APPENDIX III

Paul Johnson Cruise Highlights

A Geophysical Investigation of Two New Eruption Sites on the Juan de Fuca and Gorda Ridges

Field Program; September, 1996

P.I. - H. Paul Johnson
University of Washington

Science Party

Johnson, H. Paul	Nelson, Erin
Tivey, Maurice	Hutnak, Michael
Holmes, Mark	Ruppel, Byron
Van Patten, Darcy	Rees, Sheri
Pruis, Matt	Johnson, Matthew

JASON Group

Andy Bowen, Tom Crook, Bob Elder, Skip Gleason, Peter Lemmond, Craig Sayers, Will Sellers, Hanu Singh, Bob Waters, Bob Williams

ABE Group

Al Bradley, Dana Yoerger, Rod Catanach, Al Duester, Steve Libertore

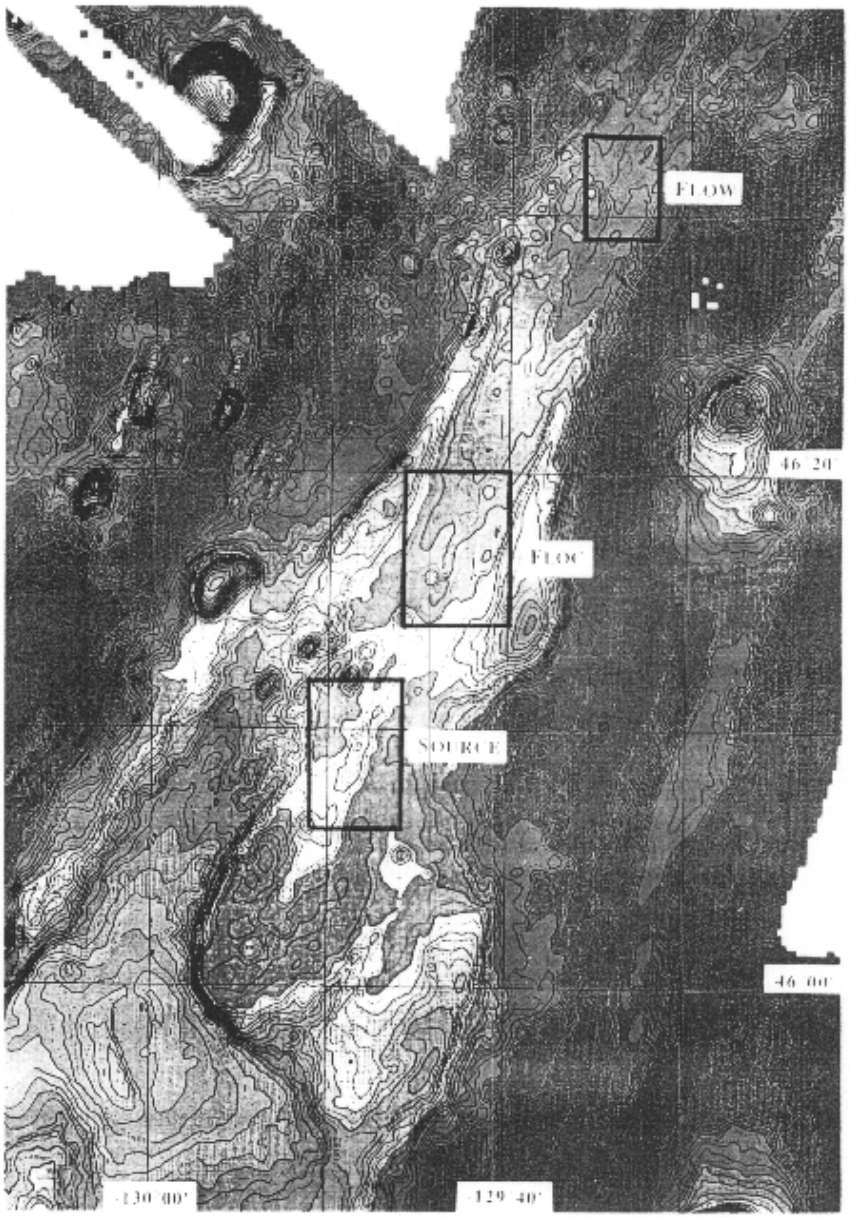
Large-Scale Goals:

To study the Formation and Evolution of Oceanic Crust; particularly the Near Zero-age Changes in Physical Properties of Young Lava Flows.

Specific Goals for 1996 program:

1. pick up sea floor magnetometers/tiltmeters
2. repeat previous magnetic surveys of New Flow
3. deploy thermal blanket in young crustal rocks
4. recover additional rock samples from eruption site
5. survey 10-year-old flows in same area

6. investigate January, 1996 eruption on Gorda Ridge


FLOW
FLOW
SOURCE
46 20'
46 00'
130 00'
129 40'

Continuation of Time Series of Geophysical Measurements on the CoAxial Eruption Site

1993 - ALVIN

1994 - TURTLE/ATV (Navy assets)

1995 - ALVIN (+ ABE)

1996 - JASON (+ ABE)

1997 - JASON (recovery of mag/tiltmeters from Gorda)

SCIENTIFIC RESULTS

1. MAGNETICS - magnetization seems to be decreasing systematically over three year period. Axial 'notch' in middle of New Flow is growing (due to alteration).

