# GRN89

## The 1989 Greenland Seismic Survey

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## PASSCAL Data Report 94-005

IRIS DATA MANAGEMENT SYSTEM

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# 1989 Greenland Seismic Survey

**Introduction:**
The 1989 Seismic survey was part of a large cooperative project mounted in Greenland to carry out geophysical studies of the Earth's oldest crust. The targets included possible oceanic crust under the oldest supracrustal rocks, granulite terrains and three crustal sutures. Geophysical studies consisted of gravity, CDP reflection and wide-angle reflection studies that combine recording on land and at sea using a 6000 cu. in. airgun array from the University of Bergen's research vessel. The PASSCAL instrument were used for the first time with controlled sources for three component recording in three different deployments on land. The PASSCAL 2-Hz, three component seismometers were tested against 7.5 Hz geophones and provided better results, so they were used in all recordings. The marine airguns were fired at one minute intervals to generate common receiver gathers with trace spacing of about 105 meters. P-waves and S-waves converted off the water were recorded out to more than 100 km. Strong moho reflections were recorded on many profiles.

**Experiment**
There were a total of three major deployments to record the various lines. Figure 1 shows a map of the area of study with all of the lines and stations on it. The first deployment was along Ameralik Fjord. Stations Amer1-Amer8 were deployed to record line 2. Stations were then deployed along the coast and at MA1 and MA2 to record line 3. Lines 4, 5 and 8 were shot principally as marine CDP lines. In these lines only 3 of the 5 airguns were used. Each airgun was a 19.7 liter gun and the array was towed at a depth of 15 meters. The third and final deployment was along Godthaab Fjord, and stations GOD1-GOD11 recorded lines 6 and 7.

All stations were deployed with the sensors aligned according to true North. The sensors were secured to bedrock with plaster of paris.

Table 1 shows a breakdown of the operation of each of the stations. Table 2 shows the location of each of the stations.

**Calibration Information:**
The gain information for the instrument is stored in bytes 121-122 of the header. For all of the deployments, the gain was 8192. The data in the SEGY traces is in counts at the A/D, to get to volts you will

need to multiply the counts by the conversion constant of the A/D (114.4e-6 volts/count) and then divide by the gain (8192). The sensitivity of the geophone is 88 volts/m/sec. Note that for this sensor the direction of positive velocity for the vertical channel (channel 1) is down, for the North/South channel (channel 2) it is North and for the East/West channel (channel 3) it is East.

**Data Product**

The data product for this experiment consists of several tapes. The first tape contains a copy of this report and all of the navigation data. The rest of the tapes contain the data from each of the stations in SEGY format and in the form of common receiver gathers. The horizontal components are multiplexed with the vertical so that traces 1,4,7, .... are the vertical components, while traces 2,5,8 ... are the North/South components and traces 3,6,9,..... are the East/West components. The data are sampled at 10 ms and there are 3154 samples per trace. Each tape has all of the data for a given station, Table 1 shows the time windows that must be pulled out for each line.

The traces were cut so that the time of the shot should be at 3 seconds, however, the PASSCAL instrument at that time had a bug such that it was possible to be locked to Omega and report the time off by 1 second. This can easily be checked by looking at the first arrivals at the shortest offsets.

The shot locations are not stored in the headers of the data. All shot locations are given in the navigation files sent with the data. These files contain a one line header then a one line entry for each shot. The section below is an example of one of the navigation files:

```
GR89  2  1 250.0   2.83  64.224 -50.272  64.202 -50.367 -51.150. 10
  1.   1.2642321 1  64 13.286 -50-17.632 7122056  534265 100.137946.0     .0
  2.   2.2642322 1  64 13.254 -50-17.742 7121995  534178 107.137966.0     .0
  3.   3.2642323 1  64 13.222 -50-17.850 7121935  534090 112.137981.0     .0
  4.   4.2642324 1  64 13.191 -50-17.960 7121877  534002 116.137992.0     .0
  5.   5.2642325 1  64 13.160 -50-18.071 7121817  533914 120.137998.0     .0
  6.   6.2642326 1  64 13.129 -50-18.180 7121759  533826 124.138001.0     .0
  7.   7.2642327 1  64 13.097 -50-18.288 7121698  533739 128.138001.0     .0
  9.   8.2642329 1  64 13.034 -50-18.508 7121580  533563 134.137993.0     .0
 10.   9.2642330 1  64 13.003 -50-18.618 7121520  533474 138.137987.0     .0
```

Looking at the line beginning with 1. the data can be interpreted as follows:

The first two elements 1. 1. are counters;

The next element 2642321 is the time (day 264 23:21);

Skip the next element, then 64 13.286 represents the latitude in degrees and minutes;

The next element -50-17.632 represents the longitude in degrees and minutes;

The next two elements 7122056 534265 represent the Northing and Eastings for the 1923 Potsdam Sphere; and

The last elements represent readings from some uncalibrated ancillary sensors.

