serial # 90014

U.S. GEOLOGICAL SURVEY
BRANCH OF ATLANTIC MARINE GEOLOGY
MEMORANDUM
10 July, 1990

To: Distribution

From: Peter Popenoe

Subject: Administrative Cruise Report: Submersible DELTA, Escort Vessel R/V POWELL

1. Escort Ship: R/V POWELL
   SUBMERSIBLE DELTA

2. Cruise: NOAA-NURP Designation 90-OR-SUB-POPENOE

3. Parent Project: EEZ Inventory, 9470-30041

4. Funding Agency: All costs but travel to and from the area of the dives and shipment of equipment were paid by the NOAA-National Undersea Research Program. Costs to NOAA-NURP were estimated at $62,500. USGS costs are estimated at $3,000. Each institution or agency paid travel expenses for their participant.

5. Area of Operations: Blake Plateau 80 miles east of Charleston, South Carolina. Water depths of 500 to 1200 feet (152-366 m).

6. Cruise start and end dates, ports:
   Start July 2, 1990 from the Charleston, S.C. Port Authority Dock.

   End July 6, 1990 at Morehead City, N.C. at the Maritime Authority Dock.

7. Chief Scientist: Peter Popenoe
   Co-Chief Scientists: Frank Manheim, Vernon J. Henry

8. Cruise Data Curator: Peter Popenoe, Fisal Idris

9. Scientific Party:

Peter Popenoe	USGS
Frank T. Manheim	USGS
Vernon J. Henry	Georgia State University
John B. Wilson	Institute of Oceanographic Sciences
Paul Huddlestun	Georgia Geological Survey
Robert Woolsey	U. of Miss. Mineral Resource Inst.
Mark Evans	Emory University
Fisal Idris	Skidaway Institute
Clark Alexander	Skidaway Institute

NOAA NURP Representative:

Andrew Shepard — Science Director, Wilmington, N.C. Office

10. Ships Captain: Captain Frank
Sub Pilots: David Slater, Bob Wicklund
Sub roustabout: Jim Prescott
Mate: Grant, Cook: Sally, Engineer: Don, Deckhands: Scott, John.

11. Purpose of Cruise:

1. To establish stratigraphic age, lithology, and phosphorite content of strata by bottom sampling of outcrop areas.

2. To determine the nature of scarps. To observe and measure fracture patterns and possible scour and bioerosion features.

3. To observe and record phosphorite pavement thickness and extent and presence and thickness of manganese rinds.

4. To assess the benthic ecology of the study area, with particular emphasis on sessile epifauna.

5. To record current directions and speed with time.

6. To observe and record nepheloid layers, acoustic scattering and other organisms in the water column, and other water column parameters.

12. Navigation techniques: Positions for dives were picked from sparker profiles from the FAY 17 survey and transferred to topo-bathy maps where latitude and longitude were picked. The R/V POWELL used standard Loran-C to find the dive sites. When the submersible was on the bottom, the POWELL would calculate the submersible's position by passing directly over the sub. Several times during the dives the POWELL would pass over the sub and record its position again, and usually the end position of the dive was recorded. Traverses in the submersible were made on compass headings from a gyro compass.

13. Scientific Equipment:

The DELTA Oceanographics two-man submersible with object recovery claw, slurp sampler, external benthos camera, external and internal videocorder, internal hand-held camera with external strobe.

A gravity corer borrowed from WHOI and 25 five-foot long core barrels. This equipment was not used due to the fact that the winch borrowed from Pacific Marine Geology to operate the 200 lb gravity corer did not have the power to

lift the core bomb off the deck.

A 30 Joule Bubblepulse seismic-reflection system borrowed from the Marine Minerals Institute, University of Mississippi. This equipment failed to find the bottom due to its low power, so the system was not used.

14. Tabulated Information:

a. Days at sea: 4 1/2
b. Individual dives: 23. the positions are indicated in Figure 1.
c. Data Acquired:

Nine video tapes taken with the external camera.
Nine video tapes taken with the internal camera.
Three rolls of 36 exposure slides.

Unknown amount of pictures taken with the external Benthos camera. (these have not yet been sent to me by NOAA.

12 rock samples, of which three were calcarenites taken from the walls of tilefish holes.

38 sand samples taken with the slurp suction.

15. Narrative: Targets for the submersible dives were picked from the FAY 17 sparker lines and from the James Island topographic-bathemetric sheet. Generally, the targets selected were areas of rugged topography where it was believed that bedrock would be exposed and assessable for sampling. We had also planned to visit several "pinnacles" which abound in deeper water on the Blake Plateau, and have traditionally been interpreted as buildups of deep-water coral (coral mounds). The limitation on dive depth for the DELTA submersible of 1200 feet, however, prevented our visiting the pinnacle area.

Dives 1877 through 1887 were located on a series of northeast-southwest trending ridges and troughs of 20 to 30 feet (10 m) relief, and on the flanks of several erosional "mesas" along FAY line 13 (Figs. 2, 3) in water depths of 570 to 880 feet (114-268 m). Bottom in the trough areas consisted of a mixture of calcareous and phosphatic sand, with scattered phosphorite cobbles, boulders and slabs lying on its surface. As the ridges were approached phosphorite cobbles became more abundant and their size increased as the ridges were climbed. Slope angles were up to 45°. The tops of the ridges were capped by large phosphorite slabs, some exceeding 1 m in thickness, piled upon each other with bedding at different angles. In other areas the pavements were more continuous on the tops of ridges and undercut, forming a habitat for fish. These rock piles were a live-bottom with abundant attached sessile epifauna including

gorgonian corals, hydroids, sponges, anemones, and bryozoans. Spiny echinoids, sea cucumbers, gastropods, and spider crabs browsed the surface. Small fish, including many sculpin, were abundant and occasional large snowy grouper or orange roughie were seen.

On dive 1885 a flat pavement was observed (Huddlestun) with joints set at right angles. The weathered joints had a separation of a few inches to roughly one foot and some of the slabs were slightly tilted. Unfortunately, no joint orientation was taken.

Bedrock beneath the pavement in the dive area had been interpreted from seismic stratigraphy (Paul and Dillon, 1980, Popenoe, unpublished) as consisting mainly of calcareous silty clay and calcareous mudstones of Paleocene age, with occasional small erosional remnants of Eocene calcarenites. It was not known how extensive the capping layer of Miocene-age phosphorite pavements would be. We found the phosphorite pavement to be nearly ubiquitous, which prevented our sampling of bedrock in most areas. On dive 1883 a large tilefish hole was observed which penetrated strata beneath the pavement. The hole was cut into a cream-colored calcarenite or silty mudstone, which was sampled. Preliminary examination aboard ship found the calcarenite to consist of uniformly-sized small foraminiferal tests of early Tertiary age. An examination of this sample by Wiley Poag in Woods Hole identified the foraminifera Planorotalites Pseudomenardii , which pinned the age to Blow foraminiferal zone P.4, or early Paleocene, as predicted from the seismic stratigraphy. In all other areas the ubiquitous pavements prevented sampling bedrock.

Visibility was generally 50 to 80 feet on all dives and bottom currents were zero in troughs increasing to 1/2 and occasionally 1 knot, from the east or southeast, over ridges. Temperatures were 22° C at the surface decreasing to 13° C on the bottom.

Dives 1888-90 were made along FAY 17, line 15 across the flanks and top of a large erosional "mesa" where outcrop areas were anticipated (Fig. 4). Depths of dives ranged from 970 feet (296 m) at start to 820 feet (250 m) at dive end and currents were 1/2 knot from the east. Bottom temperature was 12° C. Bottom along the mesa flanks consisted typically of cobbley phosphorite with interspersed boulders. These were littered on gray carbonate sandy bottom with dark specks of glauconite and phosphorite. Slopes of 3-4° increased to 10-15° and slopes of up to 40o were encountered toward the crest of the mesa. On climbing the mesa, occasional large boulders of phosphorite were seen at regular intervals, some estimated to be 1 1/2-2 m in thickness. The coarser sediment was always correlated with an increase in slope. It was clear (Manheim) that the slope

consisted of a series of intersecting ridges that were typically concave and had their greatest slopes near the tops of the ridges where the coarsest slabs and boulders were exposed. Slopes decreased flankward with a corresponding increase in sediment. In moving upward, ridge after ridge was crossed for about 20-30% of the traverse.

The top of the mesa was capped with a rubble of phosphorite cobbles and slabs interspersed with coarse sand and pea-sized phosphorite gravel. On moving across this surface (Popenoe), patches of larger slabs and boulders were randomly encountered but there was very little relief. On suctioning up the pea-sized gravel, an unbroken phosphorite pavement was found at about 1 1/2 inches depth beneath the phosphorite rubble and sand at the surface. To confirm the extent of pavement beneath the thin sand cover an attempt was made to scrape several holes with the submersible's ballast base and in all cases continuous pavement was encountered. Currents were from the east-southeast at 3/4 knot on the mesa top.

Dives 1891-93 were in deeper water (1000-1100 m) eastward along on FAY 17, line 15 (Fig. 5). On Dive 1891 (Henry) the submersible landed on a bottom characterized by large sand waves or mega-ripples moving across a flat phosphorite cobble and boulder strewn surface. The mega-ripples ranged from one to three meters in height and had a wavelength of 8 to 12 m from crest to crest. The waves were made of modern carbonate sand (sampled) whose surface on the stoss side rose at about 12° slope and was covered with lunate or linguoid ripples. The lee slope was steep with an angle of 30 to 45° and was free of ripples. The troughs were also rippled and strewn with cobbles and boulders of phosphorite. Ridges and ripples were oriented north-south transverse to the direction of the prevailing current, which during the dives was from about 112° at 3/4 knot.

Also seen on this dive were rock ridges capped with phosphorite cobbles, boulders, and large slabs. In some cases the upcurrent face of the ridge was current swept, uncovering phosphorite slabs. Dives 1892 and 1893 in the same area encountered a more flat sandy bottom strewn with phosphorite cobbles.

Dives 1894 and 1895 were made in an area just north of FAY 17, line 11, where the James Island topo-bathy map showed an area of ridges and troughs of over 10 m relief. In both dives the submersible landed on a coarse, iron-stained and highly bioturbated sand-covered bottom with possible relict ripple marks. Current was from the southwest at about 1/4 knot. On traversing the bottom in a northeast direction several ridges of 3 to 4 m relief, capped by phosphorite boulders and rubble, were crossed. Toward the end of dive 1895 (Manheim) an area of larger filled circular depressions

was crossed which were believed to be ancient filled tilefish holes. This was an area of very little phosphorite rubble or debris and the bottom was either sand or near-outcrop. The filled tilefish hole hypothesis was confirmed when a large circular depression of 7-8 m diameter and 1 1/2 m depth was found to have several inner holes about a meter across excavated by a tilefish. The hole was cut into off-white colored, layered, partly-cemented sediment which was sampled. Examination of the sample by C. Wiley Poag in Woods Hole indicated that the foraminiferal calcarenite was early Oligocene in age.

Dives 1896-99 were positioned over a depression seen on FAY 17, line 11, which appeared to have pinnacle-like buildups on both it's eastern and western flanks similar to levees associated with canyon systems (Fig. 6). These buildups at the edges of scour depressions are quite commonly seen in seismic-reflection records over the Blake Plateau and have always been attributed to coral mounds or colonies proliferating in the increased water turbulence caused by the interaction of bottom currents of the Gulf Stream and the bathymetry. The buildups were believed to be accumulations of coral skeletal debris mixed with hemipelagic material trapped in the coral framework (Stetson, Squires, and Pratt, 1962). The "pinnacles" at the edges of channels quite commonly have fish signatures over them and the "coral mounds" were believed ecologically analogous to shallow-water reefs as a biological habitat for numerous sessile benthos and benthic fish. It was the theory of John B. Wilson that deep-water coral skeletal remains could not support such structures, therefore these dives presented a primary target for our dive series.

Dive 1896 landed at a depth of 700 feet, indicating that the dive had landed in a channel, the deepest feature seen in this area of line 11. Bottom temperature was 14°C. The bottom consisted of light-colored medium-to-coarse sand that was highly bioturbated, hummocked, and mounded, and tracked with many trails. There were no sand ripples. Pectinaria tubes, caryophyllas, cidaroids, and starfish were abundant.

On traversing the bottom a small ridge of phosphorite pebbles and cobbles was crossed, with many fish. No deep-water colonial corals were observed. A second and third ridge of phosphorite boulders was crossed, the 3rd with a 25° slope approximately 20 m in height. The slope was covered with phosphorite cobbles and many attaching sponges, anemones, gorgonians, and bryozoans. These and abundant crabs and fish formed a rich bottom. The ridge was oriented east-west and the cap consisted of large up-ended slabs and boulders of phosphorite. The dive (Wilson) proceeded down a steep slab-strewn slope (appr. 25°) to a depth of 710', then climbed a phosphorite covered ridge to 662', and after a slight downward slope again entered a sand field with

occasional cobbles of phosphorite. Also crossed was a ridge of fractured and bedded phosphorite? with a slight cover of sand. The ridge had a strike of 210° and bedding dips estimated to be 45° to the east were seen. This was like no other phosphorite outcrop seen in the dive series (Popenoe observation from viewing the video-tape) and it's significance will have to be studied. It was not sampled. The levee system seen on the seismic records did not consist of coral rubble, but was comprised of a buildup of phosphorite cobbles, boulders and slabs at the margin of the channel. The origin of these buildups is currently not understood.

In order to confirm that the channel and levee system had been crossed, dive 1897 traversed due east from the end point of dive 1896 (which had traversed northwestward). This dive landed on a sand and cobble strewn bottom at a depth of 680'. On traversing eastward the dive first encountered a circular cobble-strewn hill, as though a pile of rocks had been dumped on the sea floor. We later climbed a slight rise strewn with phosphorite cobbles and boulders to 665' depth, then dropped on a cobble-covered 20-30° slope to 689'depth, confirming that we had crossed the levee system and were now in the channel seen on the seismic record. This traverse encountered hundreds of small fish associated with the "levee pinnacle".

Dive 1898 landed on a sandy bottom not different from the bottom that was observed on the two previous dives. The dive wandered around looking for the levee and the scour depression, but was unable to find it. Toward the end of the dive a tilefish hole was encountered and a sample of tan calcarenite was taken from the wall of the hole. An examination of this sample by Wiley Poag in Woods Hole indicated that the sample was early Oligocene in age, confirming the seismic-stratigraphic interpretation that the bottom material was post Paleocene and probably Oligocene or early Miocene in age (Fig. 6).

16. Tables:

Table 1: Dive, Observer, Time, Depth, and Locations

17. Figures:

Figure 1: Track chart showing locations of dives and seismic track lines along which dives were made. An expanded track chart has been filed in the USGS Data Library in Woods Hole, MA

Figure 2: Minisparker seismic-reflection record of FAY 17, line 13, showing locations of dives 1877 through 1883.

Figure 3: Minisparker seismic-reflection record of FAY 17,

line 13, showing locations of dives 1883 through 1887.

Figure 4: Minisparker seismic-reflection record of FAY 17, line 15, showing locations of dives 1888, 1889, and 1890.

Figure 5. Minisparker seismic-reflection record of FAY 17, line 15, showing locations of dives 1891 through 1893.

Figure 6: Minisparker seismic-reflection record of FAY 17, line 11, showing the locations of dives 1896 through 1899.

