | 287.43 |
| SD28 | 68.930 | 33.096 | 2.77 | 331.448 | 286.18 |
| SD18 | 68.932 | 34.938 | 3.41 | 408.182 | 284.60 |
| SD27 | 68.943 | 32.965 | 2.72 | 325.576 | 286.08 |
| SD26 | 68.997 | 32.871 | 2.68 | 319.927 | 285.07 |
| SD25 | 68.999 | 32.910 | 2.69 | 321.488 | 284.99 |
| SD23 | 69.012 | 33.641 | 2.94 | 351.583 | 284.07 |
| SD24 | 69.013 | 32.939 | 2.70 | 322.265 | 284.67 |
| SD22 | 69.034 | 33.506 | 2.89 | 345.307 | 283.75 |
| SD21 | 69.060 | 33.484 | 2.87 | 343.658 | 283.26 |
| SD17 | 69.064 | 35.008 | 3.41 | 407.414 | 282.40 |
| SD16 | 69.070 | 35.008 | 3.41 | 407.260 | 282.30 |

Table 49: SPOT mine locations

| Label | Latitude | Longitude | Distance 1 | Distance 2 | Azimuth |
|-------|----------|-----------|------------|------------|---------|
| SD20 | 69.093 | 33.482 | 2.87 | 342.686 | 282.62 |
| SD19 | 69.111 | 33.594 | 2.90 | 346.913 | 282.20 |
| SD15 | 69.223 | 33.168 | 2.73 | 326.429 | 280.16 |
| SD14 | 69.256 | 33.106 | 2.70 | 323.149 | 279.49 |
| SD12 | 69.276 | 32.811 | 2.60 | 310.367 | 279.16 |
| SD13 | 69.286 | 32.903 | 2.63 | 314.044 | 278.91 |
| SD11 | 69.299 | 32.721 | 2.56 | 306.157 | 278.68 |
| SD4 | 69.329 | 30.019 | 1.61 | 192.217 | 279.50 |
| SD2 | 69.367 | 30.093 | 1.63 | 194.620 | 278.09 |
| SD3 | 69.368 | 30.134 | 1.64 | 196.324 | 278.02 |
| SD7 | 69.398 | 30.614 | 1.81 | 216.018 | 276.75 |
| SD8 | 69.401 | 30.847 | 1.89 | 225.767 | 276.58 |
| SD9 | 69.409 | 30.953 | 1.93 | 230.115 | 276.31 |
| SD10 | 69.410 | 32.135 | 2.34 | 279.794 | 276.17 |
| SD6 | 69.432 | 30.527 | 1.77 | 211.918 | 275.69 |
| SD5 | 69.435 | 30.531 | 1.77 | 212.051 | 275.59 |
| SD1 | 69.597 | 30.049 | 1.60 | 190.838 | 269.89 |

Two tables are provided for the Helsinki mine locations. The locations shown in Table 50 started to be used at the beginning of June 1991. A mapping between the new Helsinki locations and the old Helsinki locations is proposed in this table. Certain mines can have up to four different locations reported in the Helsinki bulletin; only the most frequent are listed. Locations given with one decimal were obtained by averaging seismic locations; locations with two decimals were obtained from the SPOT imagery.

Table 50: Helsinki mine locations

| Label | Old label | Latitude | Longitude | Distance 1 | Distance 2 | Azimuth |
|-------|-----------|----------|-----------|------------|------------|---------|
| HE1 | HB1 | 59.24 | 24.33 | 10.35 | 1237.270 | 2.30 |
| HE5A | HB9 | 59.24 | 27.83 | 10.39 | 1241.480 | 355.46 |
| HE5 | HB9 | 59.27 | 27.73 | 10.35 | 1237.420 | 355.64 |

