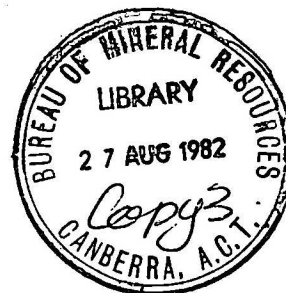


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TRIPARTITE INVESTIGATIONS OF THE MARINE
GEOLOGY OF THE SOUTH PACIFIC : PRELIMINARY
REPORT OF ACTIVITIES UNDERTAKEN
DURING THE FIRST CRUISE OF THE
R.V. KANA KEOKI

R.V. BURNE
CCOP/SOPAC Representative

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SUMMARY

The first Kana Keoki cruise of the 1982 ANZUS programme completed 2,858 nautical miles of surveying and held eighteen sampling stations. The objectives of the cruise were to examine the geology of the northern Melanesian Borderland. The results of the cruise in general supported suggested tectonic models for the region. The only area of possible economic potential is the Baravi Basin southwest of Viti Levu, where seismic profiling indicates the existence of a thick sedimentary sequence which may constitute a hydrocarbon prospect.

Introduction

The first of the three R.V. KANA KEOKI cruises scheduled for the 1982 ANZUS programme (cruise KK 820316-02) departed Pago Pago, American Samoa at 0400 UTC on 31st March 1982 and arrived in Suva, Fiji, at 21.27 UTC on 18th April after completing 2,858 nautical miles of surveying and holding eighteen sampling stations (Fig. 1). I participated in this cruise as a CCOP/SOPAC representative with special responsibility for sedimentological investigations. Important sedimentological contributions were also made by Chris Mato of the Hawaiian Institute of Geophysics (HIG), who was more familiar with some of the sediment types recovered, and was experienced with the sampling methods used.

The objectives of the cruise, as agreed at the pre-cruise meeting held in Suva on 17-18 November 1981, were to examine the geology of the northern Melanesian Borderland between the east end of the Vitiaz Trench and the Pasco Bank. Special attention was to be given to the study of the age and composition of the seamounts and atolls of the area; to the investigation of the existence of either ridge segments, or a triple junction between the northern Lau Basin and the Fiji Plateau; and to the elucidation of the nature of the eastern extensions of the Vitiaz Trench.

Although the cruise was primarily directed towards solving the various tectonic problems of the area, attention was to be given to the assessment of potential areas of metal enrichment or of hydrocarbon prospectivity. A short seismic survey of the Baravi Basin, southwest of Viti Levu, was undertaken specifically to increase seismic coverage of this potentially oil-prospective area.

Personnel

Chief Scientists	:	Dr T.M. Brocher, HIG, Geophysicist Mr R. Holmes, IGS/DMR - Suva/CCOP/SOPAC, Marine Geologist
Scientists	:	Dr R.V. Burne, BMR/CCOP/SOPAC, Sedimentologist Dr G.C. Chaproniere, BMR, Micropalaeontologist Dr B. Pontoise, ORSTOM-Noumea, Geophysicist Dr R.C. Price, Latrobe Uni., Petrologist Dr J.M. Sinton, HIG, Petrologist

Students : Mr K. Johnson, HIG, Petrology
Mr S. Wirasantosa, HIG, Geophysics

Technicians : Mr R. Cote, Electronics Tech.
Mr D. Caddy, Computer Programmer
Miss E. Demian, Data Processing Officer
Mr Harvey? Electronics Tech
Miss C. Mato, Core Tech
Mr M. Rawlins, Marine Tech

Ship's Captain : Mr B. Hayes

Methods

This ship's navigation was based on the use of a Magnavox satellite navigation system.

Underway recording of gravity, bathymetry (3.5 and/or 12 kHz records), magnetics, and seismic data were undertaken. The quality of the seismic data, although generally good, was somewhat variable, and suffered from rather frequent equipment failures. A 40 cu. in. airgun firing at 4 second intervals was used. Forty sonobuoy refraction profiles were attempted, at least eight of which yielded good data.

Bottom sampling was undertaken by weighted chain-bag dredge, piston-coring (using a 1-m gravity core as trigger weight), and by free-fall corers.

Dredging was generally successful, with only one of the fourteen dredges returning empty. A pipe dredge was prepared, but was not rigged in tandem with the chain dredge as it was felt that there was some danger of such a system jeopardising recovery by the rock dredge.