APPENDICES

Appendix 1: Delta Submersible Dive Logs

Appendix 2: Bridge Dive Logs

Appendix 3: NOAA-NURP Mission Coordinator's Daily Logs

Appendix 4: NURC-UNCW Video Tape Log

Appendix 5: UNRC-UNCW Submersible Photo Log

Appendix 6: Submersible Photography Parameters

TABLE 1: DIVE, OBSERVER, TIME, DEPTH, AND LOCATION, CRUISE 90-0R-SUB-POPENOE

Latitude	Longitude	Dive no.	Observer	Date	Time	Depth	Samples Rock	Sediment
32°36.25'N	78°26.18'W	Dive 1877	Manheim	7/2/90	1157	565	1	0
32°36.69'N	78°23.96'W	Dive 1878		7/2/90	1327	590		
32o36.72'N	78°23.07'W	1878	Popenoe	7/2/90	1349		1	0
32°36.67'N	78°23.79'W	1878		7/2/90	1358			
32o36.61'N	78°24.01'W	Dive 1879	Henry	7/2/90	1440	595	1	3
32°36.71'N	78°23.97'W	1879		7/2/90	1449	580		
32°36.65'N	78°23.96'W	1879		7/2/90	1502			
32°36.58'N	78°23.91'W	1879		7/2/90	1517			
32°36.53'N	78°24.20'W	Dive 1880	Wilson	7/2/90	1556	570	1	1
32°36.57'N	78°24.03'W	1880		7/2/90		580		
32°36.57'N	78°23.89'W	1880		7/2/90		600		
32°36.56'N	78°24.30'W	Dive 1881	Woolsey	7/2/90	1727	570	1	2
32°36.61'N	78°24.16'W	1881		7/2/90	1739	570		
32°36.53'N	78°24.20'W	1881		7/2/90				
32°36.51'N	78°24.36'W	Dive 1882	Evans	7/2/90	1840	570	1	0
32°36.66'N	78°24.31'W	1882		7/2/90	1901	568		
32°36.66'N	78°24.30'W	1882		7/2/90		580		
32°34.96'N	78°24.01'W	Dive 1883	Popenoe	7/3/90	0828	670	0	1
32°35.06'N	78°24.70'W	1883E		7/3/90	0952			
32°34.90'N	78°25.40'W	Dive 1884	Alexander	7/3/90	1020	650	1	1
32°31.04'N	78°20.37'W	Dive 1885	Huddlestun	7/3/90	1410	880	1	2
32°31.05'N	78°20.43'W	1885		7/3/90	1420			
32°31.06'N	78°20.53'W	Dive 1886	Manheim	7/3/90	1541	870	1	1
32°31.30'N	78°19.70'W	1886		7/3/90	1741	875		
32°30.59;N	78°20.25'W	Dive 1887	Henry	7/3/90	1823	760	0	2
32°30.23'N	78°19.98'W	1887		7/3/90				
32°30.24'N	78°20.04'W	1887		7/3/90	1944	750		
32°22.26'N	78°31.74'W	Dive 1888	Wilson	7/4/90	0815	1000	0	1
32°22.29'N	78°31.71'W	1888		7/4/90	0840	1010		
32°22.30'N	78°31.63'W	1888		7/4/90	0846	1020		
32°22.40'N	78°31.51'W	1888		7/4/90	0856	1018		
32°22.65'N	78°31.05'W	1888		7/4/90	0929	940		
32°22.67'N	78°31.10'W	1888E		7/4/90	1003	940		
32°22.63'N	78°31.15'W	Dive 1889	Manheim	7/4/90	1035	970	1	1
32°22.62'N	78°31.26'W	1889		7/4/90	1048	970		
32°22.68'N	78°31.17'W	1889		7/4/90	1102	940		
32°22.89'N	78°30.71'W	1889		7/4/90	1132	910		
32°22.90'N	78°30.68'W	1889		7/4/90	1133			
32°23.35'N	78°30.06'W	1889E		7/4/90	1255	830		
32°23.35'N	78°30.62'W	Dive 1890	Popenoe	7/4/90	1327	870	0	1
32°22.98'N	78°31.13'W	1890		7/4/90	1417			
32°22.96'N	78°31.20'W	1890E		7/4/90	1425			
32°17.60'N	78°26.20'W	Dive 1891	Henry	7/4/90	1637	1070	0	2
32°17.46'N	78°26.24'W	1891		7/4/90	1700	1090		
32°17.43'N	78°26.28'W	1891		7/4/90	1711	1090		
32°17.41'N	78°26.67'W	1891		7/4/90	1731	1100		
32°17.42'N	78°26.71'W	1891		7/4/90	1740	1110		
32°17.37'N	78°26.81'W	1891E		7/4/90	1849	1120		
32°17.40'N	78°27.00'W	Dive 1892	Woolsey	7/4/90	1900	1140	0	2
32°17.27'N	78°26.96'W	1892		7/4/90	1926	1110		
32°17.28'N	78°26.94'W	1892E		7/4/90	1938			
32°17.30'N	78°27.00'W	Dive 1893	Evans	7/4/90	2027	1125	0	2
32°44.55'N	78°09.14'W	Dive 1894	Huddlestun	7/5/90	0922	590	1	2
32°44.62'N	78°09.21'W	1894		7/5/90	0933	600		
32°44.65'N	78°09.24'W	1894E		7.5/90	1016			
32°44.51'N	78°09.11'W	Dive 1895	Manheim	7/5/90	1042		1	2
32°44.47'N	78°09.17'W	1895		7/5/90	1049	595		
32°40.97'N	78°09.54'W	Dive 1896	Wilson	7/5/90	1352	700	1	2
32°41.17'N	78°09.60'W	1896		7/5/90	1423	690		
32°41.33'N	78°09.79'W	1896		7/5/90	1445	662		
32°41.32'N	78°09.81'W	1896R		7/5/90	1440	662		
32°41.35'N	78°09.77'W	Dive 1897	Popenoe	7/5/90	1536	680	0	0
32°41.34'N	78°09.77'W	1897		7/5/90	1548	650		
32°41.35'N	78°09.82'W	Dive 1898	Henry	7/5/90	1646	688	0	1
32°41.36'N	78°09.82'W	1898		7/5/90	1654			
32°41.34'N	78°10.02'W	Dive 1899	Idris	7/5/90	1741	685	0	0