Table 50: Helsinki mine locations

| Label | Old label | Latitude | Longitude | Distance 1 | Distance 2 | Azimuth |
|-------|-----------|----------|-----------|------------|------------|---------|
| HE6A | HB10 | 59.3 | 27.5 | 10.31 | 1232.810 | 356.08 |
| HE7 | HB11 | 59.3 | 28.1 | 10.34 | 1235.700 | 354.91 |
| HE6 | HB10 | 59.31 | 27.63 | 10.31 | 1232.180 | 355.82 |
| HE4 | HB6 | 59.33 | 27.27 | 10.28 | 1228.310 | 356.52 |
| HE4A | HB6 | 59.33 | 27.07 | 10.27 | 1227.610 | 356.91 |
| HE12A | HB12 | 59.36 | 28.37 | 10.29 | 1230.080 | 354.35 |
| HE12 | HB12 | 59.37 | 28.43 | 10.28 | 1229.260 | 354.23 |
| HE8 | HB13 | 59.37 | 28.53 | 10.29 | 1229.880 | 354.04 |
| HE2 | HB2 | 59.41 | 24.59 | 10.18 | 1216.320 | 1.82 |
| HE9 | HB5 | 59.45 | 26.49 | 10.14 | 1211.660 | 358.03 |
| HE3 | HB3 | 59.5 | 25.0 | 10.08 | 1204.910 | 1.02 |
| HE11 | HB16 | 59.6 | 30.0 | 10.16 | 1214.190 | 351.01 |
| HE10 | HB15 | 60.0 | 29.9 | 9.75 | 1165.860 | 350.85 |
| HE10A | HB15 | 60.02 | 29.74 | 9.72 | 1161.990 | 351.15 |
| HM1 | HA1 | 60.17 | 23.84 | 9.43 | 1127.390 | 3.58 |
| HM3 | HA2 | 60.30 | 22.29 | 9.37 | 1120.340 | 6.96 |
| HV11 | HC3 | 60.6 | 29.2 | 9.11 | 1088.420 | 351.77 |
| HV12 | HC1 | 60.7 | 28.7 | 8.97 | 1072.570 | 352.78 |
| HV5 | HC2 | 60.7 | 29.0 | 8.99 | 1074.890 | 352.12 |
| HV13 | HC7 | 60.8 | 29.5 | 8.93 | 1067.350 | 350.92 |
| HV1B | HC4 | 60.8 | 29.3 | 8.91 | 1065.550 | 351.36 |
| HV1A | HC6 | 60.9 | 29.4 | 8.82 | 1054.590 | 351.04 |
| HV1C | HC5 | 60.9 | 29.3 | 8.81 | 1053.690 | 351.26 |
| HV2 | HC11 | 61.1 | 30.3 | 8.70 | 1040.140 | 348.80 |
| HV8 | HC11 | 61.1 | 29.9 | 8.66 | 1035.800 | 349.70 |
| HM2 | HA3 | 61.33 | 23.03 | 8.30 | 992.660 | 6.04 |
| HV4 | HC14 | 61.4 | 31.6 | 8.55 | 1021.780 | 345.45 |
| HV6 | HC15 | 61.4 | 34.3 | 8.94 | 1068.340 | 339.75 |