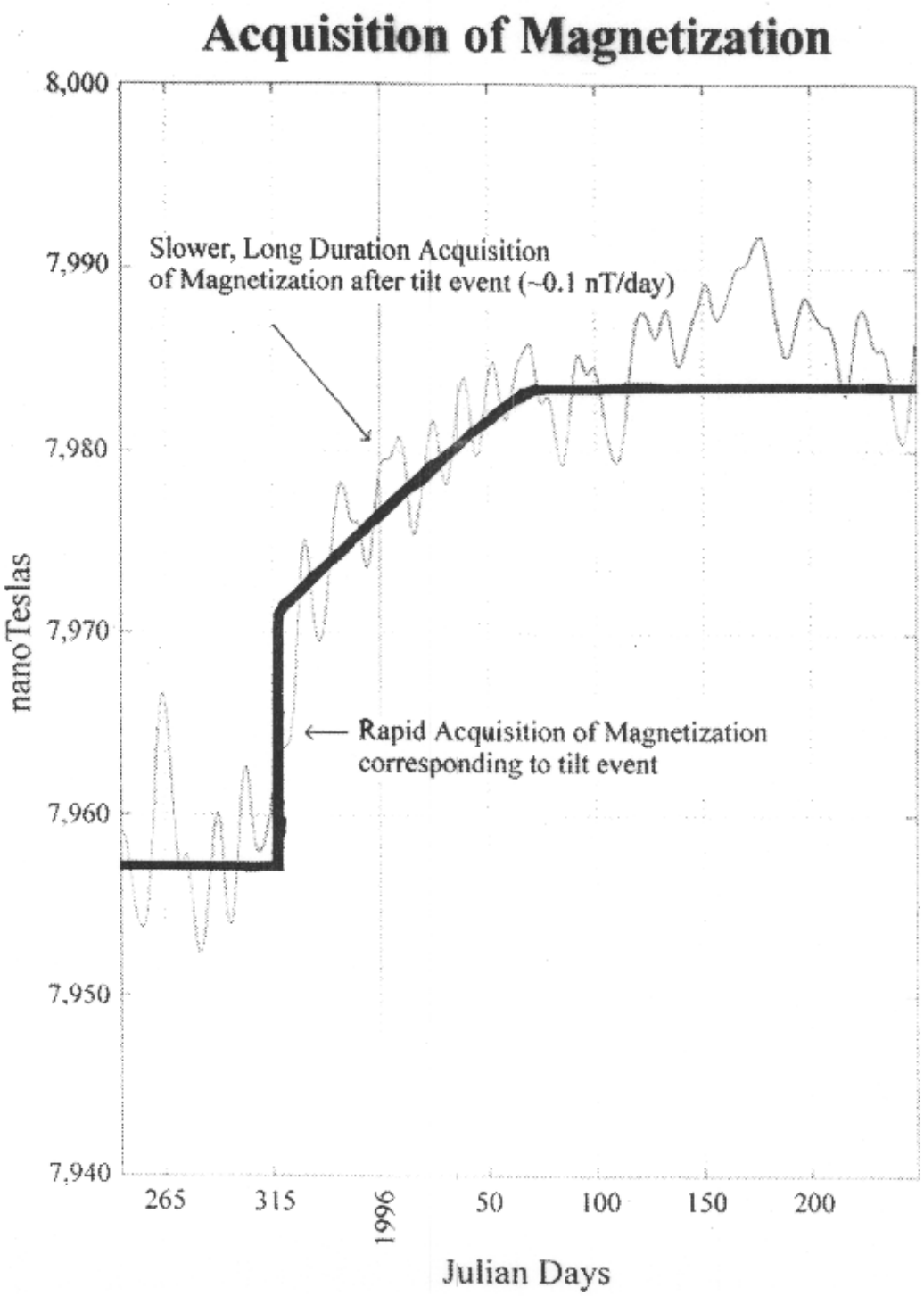
2. GRAVITY - CoAxial New Flow has a very low density and high porosity near 28%. Surrounding lava flows are higher in density, and have porosities of 11 to 13%. This implies a high permeability and predicts mechanical collapse soon after formation.

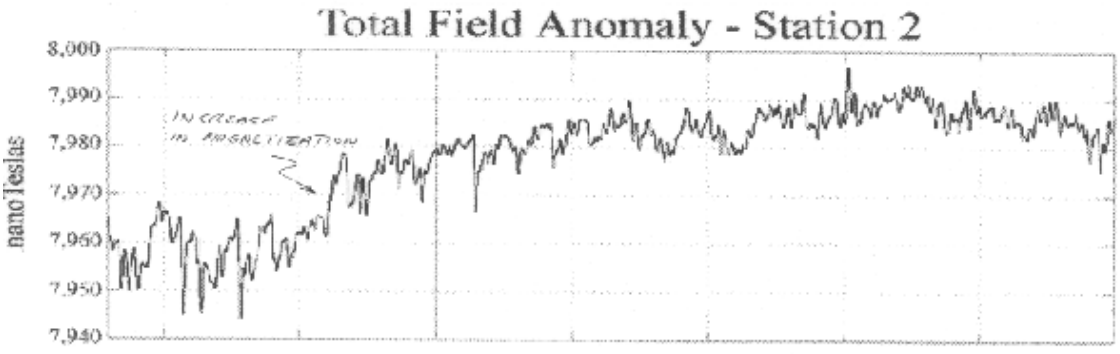
3. HEAT FLOW - bare rock HF measurements indicate that the extrusives cool by internal convection very quickly, and after 10 years have heat flux values near ambient.

