.....August 6, 1998
POST-CRUISE REPORTING FOR UC-FUNDED SHIP TIME
KIWI EXPEDITION LEG 12; MAY 1998
CHIEF SCIENTIST BRUCE LUYENDYK, UC SANTA BARBARA

1. Work Accomplished:

The R/V Roger Revelle departed Pago Pago, American Samoa Saturday afternoon May 9, 1998 for Kiwi expedition Leg 12. Aboard were 17 scientists including two SIO technicians. There were 9 scientists from UC Santa Barbara including 7 undergraduate students and 4 from Cal Tech including 3 graduate students, and a professor and student from American Samoa College. Our objective was to map the structural and tectonic setting of the Manihiki Plateau, a Cretaceous-age Large Igneous Province comprising about 500,000 square kilometers, located south and west of Manihiki Atoll (161 W, 10-23 S). Our operating area included the south flank of the Manihiki Plateau including the Samoan Basin, the Eastern Scarp of the Plateau, and the Penrhyn Basin east of the Scarp. We completed a detailed Sea Beam survey of an area in the Penrhyn Basin east of the Plateau. From there we made several crossings of the Eastern Scarp of the Plateau, then crossed into the deeper regions of the Plateau to the north. Our final survey line crossed the NW-trending gravity lineation that apparently is the north boundary of the Manihiki Plateau near 160 W, 6 S. We ran all profiles at 8.5 knots except the Penrhyn Basin survey when we pulled the seismic system and ran at 12 knots. We acquired underway data enroute to Honolulu.

We used the Bathy 2000 3.5 kHz echo sounding system, a single channel seismic reflection system employing two 150 cubic inch generator-injector airguns, the Seabeam 2100 multibeam echo sounding system, and a total field magnetometer. We steamed out of Pago Pago at full speed towing the magnetometer and acquiring mutibeam data. We deployed our seismic system at 167 W, 12.7 S. We profiled with seismics at 8 knots. All survey systems functioned well except that the magnetometer failed near the end of our last line. The Bathy 2000 system functioned better than expected and penetrated almost 300 meters of section atop the Plateau. The Manihiki survey ended with 5268 kilometers of profiles including 4326 kilometers of single channel seismic reflection data. We made nine sonobuoy profiles.

A program of chlorophyll sampling was undertaken by American Samoa participants to measure primary productivity.

2. Scientific Results and implications from the work

Manihiki High Plateau and Nassau Step

Our expedition focused on the High Plateau region and the Nassau Step, a complex area south of there. The southwestern edge of the High Plateau is defined by a graben named the Suvorov (not Suvarov as published previously) Trough. The Suvorov Trough is asymmetric in that the seafloor depth is about 300 m deeper than the High Plateau on the Nassau Step southwest of this graben. From seismic interpretation, basalt basement, the volcaniclastic (and chert?) units are found in the bottom of the Trough. The High Plateau edge of the Suvorov Trough shows upper chalk and ooze units onlapping back-tilted (NE) volcaniclastic (and chert?) units indicating that graben faulting is post Late Cretaceous (or post-Eocene and pre-Oligocene). The Nassau Step immediately southwest across the Suvorov Trough is comprised of a series of terraces stepping down into the deep Samoan Basin and includes tilted fault blocks. At the foot of the Nassau Step apparent dips of the basement are south towards the Samoan Basin; in two locations the volcaniclastic (and chert?) units appear folded and onlapped by

younger sediments. The chert sequence outcrops at locations on the Step; its surface is disrupted in an incoherent fashion. The terraces appear to be defined by faults but Sea Beam maps show they have variable strike. Seamounts and volcanic islands and atolls are found on the Nassau Step.

Eastern Scarp/Manihiki Fracture Zone

The Eastern Scarp or Manihiki Fracture zone trends NNE along the east side of the Manihiki Plateau. North of 13° S it trends 014° and south of there 017°. It is of variable width but approximately 100 kms. The zone is comprised of four to five linear ridges and basins; the ridges have 500 to 2000 m of relief and the basins are often deeper than the adjoining deep sea floor. Within the basins are smaller hills and valleys that trend NE to ENE, parallel to faint bathymetric trends in the Penrhyn Basin. This may be a result of the fracture zone being formed during two spreading regimes or under transtension. The boundary between the Eastern Scarp and the Manihiki High Plateau is expressed as a ridge elevated 200 to 700 meters above the Plateau. It has dammed the section of the Plateau behind it. Adjacent to this ridge the volcaniclastic and chert units are faulted. The relief on the first scarp of the zone is about 2 kms.