Each of the SEGY traces has the start time for the trace in the header. The day is in bytes 159-160, the hour in bytes 161-162, the minutes in bytes 163-164 and the seconds in bytes 165-166. For most of the data the time should be of the form ( day 264, hour 23, minute 20, second 57), this would correspond to shot shown in the example above.

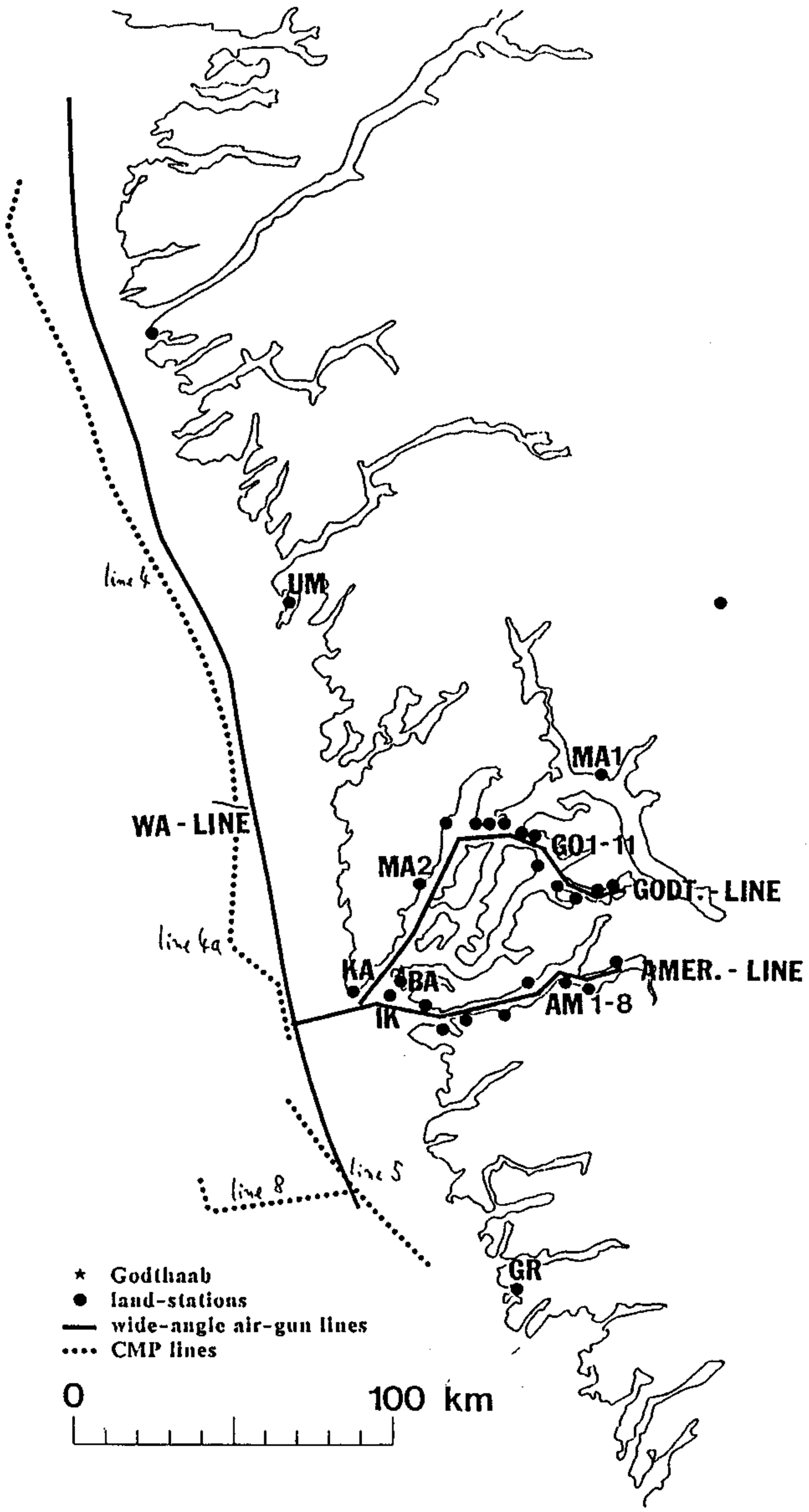


Figure 1. Map of Greenland Seismic Survey

Table 1
Station Performance

| Station | # | Time | | OMEGA Time | Line |
|---|---|---|---|---|---|
| | | Start | End | | |
| NUUK | 1 | Noise Test | | | |
| IKAA1 | 2 | No Data | | | |
| IKAA2 | 2 | No Data | | | |
| IKAA3 | 2 | 264 2321 | 265 1648 | All Omega | AMER (Line 2) |
| | | 265 2140 | 267 0501 | All Omega | WA (Line 3) |
| IKAA4 | 2 | 267 1500 | 267 2301 | No Omega | WA (Line 4) |
| | | 269 0701 | 271 0456 | No Omega | GR89-4/5 (Line 4/5) |
| | | 271 1801 | 271 1955 | No Omega | GODT (Line 6) |
| NUUK | 3 | Noise Test | | | |
| NUUK | 4 | Noise Test | | | |
| NUUK | 5 | Noise Test | | | |
| GRAD1 | 6 | 264 2321 | 265 1648 | All Omega | AMER (Line 2) |
| | | 265 2140 | 268 0055 | NO:265:2252 -2305 | WA (Line 3) |
| | 7 | No Data | | | |
| UMAN1 | 8 | 264 2321 | 265 1648 | All Omega | AMER (Line 2) |
| | | 266 0116 | 267 2346 | NO:267:2123 -2225 | WA (Line 3) |