DELTA SUBMERSIBLE DIVES, James Island S.C. Quadrangle, July 2–6, 1990

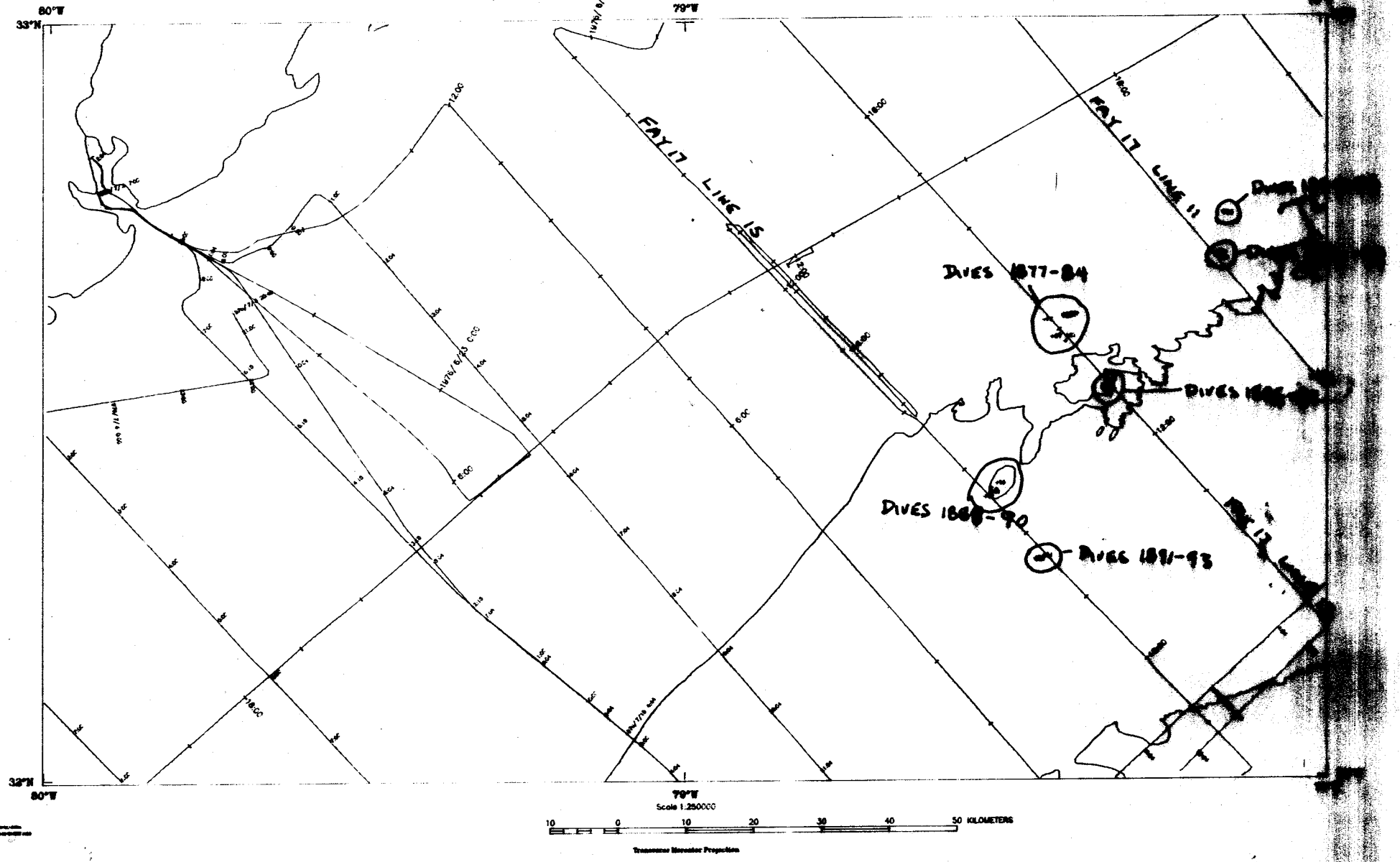


Figure 2

FAY 17, line 13 MINISPARKER

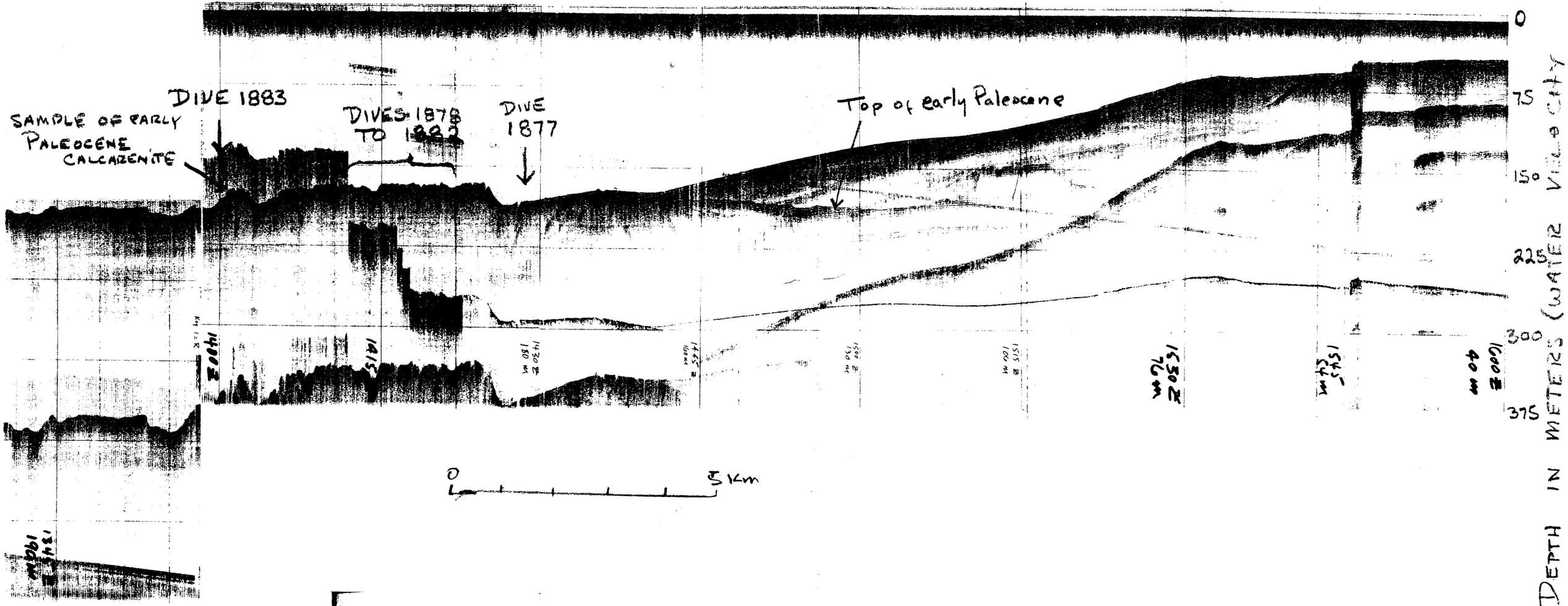


Figure 3

FAY 17, LINE 13 MINISPARKER

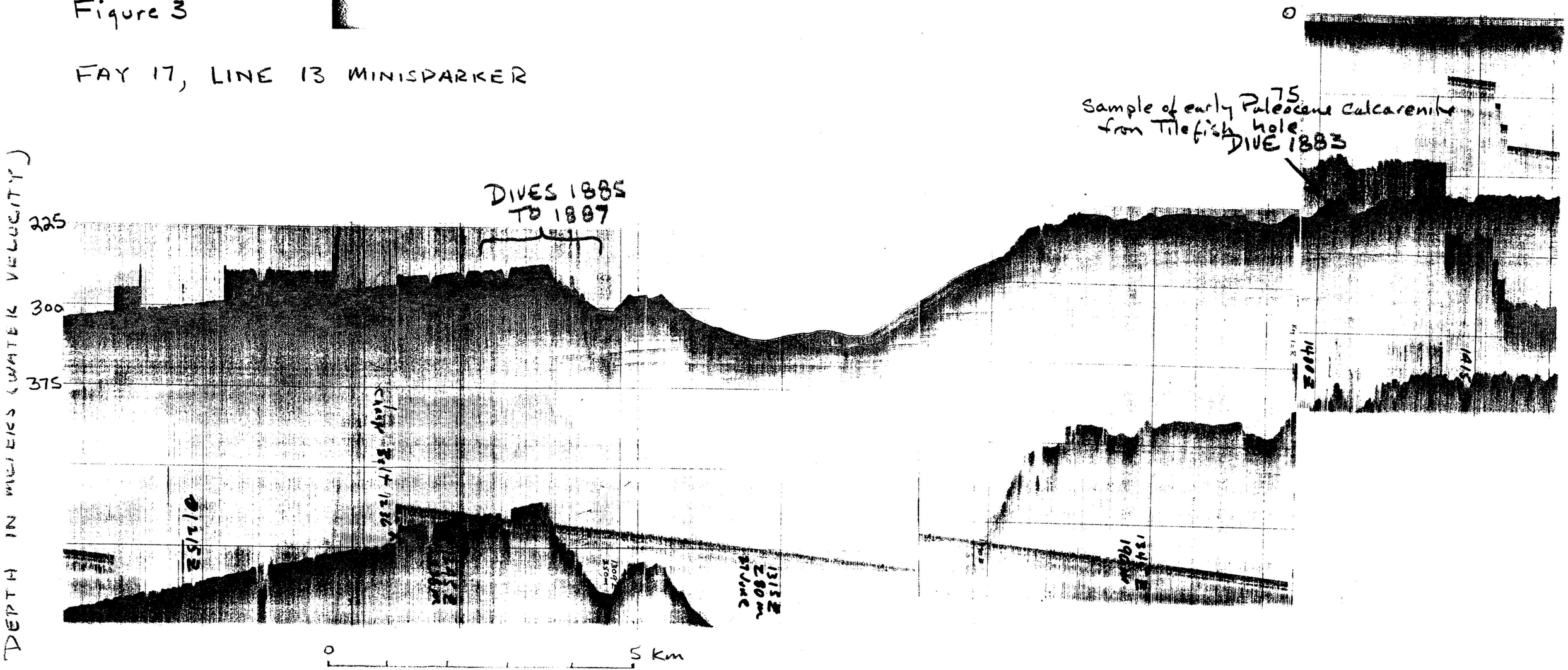


FIGURE 4

FAY 17, LINE 15

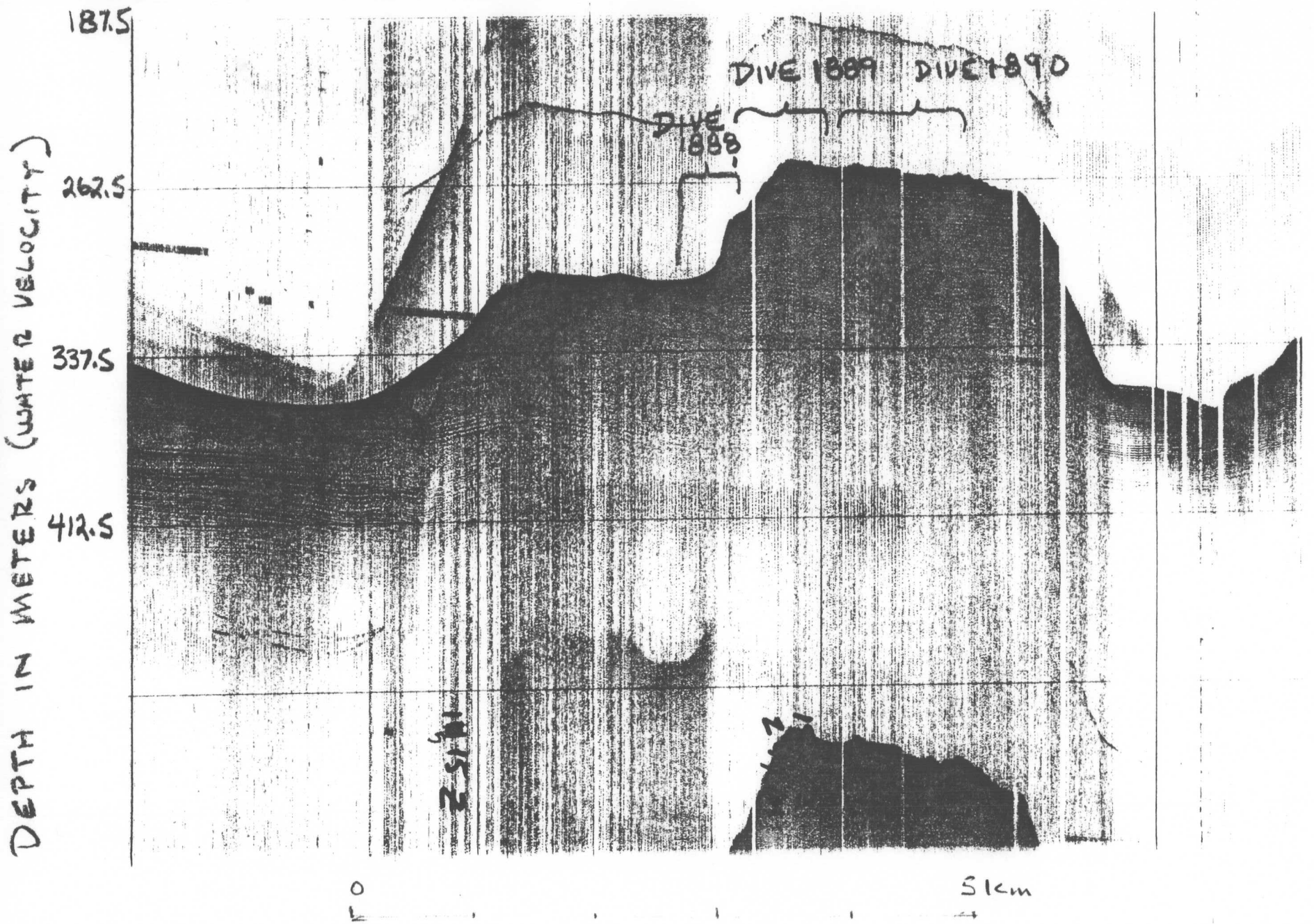


FIGURE 5

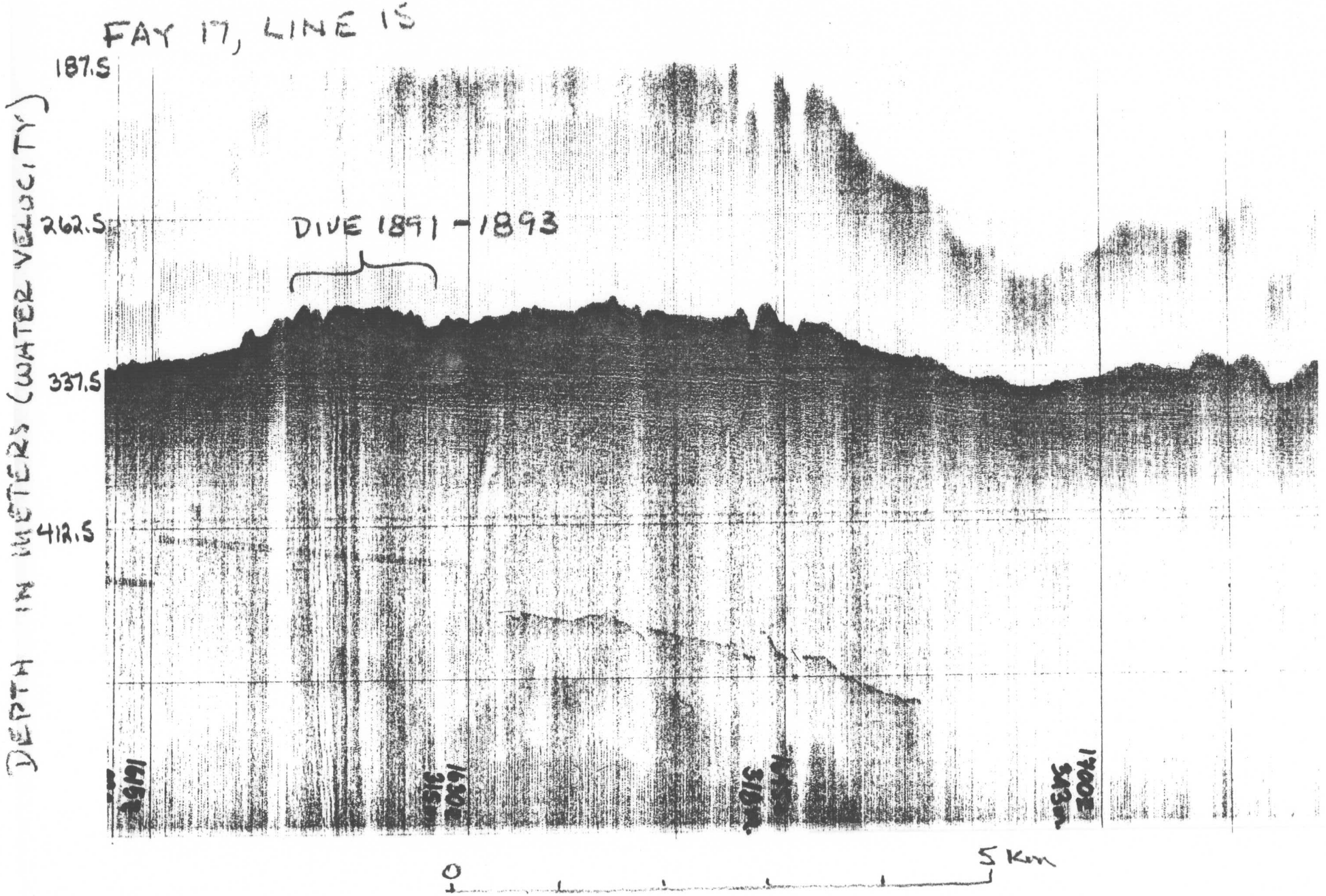
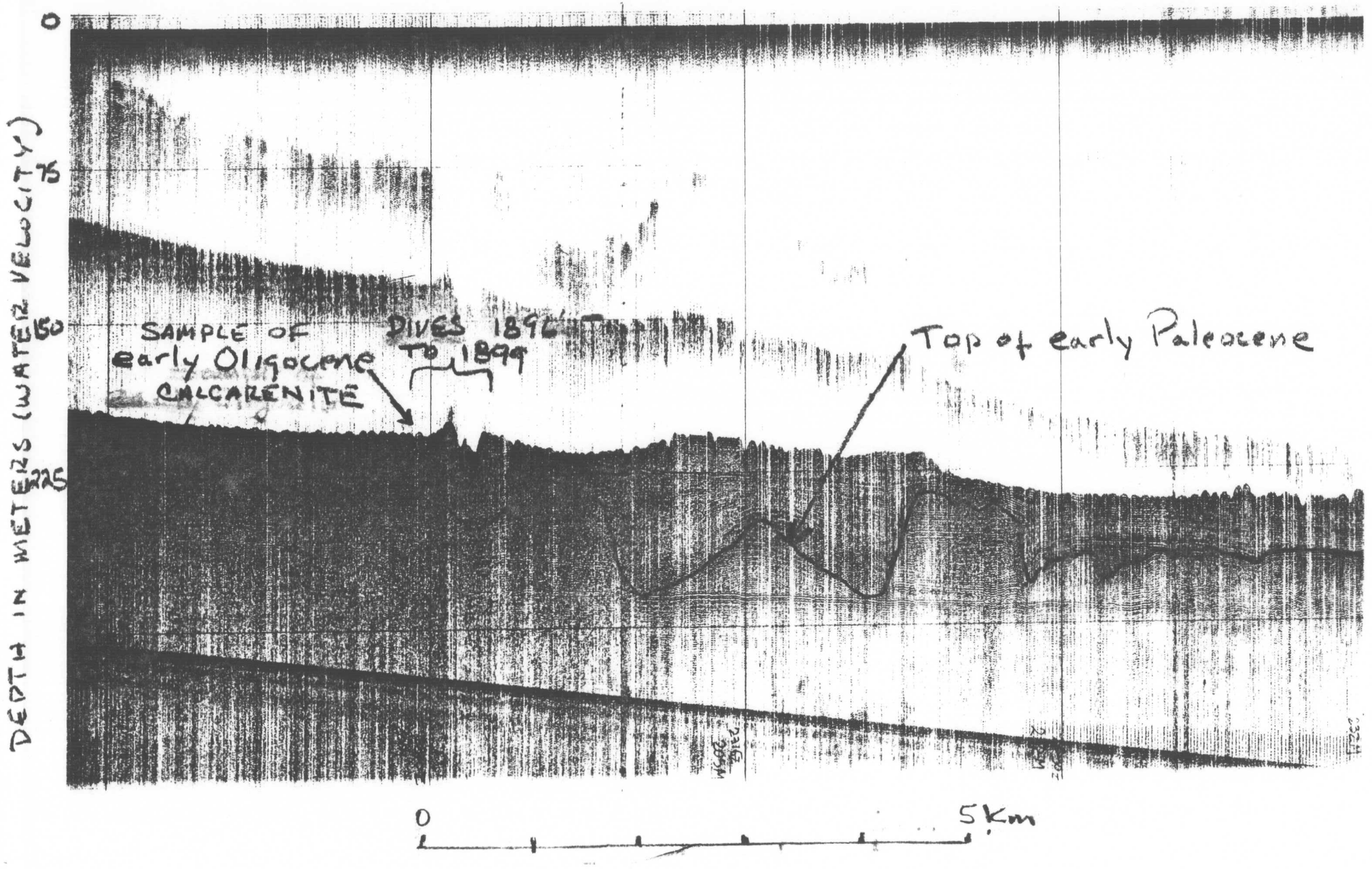

FAY 17, LINE 15
187.5
262.5
337.5
412.5
DEPTH IN METERS (WATER VELOCITY)
DIVE 1891 - 1893
1891
1892
1893
1894
1895
0
5 Km

FIGURE 6

FAY 17, LINE 11



Appendix 1: Delta submersible dive logs

D:\>type quickdk.dos
Mission No. 90-OR-SUV-Popenoe

oject Title: Geology, mineral Resources and Ecology of the Miocene Outcrop, Fl
orida Hatteras Slope and Inner Blake Plateau

Period of Performance July 1-6, 1990. Site/Area: Blake Plateau, Upper Charles
ton Bump 80 mi. east of Charleston, South Carolina.

Principal Investigator: Peter Popenoe Institution: U.S. Geol.Survey

A. The Success of this Mission Relevant to Research Goals

At all sites and locations extensive cover of phosphorite and pavement were foun
d, some in excess of two meters. This confirmed stratigraphic hypotheses that ph
osphorites should be more or less continuous in the offshore area.

Three samples of calcarenite of probable Mid Eocene age were recovered from Tile
fish burrows and outcrops underlying phosphorite rubble pavement. These samples
confirm stratigraphic inter- pretations from seismic reflection data. Because of
extensive pavement cover, we believe that it would not have been possible to ha
ve obtained these data in any other way than submersible operation.

Study of benthic organisms showed very little indication of ahermatypic deepwate
r corals, even on rock pinnacles, which had been hypothesized in earlier literat
ure to be built up of such corals.

extensive overview of the fauna populating phosphorite pavements was obtained

Study of sections of pavements from different localities showed both regional mi
neralogic and lithologic coherence, including features that will constrain the n
ature and time of origin of the pavements.

B. Significance of the Results of this Mission

Our observations suggest at least two major layers of phosphorite pavement exist
ed at one time. Unbroken phosphorite pavement was observed with large slabs of b
oulders and cobbles of phosphorite lying on their surfaces. This means that the
slabs must be fragments of a higher layer of pavement that is now gone. or absor
bed in the lower layer. In every cobble and boulder field. pavement existed only
a few inches beneath the rubble. These observations mean that great quantities
of phosphorite are present in the area.

Examination of foraminiferal ages in the recovered materials had several implic
ations. First, The surficial sediments were uniformly Holocene, as indicated by
the faunal assemblage. However, surprisingly, the preponderance of foraminifera
were of planktonic rather than benthic type. Samples from three sites showed pre
Miocene character, possibly Mid-Eocene.

The surficial sediments showed an extraordinary variety and richness of glauconi
te development, both as replacements in a variety of organisms, and as coatings
and impregnations in carbonates and phosphorite pebbles.

manganese nodules, reported by previous investigators were found, and conditi
ons seem unconducive to them.

"Levee" systems bordering deep depressions consist of piles of phosphorite rubbl
e, not coral mounds as earlier suggested. The origin of these features is obscu
e.

In one of the deeper areas investigated (1100+ feet) mobile bedforms such as mes

a ripples and sandwaves were observed. This provided evidence for the presence o
f significant bottom movements perhaps related to GulfStream eddies.

C. Application, Products and Benefits:

great variety of visual and sample materials was recovered during the 22 dives
. The first products from this work will be presented in lectures at the Woods H
ole Oceanographic Institution, Georgia State University, Skidaway Institute, Georg
ia Dept. of Natural Resources, and Institute of Oceanographic Sciences, U.K.

As analyses on the data become available, results will be published in professio
nal journals and presented at national society meetings. .

D.The Advantages of the Undersea Research Program Research Program, particularly
in-situ technology:

1. There is no way samples could have been obtained under the phosphorite cover
without a research submersible.

2. The Delta sub has the advantage of permitting quick descents and investigati
on of many research targets on a single day. It is robust and forgiving in roug
h topography. Maneuverability is excellent.

3. Ability to videorecord all dives is especially valuable

4. The slurp gun proved to be highly versatile and valuable, even for recovering
bedrock fragments.

E. Comment on Operations, Vessel and Diving:

eration of pilots and ships crew was highly professional. The turnaround time
was extraordinarily rapid and the sub otherwise performed very well.

At deeper depths the suction device and grasping arm was very difficult. Best
esults were gained when experience pilots did most of this work. They were very
helpful in spite of their awkward positioning. Nevertheless, the simplicity of
he arm is a major plus.

