April 8, 1985

TO:

| | | |
|---|---|---|
| Barbee, W.D. | - | UNOLS |
| Gerard, S. | - | LDGO |
| ✓Hayes, D. | - | LDGO |
| Leyden, R. | - | LDGO |
| Raleigh, B. | - | LDGO |
| Ruddiman, W. | - | LDGO |
| Sykes, L.R. | - | LDGO |
| Takahashi, T. | - | LDGO |
| Science Officer | - | CONRAD |
| Captain | - | CONRAD |

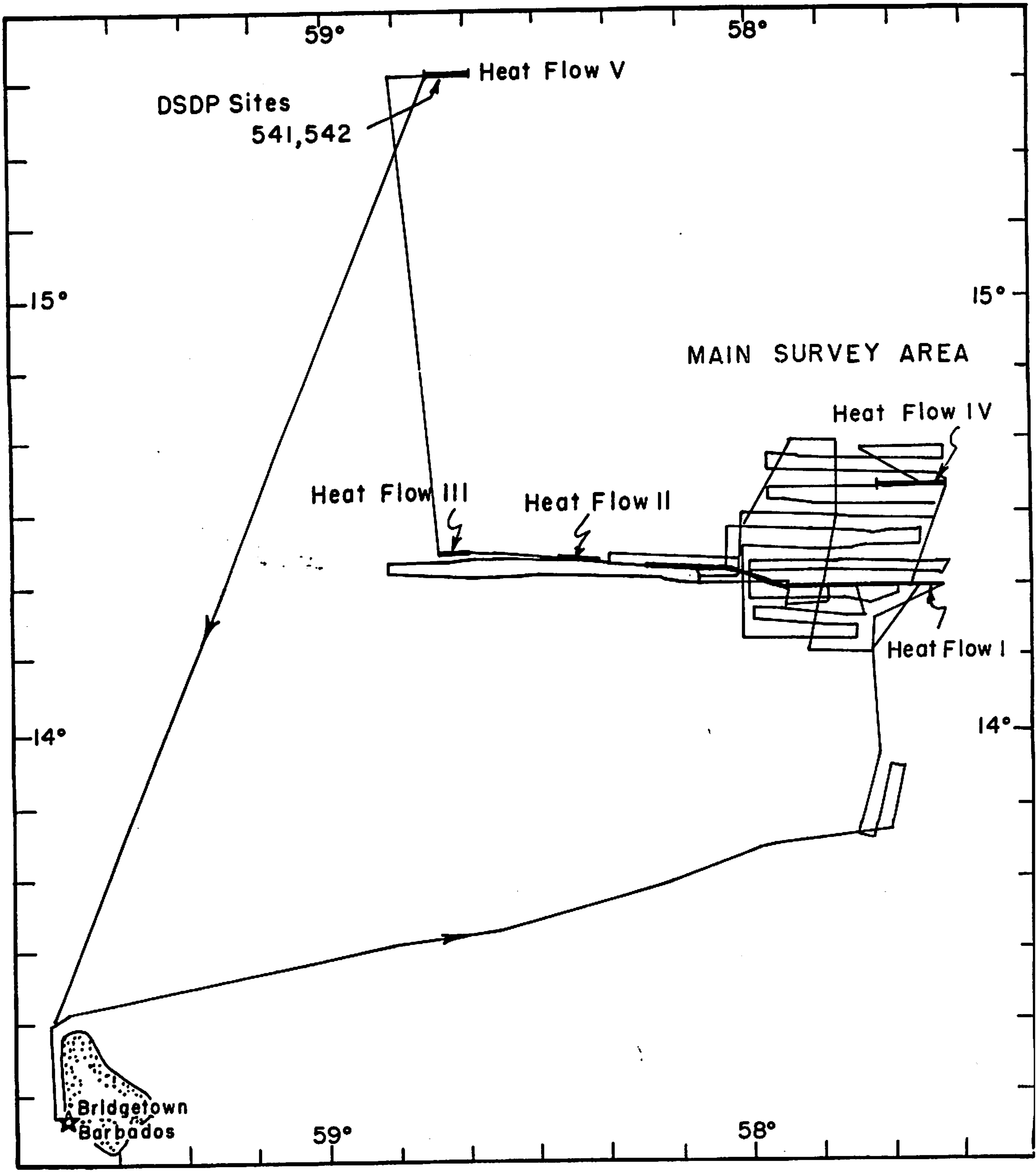
RESEARCH CRUISE REPORT

R/V ROBERT D. CONRAD 26-03

Attached is a copy of a cruise report for the above CONRAD cruise.

Ann Burns
Ann Burns
Marine Office

Enc.