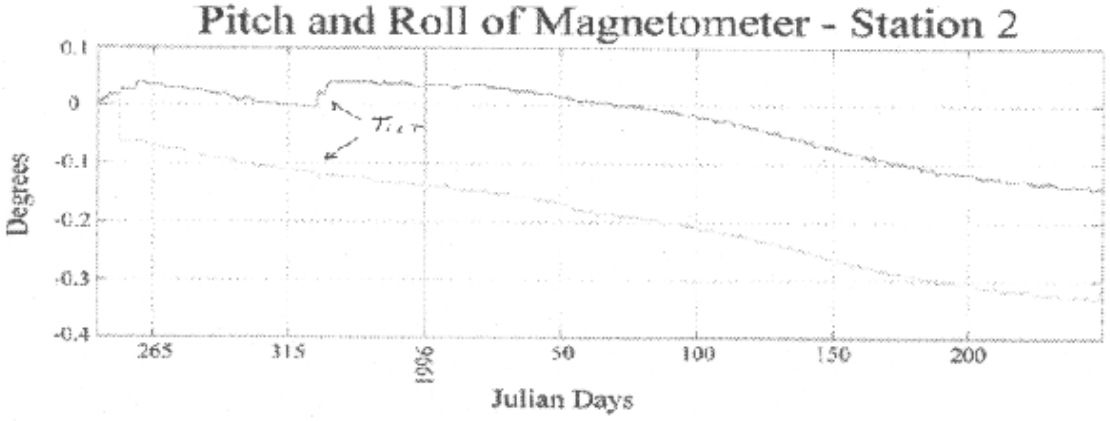
RESULTS - **Hardware**

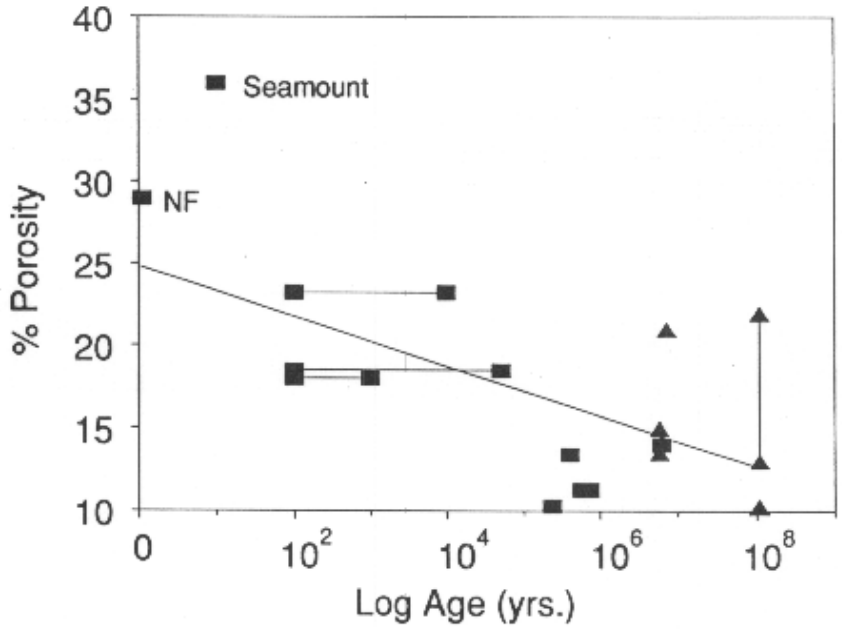
JASON - worked very well. Had several long dives, including one 84 hours long. Recovered and deployed sea floor magnetometers, deployed heat flow blanket 13 times, recovered rocks, near-bottom magnetometer and Mesotech survey, CTD data, superb video. Use of elevators allows almost unlimited payload. **mature, reliable vehicle.**

ABE - our third cruise with this vehicle. Worked very well. Fly pre-determined course with remarkable accuracy. Constant altitude, constant depth. Magnetometer, CTD, photos. **now a working vehicle.**


Acquisition of Magnetization
8,000
7,990
7,980
7,970
7,960
7,950
7,940
nanoTeslas
Slower, Long Duration Acquisition
of Magnetization after tilt event (~0.1 nT/day)
← Rapid Acquisition of Magnetization
corresponding to tilt event
265
315
1996
50
100
150
200
Julian Days


Total Field Anomaly - Station 2
nanoTeslas
8,000
7,990
7,980
7,970
7,960
7,950
7,940
INCREASE IN MAGNETIZATION