Piston-coring was also successful, with four cores recovering between 0.89 and 11.69 m of sediment. The retention of cored sediment, particularly in the trigger core, was assisted by the use of a polythene bag valve fitted over the core-catcher at the suggestion of Richard Holmes. The method used to ensure orientation of the core liners added considerably to the time and effort required to assemble the piston corer.

Free-fall coring was unsuccessful. Only one of four free-fall corers dropped was recovered, and this contained only a few grams of sediment trapped in the core-catcher valve. The non-return of the three other corers may have been due to their having been dropped on hard bottoms, although every effort was

made to position them in areas where the 3.5 kHz indicated soft sediment. However, the incorrect assembly of the corers which resulted from an ambiguity in the assembly instructions provided, may have been a factor in their loss.

Shipboard analysis of samples was limited to: rough classification and, where appropriate, micropalaeontological age determinations of rocks from dredge hauls (assisted by sawing and polishing samples where necessary); description of piston-core sediments in so far as they were visible through the core-liners; description and micropalaeontological investigation of samples from the ends of piston core sections; and description of opened trigger cores. Preliminary core logs are presented in figure 2. A small, representative collection of samples was made, and has been brought back to Australia for detailed analysis now in progress. However, most of the sampled material will be returned to Hawaii for investigation in the HIG core laboratories.

It had been intended to destructively analyse one piston-core on board to study the geochemistry of the pore waters and sediments and particularly the sulphide profile. Considerable efforts had been made by HIG to provide materials to support this work, but unfortunately the sediment squeezer and other equipment were held up by Air New Zealand for two weeks in Auckland and failed to arrive in Pago Pago in time for the departure of the Kana Keoki. As it happened, due to time constraints, the cruise programme had to be somewhat curtailed, and no samples suitable for this type of analysis were in fact recovered.

Concise Log

31 March 1982 0400 UTC	Departed Pago Pago. After a short delay caused by malfunctioning Automatic Steering, steered NE to survey the magnetic anomaly sequence of the sea floor as far as 11°08'S 172°51'W.
1st April 1982	60' piston core was attempted in 4680 m of water. Attempts to orientate the core-liners caused substantial delays to the rigging of the core. The 1169 cm core recovered, which was to have been analysed to determine the relationship between micropalaeontological zonation and magnetic reversal sequence, was of unknown orientation due to malfunction of the core-orientating device. The core consisted of pelagic mud with some volcanic ash layers (Table 1).

1660 UTC Surveying including sonobuoy deployment en route for Taviuni Bank. Air-gun profiling shows interesting sequence with surface stratified sediments eventually thinning over a hummocky underlying sequence.

2nd April 1982 Dredging slope of Taviuni Bank, and recovered Vesicular basalt
1125 UTC and Pliocene deep water, planktic limestones (Table 2).

1515 UTC Surveying en route for Lalla Rookh Bank, including sonobuoy deployment.

3rd April 1982 Piston-core attempted on basin floor surrounding Lalla Rookh Bank with the object of recovering a sequence of Bank-derived turbidites suitable for dating the recent history of the Bank. The core recovered 740 cm of pelagic mud interbedded with turbiditic sands of tuffaceous and shallow water carbonate origin. Base of the core was Middle to Late Pliocene in age (Table 1).

0151 UTC Surveying Lalla Rookh Bank, which is capped by living corals.

2007 UTC Dredge slope of Lalla Rookh Bank from 2830 m to 2495 m. Recovered only two volcanic rocks (Table 2). Dredged the same slope, from 2820 to 2675 m, and recovered basalt, hyaloclastic breccias, as well as Pliocene calcareous sandstones, algal rhodoliths, and bored coral fragments. (Table 2).

4th April 1982 Surveying en route for Wallis Island.
0315 UTC

0915 UTC Dredging flank of Wallis Island from 2270 m to 2130 m. Recovered silty calcareous sand with a Late Pliocene planktonic foram fauna, and basalt (Table 2).

1147 UTC Surveying area west of Wallis Island, a 750 m deep sea-mount passed over has asymmetrical terraces, at 900 m depth on eastern side and 1200 m depth on western side. Sonobuoy deployed, but intermittent problems with air-gun.