| | | | | NO:267:2234 -2243 | |
| UMAN2 | 9 | No Data | | | |
| BASE | 10 | | | | |
| SOND1 | 11 | No Data | | | |
| ISUA | 13 | No Data | | | |
| MANI1 | 14 | 269 0433 | 270 0629 | All Omega | GR89-4 (Line 4) |
| | | 270 1021 | 271 0456 | All Omega | GR89-4/5 (Line 4/5) |
| | | 271 1816 | 272 2101 | All Omega | GODT (Line 6) |
| | | 273 1531 | 273 2146 | All Omega | GR89-8 (Line 8) |
| MANI2 | 15 | 269 0431 | 270 0055 | All Omega | GR89-4 (Line 4) |
| KANG1 | 16 | 264 2321 | 265 1648 | No Omega | AMER (Line 2) |
| | | 265 2140 | 267 1659 | No Omega | WA (Line 3) |
| KANG2 | 16 | 267 1800 | 268 0055 | No Omega | WA (Line3) |
| | | 269 0431 | 270 0631 | No Omega | GR89-4 (Line 4) |
| | | 270 1021 | 271 0456 | NO:270:1508 | GR89-4/5 (Line 4/5) |
| | | 271 1816 | 271 2359 | All Omega | GODT (Line 6) |
| AMER1 | 17 | 264 2321 | 265 1648 | No Omega | AMER (Line 2) |
| | | 265 2140 | 266 2043 | No Omega | WA (Line 3) |
| AMER2 | 18 | 264 2341 | 265 1648 | All Omega | AMER (Line 2) |
| | | 265 2140 | 266 1856 | NO:266:1837 -1853 | WA (Line 3) |
| AMER3 | 19 | No Data | | | |
| AMER4 | 20 | 264 2321 | 265 1648 | All Omega | AMER (Line 2) |
| | | 265 2140 | 266 1519 | All Omega | WA (Line 3) |
| AMER5 | 21 | 264 2321 | 265 1648 | All Omega | AMER (Line 2) |