The greatest problems and loss of valuable information occurred the area of vid
ocameras, owing to inexperience of users, and very limited instruction. Greater
time should be devoted to above-deck practice by users on this equipment. On a
ouple of dives we were without external TV.

Captain Wiltse and Mate Grant ~~Grant~~ provided exemplary service to the operation
especially in keeping locations and maneuvering the ship for sub deployment an
retrieval. Grant also was of major help in recovering the gravity corer.

F. Other comments and suggestions:

Improved means of coring and grabbing will be a good addition to the submersibl
. CTD would would be an excellent optional equipment item. The thermometer was
elpful but is too inaccurate for publication purposes.

In summary, the mission was highly successful, not only in providing great insi
ht into the occurrence and origin of phosphorite, but also in raising many new
uestions as a result of the dives. Several totally unanticipated issues came u
for instance, the origin of levee systems and channels on the Blake Plateau,
d the establishment of the offshore Carolina area as perhaps the U.S.'s most
rominent offshore area for Recent glauconite formation.
D:\>

type cruise.dos

SUBMERSIBLE DIVE LOG Frank Manheim

:uise Dive # 1
Lat 32o36.25´, Long. 78o14.84´ Depth Start 565´
Finish 550´

Water column: Time 11:54, July 2, 1990

Depth	Temperature	Observations
surface	28.2oC	Prominent "snow" with particles less than.1 to 3 mm, often feathery, arcuate forms; small jellyfish, about 2.5 cm at 3 m depth
185		Snow diminished to 1/4; enroute to 185 one particle 2.5 cm with "weighted" ballast buoyed up by feathery "sails", light color
250	23.5oC	
285	22.2oC	
320		Snow gone
410	18.7	Solitary big floc
530	17.0	
55	13.8	70´ visibility; somelight still visible
565	12.1	(maybe thermometer needs time to equilibrate) Each of above temperatures may need adjustment

Current velocity

Particles moved past port at speed of 3-4 cm per 4 sec. = about 1 cm/sec. Yet, appearance of rocks clearly showed that episodic currents must sweep area and prevent buildup of sediment on them.

See later bottom observations.

Bottom observations

Time	Observations
1206	On bottom. Field of cobbles, 3-15 cm, often encrusted with Gorgonian corals, hydroids, sponges and bryozoans Matrix is grayish white sandy carbonate sediments with many dark grains and miscellaneous debris of carbonate and siliceous organisms.
17	Undercut boulder, 70 cm and 20-25 cm thick with a moat cing the starboard side of the vessel, at about a 10- 15o angle counterclockwise from the sub´s direction (SE). I.e. current coming from about 235o (SW), consistent with a roughly Gulfstream configuration. 7 cm goldfish-like fish perched on top of boulder staring rigidly at sub until we raised mud cloud in moving. Then ducked under slab.

12:34 Encountered increasing cobbles, 3-10cm, upslope angle estimated; occasional larger boulder. Slope angle 1-3o

?:18 Phosphorite cobbles and boulders, 3-50 cm, black stained

Depth 565′ Boulders are more encrusted with sponges, hydroids Gorgonian corals.

12:20 Boulders increase infrequency, larger barrel sponges, 40 cm high. First large plate, 30 cm x 1.5 m; many small forktail, yellowish fish; grayish sandy carbonate ooze
Cobbles and boulders are subrounded and stained with manganese

12:25 Ahead see slope of 10-15o in directionof travel leading down to white "river" two meters across. Unusual fauna, including several ophiuroids, to 12-15 cm, and a holothurian in the "river". Top of bank is 550′, bottom of river is about 555′. Slope facing SE is steeper than other side

12:27. Not far from river encountered two large grouper, about 80 cm, swimming direction approximately opposite to sub approximately WNW

12:29 Depth 550 Temp. 13oC, Noted big pavement slabs piled on each other. Failed to note in log but think it was about here. Slabs 15-30cm (1′)thick, and up to several meters long, very dark, manganese stained. Port side and oriented in a rather round patchy pattern. Question: how can an isolated patch of slabs be formed like this, and surrounding areas not have slabs?

2:34 Return to cobbly landscape, 3-10cm, rather open scenery with few large forms, either organisms or rocks visible.
Maybe the "rivers" and the slab area are linked to the small cut in the profile on Pete′s map.
Depth 565, Temp 12.5.

Retrieve typical cobble half-buriedin sediment. came out easily.

Lift off

At 520′recorded 13oC, some particulate snow
At 5o′above bottom still saw bottom clearly and recorded a linear, honeycomb pattern of rocks, which could not be seen when we were close to them. The pattern seemed to be from ESE to WNW. Relatively clear water

At 150′turbid water with big flocs

Total photo during dive: 11 external 35′s, 22 handheld camera (color), 7 video(?) and continuous external videocamera.

D:\>

NURC/UNCW

SUBMERSIBLE DIVE LOG

Cruise: RV Powell Dive #: 2 dive 1878 Date: 7/2/90

Location: Blake Plateau, Top of Charleston Bump

Start Time: 13:27 End Time: ________ Max Depth: ________

Personnel: Observer Popenoe, Dave Slater

Mission/Dive Objective: Orientation and observation

Photographs: Forward ________ Aft ________ Handheld ________

Video Tapes: 1/2" VHS ________ 3/4" Umatic ________ 8mm ________

Samples Collected: ________

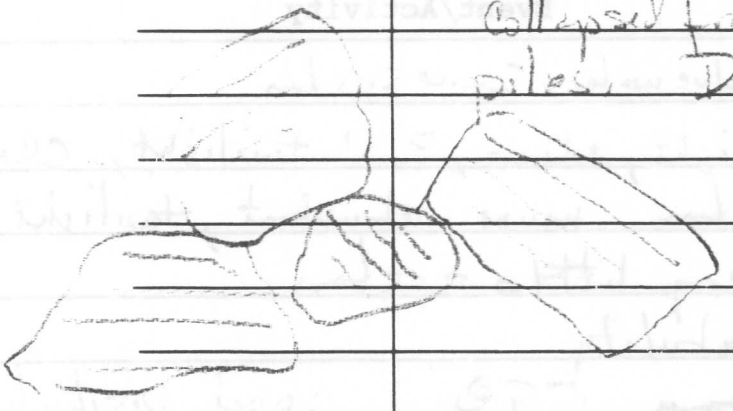
Equipment Deployed/Retrieved: ________

Brief Description of Dive:

Approx. Time	Event/Activity
1328	40' clear blue water, some seston
	200' Twilight, clear, 300' twilight, clear
	350' Seston more abundant, twilight
	430' very little seston
	90' visibility
1336	On bottom 598', good visibility
	bottom coarse sand, many cobbles
	No current - [illegible]
	large 8' high rock pile, 1½m thick
	Slabs
	Troughs 20' deep - Ridges capped
1355	with large slabs

SUBMERSIBLE DIVE LOG Page ___ of ___

Approx. Time	Event/Activity
	1338 Ridge oriented 110
1403	Picked up cobble, coming up
	600' depth
	Temp 13° C, No current
1415	On Surface
	landed on a phosphate cobble covered surface with coarse, calcareous & glauconitic sand. Traversed a rock marked surface with phosphate boulder capped hills, cobble strewn slopes, and sand and cobble filled valleys of about 20' relief. Small cobbles were layered and stud boulders (Thick slabs) with more than 1 1/2 m thickness. Boulders were at all angles as though they had collapsed from some higher level into rubble piles. Dive another on this



NURC/UNCW

SUBMERSIBLE DIVE LOG

Cruise: 90-OR-SUB-Pequeno Dive #: 1879 (3) Date: 7/2/90

Location: 32 32.61 78 24.01

Start Time: 1440 End Time: 1540 Max Depth: _____

Personnel: _____

Mission/Dive Objective: Recon Mission

Photographs: Forward _____ Aft _____ Handheld _____

Video Tapes: 1/2" VHS _____ 3/4" Umatic _____ 8mm ~20 mins

Samples Collected: 2 sponge + 1 rock samples

Equipment Deployed/Retrieved: _____

Brief Description of Dive:

Approx. Time	Event/Activity
1454	on bottom
Sample 1	580'
	ascend 5 to ledge
15 [illegible]	[illegible]
Sample 2	570'
	current veloc. [illegible] valley
	[illegible] ridges.
rock sample	545' Sample #3
1527	begin ascent

SUBMERSIBLE DIVE LOG Page ___ of ___

Approx. Time	Event/Activity
	no specific compass direction was followed, rather, a circular pattern was taken to locate open patches of sand for 1) sediment sampling using the suction device and 2) obtaining a rock sample. Both of these objectives were accomplished. Initially, the traverse encountered a cobble-strewn bottom followed by areas of open sand (sample #1), then ridges and valleys (10'-15' relief) with shale and boulder, then low relief almost flat cobble strewn areas (sample #3) with patches of sand (sample 2). A number of still photos were taken which together with the 10 minutes of 20 ft. hand held video will be analyzed along with the sediment and rock samples following the cruise. Thin sections will be prepared from the rock samples

NURC/UNCW

SUBMERSIBLE DIVE LOG

Cruise: Nekton Delta Dive #: 4 (1880) Date: 2/7/90

Location: 32 36.53 78 26.20 Seismic Line 13 Mesa

Start Time: 1556 End Time: 1703 Max Depth: 600

Personnel: Pilot Dave Observer Wilson

Mission/Dive Objective:

Photographs: Forward ______ Aft ______ Handheld ______

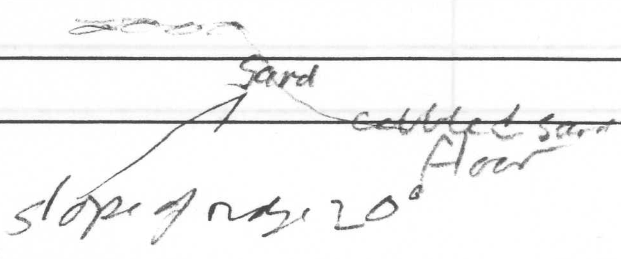
Video Tapes: 1/2" VHS ______ 3/4" Umatic ______ 8mm ______

Samples Collected: 1 Sed 1 Rock

Equipment Deployed/Retrieved:

Brief Description of Dive:

Approx. Time	Event/Activity
	Landed on cobble phosphate bottom with an apparent topographic low which was sand filled. Saw surface bioturbation but no current structures.
	Moved off onto a ridge with sand appearing [illegible] Surface was a broken phosphate pavement with well developed epifauna
	Section



SUBMERSIBLE DIVE LOG

Approx. Time	Event/Activity
	Moved along ESE course
	passed over gentle depression
	with sand and a cobble floor.
	Where there are topographic highs we
	ridges with broken pavement, the
	fauna [illegible]
	[illegible] etc.
	The fauna [illegible]
	or [illegible] shaped depressions [illegible]
	[illegible]
	[illegible]
	[illegible]
	slabs were often [illegible]
	[illegible]
	[illegible]
	Large [illegible]

NURC/UNCW

SUBMERSIBLE DIVE LOG #5

Cruise: Delta Sub Dive #: 1881 - #5 Date: 7-2-90

Location: Seismic line #13, Mesa 32°36.56 78°27.30'

Start Time: 1727 End Time: 1823 Max Depth: 580

Personnel: J. B. Woolsey

Mission/Dive Objective: familiarization, reconnaissance

Photographs: Forward 35mm 8-10 Aft _____ Handheld ✓

Video Tapes: 1/2" VHS ✓ 3/4" Umatic _____ 8mm ✓

Samples Collected: Sediment, 2 bags

Rock, 1 spec.

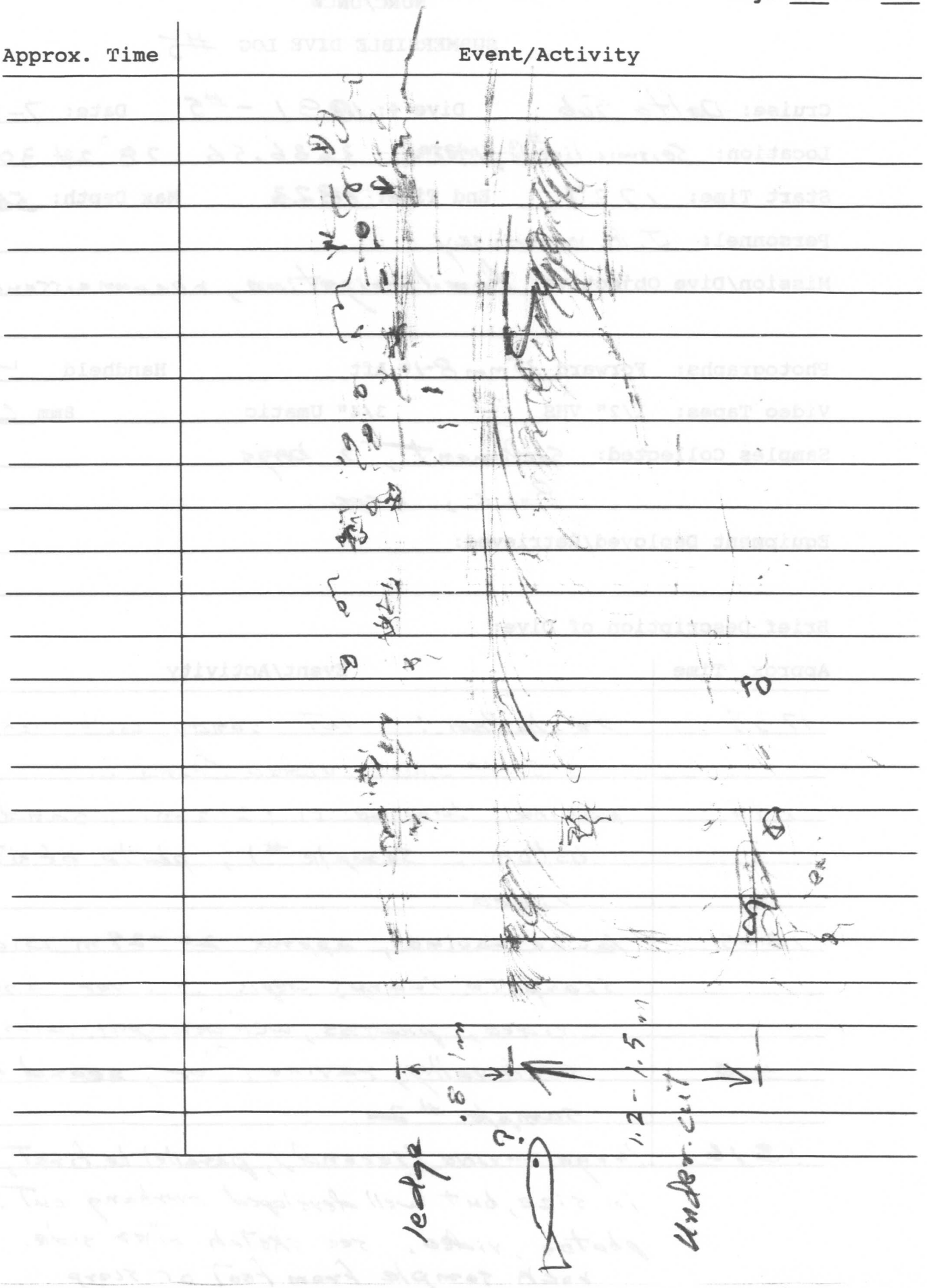
Equipment Deployed/Retrieved: _____

Brief Description of Dive:

Approx. Time	Event/Activity
1735	on bottom: flat sandy, with rock frags. 5-10 cm, video [illegible]
1745	ravine, low relief ~2-3 m, sand in bottom, sample #1, photo at site, video
1805	large ravine, approx 20-25 m wide, scarp to scarp; depth to floor 5 m. video, photos, well developed talus slopes
1810	sand valley, ravine floor, weak scarp, sample #2
1816	large ravine (second), parallel to first, similar in size, but well developed overhang cut in side, photos, video, see sketch other side. rock sample from foot of scarp