Table 50: Helsinki mine locations

| Label | Old label | Latitude | Longitude | Distance 1 | Distance 2 | Azimuth |
|-------|-----------|----------|-----------|------------|------------|---------|
| HV3 | HC12 | 61.5 | 30.4 | 8.32 | 994.286 | 348.03 |
| HM5 | HA4 | 61.6 | 21.7 | 8.12 | 970.875 | 9.51 |
| HM26 | HA5 | 61.64 | 24.26 | 7.95 | 949.899 | 3.17 |
| HM4 | HA6 | 61.9 | 21.5 | 7.84 | 937.384 | 10.37 |
| HV7 | HC13 | 61.9 | 30.6 | 7.95 | 949.899 | 346.94 |
| HM27 | - | 61.94 | 29.03 | 7.76 | 928.011 | 350.79 |
| HM6 | HA7 | 62.07 | 27.41 | 7.54 | 901.123 | 354.89 |
| HV9 | HC16 | 62.2 | 34.3 | 8.19 | 978.847 | 337.82 |
| HM15 | HA8 | 62.5 | 30.1 | 7.31 | 873.457 | 347.20 |
| HM21 | HA9 | 62.6 | 23.6 | 7.01 | 837.805 | 5.50 |
| HM20 | HA10 | 62.7 | 23.2 | 6.93 | 828.226 | 6.74 |
| HM14 | HA11 | 62.8 | 22.9 | 6.85 | 818.395 | 7.71 |
| HM12 | HA12 | 62.83 | 29.25 | 6.90 | 825.018 | 348.98 |
| HM18 | HA14 | 63.0 | 26.8 | 6.59 | 787.184 | 356.03 |
| HM19 | HA13 | 63.02 | 29.23 | 6.71 | 802.434 | 348.73 |
| HM7 | HA15 | 63.12 | 27.74 | 6.51 | 777.713 | 353.05 |
| HM17 | HA16 | 63.16 | 27.99 | 6.48 | 774.690 | 352.24 |
| HM23 | HA18 | 63.3 | 29.3 | 6.44 | 770.283 | 348.03 |
| HM16 | HA17 | 63.4 | 27.3 | 6.20 | 741.663 | 354.15 |
| HM13 | HA19 | 63.66 | 26.05 | 5.91 | 705.992 | 358.14 |
| HM24 | HA20 | 63.85 | 25.05 | 5.71 | 683.054 | 1.61 |
| HM10 | HA22 | 64.1 | 27.1 | 5.50 | 656.995 | 354.14 |
| HM9 | HA21 | 64.1 | 24.7 | 5.47 | 653.804 | 2.97 |
| HM8 | HA23 | 64.12 | 28.06 | 5.53 | 661.291 | 350.64 |
| HM11 | HA24 | 64.41 | 25.15 | 5.15 | 615.717 | 1.39 |
| HV10 | HC17 | 64.68 | 30.66 | 5.27 | 630.425 | 339.89 |
| HM22 | HA25 | 65.78 | 24.70 | 3.79 | 452.502 | 4.30 |
| HM25 | HA26 | 65.8 | 28.10 | 3.88 | 463.898 | 346.40 |

Table 50: Helsinki mine locations

| Label | Old label | Latitude | Longitude | Distance 1 | Distance 2 | Azimuth |
|-------|-----------|----------|-----------|------------|------------|---------|
| HR3 | HE1 | 67.12 | 20.90 | 2.97 | 354.734 | 33.06 |
| HR1 | HE1 | 67.18 | 20.67 | 2.97 | 354.764 | 34.94 |
| HK8 | HD1 | 67.56 | 30.44 | 2.69 | 321.321 | 319.83 |
| HK5 | HD10 | 67.6 | 34.2 | 3.74 | 446.567 | 305.31 |
| HK1A | HD8/HD9 | 67.53 | 33.84 | 3.61 | 431.064 | 305.85 |
| HK2 | HD8/HD9 | 67.64 | 34.02 | 3.66 | 437.065 | 305.26 |
| HK2A | HD8/HD9 | 67.64 | 33.88 | 3.61 | 431.848 | 305.62 |
| HR2 | HE2 | 67.65 | 21.00 | 2.51 | 300.478 | 39.05 |
| HK1 | HD8 | 67.67 | 33.74 | 3.55 | 424.547 | 305.59 |
| HK7 | HD3 | 67.7 | 31.4 | 2.84 | 339.396 | 313.18 |
| HM28 | - | 67.79 | 24.43 | 1.80 | 214.830 | 12.16 |
| HR4 | HE2 | 67.8 | 20.2 | 2.61 | 311.740 | 45.63 |
| HK4 | HD6 | 68.16 | 33.18 | 3.11 | 371.356 | 299.93 |
| HK11 | HD5 | 68.87 | 33.03 | 2.77 | 330.799 | 287.46 |
| HK10 | HD12 | 69.2 | 34.7 | 3.27 | 391.275 | 280.18 |
| HK12 | HD7 | 69.23 | 33.17 | 2.73 | 326.366 | 280.01 |
| HK9 | HD11 | 69.3 | 34.4 | 3.15 | 376.717 | 278.44 |
| HK3 | HD2 | 69.4 | 30.8 | 1.87 | 223.806 | 276.63 |
| HK6 | HD4 | 69.6 | 32.3 | 2.39 | 285.180 | 271.61 |
| HN1 | HF1 | 69.6 | 29.9 | 1.54 | 184.594 | 269.63 |