5th April 1982
0530 UTC Core site selected to recover turbidites at distal end of Wallis Basin in the hope of dating events related to the evolution of Wallis Island area. 80' piston core rigged with considerable delays due to problems with orientating the core-liners. 10 m core recovered consisting of brown clay interbedded with turbidites overlying grey clay (Table 1). Core orientating device did not trigger.

09.25 UTC Surveying en route to Peggy Ridge south of Futuna Island. Two sonobuoys deployed, intermittent problems with the air gun.

6th April 1982
0834 UTC Dredging a site selected on the basis of a magnetic anomaly in the Lau Basin, west of Peggy Ridge. Dredge from 2080 m to 2040 m recovered Early Pleistocene mudstone and tuffaceous sandstone, pumice, and glass-coated pillow fragments (Table 2).

1111 UTC Surveying en route for Futuna Island including sonobouy deployment.

2248 UTC Dredged insular slope of Futuna Island from 1965 m to 1230 m. Dredge recovered fresh and altered basalt pillow fragments, altered dolerites(?) and breccias, and Holocene mud (Table 2).

7th April 1982
0151 UTC Surveying en route for Combe Bank. Air-gun misfiring briefly, sonobuoy deployed.

1600 UTC Dredging flank of Combe Bank from 2660 m to 2530 m. Dredge recovered coarse-grained igneous rock, olivine basalt, vesicular basalt as well as an algal boundstone (Miocene-Recent), a recrystallised limestone, and a fine sand with volcanic ash particles and Plio-Pleistocene forams (Table 2).

2034 UTC Surveying en route for Robbie Bank. Good air-gun record showing hummocky topography giving way to a thick sedimentary section with considerable surface topographic expression of structure. Sonobuoy deployed.

8th April 1982 Dredging flank of Robbie Bank from 1730 to 1665 m. Dredge recovered whole coral heads, Halimeda and coralline algal limestone, as well as clams and oysters. These sediments probably represent a slumped fore-reef slope deposit.

1936 UTC Surveying en route for Tuscarora Bank. Sonobuoys deployed.

9th April
0919 UTC A piston-core site was selected on the margin of the top of Tuscarora Bank where airgun-profiling showed a condensed sequence of the sediments capping the Bank. The core recovered carbonate sands with a Pliocene foram fauna at the base. (Table 1).

1100 UTC Surveying of Tuscarora Bank showed local development of a drowned reef rim to the bank.

1432 UTC Dredge the margin of Tuscarora Bank from 1790 to 1325 m. Dredge recovered four pieces of manganese-coated hyaloclastic breccia. (Table 2).

1732 UTC Surveying en route for Bayonnaise Bank. Sonobuoys deployed.

10th April 1982 Dredge ESE margin of Bayonnaise Bank from 1555 to 715 m. Dredge recovered fine and medium-grained lava fragments, Early Pliocene Globigerina ooze, rounded conglomerate of volcanic pebbles set in a foraminiferal clay, manganese-coated coral and mollusc fragments and hyaloclastic breccias.

1050 UTC Surveying basin SE of Bayonnaise Bank. Decision taken not to attempt a piston-core due to time limitations.

11th April 1982 Dredging S.E. flank of Hera Bank from 2550 to 1880 m. Although several large bites were recovered the dredge
0706 UTC returned empty.

1001 UTC Surveying en route for Nukulaelae Island, Tuvalu. Sonobuoys deployed.

12th April 1982 Airgun-profiling shows presence of steep northward-facing fault scarps possibly related to normal faulting with vertical walls 750 m high, N.E. of Nurakita Bank (10°00.62'S 179°25.11'W).

0446 UTC Continued surveying en route for Tuvalu.

1791 UTC Commenced a survey in the vicinity of Nukulaelae Island to select a suitable site for dredging.

13th April 1982 Having failed to identify a suitable dredge site, course was set for the area of the suggested ridge segment of triple junction north of Fiji at about 14°25'S 177°44'E. Sonobuoys were deployed during the course of this surveying track. Magnetic data were monitored and the supposed spreading-centre was identified on the basis of magnetic anomalies.

1227 UTC After crossing the supposed spreading-centre and reaching
1440 UTC 14°35.12'S 177°39.57'E the centre was crossed again, with four free-fall corers being dropped in a transect area where soft sediments were identified on the 3.5 kHz. The vessel then returned to the area where the first corer had been dropped. However, radio signals were received from only one corer.