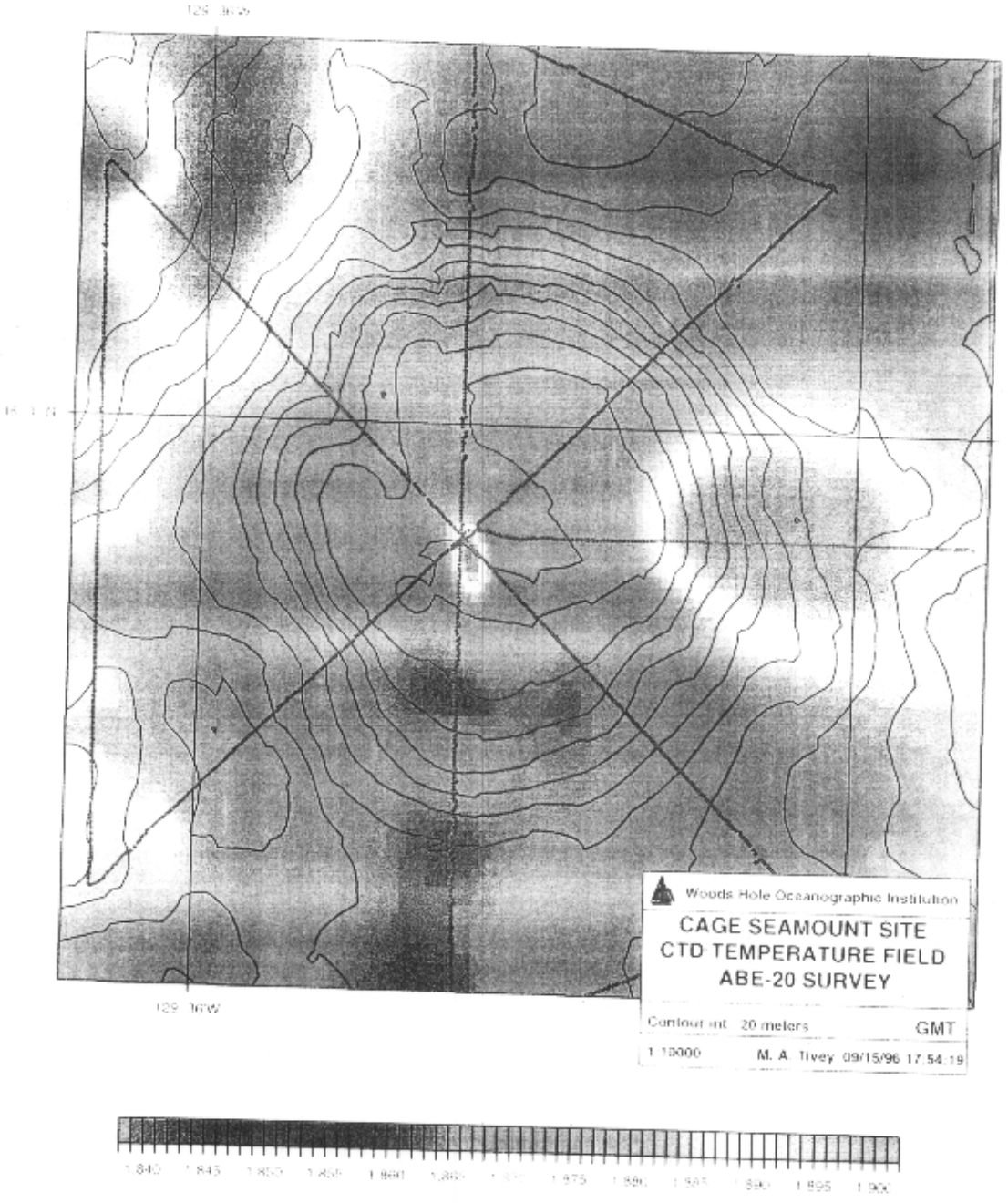

Pitch and Roll of Magnetometer - Station 2
Degrees
0.1
0
-0.1
-0.2
-0.3
-0.4
Tilt
265
315
1996
50
100
150
200
Julian Days


% Porosity
40
35
30
25
20
15
10
Seamount
NF
0
10^2
10^4
10^6
10^8
Log Age (yrs.)

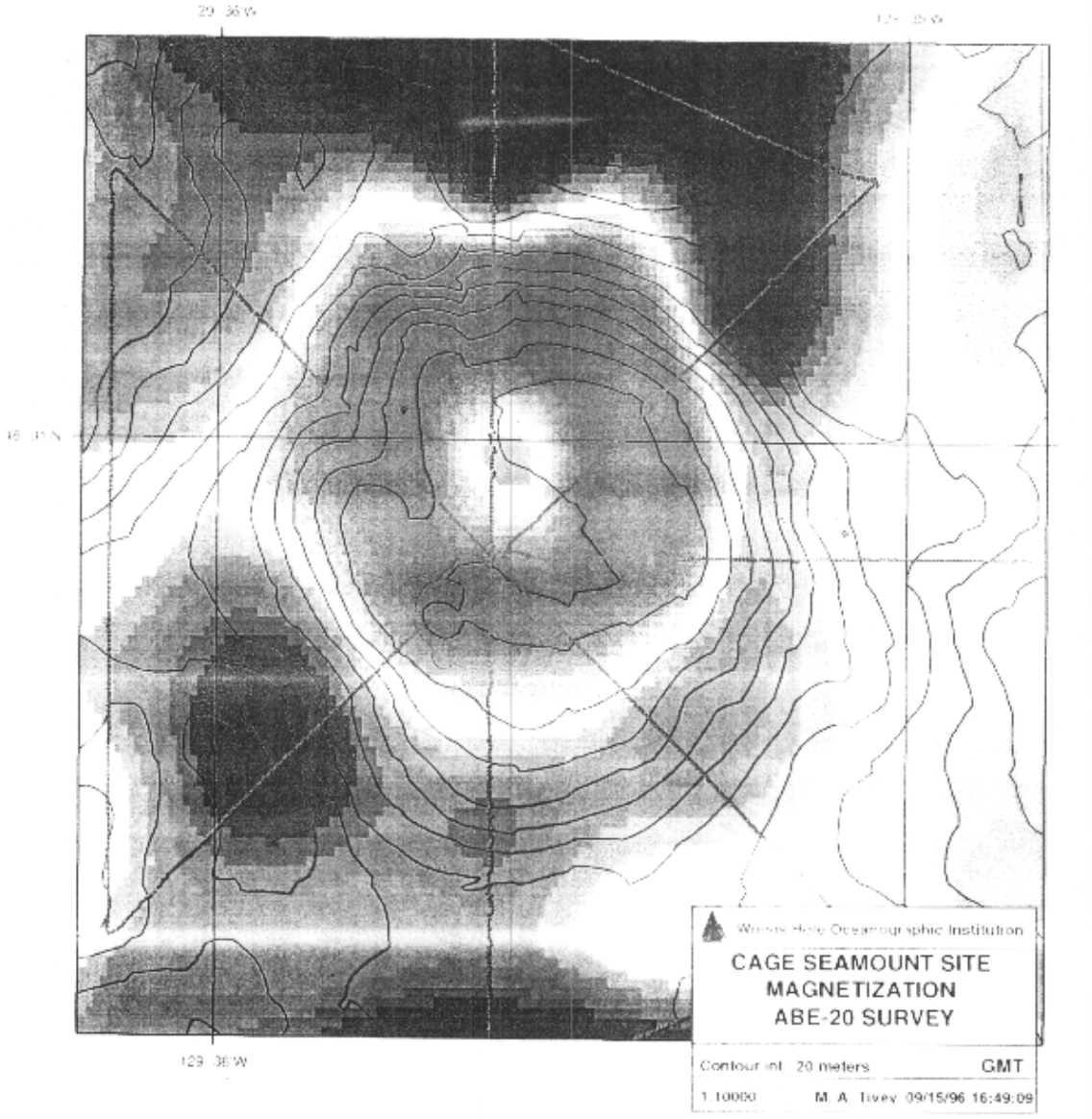
Summary of Gravity Data from New Flow Site