Table 51: Old Helsinki mine locations

| Label | Latitude | Longitude | Distance 1 | Distance 2 | Azimuth |
|-------|----------|-----------|------------|------------|---------|
| HB9 | 59.2 | 27.6 | 10.417 | 1158.32 | 355.924 |
| HB1 | 59.3 | 24.4 | 10.289 | 1144.09 | 2.178 |
| HB10 | 59.3 | 27.6 | 10.317 | 1147.2 | 355.884 |
| HB11 | 59.3 | 28.1 | 10.337 | 1149.43 | 354.910 |
| HB6 | 59.3 | 27.2 | 10.303 | 1145.65 | 356.667 |

Table 51: Old Helsinki mine locations

| Label | Latitude | Longitude | Distance 1 | Distance 2 | Azimuth |
|-------------------|----------|-----------|------------|------------|---------|
| HB12 | 59.4 | 28.4 | 10.252 | 1139.98 | 354.273 |
| HB13 | 59.4 | 28.5 | 10.257 | 1140.53 | 354.078 |
| HB2 | 59.4 | 24.6 | 10.185 | 1132.53 | 1.802 |
| HB3 | 59.5 | 25.0 | 10.080 | 1120.85 | 1.016 |
| HB5 | 59.5 | 26.5 | 10.086 | 1121.52 | 358.003 |
| HB16 | 59.6 | 30.0 | 10.157 | 1129.41 | 351.009 |
| HB15 | 60.0 | 29.9 | 9.753 | 1084.49 | 350.847 |
| HA1 | 60.2 | 23.1 | 9.429 | 1048.46 | 5.170 |
| HA2 | 60.4 | 22.4 | 9.266 | 1030.34 | 6.797 |
| HC3 | 60.6 | 29.2 | 9.105 | 1012.43 | 351.767 |
| HC1 | 60.7 | 28.7 | 8.972 | 997.645 | 352.781 |
| HC2 | 60.7 | 29.0 | 8.992 | 999.869 | 352.117 |
| HC4 | 60.8 | 29.3 | 8.914 | 991.196 | 351.361 |
| HC7 | 60.8 | 29.5 | 8.929 | 992.864 | 350.918 |
| HC5 | 60.9 | 29.3 | 8.815 | 980.187 | 351.264 |
| HC6 | 60.9 | 29.4 | 8.822 | 980.966 | 351.040 |
| HC10 ^a | 61.1 | 39.9 | 10.351 | 1150.98 | 330.883 |
| HC11 | 61.1 | 30.2 | 8.692 | 966.51 | 349.020 |
| HA3 | 61.4 | 22.8 | 8.246 | 916.917 | 6.647 |
| HC14 | 61.4 | 31.6 | 8.548 | 950.498 | 345.450 |
| HC15 | 61.4 | 34.3 | 8.937 | 993.753 | 339.749 |
| HC12 | 61.5 | 30.4 | 8.318 | 924.923 | 348.028 |
| HA4 | 61.6 | 21.7 | 8.122 | 903.129 | 9.511 |
| HA5 | 61.6 | 24.2 | 7.988 | 888.229 | 3.306 |
| HA6 | 61.9 | 21.5 | 7.842 | 871.994 | 10.375 |
| HC13 | 61.9 | 30.6 | 7.946 | 883.559 | 346.944 |
| HA7 | 62.1 | 27.4 | 7.508 | 834.855 | 354.895 |
| HC16 | 62.2 | 34.3 | 8.188 | 910.468 | 337.819 |