1919 UTC The fourth corer was recovered. Due to incorrect assembly the core barrel had partially separated from the buoyancy system, which was floating horizontally, resulting in poor performance of the strobe and radio. The corer contained only a few grams of sand composed of forams and volcanic rock fragments (Table 3). Course was then set for a dredge site on a slope associated with the ridge system.

2104 UTC Dredging a slope in the vicinity of 14°28'S 177°41'W from 2340 m to 2250 m. Dredge recovered manganese-encrusted pillow fragments, manganese-encrusted wood, and black sand. (Table 2).

15th April 1982 Surveying en route for eastern extension of Vitiaz Trench
0012 UTC north of Hazelholme Bank, including deployment of sonobuoys.

16th April 1982 Dredging the northern wall of a basin near Alexa Bank. The
 basin contains 1 sec thick sediment sequence. An area of
 faulted sediments occurs at the foot of the northern wall of
 the basin. Dredging from 3170 m to 2330 m recovered
 amygdaloidal volcanics, altered massive volcanics, green
 argillites, siltstone, breccia, and indurated black shale with
 graded siltstone layers (Table 2).

08:30 UTC A suggested core site in the centre of the trough was
 abandoned due to shortage of time, and course was set for
 Suva, Fiji. Surveying and sonobuoy deployment continued,
17th April 1982 although ship's speed was increased to 9Kts. Airgun
 malfunctions interrupted the record.

18th April 1982 Commenced survey of the Baravi Basin. Good air gun records
0907 UTC show a thick sedimentary sequence. Sonobuoys deployed.

2127 UTC At anchor in Suva Harbour.

Discussion

The reconnaissance nature of the cruise prevented detailed study of many features worthy of further investigation, and shortage of time necessitated the considerable abbreviation of the intended cruise track and sampling stations.

In general, the cruise confirmed the tectonic models proposed for the region by previous workers. Volcanics recovered from Tavinui Bank, Lalla Rookh Bank, Wallis Island, Combe Bank, Robbie Bank and Bayonnaise Bank were all associated with limestones containing probable Pliocene faunas.

The existence of spreading ridge segments north of Fiji is supported by the volcanics and ashy sediments recovered from an area with appropriate morphology and magnetic signature in the region.

The indurated turbidite sediments associated with volcanics dredged from the southern margin of the Alexa Bank, together with the airgun records which show an asymmetrical basin structure indicate that activity along the Vitiaz Trench formerly extended at least this far east.

Further understanding of the tectonic framework of the region and its evolution will come from detailed petrological, geochemical, sedimentological and palaeontological analysis of the samples, and careful examination of the seismic records.

No indications of accumulations of metalliferous sediments were observed. Representative samples of sediments recovered have been submitted to AMDEL for analysis of metal concentrations.

Hydrocarbon prospects are largely limited to the area of the Baravi Basin, but detailed assessment will only be possible after seismic records have been analysed.

Table 1 - Piston and Trigger Cores

(Prepared by H.I.G.)

Piston Cores	Geographic Location	Latitude	Longitude	Water Depth	Core Length (m)	Maximum Age Based on Foraminifera	Summary
Station 1/ PC01	North of Melanesian borderland	11°08.13'S	172°50.33'W	4680	11.69	Not known	6.2 m light brown foram ooze/2.5 m fresh volcanic sand/reddish brown semi-indurated mud in core catcher
Station 3/ PC00 02	Lalla Rookh Bank	13°12.39'S	175° 29'W	4215	7.25	Mid-to-Late Pliocene	2 turbidites containing calcareous sand, coral fragments and volcanic glass fragments
TC 02	"	"	"	"	0.30	Pleistocene	0.30 m light brown foram ooze
Station 6/ PC00 04	West of Wallis Islands	13°15.86'S	177°08.87'W	4520	10.46	Probably Pliocene	5 m brown mud with interbedded Pleistocene turbidites with forams/3 m nannofossil chalk
TC03	"	"	"	"	0.70	Pleistocene	0.61 m brown mud interbedded with 0.06 m Pleistocene turbidite
Station 4/ PC00 04	Tuscarora Bank	11°45.12'S	178°00.94'W	1060	0.89	Pliocene	0.89 m carbonate sand and fragments
TC04	"	"	"	"		Holocene	few gms sediment in core catcher
Station 16/ FFC4	North Fiji Basin	14°35.12'S	177°39.57'W	3320	0.05	Holocene	Planktonic foram sand and volcanic rock fragments