Samoan and Penrhyn Basins

SeaBeam mapping in the Samoan and Penrhyn Basins detected bathymetric grain that is E-W to ESE in the former and ENE in the latter. Sediment thicknesses in the deep sea are very thin - 100 msec or less. Ocean Drilling results in the central Pacific basin suggest this section is pelagic clays and cherts with the chert layer being smooth acoustic basement. Magnetic anomalies do not appear to be related to known reversal sequences. Rather, they are largely incoherent in both basins except immediately north of Samoa where E-W trends are clear but the anomalies cannot be correlated to reversal sequences. In the Penrhyn basin there is a suggestion of ENE trends in anomalies of 100 nannoTesla amplitude and 10-20 km wavelength. In this same basin the sea floor steps down to the north across a series of E-W trending faults. These trends are close to, but not precisely orthogonal to the trend of the Eastern Scarp/Manihiki Fracture Zone, and it is unclear how to interpret this at this time.

Primary Productivity

Sampling revealed very low primary productivity over the Manihiki Plateau ands Samoan Basin. Immediately north of the Plateau productivity increased to high levels just south of the Equator.

3. Scientific Party

Bruce Luyendyk	UCSB	professor	chief scientist
Rob Clayton	Caltech	professor	scientist
Erika Birk	UCSB alumni	volunteer	watch/data proc.
Bill Keller	Caltech	grad student	watch/data proc.
Leo Eisner	Caltech	grad student	watch/data proc.
Anu Venkataraman	Caltech	grad student	watch/data proc.
Tracy Hoganson	UCSB	undergrad	watch/data proc.
Karen Powers	UCSB	undergrad	watch/data proc.
Carmen Alex	UCSB	undergrad	watch/data proc.
Marcy Davis	UCSB	undergrad	watch/data proc.
Annalisa Schilla	UCSB	undergrad	watch/data proc.
Charlotte Evans	UCSB	undergrad	watch/data proc.

Neil Morgan	UCSB	undergrad	watch/data proc.
Jennifer Aicher	Amer. Samoa Coll.	professor	watch/data proc./chlorophyll
Tepora Toliniu	Amer. Samoa Coll.	undergrad	watch/data proc./chlorophyll
Seth Mogk	SIO	technician	seismics
Dan Jacobsen	SIO	technician	computing

4. Formal course work at sea

UCSB students participated in Geological Sciences 181, Marine Geophysical Field Methods. This course involved meetings ashore for the month prior to the cruise where we read and discussed literature pertaining to the Manihiki Plateau and south Pacific Ocean tectonics. At sea we continued these meetings once per week.

Students were also required to turn in an original research report using data obtained on the expedition. Profs. Bruce Luyendyk and Rob Clayton assisted students in preparation of the research reports. Four reports were produced by student teams. These are entitled:

"Results from Preliminary Analysis of Sonobuoy Data from the Manihiki Plateau, southwest Pacific Ocean"
by Neil Morgan

"Structure and Sediments Interpretation of the High Plateau on the Manihiki Plateau"
by Tracy Hoganson, Karen Powers

"Penrhyn Basin, East of the Manihiki Plateau"
by Carmen Alex, Annalisa Schilla

"Preliminary Observations of the Eastern Scarp, Manihiki Plateau"
by Marcy Davis, Charlotte Evans

5. Funds applied towards the expedition

Sources from UCSB are all State funds and are as follows
Academic Senate grant; $3,500
Travel for Luyendyk, research assistance, miscellaneous expenses
College of Letters and Science Mentor Program; $3,150
Research stipends and perdiem costs for undergraduates
College of Letters and Science; $7,000
Travel stipends for undergraduates
Total UCSB $13,650

Sources from Caltech are as follows:
Funds from private donors, $4000
Travel for Clayton and Caltech graduate students
GRA stipends at approximately $2,700/student; $10,800
Total Caltech $14,800

TOTAL from UCSB and Caltech $28,450

not including salaries of professors

6. Related grant proposals

Luyendyk and Joann Stock submitted a collaborative grant proposal to the NSF OCE August 15, 1997 deadline to cover non-ship time costs of this project prior to the expedition. This proposal was declined.

We (including Clayton) are currently evaluating a resubmittal that would be made in February, 1999.