| | | | | | |
|---|---|---|---|---|---|
| | | 265 2140 | 266 1331 | All Omega | WA (Line 3) |
| AMER6 | 22 | 264 2321 | 265 1648 | All Omega | AMER (Line 2) |
| AMER7 | 23 | 264 2321 | 265 1648 | All Omega | AMER (Line 2) |
| AMER8 | 24 | No Data | | | |
| GOD1 | 25 | 270 2201 | 271 0451 | All Omega | GR89-5 (Line 5) |
| | | 271 1816 | 272 1221 | All Omega | GODT (Line 6) |
| GOD2 | 26 | No Data | | | |
| GOD3 | 27 | 270 2201 | 271 0456 | All Omega | GR89-5 (Line 5) |
| | | 271 1816 | 272 1221 | All Omega | GODT (Line 6) |
| GOD4 | 28 | 270 2201 | 271 0456 | All Omega | GR89-5 (Line 5) |
| | | 271 1816 | 272 1221 | All Omega | GODT (Line 6) |
| GOD5 | 29 | 270 2201 | 271 0456 | NO:- 270:2318 | GR89-5 (Line 5) |
| | | 271 1816 | 272 1221 | NO: 272:1215 - | GODT (Line 6) |
| GOD6 | 30 | 270 2201 | 271 0456 | All Omega | GR89-5 (Line 5) |
| GOD7 | 31 | 270 2201 | 271 0456 | No Omega | GR89-5 (Line 5) |
| | | 271 1816 | 272 1221 | No Omega | GODT (Line 6) |
| | | 272 1546 | 272 1849 | No Omega | GODT (Line 7) |
| GOD8 | 32 | 270 2201 | 271 0456 | All Omega | GR89-5 (Line 5) |
| | | 271 1816 | 272 1221 | All Omega | GODT (Line 6) |
| GOD9 | 33 | 270 2201 | 271 0346 | All Omega | GR89-5 (Line 5) |
| GOD10 | 34 | 270 2201 | 271 0456 | All Omega | GR89-5 (Line 5) |
| | | 271 1816 | 272 1221 | All Omega | GODT (Line 6) |
| GOD11 | 35 | 270 2201 | 271 0456 | All Omega | GR89-5 (Line 5) |
| | | 271 1816 | 272 1128 | All Omega | GODT (Line 6) |

Table 2
Station Locations

| Station # | Station | Longitude | Latitude |
|---|---|---|---|
| 1 | Airport | (Noise Test) | |
| 2 | IKAA | 51.7875 | 64.1253 |
| 3 | Airport | (Noise Test) | |
| 4 | Airport | (Noise Test) | |
| 5 | Airport | (Noise Test) | |
| 6 | GRAD1 | 51.0450 | 63.2842 |
| 7 | GRAD2 | 51.0433 | 63.2825 |
| 8 | UMAN1 | 52.4567 | 65.2633 |
| 9 | UMAN2 | 52.4583 | 65.2650 |
| 10 | BASE | 51.7358 | 64.1663 |
| 11 | SOND1 | 53.4617 | 66.0133 |
| 12 | Not Used | | |
| 13 | ISUA | (No Data) | |
| 14 | MANI1 | 50.3818 | 64.7400 |
| 15 | MANI2 | 51.5854 | 64.4519 |
| 16 | KANG | 52.0617 | 64.1342 |
| 17 | AMER1 | 51.5667 | 64.0908 |
| 18 | AMER2 | 51.4333 | 64.0383 |
| 19 | AMER3 | 51.3000 | 64.0600 |
| 20 | AMER4 | 51.0459 | 64.0837 |
| 21 | AMER5 | 50.8853 | 64.1591 |
| 22 | AMER6 | 50.6415 | 64.1811 |
| 23 | AMER7 | 50.5000 | 64.1543 |
| 24 | AMER8 | 50.3112 | 64.2029 |
| 25 | GOD1 | 51.4011 | 64.6257 |
| 26 | GOD2 | 51.2273 | 64.6114 |
| 27 | GOD3 | 51.1387 | 64.5986 |
| 28 | GOD4 | 51.0480 | 64.6029 |
| 29 | GOD5 | 50.9333 | 64.5874 |
| 30 | GOD6 | 50.8467 | 64.5686 |
| 31 | GOD7 | 50.7767 | 64.5043 |
| 32 | GOD8 | 50.7285 | 64.4429 |
| 33 | GOD9 | 50.5894 | 64.4066 |
| 34 | GOD10 | 50.3245 | 64.4320 |
| 35 | GOD11 | 50.4371 | 64.4200 |