Key

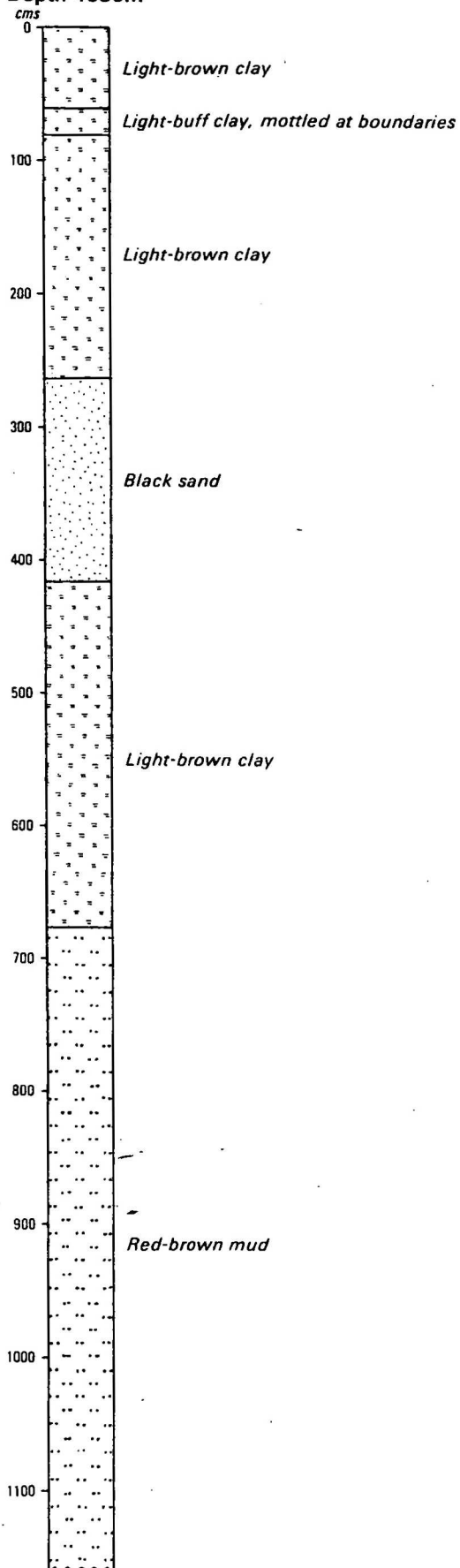
PC0 Piston core no orientation
 PC00 Piston core with orientation
 TC Trigger core
 FFC Free fall core

KK 820316 - LEG 2
Table 2 - Rock Dredges
(Prepared by H.I.G.)

Rock	Geographic Area	Latitude	Longitude	Water Depth (m)	Basalts	Hyaloclastites	Lithologies Pumice	Sedimentary	Coarse Grained Volcanics
1	Talviuni Bank	12°16.02'S	174°37.55'W	1470	Mn-coated			Pliocene planktonic Foram ls.	
2	Lalla Rookh Bank	13°02.46'S	175°38.30'W	2800		Mn-coated			
3	Lalla Rookh Bank	12°59.07'S	175°38.13'W	2800	Ankarmite	X		Shallow carbonate, probably Miocene	
4	Wallis Island	13°05.11'S	176°12.57'W	2250	Pillows			Sand containing Late Pliocene forams	
5	North Fiji Basin NE of Peggy Ridge	15°39.49'S	178°29.69'W	1900-2200	Pillows		X	Mudstone foram ls., early Pleistocene	
6	Futuna Island	14°21.4'S	177°52.5'W	1000-1500	Pillows			Holocene foram rich mud (n23)	
7	Combe Bank	12°42.1'S	177°41.1'W	2800-2550	X			Miocene-to-Recent ls., ss Plio-Q	
8	Robbie Bank	10°55.26'S	177°00.91'W	2125-1700				Pliocene-to-Recent ls.	
9	Tuscarora Bank	11° 51'S	177° 53'W	1800-1400		X			
10	ESE of Bayonnaise Bank on North Fiji Basin	13°22.06'S	179°16.49'W	1550	X	X		Pliocene ls.	
11	Hera Bank	12°22.70'S	179° 7.24'W	2250	NO SAMPLE RECOVERED				Altered
12	NE of Narakita Bank	10°01.13'S	179°24.66'W	4000-3370	Pillows	X	X		Gabbro
13	North Fiji Basin Ridge	14°28.8'S	179°41.2'W	2600-2250	Pillows Mn-coated				
14	Alexa Bank	11°41.87'S	175°02.56'W	3320	Altered	X		Green argillites, black laminated shale, siltstone	Altered