59°
58°
Heat Flow V
DSDP Sites
541,542
15°
15°
MAIN SURVEY AREA
Heat Flow IV
Heat Flow III
Heat Flow II
Heat Flow I
14°
14°
Bridgetown
Barbados
59°
58°

March 4, 1985

# R/V ROBERT D. CONRAD
# CREW LIST
# 26-03

| | |
|---|---|
| DEPARTED: BRIDGETOWN, BARBADOS | 02 MAR. 1985 |
| ETA: BRIDGETOWN, BARBADOS | 17 MAR. 1985 |

| | |
|---|---|
| 1. Peterlin, John G. | Master |
| 2. O'Loughlin, James E. | Ch. Mate |
| 3. Martin, David C. | 2nd Mate |
| 4. Young, Ian W. | 3rd Mate |
| 5. Hutchison, John | Bosun |
| 6. Heinze, Blaine | A.B. |
| 7. Martin, Daniel | A.B. |
| 8. Woodward, Bradlee | A.B. |
| 9. Gallagher, Paul | O.S. |
| 10. Nolan, Timothy | O.S. |
| 11. Robertson, Ronald E. | Chief Engr. |
| 12. Nissen, Paul A. | 3nd A/E |
| 13. Field, Richard | 3rd A/E |
| 14. Tucke, Matthew S. | 3rd A/E |
| 15. Uribe, Guillermo | Oiler |
| 16. Patterson, Emery E. | Oiler |
| 17. Laughead, Leroy | Oiler |
| 18. Faria, Manuel | Steward/Cook |
| 19. Tuiqiali, Vateresio | Messman |
| 20. Mugford, David A. | Messman |
| 21. Moqo, Luke | Messman |

## SCIENTIFIC CREW

| | |
|---|---|
| 22. Smith, James | Science Officer |
| 23. Stennett, Joseph | Electronic Tech. |
| 24. Iltzsche, Martin | Air Gun Tech |
| 25. Qali, Ropate | Air Gun Tech |

## SCIENTISTS

| | |
|---|---|
| 26. Langseth, Marcus | Chief Scientist |
| 27. Westbrook, Graham V. - Univ of Birmingham | Co-Chief Scientist |
| 28. Chayes, Daniel - URI Seabeam | Scientist |
| 29. Byrne, Daniel E. - L-DGO seismic properties | Scientist |
| 30. Carey, Steven N. - URI - Tephrachronology | Scientist |
| 31. Davis, Daniel M. - L-DGO Prism mechanics | Scientist |
| 32. Dolan, James F. - Univ. Calif. Santa Cruz Structural Geol | Scientist |
| 33. Hobart, Michael A. - L-DGO Geothermal | Scientist |
| 34. Junsheng, Wang - Peoples Rep China | Scientist |
| 35. Medici, Paul - L-DGO Geothermal | Scientist |
| 36. Miller, Joyce E. - URI Sea Beam | Scientist |
| 37. Robinson, Frank - L-DGO Coring | Scientist |
| 38. Wessel, Paul - L-DGO Gravity | Scientist |
| 39. Yao, Bochu - People's Rep China | Scientist |

CRUISE REPORT R/V CONRAD 26-03

March 17, 1985

CONRAD 26-03 was the first of two legs devoted to geophysical and geological studies of the actively deforming accretionary prism underlying the Barbados Ridge. Emphasis was on studying the geothermal regime of the seaward edge of the prism, its detailed morphology, the tephrachronlogy and subsurface structures as revealed by single channel seismic sections. Ten days of this fifteen day leg was spent in an area bounded by latitudes 14 10N and 14 40N, and longitudes 57 30W and 59 00W. This area encloses a portion of the thickly sedimented basin that lies seaward of the accretionary prism, the active deformation front and the outer slope of the prism. A large mud diapir structure (mud volcano) penetrates the basin sediments on latitude 14 20N. The last two days of the leg were spent making a heat-flow survey in the vicinity of the DSDP Sites 541 and 542. The tools used in the survey work included: SEABEAM multibeam echo sounding, digital heat-flow instruments, piston cores, 3.5 echo sounding, magnetometer and the new BGM Bell gravimeter. The scientific complement on the leg included specialists in the development, mechanics, structure and thermal regime of accretionary prisms and a tephrachronologist. A list of the scientific personnel is attached to this report.

Scientific accomplishments of the cruise: During cruise RC 26-03 we were able to meet all of the primary objectives we had set for ourselves. We made a profile about 100km long of relatively closely spaced sea floor thermal gradient measurements that extends from the basin seaward of the rise westward up onto the accretionary prism. This line is the first complete profile of an accretionary prism ever measured and defines a substantial variation in geothermal gradient across the accretionary complex In the basin the values are appropriate for oceanic lithosphere of late cretaceous age. Values of about the same level are observed in the actively deforming outer edge of the prism; however some isolated high values were observed in this region. Farther arcward the thermal gradients decrease regularly toward values only 1/2 of the basin values. The heat flow measurements along this profile should provide a direct comparison with subseafloor gradients inferred from the "clathrate layers" that have been seismically observed over this part of the Barbados rise. Two additional short lines of measurements were made across the deformation front, one about 14 miles north of the main profile, and a second profile in the vicinity of the DSDP sites 541 and 542.