SUBMERSIBLE DIVE LOG Page ___ of ___

Approx. Time	Event/Activity



NURC/UNCW

SUBMERSIBLE DIVE LOG

Cruise: RV. Powell Dive #: 18-82 Date: 7-2-90

Location: 32° 36.51 78° 24.36

Start Time: 1840 End Time: 1940 Max Depth: 570'

Personnel: Evans / D. Slater

Mission/Dive Objective:

Photographs: Forward 17 Aft Handheld

Video Tapes: 1/2" VHS 3/4" Umatic 8mm

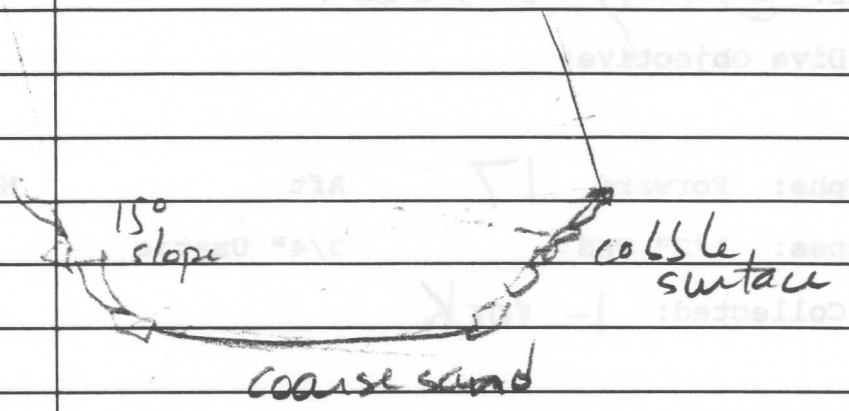
Samples Collected: 1- rock

Equipment Deployed/Retrieved:

Brief Description of Dive:

Approx. Time	Event/Activity
1841	3-4' drop
43	[illegible] ~160'
5	570' plateau
	blocks 20-40cm rectangular w/ smaller hyaloids
1853	
1855	smaller cobbles flat w white coarse sand
	approach ridge
	head up along ridge ~140°
	current negligible

SUBMERSIBLE DIVE LOG Page ___ of ___

Approx. Time	Event/Activity
	channel/trough 30-40' wide floored w/ sand
	

NURC/UNCW

SUBMERSIBLE DIVE LOG

Cruise: RV Powell Dive #: 18-82 Date: 7-2-90

Location: 32°

Start Time: ~~0~~ 1840 End Time: 1940 Max Depth: 570'

Personnel: Evans/Slater

Mission/Dive Objective:

Photographs: Forward Aft Handheld

Video Tapes: 1/2" VHS 3/4" Umatic 8mm

Samples Collected:

Equipment Deployed/Retrieved:

Brief Description of Dive:

Approx. Time	Event/Activity
	ridge/[illegible] swale
1914	beginn swath
	trend of trough ~ 240°
	traversed ~ 100 feet: 3 spurs
	on ridges extending [illegible]

NURC/UNCW

SUBMERSIBLE DIVE LOG

Cruise: 90-OTR-SUB-Popenoe Dive #: 7 1883 Date: 7/3/90

Location: Line 13 Fay, 32° 34.9 78° 24.0

Start Time: _____ End Time: _____ Max Depth: _____

Personnel: Popenoe, Wickland

Mission/Dive Objective: To investigate steep slope on Fay line B

Photographs: Forward _____ Aft _____ Handheld _____

Video Tapes: 1/2" VHS _____ 3/4" Umatic _____ 8mm _____

Samples Collected: _____

Equipment Deployed/Retrieved: _____

Brief Description of Dive:

Approx. Time	Event/Activity
0822	Entered Sub -
0827	Launch In Gulf Stream very clear water and sailing
	Twilight at 230 Temp 22°
	500' - Temp 17.8
0835	On bottom, VIS 50'
943	Terminate dive
	[illegible]
	[illegible] we cut
	into a white clay material,
	We sampled the clay unit
	for analyses

SUBMERSIBLE DIVE LOG Page __ of __

Approx. Time	Event/Activity
	current 1/2 knot from SE at end of dive
	No Nepthaloid layers were observed in water column on way up or down
	Visibility less than 7/2/94

NURC/UNCW

SUBMERSIBLE DIVE LOG

Cruise: 90-UR-SUB Pegasus **Dive #:** 8 1884 **Date:** 7/3/90

Location: Fay line 13, slope

Start Time: 1017 **End Time:** ______ **Max Depth:** ______

Personnel: Clark Alexander, Dave Slater

Mission/Dive Objective: ______

Photographs: Forward ✓ Aft ______ Handheld ✓

Video Tapes: 1/2" VHS ______ 3/4" Umatic ______ 8mm ✓

Samples Collected: 1 slurp under scarp / 1 rock on bottom
↓ fix taken on ship

Equipment Deployed/Retrieved: ______

Brief Description of Dive:

Approx. Time	Event/Activity
1017	Going down – visibility ~60-70 ft
	max depth 610' ~1030
[illegible]	[illegible]
	→ [illegible]
	current ~ 1-3 cm/s, relief ~1 foot on bottom
	→ 1 small outcropping pavement, ~2-3 cm
	thick, ≈45' long, undercutting up to 20cm
	in.

NURC/UNCW

SUBMERSIBLE DIVE LOG

Cruise: ______ Dive #: 9 1885 Date: 7/2/90

Location: 32° 31' 04" 78° 25' 37"

Start Time: ______ End Time: ______ Max Depth: 880 feet

Personnel: Bob Wicklund, Paul [illegible]

Mission/Dive Objective: practice - reconnaissance

Photographs: Forward ______ Aft ______ Handheld 3 strobe [illegible]

Video Tapes: 1/2" VHS ______ 3/4" Umatic ______ 8mm ______

Samples Collected: 1 cobble w/ epifauna; 2 "sand" drift samples, 1 amidst phosphorite cobble field, 1 in low lying drift field

Equipment Deployed/Retrieved: sampler arm, sample bags

Brief Description of Dive:

Approx. Time	Event/Activity
	[illegible] - getting feel for submersible activity;
	[illegible] ridges [illegible] phos-
	cobble fields; traced out a "V" shaped valley or
	topographic low bounded by cobble-strewn ridges;
	noted light intensity w/ depth and abundance of biota.

Dive 9 Paul Huddleston

During descent, attention was given to the degree of illumination. I could readily read the settings on my camera under natural illumination to 400'. At 500', reading the settings was difficult and at 600' I needed submersible lights. From 700' down, the exterior had the impression of very deep twilight and, at the bottom, about 880', outside illumination resembled a dim full moon or a gibbous moon. In quantitative terms, w/ the camera set @ ASO 3200 and at f 1.4, exposure timing was 1/4 second.

The bottom upon descending to it had the appearance of a snow-swept desert surface; in some directions w/ cobbles strewn on the bottom as far as the eye could see. In one place, however, the bottom consisted of a seemingly flat pavement w/ joints set at right angles. It gave the impression of an old or ancient building having been torn down but the concrete floor left in place. The weathered joints now have a separation of a few inches to roughly 1 foot and some of the slabs are slightly tilted.

The pavement and cobble fields appeared to be covered with "snow". There was no apparent drifting of the "snow" that I could see at close inspection but upon later leaving the site and ascending above it, I could make out elongate drift patterns. We took two samples of the "snow" or drift, which turned out to be primarily a glauconitic planktonic foraminiferal arenite w/

other calcitic biogenic debris. The first sample was in a cobble field. The vacuuming device exposed more cobbles underneath, giving the impression that, at this site, the cobbles were heaped on each other to undetermined depth. Also, the freshly exposed buried cobbles were clean of encrusting biota and being phosphate, were very dark.

We traversed a drift ("snow") - filled swale for some distance. It turned out to be enclosed by a rim of cobble strewn surface that stood 3 to 5 feet (1-2 m) above the floor of the swale, but higher on one side than the other. Furthermore, the shape of the swale did not appear to be regular but seemed to be "J", or rather "U" shaped. We took a sediment sample in the swale and the vacuum hose did not touch "bottom". We sampled where we did because the surface appeared to be strewn with dark "phosphate" grains 1 to ~ 5 mm (only glauconite was noted upon cursory examination in recovered sample).

On initial descent, the bottom had the appearance of a [illegible] level surface. However, [illegible] the bottom, it became obvious that the bottom was covered by a rich biota. There were many kinds of fish, most of them only a few inches long. The largest fish I saw were sculpins, less than 1 foot long. I noticed several species of echinoid, sea cucumber, sponges, alcyonarians, hydroids, crabs ("spider" crabs + smaller) 2 arachnectomia-like gastropods, worms anemones. Mollusks, other

than the two snails were conspicuously lacking, no abundance of bryozoa or calcitic skeletal debris.

Illumination

20 ASO	f stop	depth	speed	comments
	f11	0 ft		
	f11	100'	1/30 - 1/60"	
	f11	200'	1/8 - 1/15"	plenty bright, bright twilight
	f11	300'	1/2"	moderate twilight, still bright
	f11	400'	1 sec+	dimmer, still fairly bright
	f1.4	500'	1/15"	still light but hard to read
	f1.4	600'	1/8"	deeper twilight, need artificial light
	f1.4	700'	1/4"	bright moonlight
	f1.4	800'	1/4"	"
	f1.4	880'	1/4"	dim full moon or gibbous moon

1886 Dive 10

D:\>type cruise3.dos
Dive No. 10 July 3, 1990 F.Manheim, observer. Pilot Dave Slater

Location:

pth. 960'

Arrive bottom 3:51. Typically cobbly phosphorite bottom with interspersed boulde
rs. Cobbles 5-15 cm to 30 cm . These were littered on gray carbonate sandy botto
m with dark specks of glauconite and phosphorite. Sculpins were omnipresent, alo
ng with spiny echinoids, with spines to 10 cm.

3:54 Decrease in large sizes, then increase slope to 10-15o rooling off to sta
rboard . Boulders are dusty with deposited sedimenta lineup of corals in curious
ly linear fashion 40o to our course.

4:00 Nearly every boulder encrusted with hydroids

4:03 More sediment

4:05 Larger boulders

4:08 Big slabs over 1 m

4:11 Cobble and boulders

4:17 Same variation as before

[incomplete: to be continued]

NURC/UNCW

SUBMERSIBLE DIVE LOG

Cruise: 90-OR-SUB-Pogonoe Dive #: 1887 Date: 7/3/90

Location: Lat 32°30.52 Long 78°20.33'

Start Time: 1823 End Time: 1943 Max Depth: 780 ft

Personnel: V.J. Henry obs, R. Wicklund, pilot

Mission/Dive Objective: transect across valley-like feature

Photographs: Forward ✓ Aft ______ Handheld ______

Video Tapes: 1/2" VHS V.J.H. 3/4" Umatic ______ 8mm ______

Samples Collected: 2 sediment samples

Equipment Deployed/Retrieved: n/a

Brief Description of Dive:

Approx. Time	Event/Activity
1833	on bottom at 760 ft. proceed up 15° slope on SE heading. Sandy bottom with phos. pebbles and cobbles, some slabs, vis. ~ 30 ft
1847	745 ft, flat bottom similar to initial landing site, i.e., phos. pebbles and cobbles still on SE heading current < .5 kt
1904	moving across a series of ridges

SUBMERSIBLE DIVE LOG

Approx. Time	Event/Activity
	and swales; the former are quite rocky, the latter less so. max relief ~ 30-45 ft. Sediment sample taken @ 780' 32° 30.23' 78° 19.48'
1922	still heading SE up a 15° slope over a ridge and into a swale. Sediment sample taken at 750 ft depth 32° 33.15' 78° 20.02'
	Summary: SE transect over a series of ridges capped with phos. pavement, i.e. broken angular slabs of rock, and swales mostly composed of sand w/ phos. pebbles and cobbles. Several undercut ledges observed w/ tile fish near burrows. Red crabs, several species of fish and moderate cover of sessile benthos including [illegible] [illegible] sponges.

NURC/UNCW

SUBMERSIBLE DIVE LOG

Cruise: Delta. Dive #: 1888 (12) Date: 4/7/90

Location: 32 22.2N 78 31.7W end 32 22.67 78 31.10

Start Time: 0815 End Time: 1003 Max Depth: 980 ~~940~~ 1020'

Personnel: WILSON / SLATER

Mission/Dive Objective: Ascent of 'scarp' face

Photographs: Forward 56 Aft _____ Handheld -

Video Tapes: 1/2" VHS Continuous 3/4" Umatic _____ 8mm _____

Samples Collected: 1 Sed sample from surface of pavement location - end of dive

Equipment Deployed/Retrieved: _____

Brief Description of Dive:

Approx. Time	Event/Activity
0834	landed on phosphate cobble and pebble bottom with sand cover. Some of the pebbles ~~are~~ support an epifauna
0839'40	Sandworm observed on bottom. Recorded on video.
	Continuous bottom of cobbles and pebbles with sand cover. Some large slabs with erosion hollows around them.
085355	Gorgonians on large cobbles. Oriented to force

SUBMERSIBLE DIVE LOG

Approx. Time	Event/Activity
	east into current.
0856 42	Gorgonians and cidaroids. Pebbles small &
	separated by large areas of sand in interstices
	Depth 1018 feet
0857	Large spider crab
0901-20	Depth 1008 slight rise from previous depth
0905	Cobbles getting larger
0906	more continuous pavement 1002' slight
	slope. Irregular undulating surface
	with breadcrust appearance Irregular
	broken slabs sitting on the undulating
	surface
0909	Small shelf [illegible] Relief about 25 cm
0910	depth 960 m Stylaster colonies also
	oriented into current
0915	biogenic area
092033	back onto rubble surface. Stopped
	to take sediment sample. Surface sand from
	phosphorite pebble surface [illegible] to reveal older
	[illegible]
	Attempt [illegible]
	[illegible] failed due to difficulties
	in ~~[illegible]~~ working manipulator arm at that
	depth. End of dive

]Dive 13, (18 89 90) F. Manheim, July 4, 1990

13

Location 32o22.63´N, 78o31.15´W, Depth 970 start
32o23.35´N, 78o30.03´W, Depth 830 finish

Water column

Up Depth	Temperature	Down Depth	Temperature
30´	27.8		
140´	27.5		
		150	19
		200	18
270	21.5	300	16.0
330	20.0		
400	17.0		
520	15.5	520	14.5
600	14.5	630	13
700	14	700	12
800	13.8		
)0	12.2		

Encounter bottom 10:46
Current 5-8 cm/sec. Direction SW

10:55 Temp. 12o
Current increased soon after start to about 1/2 knot from E, switching to SE direction for a shorter burst at 3/4 to 1 knot at 12:22; current at top of feature was again around 1/2 knot.
There seemed to be a clear 'hug the topography' component to the current, since such rapid currents were not hinted at in the flow of particulate debris past the sub on descent or ascent. In this and previous dives particulate matter seemed to intensify a 200 or so above bottom, as though it were being swept off higher levels of bottom areas. Mostof the material is clearly organic judging from its flucculant and irregular shape and size (a noted component is about 1 mm or more in size and has easy floatability. The difference between biogenic particulate matter is particularly easy to see by comparing it with bottom sediments stirred up. These clouds spread and quickly sank out of sigh in a few minutes.

Bottom sediment

11:04 Cobbly bottom 5-30 cm with thin blanket of grayish sandy sediment on pavement. Slopes 3-4o lead to increasingly coarse rubbly debris, with boulders and plates 30-70 cm at regular intervals.