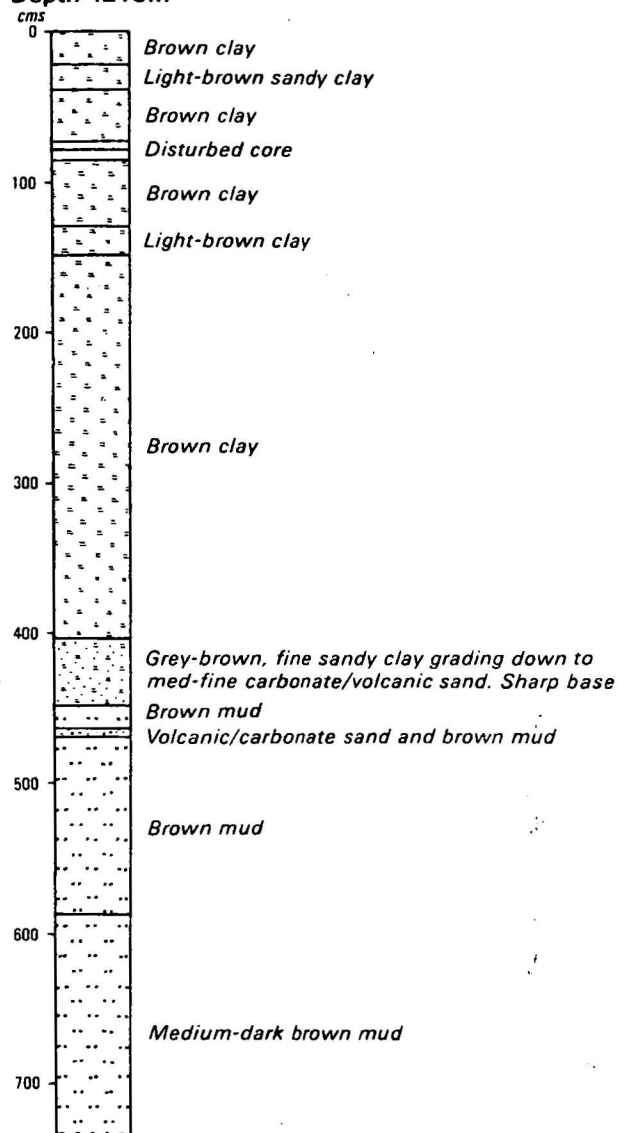
PC -1

Lat. 11°08.13'S Long. 172°50.33'W
Depth 4680m



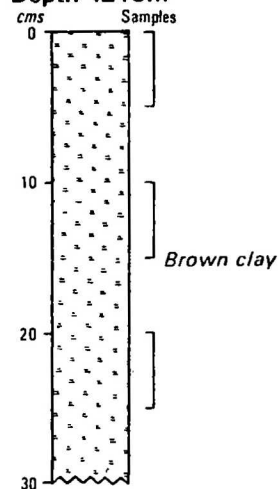
PCOD-2

Lat. 13°12.24'S Long. 175°29.76'W
Depth 4215m



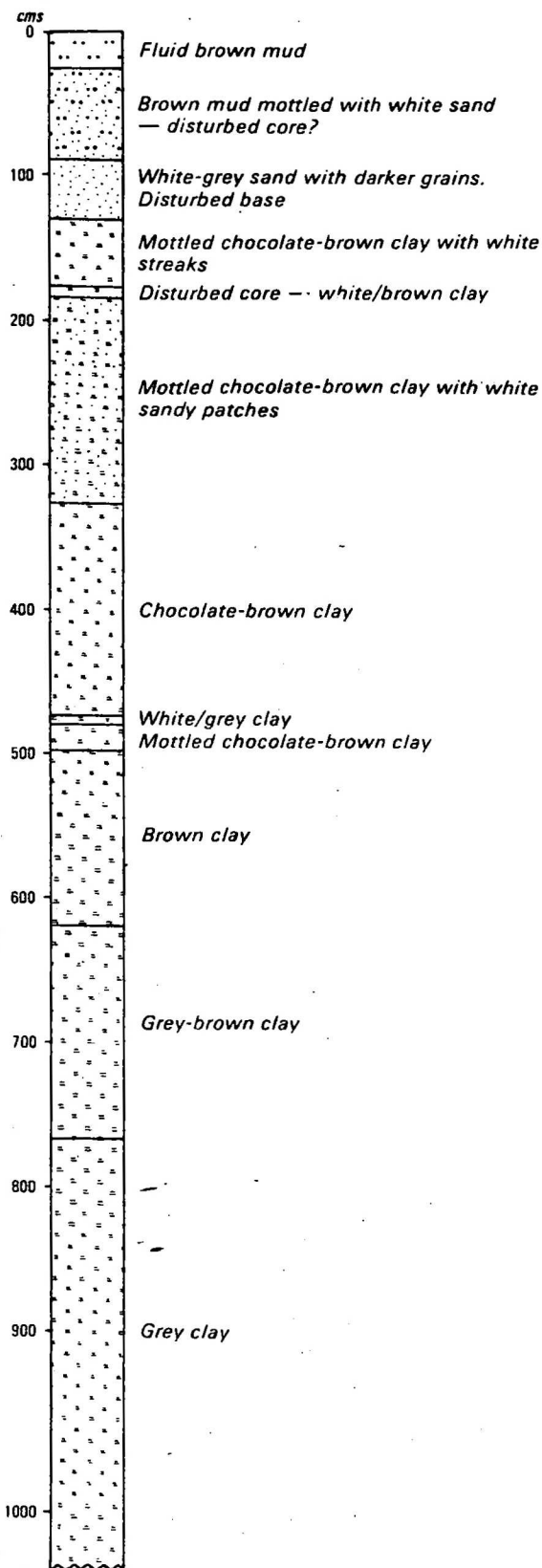
TC-2