A geothermal survey was made over the mud diapir or "mud volcano". Anomalously high gradients were observed over the central part of this feature.

We made a comprehensive SEABEAM survey of the principal study area. The coverage within an 900 sq mile area is nearly complete and provides a splendid bathymetric map of the north-south trending nearly linear slope benches and basins that are a surface expression of thrusts and folds in the upper strata of the prism. The map revealed other features such as a prominent E-W trending north-facing escarpment that cuts stepwise thru the prism at about 14 20N.

Additional SEABEAM mapping included a 6 mile wide swath extending arcward from the main survey area to 59W, and a line connecting the DSDP Sites.

We cored extensively in the survey area to obtain ash stratigraphies, and to make physical properties measures. The physical property measurements included thermal conductivity, sound velocity and gravimetric measurements. The cores were disappointingly short, the longest being about meters, however ash layers were prominent in nearly all core samples. The thicker ash layers may have played a role in limiting the penetration. (See below).

Single channnel seismic lines using water guns were made over the outer part of the deformation front. The number of lines made were limited because they had to be run at 5 knots to get reasonable records. We were not able to use watergun single channel seismics to map the "bottom simulating reflector" as we had hoped.

In summary we gathered a wealth of new geophysical and geological data on the outer 50km of an actively deforming accretionary prism. We were able to define the variation of geothermal heat flow normal to the feature and to map the morphology of the outer part of the wedge in great detail.

Operational report on ship:

Overall the operation of the CONRAD was excellent. The crew is capable, professional, and genuinely interested in making the cruise a success.

A major problem continues to be the air conditioning in the laboratory spaces. There were several breakdowns of the units in the main electronics labs, one of which necessitated shutting down nearly all of the surveying equipment for risk of overheating. The engineering staff spent a lot of time during the cruise trying to repair these units, and major progress was made when the salt water piping to main lab AC units was replaced with larger ID pipes. The main lab units have been working well ever since. The unit in the "wet lab" broke down at regular intervals and is still out of service as of this writing. This was a considerable hardship as the coring work used the wet lab a lot.

The Chief Engineer's report will describe a break in a saltwater line that runs through the number 3 ballast tank. This piping will have to be renewed soon.

The capstain on the starboard after deck is in terrible condition. When operated it schreeches like a banshee. The chief tells me that when he opened the gearbox below decks, he found a lot of water and that the gearing of the capstain shows signs of heavy wear. The capstain head has been pulled for repairs, but it looks like this unit needs a complete overhaul or replacement soon.

To my knowledge no other major systems on the vessel gave problems during the cruise.

Operation of the scientific equipment:

First about those systems that worked well. The gravimeter suffered atleast one failure of control board which was repaired by replacing the board. Reportedly this the third time that the control board has given problems and some one should notify Bell about a possible inherent problem. Otherwise the operation of the gravimeter was trouble free. Unfortunately, we did not make the required changes to log the gravity on the Buhl Data

Logger. There is no real hurdle to solving this problem and Peter may be able to accomplish it early in the next leg.

The operation of the SEABEAM system astounds the ordinary mortal. The system on board is at a high level of development and the end products of the SEABEAM system are impressive and exceedingly useful. The operation during the cruise was trouble free. The VAX 11 730 computers are also reliable and rapidly becoming an essential part of the scientific equipment on the ship.

The GPS navigation system had a few minor problems that caused us to miss two days of fixes. This unit is a true black box in that trouble shooting is impossible except at the most superficial level. On two occasions a "resnugging" of the boards in the T-SET is all that was needed to restore proper operation. Otherwise this unit is fantastic and we were able to get 6 to 8 hours of valid high precision fixes from the unit. One hopes that the upgrade in the receiver to get reliable fixes from only two satellites will be accomplished soon. We should also move quickly to put the GPS fixes on the Buhl logger. The SEABEAM people are logging GPS routinely and are using it in a realtime navigation application.

The heat-flow equipment and operation went well. The heat-flow instruments are getting somewhat out dated. A new digital conductivity device is urgently needed and an instrument that measures conductivity insitu (similar to the Cambridge device) is overdue. We made 122 successful measurements of thermal gradient during the cruise with the heat flow equipment. The heatflow group has developed an excellent suite of software for reducing the records at sea. A way to move more rapidly between penetrations is a much needed improvement.