	density	porosity
Flow Site, Average	2.63	17%
Old Flows, Only	2.62	18%
New Flow, Only	2.42	29%

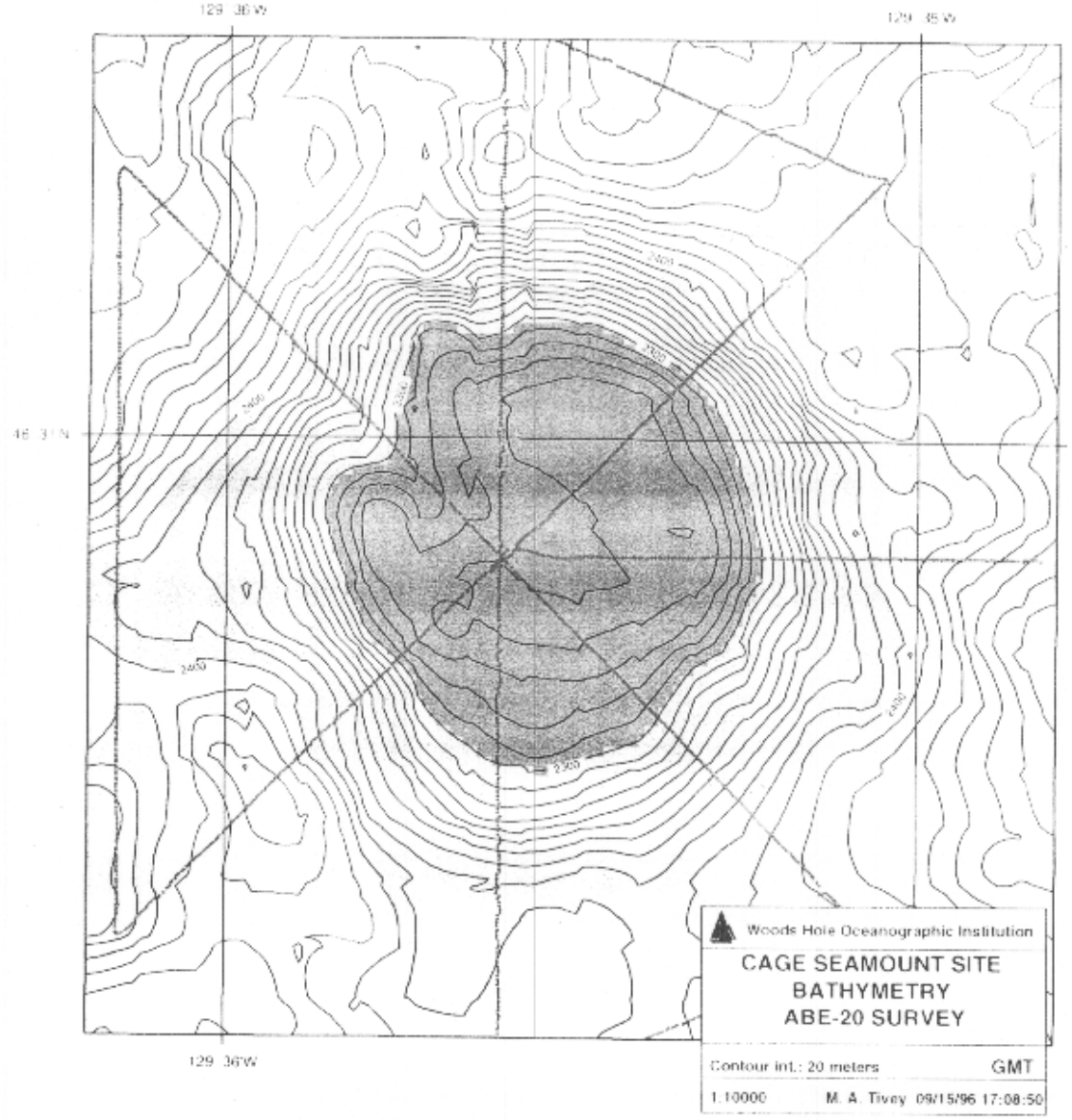
Cage Seamount

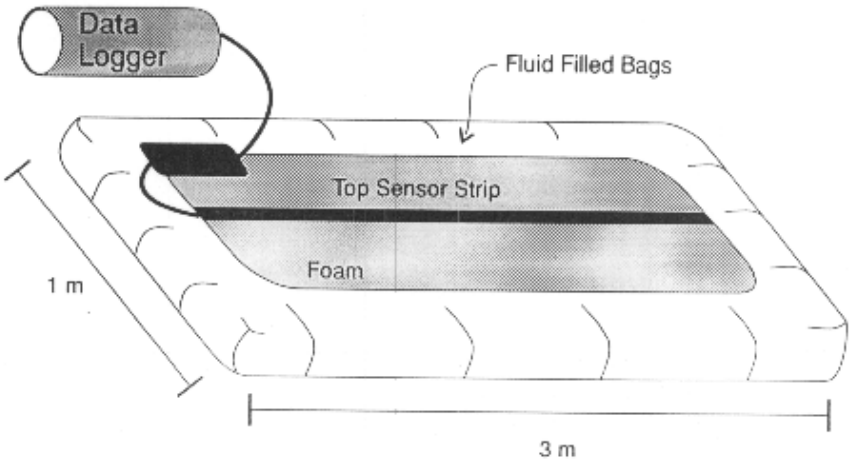


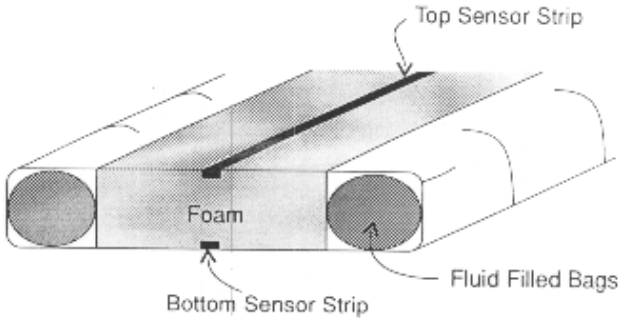
Cage Seamount



Cage Seamount

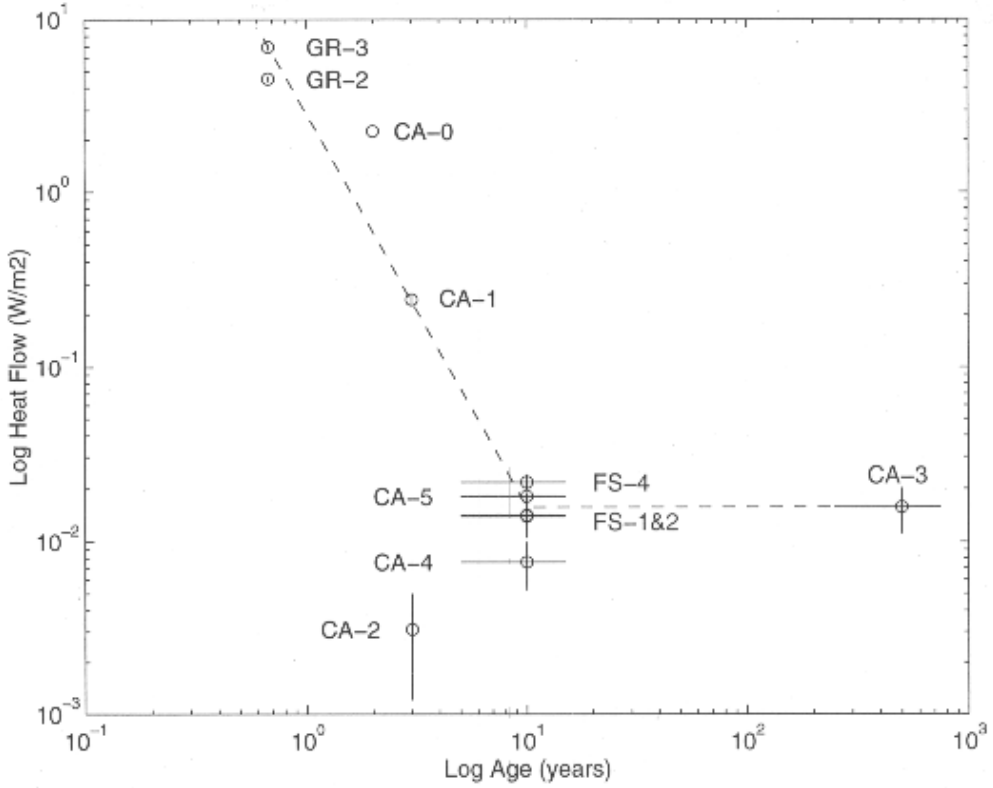



Data Logger
Fluid Filled Bags
Top Sensor Strip
Foam
1 m
3 m


Top Sensor Strip