Subsequent bottom sediments consisted of sequences of the above sediment interspersed with large boulders at regular intervals. The coarser sediment was always correlated with increase in slope, which varied from 15o ro maximum of about 40o. It was clear that the slope consisted of a series of intersecting ridges that were typicall concave and had their greatest slopes near the tops of the ridges where the coarsest slabs and boulders were exposed. Slope decreased flankward where increasing sediment was obtained. In moving upward we kept crossing ridge after ridge at a steep angle, about 20-30o to our transect.

about 3/4 of the way up we encountered a massive, reddish-brown outcrop or perch
ed plate having an aggregate thickness of 1.5 to 2 m, with very irregular shape
and unknownlateral extent. We were anxious to reach the top and so did not sto
p to investigate it further, because no immediate moat and undercutting with out
cropping sediment was noted. On top of the feature the hills and valleys apparen
tly continued.

We picked up a reddish-brown small slab that turned out to be la
rger than we thought by holding the jaws of the fingers open and drifting into t
he rock. Just before this we tried to find an open patch of the black-speckled,
gray carbonate sand to slurp up. It proved difficulat because the patch chosen
was vacuumed clean in only 2 cm below which there was a reddish-orange hard sub
strate.

Inside video camera proved to be a big disappointmentbecause it was ap
parently on autofocus most of the time, spending our expectations on beautiful c
overage of the port plexiglass with hazy shapes of the outside stuff. Hard way t
o learn that maintaining fixed focus is not the way.

Discussion of phosphorite distribution: The results of this dive
suggested that in some areas the nature of sediments is intimately connected wi
th topographic variability, steeper slope resulting in much greater erosion and
thus exposure of larger plates. Why this should be so is less clear, because the
presence of phosphorite slabs of a given size must be dependent on their presen
ce in an eroded formation, since these objects are sitting loose on a hard bott
om and seem not to have been formed in place, but are lag deposits from a since
eroded and ruptured stratum. are obvious not formed in place. One possibility i
s that whereas the general height of the topography may reflect the remnant of T
ertiary rocks underlying the pavement, the more local "wrinkles" are due to vari
ability of resistent phosphorites that got left behind the winnowing process. Th
ese would naturally form larger slabs and boulders than the thinner phosphatic h
orizons. If correct, this concept would relate the variability in phosphate hori
zon thickness to difference in topographic relief between valleys and ridges. Th
is was about 2 m to rarely as much as 4 - 5 m. This would imply that one might
find as much as 5 m thickness of phosphorite in some locations.

Fauna

Fauna includes red sculpins from 8 cm to 40 cm long, a slender grayish s
ilver fish with a flat parallel tail and projecting curved fin behind head (o -2
0 cm), and a yellowish green metallic fluorescent fish somewhat similar to a sc
ulpin without massive head, also perching on rocks with forefins, 14-20 cm long.
Other fauna are hydroids of many kinds, including a massive reddish orange typ
e with coral-like polyps (somewhat resembling a miniature nuclear power cooling
tower), pure white horny corals resembling ornate candelabra, and the a feathery
soft coral that sometimes encrusted every cobble and boulder, and a bush-like g
orgonian that reached to 2 m. in height. Small reddish polyps were common as we
re omnipresent bryozoans, tunicates, and sponges. Barrel sponges were more rarel
y noted, and then near large plate areas.

Higher up on the slope red crabs with very long claws which were stretch
ed when the crabs noted the invading sub (length from 10-20 cm, a squat, white t
o yellowish green crab with short claws and not exhibiting defensive motions (ca
rapace about 20-25 cm), sea urchins invarious sizes and spine lengths, from 4-5
cm to massive "night lamp" types, 20 cm or more. The spiny urchins were very com
mon and are well represented in the carbonate debris sucked up with the slurp gu
n. Toward the largest outcrops we observed small schools of silvery fish with lo
ng curved tail fins like ornate goldfish have. Fish length about 5 -7 cm. Also t
wo large grouper were passed by the sub going in opposite direction. One octopus
was found climbing around an undercut rock, which type was always a favorite hi
ding place for some organism. A variety of small creeping organisms lived in the
sands, which we could not really investigate. They were fairly mobile, and may
have moved out of the way when we maneuvered the slurp gun into position.

NURC/UNCW

SUBMERSIBLE DIVE LOG

(14)

Cruise: Blake Plateau Dive #: 1890 Date: 7/4/90

Location: Line 15 Fag

Start Time: 1329 End Time: ______ Max Depth: ______

Personnel: Popenoe Slater

Mission/Dive Objective: Continue traverse across line 15 "mesa" of Paleocene erosional remnant

Photographs: Forward ______ Aft ______ Handheld ______

Video Tapes: 1/2" VHS ______ 3/4" Umatic ______ 8mm ______

Samples Collected: One vacuum sample

Equipment Deployed/Retrieved: ______

Brief Description of Dive:

Approx. Time	Event/Activity
1333	20°C at 230'
1335	380' 16°C
1337	[illegible]
12°C	750' – lots of [illegible]
	bottom in sight 20' above
870'	current ESE at [illegible] 3/4 knot
	1343 on bottom – [illegible] of [illegible]
	visibility [illegible]
1428	920' – lift off bottom after
	examining a snowbug?

14

SUBMERSIBLE DIVE LOG

Approx. Time	Event/Activity
	The major discovery of this dive was that the "gravel" (pea sized) and sand overlies continuous unbroken pavement at about 1 1/2 inch depth. When we tried to make skid marks with the sub, we bounced off the cobbles at the seafloor [illegible] push them into the sand. When we vaccummed the sand away, a hard pavement was underneath. [illegible] whole dive the bottom consisted of fist-sized and slightly larger cobbles littering the bottom.
1445	On surface

NURC/UNCW

SUBMERSIBLE DIVE LOG

Cruise: 90-OR-SUB-Poplar Dive #: 1891 Date: 7/4/90

Location: Lat 32°17.6' Long 78°26.2'

Start Time: 1637 End Time: 1806 Max Depth: 1120'

Personnel: J. Henry, Obs.; R. Wickland, pilot

Mission/Dive Objective: to observe area of irregular topography along Gilbert Line

Photographs: Forward 50 mm Aft — Handheld none

Video Tapes: 1/2" VHS _____ 3/4" Umatic _____ 8mm ✓

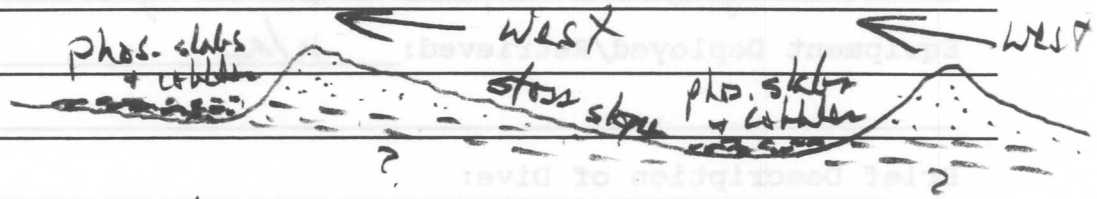
Samples Collected: 2 sediment samples, one on reaching bottom, second at point of ascent

Equipment Deployed/Retrieved: n/a

Brief Description of Dive:

Approx. Time	Event/Activity
1654	on bottom, 1070 ft slabs, cobbles and pebbles strewn over sandy rippled bottom. Vis. 50-60 ft current ~ .5 kt. Transect heading 270°
1700-1724	transect crossing highly rippled bottom i.e., sand waves, megaripples superimposed with smaller ripples sandwaves 3-4 m. high and 30+ meters long, ~~the~~ with

SUBMERSIBLE DIVE LOG Page ___ of ___

Approx. Time	Event/Activity
	wave crests oriented N/S. Flatter areas between the larger bedforms also rippled with occasional phos. pebbles & cobbles. Sed sample taken at 32°17.43' 78°26.28' @ 1308 hrs
1724-1731	similar to above sandwaves vary in length and height but crest remain N/S.
	
1731-1120	gradual decrease in large bedforms w/ increase in rock outcrops. Sample #2 taken @ 32°17.37' 78°26.81'
	Summary: Transect on [redacted] WEST heading ~270° across continuous field of sandwaves with steep lee slopes facing WEST. Rock "outcrops" often occur at base of lee slope. Wave crests N/S. Length several meters to 10's of meters, heights up to 4-5 meters, spectacular sight!

NURC/UNCW

SUBMERSIBLE DIVE LOG

Cruise: J. W. Powell Dive #: 1892 (16) Date: 7-4-90

Location: Southern area

Start Time: 1825 End Time: 1953 Max Depth: 1140

Personnel: J. R. Woolsey

Mission/Dive Objective: observe and sample bottom

1140

Photographs: Forward 35 mm (6) Aft ______ Handheld ✓

Video Tapes: 1/2" VHS ______ 3/4" Umatic ______ 8mm ✓ 20 min

Samples Collected: 2 sand samples, no rock

Equipment Deployed/Retrieved: ______

Brief Description of Dive:

Approx. Time	Event/Activity
1855	on Bottom: 1140; sandy flat surface with patches of ripple marks, wave [illegible] height 2 cm, orientation long axes N-S.
1915	Samp #1. fine to med sand on top of flat pavement, ~ 2 cm. thick.
1920	Samp #2 fine to med sand in flat area near pavement with well developed ripple marks
1925	Rock Samp: 4 attempts failed, all rock securely attached to pavement. Surface very rough and karst-like
1937	Dept. bottom

(OVER)

SUBMERSIBLE DIVE LOG Page ___ of ___

Approx. Time	Event/Activity
NOTE:	No sand waves (mega ripples) were observed, with greater than ~~about~~ a 2m. wave length. Sand occurred in thin sheets overlying flat pavement or dispersed through the more rough, irregular rocky surfaces referred to as "Karst-like". All rock appeared to be phosphorite similar to that observed on earlier dives of this cruise.

NURC/UNCW

SUBMERSIBLE DIVE LOG

Cruise: _____ Dive #: 1893 (17) Date: 7-4-90

Location: 32°17.30' 78°27.00'

Start Time: 2012 End Time: 2115 Max Depth: 1140

Personnel: Evans/Wicklund

Mission/Dive Objective: Explore the unknown & boldly go where no man has gone before..,

Photographs: Forward 9 Aft _____ Handheld _____

Video Tapes: 1/2" VHS 63 min 3/4" Umatic 20 min 8mm _____

Samples Collected: 2 sediment samples

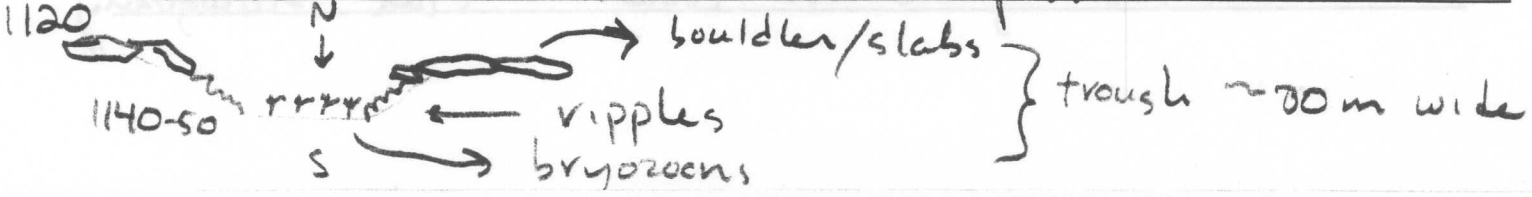
Equipment Deployed/Retrieved: _____

Brief Description of Dive:

Approx. Time	Event/Activity
2012	deployed
2025	on bottom ~90'
	fine-medium sand rippled
	w/ variable small cobbles to boulders
	ripple crest oriented N-S → westward
	transport; coarser carbonate debris
	in lee side ripples - crests semi-parallel-
	sand drifts accumulate downdrift lunate
	side rock
	heading south into ~ flat biologically

SUBMERSIBLE DIVE LOG Page ___ of ___

Approx. Time	Event/Activity
	active bottom - covered w/ small mounds & burrows - burrows possess small accumulation of pebbles → active reworking if not bio-erosion - numerous bryozoans (stalked, 5-8 cm high; even distribution 5-10 cm
2039	sed. sample #1 (bio-active bottom area)
	current westerly 3-5 cm/sec
2045	back into rippled sand ripples very fresh - appear active
2046	Sed. Sample #2 (pebbly bottom) w/ intermittent cobble/boulder
2051	turn to south, moving up slight slope rocks/ripples ~~over~~ bottom
2055	extensive rock depth 1120'



1893

medium 1120'
fine
sand cobbles/boulders

ripples oriented E-W (transport to west)

cobbles, boulders intermittent
10 cm's to

bottom flat, mounds stalked bryozoans
little physical structure

1140' Sample 1 2039

current westerly 3-5 cm/sec

back to rippled sand w/ cobble/boulder
ripples fresh lunate

(1140) sample 2 pebbly bottom 2046
intermittent cobble/boulder

2051 turn to S. head upward

rocks - ripples 1120
10's cms - 200 cm across

linear joint crossing several
boulders & slabs

trough ~ at least 100' across
& ~~~~ 100' ft length
crossed / area of boulder/cobble
⊥ extending into trough

NURC/UNCW

SUBMERSIBLE DIVE LOG

Cruise: 90-OR-SUB-POPENOE Dive #: 1894 Date: 7/5/90

Location: BLAKE PLATEAU

Start Time: 9:00 AM End Time: 10:05 PM Max Depth: 580

Personnel: PAUL HUDDLESTUN

Mission/Dive Objective: TRAVERSE, DESCRIBE, AND SAMPLE SEA BOTTOM

Photographs: Forward ✓ Aft _____ Handheld 3

Video Tapes: 1/2" VHS ✓ 3/4" Umatic _____ 8mm _____

Samples Collected: 2 SEDIMENT SAMPLES, ONE ROCK (PHOSPHATE) SAMPLE

Equipment Deployed/Retrieved: _____

Brief Description of Dive:

Approx. Time	Event/Activity
1 hr, 5 min.	TRAVERSING INNER PLATEAU, DESCRIBING AND SAMPLING THE [illegible] TYPE, DISTRIBUTION, APPEARANCE, AND NATURE OF THE BIOTA; AND TO DETERMINE, IF POSSIBLE, ANY PATTERNS OR RELATIONSHIPS BETWEEN THE ABOVE.

SUBMERSIBLE DIVE LOG Page ___ of ___

Approx. Time	Event/Activity

Dive 19 F.T. Manheim

Arrive bottom 10:49, 600'. Gray-brown carbonate-rich sandy sediment with white specks. "Moon landscape" appearance with many small pits and depressions, 1-2 to 4-5 cm. Fine pebbles. Take NE traverse. Very little current.

10:50 School of small fish, 4-6 cm.

10:53 Shallow ridge, 1.5 m height with phosphorite ledges

Bucking direction of traverse ca. 5 cm/sec

10:53.5 Rippled bottom with burrows; 50 cm fish

10:54 Heading into permanent current direction, judging by ripples, approximately 10 cm trough, 3 cm height, with present current about 1/4 knot

10:56 "Desert" gray brown carbonate sand with ridge visible ahead. Ridge crest has 3-4 m elevation over mean interridge area and consists of coarse rubble, with many sponges and crenulated organisms, sea pork, and a tropical fish, round bodied from side but very thin head on. Vertical black stripe on body, 20 cm long. at about 60 m/minute the ridge crests here appear to be about 200 m apart.

10:57 Big slab

10:59 Big undercut slab with depression all around it. Turbidity increases, corresponding to increase in current velocity. One cannot evidently judge current movements from scour zones around boulders, because fish are evidently able to create same effect. Elsewhere on dives I and others have noted fish fanning their tails while they hover at base of boulders.

11:00 Gray brown sand bottom, visibility 10 m; depth 600' no net change. Valleys and ridges are not on a net slope

11:05 Ridge and steep dropoff, 15m; first sign of dark pea-gravel ripples.