One of the disappointments was the operation of the single channel seismic system. We had hoped to use it to map with high resolution upper 1km of the subseafloor structure using the water guns, but the system was too noisy to do this effectively. It is dangerous to trust one's memory about record quality, but it seems that the system has yielded much better records under similar geological conditions in the past. We had to slow to 5 knots to get good records and if the speed was increased above 7 knots subbottom reflections all but disappeared. The problem seems to lie with the streamer. We used 3 sections of the new 4 section Teledyne streamer (one section was too noisy to use). We put two depressing birds on it fore and aft to hold it at 35 feet. Jim Smith thought the streamer with the birds was much quieter than on the NRL legs when it was tried without the birds. We later tried it with one bird near the head of the streamer and adding 6# of weight to the aft stretch section. The improvement if any was hard to detect. The teledyne streamer seems too buoyant and a careful balancing of the streamer may help.

We also tried the older L-DGO eel that was stored in the lazarette, if anything its performance seemed somewhat worse, than the Teledyne streamer.

The onboard part of the SCS system seemed to be working well despite the lash up status of it. A proper summing circuit at the frontend, renewal of the noisy section on the Teledyne streamer and balancing of the streamer would make a noticeable improvement.

This cruise further emphasized the need to improve our recording and utilization of navigation data on the CONRAD. Dan Chayes and Jim Smith have

put together a plan that could give a rather quick upgrade in the near future, and over the longer term would evolve into a more elegant system. At the heart of their proposal is a more powerful minicomputer (VAX 11 750) it could handle the numerous inputs in realtime. The implementation of the system becomes a software development problem which has largely been solved in setting up the navigation inputs for the SEABEAM. I believe that our proposal to NSF should follow this suggestion.

The environment in the main lab is tolerable (when the AC is working) although the noise level is high. One problem I noted is the lack of available counter top space. The table and bench space has all been usurped by recorders, so that there is no place to lay out a map of even a writing pad. This could be alleviated by reducing the number of recorders. I suggest:

1) Make the two LSR's the SCS recorders;

2) Use the 2 EDO 550 for the depth recorders and the Heat flow recorder. Mount these over the sounder transceivers and get rid of the UGR;

3) Record the SEABEAM center beam on the EDO 550 over the gravity table racks, and get rid of UGR now used for this purpose.

This rearrangement would free up two counters for use by the watch and the scientists.

<u>Deck equipment:</u> The core winch got a thourough workout on this cruise and it gave no problems. The new wire worked out well but it seems to be a bit stretchier than previous batches. The ram on the gallows frame chatters during deployment and retrieval, it will creep if left in one position, indicating a slow leak in the hydraulics somewhere. A pin hole leak in one of the stainless steel hydraulic lines between the operating valve and the ram was detected!

We had a number of problems coring. We used liners and managed to implode a fair number of them. On one or two occasions this may have resulted from an ash layer at about 6 meters depth that plugged the core cutter during penetration, since the piston was still travelling upward relative to the pipe a large decrease in pressure in the liner below the piston will result and possibly implosion. A break-away piston or a piston with a relief valve is needed to prevent this effect.

Two coring attempts were bungled due to start up mistakes. One pre-trip on the way down (this resulted from lowering too fast combined with yoo-yooing of the core head on the new wire) and another when a piece of tape caught the messenger and there was no trip.

We tried making careful measurements to set the trigger line and the scope to the correct values, but eventually reverted to Rapote's old values for the best results. Old guide lines such as mud on the piston and the amount of flow-in did not seem to work well.

Overall our coring vissisitudes show the erosion of our collective knowledge about how to take cores.

Mark Langseth

Scientific Complement

| NAME | ASSOCIATION | |
|---|---|---|
| Marcus G. Langseth | L-DGO | Co-chief scientist |
| Graham V. Westbrook | Univ. of Birmingham | Co-chief scientist |
| Daniel Chayes | URI | Seabeam Technician |
| Daniel Byrne | L-DGO | Phys. Properties |
| Steven Carey | URI | Tephras, coring |
| Daniel Davis | L-DGO | Accretion mechanics |
| James Dolan | Univ. Cal. Santa Cruz | Structural Geology |
| Michael Hobart | L-DGO | Geothermal Studies |
| Wang Junsheng | Peoples Rep. China | Geophysics Observer |
| Paul Medici | L-DGO | Geothermal Tech |
| Joyce Miller | URI | Seabeam Programmer |
| Frank Robinson | L-DGO | Phys. props., coring |
| Pal Wessel | L-DGO | Gravity |
| Yao Bochu | Peoples Rep. China | Geophysics Observer |
| James Smith | L-DGO | Science Officer |
| Joseph Stennett | L-DGO | Electronic Engineer |
| Martin Iltzsche | L-DGO | Machine specialist |
| Ropate Qali | L-DGO | Station Work |