Table 51: Old Helsinki mine locations

| Label | Latitude | Longitude | Distance 1 | Distance 2 | Azimuth |
|-------|----------|-----------|------------|------------|---------|
| HA8 | 62.5 | 30.1 | 7.307 | 812.505 | 347.203 |
| HA9 | 62.6 | 23.6 | 7.009 | 779.369 | 5.501 |
| HA10 | 62.7 | 23.2 | 6.928 | 770.362 | 6.736 |
| HA11 | 62.8 | 22.9 | 6.846 | 761.244 | 7.709 |
| HA12 | 62.8 | 29.3 | 6.936 | 771.251 | 348.887 |
| HA13 | 62.9 | 28.7 | 6.787 | 754.683 | 350.455 |
| HA14 | 63.0 | 26.8 | 6.585 | 732.222 | 356.028 |
| HA15 | 63.2 | 27.8 | 6.430 | 714.986 | 352.777 |
| HA16 | 63.2 | 28.1 | 6.448 | 716.988 | 351.850 |
| HA17 | 63.4 | 27.3 | 6.204 | 689.856 | 354.152 |
| HA18 | 63.5 | 29.6 | 6.277 | 697.974 | 346.723 |
| HA19 | 63.7 | 26.0 | 5.865 | 652.161 | 358.299 |
| HA20 | 63.8 | 25.1 | 5.764 | 640.93 | 1.421 |
| HA21 | 64.1 | 24.7 | 5.469 | 608.128 | 2.975 |
| HA22 | 64.1 | 27.1 | 5.496 | 611.13 | 354.136 |
| HA23 | 64.2 | 28.0 | 5.448 | 605.793 | 350.723 |
| HA24 | 64.4 | 25.2 | 5.160 | 573.768 | 1.196 |
| HC17 | 64.7 | 30.7 | 5.261 | 584.999 | 339.680 |
| HA25 | 65.8 | 24.7 | 3.765 | 418.651 | 4.319 |
| HA26 | 65.8 | 28.1 | 3.881 | 431.549 | 346.396 |
| HE1 | 67.1 | 20.6 | 3.049 | 339.035 | 34.430 |
| HD1 | 67.6 | 30.5 | 2.672 | 297.114 | 318.953 |
| HD10 | 67.6 | 34.2 | 3.736 | 415.426 | 305.315 |
| HD9 | 67.6 | 34.0 | 3.673 | 408.421 | 305.819 |
| HD3 | 67.7 | 31.4 | 2.839 | 315.684 | 313.183 |
| HD8 | 67.7 | 33.7 | 3.522 | 391.63 | 305.303 |
| HE2 | 67.7 | 21.0 | 2.475 | 275.209 | 39.783 |
| HD6 | 68.1 | 33.2 | 3.143 | 349.487 | 300.827 |

Table 51: Old Helsinki mine locations

| Label | Latitude | Longitude | Distance 1 | Distance 2 | Azimuth |
|-------|----------|-----------|------------|------------|---------|
| HD5 | 68.8 | 33.0 | 2.779 | 309.012 | 288.881 |
| HD12 | 69.2 | 34.7 | 3.273 | 363.943 | 280.184 |
| HD7 | 69.2 | 33.3 | 2.781 | 309.234 | 280.580 |
| HD11 | 69.3 | 34.4 | 3.151 | 350.377 | 278.445 |
| HD2 | 69.4 | 30.8 | 1.872 | 208.158 | 276.626 |
| HD4 | 69.6 | 32.3 | 2.386 | 265.312 | 271.612 |
| HF1 | 69.6 | 29.9 | 1.544 | 171.686 | 269.630 |

a. This mine does not have a corresponding new location.

Table 52: Norwegian mine locations

| Label | Latitude | Longitude | Distance 1 | Distance 2 | Azimuth |
|-------|----------|-----------|------------|------------|---------|
| N15 | 58.300 | 6.400 | 13.96 | 1669.200 | 28.49 |
| N205 | 58.800 | 15.100 | 11.67 | 1394.550 | 18.31 |
| N206 | 59.300 | 15.400 | 11.14 | 1331.810 | 18.63 |
| N209 | 59.700 | 14.100 | 10.99 | 1313.850 | 21.40 |
| N16 | 59.750 | 10.770 | 11.63 | 1390.170 | 26.35 |
| N14 | 59.900 | 10.500 | 11.56 | 1381.420 | 27.04 |
| N208 | 60.000 | 14.800 | 10.58 | 1265.070 | 20.84 |
| N109 | 60.100 | 22.880 | 9.54 | 1140.350 | 5.58 |
| N207 | 60.100 | 15.000 | 10.45 | 1249.600 | 20.70 |
| N202 | 60.120 | 17.520 | 10.03 | 1199.380 | 16.29 |
| N121 | 60.140 | 22.590 | 9.51 | 1137.360 | 6.21 |
| N110 | 60.170 | 23.840 | 9.43 | 1127.390 | 3.58 |
| N204 | 60.185 | 16.115 | 10.18 | 1217.390 | 18.94 |
| N203 | 60.200 | 16.130 | 10.17 | 1215.390 | 18.94 |
| N111 | 60.250 | 25.390 | 9.32 | 1114.700 | 0.25 |
| N112 | 60.270 | 24.070 | 9.32 | 1114.610 | 3.12 |