11:09 Continue NE traverse; current 3 cm/sec
Mud scarp (slightly cemented sediment)

10:10 Slurp sample into gray-brown mud; no especial dark chips 600'

10:14 Ridge with phosphorite

10:15 Ripples crossing at 45o angle to traverse, light faces forward

11:16 First big hole, 1/2 m diameter; dark coaly particles around

Dive 19 F.T. Manheim

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11:16 First big hole, 1/2 m diameter; dark coaly particles around

NURC/UNCW

SUBMERSIBLE DIVE LOG

Cruise: Delta Dive #: 1896 Date: 3/7/90

Location:

Start Time: 1352 End Time: 1645 Max Depth: 700 m

Personnel: WILSON / SLATER

Mission/Dive Objective: Investigation of lowered depression

Photographs: Forward Aft Handheld

Video Tapes: 1/2" VHS 3/4" Umatic 8mm

Samples Collected:

Equipment Deployed/Retrieved:

Brief Description of Dive:

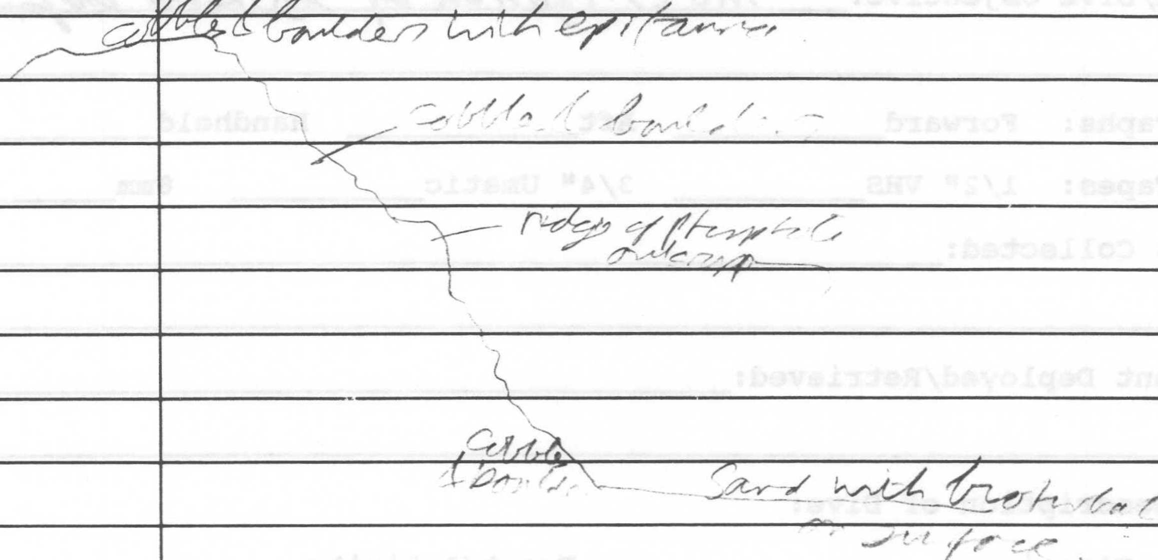
Approx. Time	Event/Activity
	Sample taken on floor at point of descent
	Proceeded towards ridge which was seen to consist of cobbles boulders & pebbles of phosphorite.
	Ascended ridge and circled about to investigate.
	Found second ridge with slope of ca 25° up to 40' high. Phosphate overhang seen with up to 50cm overhang up to 20cm thick

20

SUBMERSIBLE DIVE LOG

Page ___ of ___

Approx. Time	Event/Activity
	Proceed up ridge with phosphorite pavement outcrop associated with cobble & boulder ridge. Epifauna well developed.



NURC/UNCW

SUBMERSIBLE DIVE LOG

Cruise: Popenoe-Delta – Blake Plateau Dive #: Dive 1897 Date: 7/5/90

Location: on Fay line 11, Levied channel.

Start Time: 1527 End Time: _____ Max Depth: _____

Personnel: Obs: Popenoe, Pilot Bob Wicklund

Mission/Dive Objective: To investigate origin of levies along deep channel → to Obtain sample of substrate

Photographs: Forward _____ Aft _____ Handheld _____

Video Tapes: 1/2" VHS _____ 3/4" Umatic _____ 8mm _____

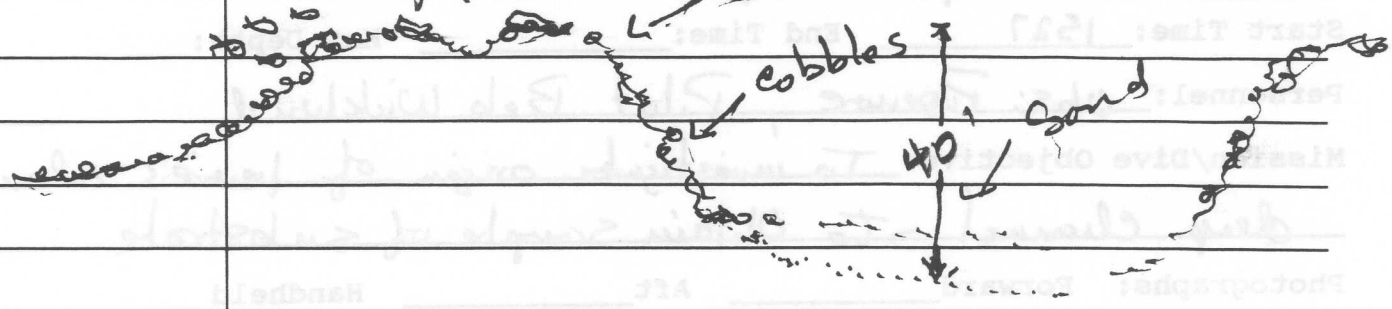
Samples Collected: _____

Equipment Deployed/Retrieved: _____

Brief Description of Dive:

Approx. Time	Event/Activity
1538	On bottom – no current
	680' of water
1607	Start up
	The dive crossed a phosphorite rubble hill and went into a deeper depression. The hill was the "levy" of the depression seen on the Fay #1 seismic record. The depression was sand floored, with lots of cobbles right at the slope breaks. The hill ("levy") looked like a pile of cobbles; some larger slabs also

SUBMERSIBLE DIVE LOG Page ___ of ___

Approx. Time	Event/Activity
	that formed a high around the depression lots of fish cobbles and slabs 

NURC/UNCW

SUBMERSIBLE DIVE LOG

Cruise: Delta, Blake Plateau Dive #: 1898 Date: 7/5/90

Location: 32°41.35' 78°05.82'

Start Time: 1633 End Time: 1714 Max Depth: 688'

Personnel: Obs: Henry Pilot: Slater

Mission/Dive Objective: to observe channel/levee system

Photographs: Forward ✓ Aft _____ Handheld _____

Video Tapes: 1/2" VHS _____ 3/4" Umatic _____ 8mm ✓

Samples Collected: one (1) slurp sample

Equipment Deployed/Retrieved: N/A

Brief Description of Dive:

Approx. Time	Event/Activity
1646 to 1705	on bottom proceed on westerly heading. sand patches but mostly low ridges of phosphatic pavement. no channel/levee systems seen. slurp sample taken at entrance to Tilefish Knolls.

SUBMERSIBLE DIVE LOG

Approx. Time	Event/Activity

(1)

NURC/UNCW

SUBMERSIBLE DIVE LOG

Cruise: R/V Powell Dive #: 1899 Date: 07/5/1998

Location:

Start Time: 5:32 End Time: 6:10 Max Depth: 685 ft

Personnel: Pilot: Bob Scientist: Faisal Idris

Mission/Dive Objective:

Photographs: Forward Aft Handheld none

Video Tapes: 1/2" VHS 3/4" Umatic 8mm √- short time

Samples Collected: None - no sampling gear was on board

Equipment Deployed/Retrieved:

Brief Description of Dive:

Approx. Time	Event/Activity
~5:41	on bottom at 685 ft. Transect heading southwest; Landing was on a flat, sandy bottom with extensive organism tracks, trails, mostly of starfishes - some small fishes and many starfishes were seen here.
	Heading southwest, the terrain became covered with phosphorite cobbles and some boulders which

Approx. Time	Event/Activity
	were encrusted with organisms, mostly hydroids. In this zone there was a higher concentration of small exotic fishes, medium size tile fishes (largest one seen was about 1 ft), starfish. This phosphoritic cobbly zone extended for about 30–40 ft and was followed by a flat, sandy bottom analogous to the landing site. Except for organisms, trails and tracks, the sand surface was featureless i.e. no sand ripples seen on the previous dives.
	Continuing the transect toward the SW, we came over another zone covered with phosphorite cobbles and boulders encrusted with organisms. A much more varied habitat was seen here, more small colorful fishes & starfishes.
	The phosphorite zones seen do not appear to be outcropping

(2)

NURC/UNCW

SUBMERSIBLE DIVE LOG

Cruise: R/V Powell Dive #: 1899 Date: 07/5/1990

Location: _____

Start Time: _____ End Time: _____ Max Depth: _____

Personnel: Idris _____

Mission/Dive Objective: _____

_____

Photographs: Forward _____ Aft _____ Handheld _____

Video Tapes: 1/2" VHS _____ 3/4" Umatic _____ 8mm _____

Samples Collected: _____

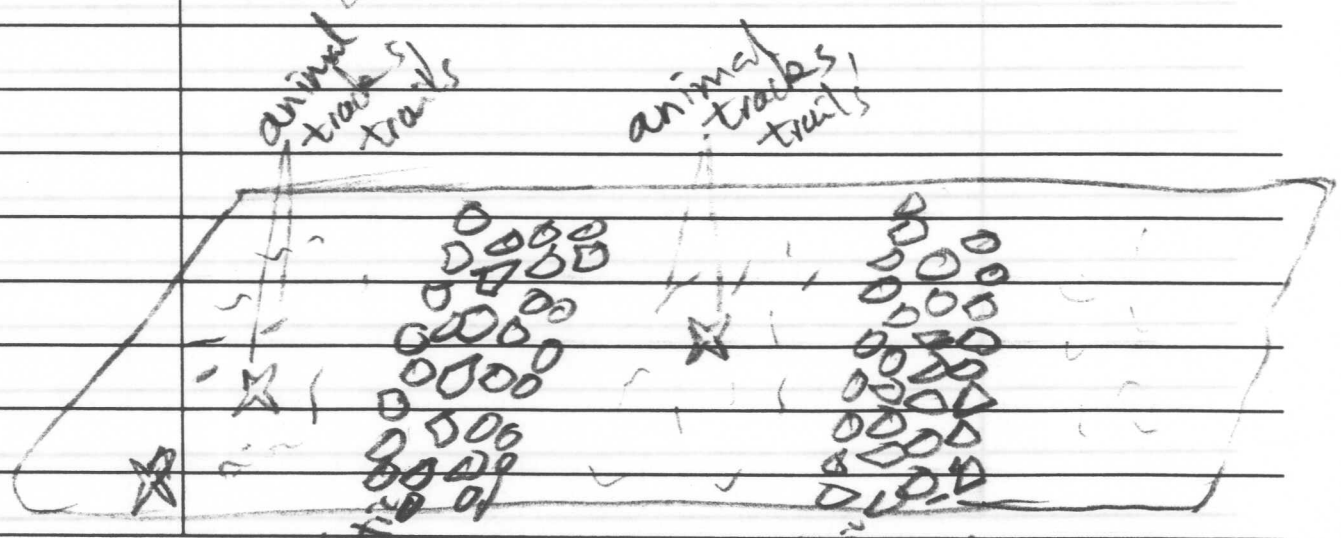
_____

Equipment Deployed/Retrieved: _____

_____

Brief Description of Dive:

Approx. Time	Event/Activity
	but rather constitute a rubble sitting on the sandy bottom.



SUBMERSIBLE DIVE LOG

Approx. Time	Event/Activity

Appendix 2: Bridge dive logs

DELTA LOG

Dive No: 1875 Date: 6/27 Time down: 1434 Max Depth: 550
Location: Toto Golding Cay Time up: 1524 PS 1 start/Fin.
Client: U of M Duration: 50
Purpose: Descriptive study Water Vis:
Pilot: R. Slater Sea State: 1
Observer: A. Bosellini Recorder: JR
Remarks:

Dive No: 1876 Date: 6/27 Time down: 1543 Max Depth: 550'
Location: Toto Golding Cay Time up: 1623 PS 1
Client: U of M Duration: 40 min
Purpose: Photo + video Water Vis: 200 (near surface) PS 5
Pilot: D. Slater Sea State: 1
Observer: ~~J~~ J. Kuntar Recorder: JP
Remarks:

DIVE DAY #14

Dive No: 1877 Date: 7/2 Time down: 1157 Max Depth: 565'
Location: 32°36.25' 78°26.18' Time up: 1249 ps. 6-10
Client: NURP / USGS Duration: 52 min hr: 22
Purpose: Recon Water Vis: 70' ex used all of dive
Pilot: B. Wickland Sea State: 3-4 I 2-3 min.
Observer: Frank Markheim Recorder: JP
Remarks:

Dive No: 1878 Date: 7/2 Time down: 1327 Max Depth: 590'
Location: 32°36.[illegible] 78°26.[illegible] Time up: 1413 ps. 11 - 3
Client: USGS / NURP Duration: 46 No HH
Purpose: Recon Water Vis: 70' few minute Interval
Pilot: D. Slater Sea State: 3-4
Observer: Peter Popenoe Recorder: JP
Remarks:

400' 1511 hrs.
300' 1514
110' 1521

550' 1556 hrs

18.5°C 440' ; 13.8° 565'
12:32 Pavement FOUND 550' heading SE.

on bottom 598' 1336 no current 13°C
to top of ridge at 580' (12° up slope)
32° 35.18' 78° 14.10' Fix on top of slope Sat Nav (good)
Heading SE 1345 hrs.
32° 36.72' 78° 23.09' 1349
32° 36.67' 78° 23.79' 1358
large dabs

(2)

DELTA LOG

Dive No: 1879 Date: 7/2 Time down: 1440 Max Depth: 595'

Location: 32°36.61' 78°24.01' Time up: 1529

Client: USGS/NURP Duration: 49 MIN

Purpose: Recon Water Vis: 70'

Pilot: B. Wicklund Sea State: 3-4

Observer: Jim Henry Recorder: J.P.

Remarks:

No external video
PS 53-86
Handheld 22-25
20 MIN HH I

Dive No: 1880 Date: 7/2 Time down: 1556 Max Depth: 600

Location: 32°36.53' 78°24.20' Time up: 1703

Client: USGS/NURP Duration: 67

Purpose: Recon Water Vis: <53'

Pilot: D. Slater Sea State: 3-4

Observer: John Wilson Recorder: JP

Remarks:

PS 87-189
HH 26-27
Tape I & I 8mm.

Dive No: 1881 Date: 7/2 Time down: 1727 Max Depth: 580'

Location: 32 36.56 78 24.30' Time up: 1823

Client: NURP/USGS Duration: 56

Purpose: Recon Water Vis: 50-60

Pilot: B. Wicklund Sea State: 3-4

Observer: Bob Woolsey Recorder: JP

Remarks:

P.S. 130-147
~~HH~~ Finished Role (1)
~~[illegible]~~

Dive No: 1882 Date: 7/2 Time down: 1840 Max Depth: 580'

Location: 32 36.5[illegible] 78 24.36' Time up: 1921

Client: USGS/NURP Duration: 41

Purpose: Recon Water Vis: <50'

Pilot: D. Slater Sea State: 3

Observer: Mark Evans Recorder: JP

Remarks:

PS 148-166
No HH
Tape 1 I

570' on bottom 1449 .25-.5knot current from S.
32° 36.71 78° 23.97' - taking first sediment sample.
Sample 1 at 580' - now heading north 1456 hrs.
32° 36.65' 78° 23.96' 1502 hrs.
Sample 2 570' 1514 hrs. on left side
Rock Sample 32° 36.58" 78° 23.91" 1517

---

on bottom 570' 1607 Slight current from S. .25 knots
Sample 1 580' 32° 36.57' 78° 24.03' good fix)
Rock sample 600' 32° 36.57' 78° 23.89' last fix

32° 36.61'N 78° 24.12'W 570' 1739
Sample 1 grey tape 1740 570' at above site.
Talus Slope 25° ~ 20' high (slab material) about 60' from fix above
Sample 2 (green tape) in ~~trench~~ ravine between two slopes. 1752
? Fix 32° 36.53 78° 24.20 Rock Sample.