Foam
Fluid Filled Bags
Bottom Sensor Strip

CONDUCTIVE HEAT FLOW
AS A FUNCTION OF CRUSTAL AGE

measurements using the bare rock heat flow pad

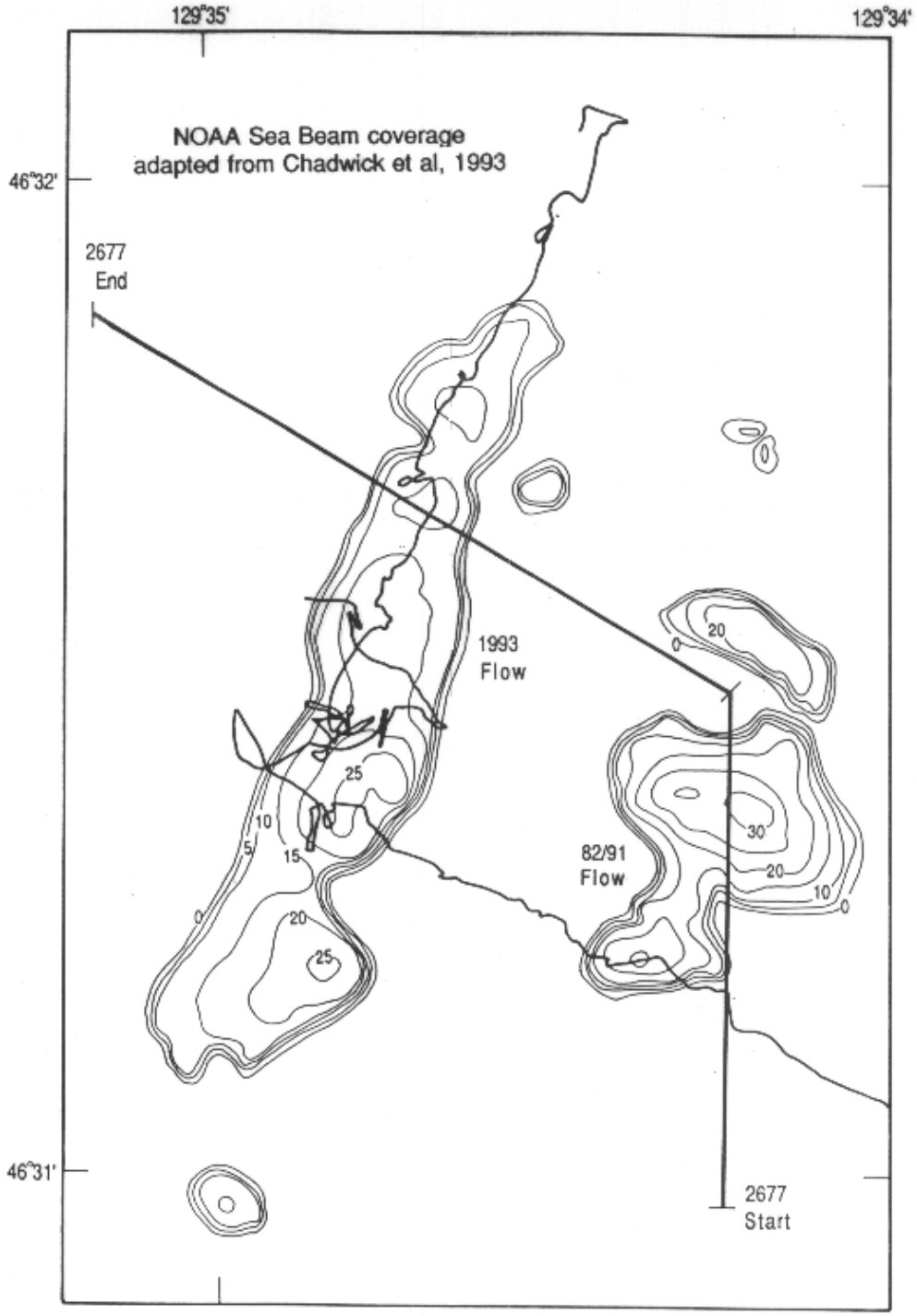


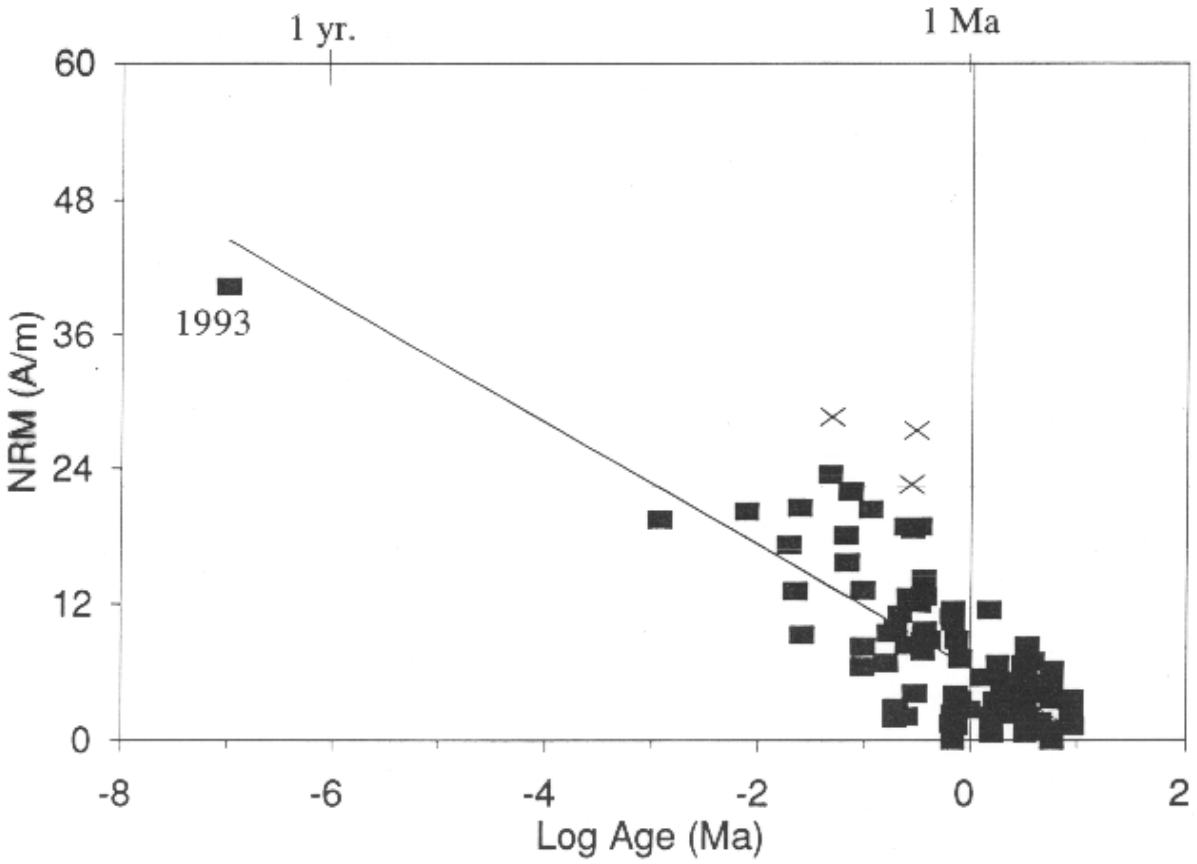
THREE METER DRILL

* Built by Williamson for University of Washington, in 1990; successfully deployed on Juan de Fuca Ridge, and off-Hawaii