Table 52: Norwegian mine locations

| Label | Latitude | Longitude | Distance 1 | Distance 2 | Azimuth |
|-------|----------|-----------|------------|------------|---------|
| N113 | 60.300 | 22.290 | 9.37 | 1120.340 | 6.96 |
| N201 | 60.620 | 15.100 | 9.95 | 1189.280 | 21.57 |
| N210 | 60.700 | 15.900 | 9.73 | 1163.470 | 20.31 |
| N13 | 60.740 | 11.020 | 10.69 | 1277.820 | 28.31 |
| N114 | 61.030 | 28.180 | 8.61 | 1029.680 | 353.71 |
| N115 | 61.050 | 22.640 | 8.60 | 1028.560 | 6.75 |
| N103 | 61.180 | 28.040 | 8.46 | 1010.910 | 353.93 |
| N101 | 61.330 | 23.030 | 8.30 | 992.660 | 6.04 |
| N116 | 61.810 | 21.740 | 7.91 | 945.651 | 9.66 |
| N6 | 61.930 | 5.450 | 11.18 | 1335.950 | 38.48 |
| N117 | 61.940 | 29.030 | 7.76 | 928.021 | 350.79 |
| N1 | 62.040 | 5.523 | 11.07 | 1323.060 | 38.76 |
| N102 | 62.040 | 28.770 | 7.65 | 913.888 | 351.34 |
| N118 | 62.070 | 27.410 | 7.54 | 901.123 | 354.89 |
| N122 | 62.820 | 29.250 | 6.91 | 826.196 | 349.00 |
| N123 | 63.020 | 29.230 | 6.71 | 802.434 | 348.73 |
| N124 | 63.120 | 27.740 | 6.51 | 777.713 | 353.05 |
| N119 | 63.150 | 24.020 | 6.44 | 770.017 | 4.66 |
| N125 | 63.160 | 27.990 | 6.48 | 774.690 | 352.24 |
| N104 | 63.660 | 26.050 | 5.91 | 705.992 | 358.14 |
| N105 | 63.850 | 25.050 | 5.71 | 683.054 | 1.61 |
| N218 | 63.867 | 20.217 | 6.07 | 725.049 | 17.87 |
| N215 | 63.917 | 20.100 | 6.03 | 721.264 | 18.37 |
| N219 | 63.917 | 20.300 | 6.01 | 717.987 | 17.76 |
| N217 | 63.933 | 20.067 | 6.02 | 719.931 | 18.53 |
| N220 | 64.050 | 20.717 | 5.82 | 696.179 | 16.82 |
| N9 | 64.070 | 11.200 | 7.85 | 938.973 | 39.49 |
| N216 | 64.100 | 19.583 | 5.94 | 709.582 | 20.54 |

Table 52: Norwegian mine locations

| Label | Latitude | Longitude | Distance 1 | Distance 2 | Azimuth |
|-------|----------|-----------|------------|------------|---------|
| N126 | 64.120 | 28.060 | 5.53 | 661.291 | 350.64 |
| N214 | 64.133 | 18.567 | 6.07 | 725.969 | 23.68 |
| N106 | 64.410 | 25.150 | 5.15 | 615.717 | 1.39 |
| N7 | 64.870 | 13.880 | 6.50 | 776.824 | 38.77 |
| N107 | 65.780 | 24.700 | 3.79 | 452.502 | 4.30 |
| N120 | 65.900 | 24.470 | 3.67 | 439.132 | 5.69 |
| N8 | 65.930 | 13.880 | 5.71 | 682.252 | 45.46 |
| N213 | 66.133 | 17.183 | 4.65 | 555.392 | 38.94 |
| N3 | 66.421 | 14.679 | 5.13 | 613.573 | 47.60 |
| N212 | 67.083 | 20.967 | 2.98 | 356.759 | 32.32 |
| N5 | 67.148 | 16.070 | 4.24 | 506.675 | 51.27 |
| N108 | 67.790 | 24.430 | 1.80 | 214.831 | 12.16 |
| N211 | 67.833 | 20.205 | 2.58 | 308.817 | 46.13 |
| N400 | 69.420 | 30.800 | 1.87 | 223.541 | 276.01 |
| N4 | 69.652 | 30.025 | 1.59 | 189.976 | 267.88 |