Lat. 13°12.24'S Long. 175°29.76'W
Depth 4215m



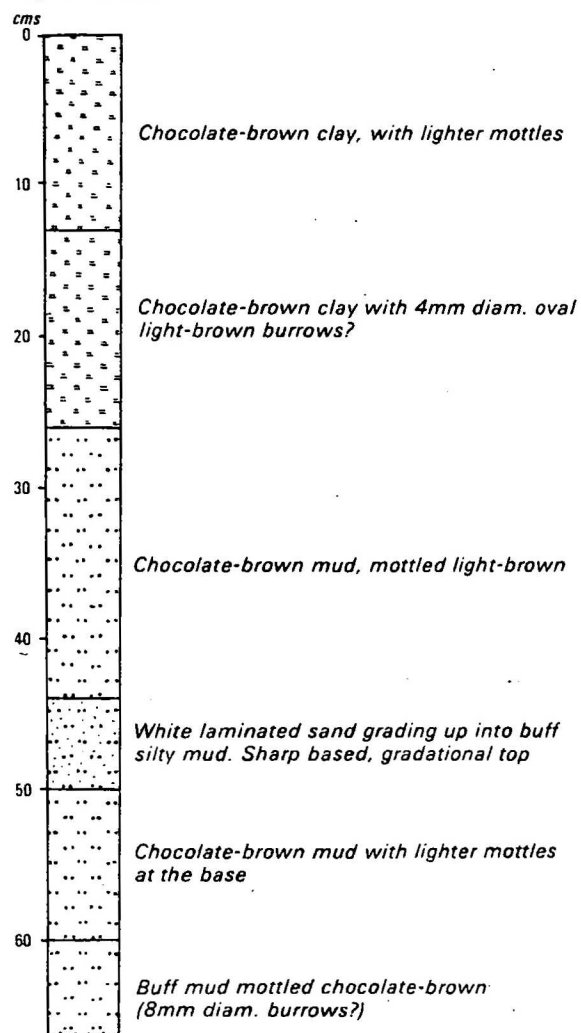
PCOD-3

Lat. 13°15.85'S Long. 177°08.87'W
Depth 4520m



TC-3

Lat. 13°15.85'S Long. 177°08.87'W
Depth 4520m



PCOD-4

Lat. 11°45.02'S Long. 178°00.94'W
Depth 1060m