* lost on EPR at 9° 30' N (wrapped around ODP guidebase)

* developed the technology for diamond drilling on the sea floor. power and data transfer over long cables.


129°35'
129°34'
NOAA Sea Beam coverage
adapted from Chadwick et al, 1993
46°32'
2677
End
1993
Flow
82/91
Flow
2677
Start
46°31'
0
5
10
15
20
25
30



Plot of NRM of Juan de Fuca rocks vs LOG (age)

Alternative Drilling Platforms

SMALL, OVER-THE-SIDE ROCK DRILLS

[at least the ones built by Williamson and Associates, Seattle]

ADVANTAGES

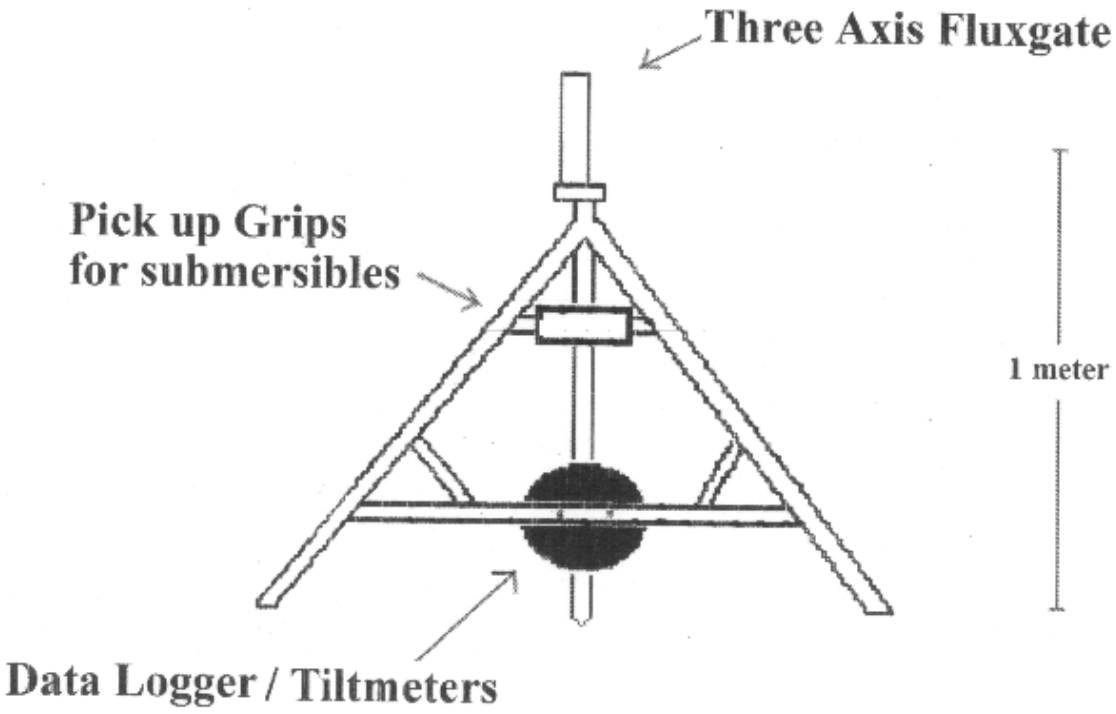
* can drill bare rock

* diamond bit (100% recovery)

* deployable from UNOLS fleet

* less in demand than RESOLUTION

* potentially shorter time constants than ODP proposals


Three Axis Fluxgate
Pick up Grips
for submersibles
1 meter
Data Logger / Tiltmeters