Table 53: Mine locations from other sources

| Label | Latitude | Longitude | Distance 1 | Distance 2 | Azimuth |
|----------|----------|-----------|------------|------------|---------|
| TIT | 58.23 | 6.43 | 14.018 | 1558.74 | 28.330 |
| BLA | 59.31 | 6.95 | 12.940 | 1438.87 | 29.989 |
| NYG | 60.39 | 5.34 | 12.453 | 1384.72 | 34.213 |
| Varanger | 70.480 | 28.500 | 1.40 | 155.764 | 228.72 |

Table 54: JOG mine locations

| Label | Latitude | Longitude | Distance 1 | Distance 2 | Azimuth |
|-------|----------|-----------|------------|------------|---------|
| JOG1 | 59.650 | 9.680 | 11.97 | 1430.810 | 27.55 |
| JOG2 | 59.660 | 9.650 | 11.97 | 1430.590 | 27.61 |
| JOG3 | 59.660 | 9.690 | 11.96 | 1429.460 | 27.56 |
| JOG4 | 59.670 | 9.680 | 11.95 | 1428.680 | 27.59 |
| JOG5 | 59.680 | 9.680 | 11.94 | 1427.620 | 27.61 |
| JOG6 | 59.690 | 9.540 | 11.97 | 1430.510 | 27.81 |
| JOG7 | 59.760 | 9.810 | 11.84 | 1415.470 | 27.63 |
| JOG8 | 59.770 | 9.520 | 11.90 | 1422.590 | 28.02 |
| JOG9 | 59.790 | 9.500 | 11.89 | 1421.050 | 28.09 |
| JOG10 | 62.040 | 10.820 | 9.61 | 1148.870 | 32.28 |
| JOG11 | 62.100 | 10.210 | 9.72 | 1161.430 | 33.35 |
| JOG12 | 62.100 | 9.800 | 9.82 | 1174.200 | 33.92 |
| JOG13 | 62.110 | 9.820 | 9.81 | 1172.580 | 33.93 |
| JOG14 | 62.110 | 9.900 | 9.79 | 1170.070 | 33.82 |
| JOG15 | 62.130 | 10.090 | 9.72 | 1162.150 | 33.62 |
| JOG16 | 62.150 | 10.080 | 9.71 | 1160.460 | 33.70 |
| JOG17 | 62.150 | 10.680 | 9.55 | 1141.990 | 32.84 |
| JOG18 | 62.280 | 10.320 | 9.54 | 1140.030 | 33.78 |
| JOG19 | 62.320 | 10.600 | 9.43 | 1127.360 | 33.51 |
| JOG20 | 62.330 | 10.620 | 9.42 | 1125.750 | 33.52 |
| JOG21 | 62.380 | 10.400 | 9.43 | 1127.580 | 34.01 |
| JOG22 | 62.380 | 10.420 | 9.43 | 1126.950 | 33.98 |
| JOG23 | 62.410 | 10.270 | 9.44 | 1128.660 | 34.29 |
| JOG24 | 62.410 | 10.280 | 9.44 | 1128.350 | 34.28 |
| JOG25 | 62.440 | 10.860 | 9.26 | 1107.360 | 33.53 |
| JOG26 | 62.440 | 10.870 | 9.26 | 1107.05 | 33.52 |
| JOG27 | 62.520 | 11.220 | 9.10 | 1088.34 | 33.26 |
| JOG28 | 62.540 | 11.100 | 9.12 | 1090.00 | 33.51 |

Table 54: JOG mine locations

| Label | Latitude | Longitude | Distance 1 | Distance 2 | Azimuth |
|-------|----------|-----------|------------|------------|---------|
| JOG29 | 62.540 | 11.250 | 9.08 | 1085.42 | 33.29 |
| JOG30 | 62.550 | 11.810 | 8.93 | 1067.57 | 32.44 |
| JOG31 | 62.570 | 11.820 | 8.91 | 1065.25 | 32.49 |
| JOG32 | 62.630 | 11.550 | 8.93 | 1067.29 | 33.13 |
| JOG33 | 62.670 | 11.280 | 8.96 | 1071.49 | 33.69 |
| JOG34 | 62.690 | 11.280 | 8.95 | 1069.50 | 33.76 |
| JOG35 | 62.710 | 11.280 | 8.93 | 1067.50 | 33.83 |
| JOG36 | 62.770 | 11.280 | 8.88 | 1061.53 | 34.05 |
| JOG37 | 62.790 | 11.250 | 8.87 | 1060.47 | 34.17 |
| JOG38 | 62.810 | 11.260 | 8.85 | 1058.17 | 34.22 |
| JOG39 | 62.820 | 10.050 | 9.16 | 1095.44 | 36.05 |
| JOG40 | 62.840 | 11.550 | 8.75 | 1046.28 | 33.88 |
| JOG41 | 62.870 | 11.630 | 8.71 | 1040.84 | 33.86 |
| JOG42 | 62.920 | 11.680 | 8.65 | 1034.34 | 33.96 |
| JOG43 | 62.940 | 11.500 | 8.68 | 1037.88 | 34.32 |
| JOG52 | 67.070 | 20.970 | 3.00 | 358.027 | 32.16 |
| JOG44 | 67.180 | 20.620 | 2.98 | 356.104 | 35.20 |
| JOG45 | 67.180 | 20.670 | 2.97 | 354.764 | 34.94 |
| JOG46 | 67.200 | 20.670 | 2.95 | 352.798 | 35.16 |
| JOG47 | 67.200 | 20.710 | 2.94 | 351.728 | 34.95 |
| JOG68 | 67.350 | 32.530 | 3.40 | 406.023 | 313.45 |
| JOG70 | 67.450 | 32.660 | 3.37 | 402.314 | 311.74 |
| JOG69 | 67.550 | 30.330 | 2.67 | 319.011 | 320.56 |
| JOG53 | 67.630 | 21.030 | 2.52 | 301.490 | 38.59 |
| JOG54 | 67.670 | 33.630 | 3.52 | 420.468 | 305.89 |
| JOG48 | 67.830 | 20.190 | 2.59 | 309.557 | 46.15 |
| JOG49 | 67.880 | 20.230 | 2.54 | 304.106 | 46.77 |
| JOG56 | 67.880 | 34.550 | 3.69 | 441.550 | 300.89 |

Table 54: JOG mine locations

| Label | Latitude | Longitude | Distance 1 | Distance 2 | Azimuth |
|-------|----------|-----------|------------|------------|---------|
| JOG57 | 67.900 | 34.630 | 3.71 | 443.438 | 300.45 |
| JOG55 | 67.930 | 34.480 | 3.65 | 435.766 | 300.36 |
| JOG61 | 68.010 | 34.710 | 3.68 | 440.043 | 298.81 |
| JOG60 | 68.020 | 34.370 | 3.56 | 426.083 | 299.34 |
| JOG50 | 68.050 | 16.020 | 3.76 | 448.921 | 62.25 |
| JOG58 | 68.150 | 33.250 | 3.13 | 374.669 | 299.91 |
| JOG59 | 68.250 | 33.270 | 3.09 | 369.611 | 298.25 |
| JOG51 | 68.470 | 16.050 | 3.57 | 426.531 | 68.19 |
| JOG62 | 68.690 | 33.110 | 2.85 | 34' 183 | 290.82 |
| JOG63 | 68.820 | 35.370 | 3.60 | 429.796 | 286.09 |
| JOG64 | 68.870 | 33.020 | 2.76 | 330.386 | 287.47 |
| JOG65 | 68.930 | 33.080 | 2.77 | 330.784 | 286.20 |
| JOG67 | 69.390 | 30.330 | 1.71 | 204.203 | 277.14 |
| JOG66 | 69.420 | 30.280 | 1.69 | 201.685 | 276.16 |