On bottom 570' 1850 hrs. No current
32° 36.66' 78° 24.31' 1901 hrs 560' Top of ridge w/ slabs
32° 36.66 78° 24.3'

DIVE DAY #15
DELTA LOG

(3)

Dive No: 1882 Date: [illegible] Time down: 0828 Max Depth: 670'
Location: 32 34.96 78 21.01 Time up: 0932
Client: NURP/USGS Duration: 64
Purpose: Transect Water Vis: 50'
Pilot: B. Weekland Sea State: 2
Observer: Peter Popenoe Recorder: JP
Remarks:

PS - 0 - 10
8mm I: tape 2; I: Tape 1, H 1-1

Dive No: 1883 Date: [illegible] Time down: 1010 Max Depth: 650'
Location: 32 34.9 78 25.4 Time up: 1101
Client: N[illegible] Duration: 41 min
Purpose: [illegible] Water Vis: 50'
Pilot: [illegible] Sea State: 3
Observer: C[illegible] Recorder: [illegible]
Remarks:

PS 11 - 14
8mm I

Dive No: 1884 Date: 7/3 Time down: 1410 Max Depth: 880'
Location: 32 31.04 78 20.33 Time up: 1515
Client: USGS/NURP Duration: 65'
Purpose: [illegible] Water Vis: 40-50'
Pilot: [illegible] Sea State: 2
Observer: Paul Valentine Recorder: JP
Remarks:

PS 15 - 17
8mm I & II
HH - 2 - 5

Dive No: 1886 Date: 7/3 Time down: 1554 Max Depth: 875'
Location: 32° 31.06' 78 20.53 Time up: 1741
Client: NURP/USGS Duration: 120
Purpose: Transect w/ slope Water Vis: 30-40'
Pilot: D. Snider Sea State: 3
Observer: Frank Manheim Recorder: JP
Remarks:

PS 0 - 11
HH 4-32
Tape 2 I & II

Section missing

(4)

DELTA LOG

Dive No: 1887 Date: 7/3 Time down: 1823 Max Depth: 780'
Location: 32 30.59 78°20.21' Time up: 1943 Tape 2I not used
Client: USGS / NURP Duration: 80 HH 1-1
Purpose: Photo transect Water Vis: 30' PS 49-89
Pilot: Rob Wicklund Sea State: 2 Jim's 1/2" video
Observer: Jim Hoover Recorder: JP Tape 3I
Remarks:

DIVE DAY 16

Dive No: 1888 Date: 7/4 Time down: 0815 Max Depth: 1020'
Location: 32°22.26' 78°31.74' Time up: 1003 TAPE 4I 4E
Client: USGS / NURP Duration: 108 HH 1-1
Purpose: Photo / sampling Water Vis: 20-30' PS 90-140
Pilot: D. Slater Sea State: 1-2
Observer: John Wilson Recorder: JP
Remarks:

Dive No: 1889 Date: 7/4 Time down: 1035 Max Depth: 970'
Location: 32°22.63 78°31.15 Time up: 1255 PS 147-162
Client: USGS/NURP Duration: 140 min H-H 1-3 (USED ROLL)
Purpose: Photo Sample Water Vis: [redacted]-30'-40' TAPES 5I & 5E
Pilot: [redacted] R Wicklund Sea State: 1-2
Observer: F. Manheim Recorder: J.P.
Remarks: 32 23.3N 78 30.6 at 1315

Dive No: 1890 Date: 7/4 Time down: 1327 Max Depth: 920'
Location: 32°23.35' Time up: OK 1445 PS 163 - 169
Client: USGS Duration: [redacted] HH 1-1
Purpose: Photos / simple transect Water Vis: 20' Tapes 6I & 6E
Pilot: D. Slater Sea State: 1
Observer: P. Popenoe Recorder: JP
Remarks:

On bottom 760' [illegible]° 30.52' 78° 20.33' heading SE. 1832 hrs
working up [illegible] (current) [illegible]

heading SE at 18[illegible] 740' [illegible]

15° Slope 760' 45 [illegible] 740'

1st sediment sample 750' @ 19[illegible]
[illegible]

Moving across [illegible] up 5' slope [illegible]

Fix 32° 30.19' 78° 20.02' 1922
Sample 2 750'

On Bottom 1000' E current .25-.5 knots 0830
Fix 32° 22.29' 78° 31.77' 0840 1010' uniform rubble / Sand bottom
32° 22.30' 78° 31.63' 1020' 0846 hrs
32° 22.40' 78° 31.51' 1018' 0856 hrs
slow rise at 1008' 0901 hrs ; 960' 0910' ; 955' 0919
Sample 1 sediment 32° 22.65' 78° 31.05' 940' 0929
current almost .5 Knot by end of dive.

On bottom 970' E. current .25-.3 knots 32° 22.62' 78° 31.26' 1048

Starting transect to E. 1053 hrs.
32° 22.68' 78° 31.17' 940' 1102 hrs very gentle slope.
rubble bottom w/ boulders & sand 940' 1112 hrs
930' 1120 hrs
910' 1129 Same bottom type.
32° 22.90' 78° 30.68' 1133 hrs.
S.E current > .5 knots 1146 hrs 12°C ; 895' 10-15° slope 1145 hrs.
Current increasing
more ridges one 4m.
leveling [illegible] 25'

880 @ 12:12

830 picking up [illegible] 12:33
32° 23.33' | 78° 30.06'

Comming up 12:40 → 32° 23.55' | 78° 30.03'

Current > .5 knots 110° 870' 1343 32° 23.32' 78° 30.62'
Course 260° 1353 hrs. 210° 1355
32° 22.95' 78° 31.13' 1417 sediment sample
32° 22.96' 78° 31.20' 1425

7/4 DELTA LOG

Dive No: 1891 Date: ~~7/4~~ Time down: 1637 Max Depth: 1120'
Location: 32°17.6' 78°26.2' Time up: 1806 PS 170-230
Client: USGS Duration: 89 MIN HH 1-1
Purpose: samples / photos Water Vis: 50-60' Tapes 6I & 6E
Pilot: R. Wicklund Sea State: 1
Observer: Jim Henry Recorder: J.P
Remarks:

Dive No: 1892 Date: 7/4 Time down: 1827 Max Depth: 1140
Location: 32°17.4' 78°27.0' Time up: 1944 PS 231-235
Client: USGS Duration: 87 MIN HH 1-5
Purpose: [illegible] Water Vis: 20' Tapes 7I + 7E
Pilot: D. [illegible] Sea State: 1
Observer: [illegible] Recorder: J P
Remarks:

Dive No: 1893 Date: 7/4 Time down: 2012 Max Depth: 1140'
Location: 32°17.3' 78°27.0' Time up: 2115 P.S. 235-244
Client: USGS Duration: 1HR 3MIN HH. 5
Purpose: Samples/Photos. Water Vis: dark Tapes 7I & 7E
Pilot: L. R. Wicklund Sea State: 1
Observer: Mark EVANS Recorder: JP
Remarks:

DIVE DAY #17

Dive No: 1894 Date: 7/5 Time down: 0904 Max Depth: 620'
Location: 32 44.55 ~~78~~ 09.14 Time up: 1016 PS 1-28
Client: USGS Duration: 72 MIN HH 6-9
Purpose: Samples/observation Water Vis: 40' Tape 8I & 8E
Pilot: D. Slater Sea State: 3
Observer: Paul Huddleston Recorder: JP
Remarks:

1070' 1654 large rocks, ridges, large grain phosphorite + sand
32° 17.46' 78° 26.24' 1700 Sample 1 (slurp) large ripples
3m feature to W at 1090'; ~.5 knot current
32° 17.43' 78° 26.28' 1711 hrs. Flat sandy bottom w/ 2-3m ridges.
Ridges running N ⟷ S.; Still heading W. 1090' 1724 hrs.
1100' 32° 17.41' 78° 26.67 1731 hrs. Slab area quite different
1110' 32° 17.42' 78° 26.71' no more mega ripples - more rock 1710
32° 17.37' 78° 26.81' Find fix sample 2.
1120': left bottom @ 1849

1140' [illegible] bottom 1900 hrs sand [illegible]
Rock [illegible] 32 17.35 78 [illegible]
Heading SE 1910 sample #1 1917 hrs; Sample 2 1921 hrs
32 17.27' 78 26.76' Fix 1926 1118' [illegible] slab / rocky
32 17.28' 78 26.74' 1928 [illegible]

On bottom 1125' 2027 32° 17.26' 78° 27.[illegible]
Flat bottom/sand 1140 2034.
Sample 1 @ 1140.
" 2 @ 1140

*(Sample 1. 2039 / Sample # 2 : 2046)

590' on Bottom flat sand and rubble .25 knot current from E
Heading NW; down to slope rocky/rubble bottom 0922
changed heading to E. at 0924
Sample 1 0930
New heading N. 32° 44.62' 78° 09.21' 0933 600' 32° 44.65' 78° 09.24'
ridges 30-40' high with 80' wide valleys between.

(6)

DELTA LOG

Dive No: 1895 Date: 7/5 Time down: 1042 Max Depth: 60'

Location: 32°44.51' 78°09.11' Time up: 1154

Client: USGS Duration: 1HR 12MIN

Purpose: Recon/Samples Water Vis: 30-40'

Pilot: B. Wicklund Sea State: 3

Observer: Frank Manheim Recorder: J.P.

Remarks: PS 29-30 HH 10-36 Tapes 8I + 8E on whole dive

Dive No: 1896 Date: 7/5 Time down: 1340 Max Depth: 700'

Location: "Hole" site Time up: 1510

Client: USGS Duration: 90 min

Purpose: Observing Hole & lewies Water Vis: 30-40'

Pilot: D. Slater Sea State: 3

Observer: John Wilson Recorder: JP

Remarks: PS 31-92 HH-1-1 Tapes 9I & 9E

Dive No: 1897 Date: 7/5 Time down: 1528 Max Depth: 680'

Location: 32°41.35' 78°09.77' Time up: 1615

Client: USGS Duration: 47

Purpose: Water Vis: 40-50

Pilot: B. Wicklund Sea State: 3

Observer: P. Popenoe Recorder: JP

Remarks: PS 93-94 Tape 9I & 9E HH 1-1

Dive No: 1898 Date: 7/5 Time down: 1633 Max Depth: 688

Location: 32° 41.35' 78°09.82' Time up: 1719

Client: USGS Duration: 52

Purpose: Recon/photos Water Vis:

Pilot: D. Slater Sea State: 3-4

Observer: Tim Heany Recorder: JP

Remarks: PS 95-101 Tape 9I & 9E HH 1-1

595' @ 10:49 ON BOTTOM 32 44.47 78 09.17 (6)
Current from N > ¼ knot. heading NE Small ridges
610' @ 11:03
first sample all mud 600' — 11:15 620'
Sample 2 in depression 625' 2m deep 3m across
Soft sediment holes 3-4m across 1m.

On bottom 702' 1552 32° 40.97 78° 09.54' Sample 1 1555.
Heading E. at 8m ridge <690'
32° 41.17' 78° 09.60' 1423
710' coming up to another ridge (~400' between 1's)
662' 14 41 hrs.
32° 41.33' 78° 09.79' 1445
Sample 2 680'

On bottom 680' 1536 hrs 32° 41.33' 78° 09.85'
Heading East.
32° 41.34' 78° 09.76' 1548
Still heading E. depth 650' 1556
Sampling

---

on bottom 689' 1646
32° 41.35' 78° 09.82' 1654

DELTA LOG

Dive No: 1899 Date: 7/5 Time down: 1731 Max Depth: 685'

Location: Same as 1898 Time up: 1758 PS 102 -

Client: USGS Duration: 27 ~~HH +~~

Purpose: Recon Water Vis: ___ Video Tapes 9I & 9E

Pilot: B. Wicklund Sea State: 4

Observer: Faisal Idris Recorder: J.P.

Remarks:

Dive No: Date: Time down: Max Depth:

Location: Time up:

Client: Duration:

Purpose: Water Vis:

Pilot: Sea State:

Observer: Recorder:

Remarks:

Dive No: Date: Time down: Max Depth:

Location: Time up:

Client: Duration:

Purpose: Water Vis:

Pilot: Sea State:

Observer: Recorder:

Remarks:

Dive No: Date: Time down: Max Depth:

Location: Time up:

Client: Duration:

Purpose: Water Vis:

Pilot: Sea State:

Observer: Recorder:

Remarks:

38° 41.34' 78° 10.02' On bottom 1741

Appendix 3: NOAA-NURP Mission Coordinator's Daily Logs

Pre-Cruise meeting:

1. storage of scoop samples (baffled: 4 comp) ✓
2. punch cores (2)
3. # + type of samples per dive
4. Current meter + CTD
5. Airport in Morehead City ?

Date	Dive	Ext 35		Ext. video	Int. video	Int 35
7/1	1877	6-10	f 8.0 roll 1	~52 m. (T1)	2-3 m (T2)	0-22
	1878	11-33		T1	2-3 m. "	
	1879	53-86		T1	20 m. "	22-25
	1880	87-129		T1	X T1	26-27
	1881	130-147		T1	T1	27-36
	1882	148-166		T1	X T1	—
7/2	1883	0-10	f 8.0 roll 2	T2	X T2	1
	1884	11-14		T2	T2	
	1885	15-17		T2	T2	2-3
	1886	18-47		T3	T2	4-32
	1887	48-89		T3	Jim Henry 3E	1

roll 3 f 5.6

Option:

1. bag
ext. 35
int. video (out port side)

2.

Date	Dive #	Ext. 35	Ext. Video	Int Video	Int 35
7/4	1888	90 - 146	4E	4I	—
	1889	147 - 162	5E	5I	1-36 roll
	1890	163 - 169	6E	6I	—
	1891	170 - 230	6E	6I	—
	1892	231 - 235	7E	7I	1-5
	1893	236 - 244	7E	7I	—
7/5	1894	1 - 28	8E	8I	6-9
	1895	29 - 30	8E	8I	10-36
	1896	31 - 92	9E	9I	—
	1897	93 - 94	9E	9I	—
	1898	95 - 101	9E	9I	—
	1899	102 - 103	9E	9I	—
		458 shots	18 (120 min) tapes		4 rolls (inside)

section

Dive	Suction	Rock
.877	—	—
78	—	—
79	II	I
80	I	I
81	I	I
82	—	—
83	I	—
84	I	I
85	II	I
86	I	I
87	II	I
88	I	I
89	—	I
90	I	—
91	II	—
92	II	—
93	II	—
94	II	I
95	II	I
96	II	—
97	—	—
98	—	—
99	—	—
	25	11

Mission Coordinator's Daily Log

Mission Title: Dopence - CHARLESTON BUMP

Mission Coordinator: A. SHEPARD

Principal Investigator/Chief Scientist: P. Popenoe

Other Participants: P. Popenoe (USGS) R. Woolsey (UMiss)
F. Manheim (USGS) F. Idris (Skidaway)
P. Huddleston (GA State Geol. Survey) A. Shepard
V. Henry (Ga. State U) C. Alexander (Skidaway)
J. Wilson (UK Inst. of Oceanog. Sci.)
M. Evans (Emery U.)

Vessel Representative: Frank Wiltse

Name of Vessel: R/V. Powell

NOTE: Log should include dive location (LAT/LONG or TDs), personnel involved, tasks to be performed, times, deviations from Cruise Plan, interactions with personnel, problems, and other significant cruise events.

Cruise Day # 1 Date: 7 / 1 / 1990

TIME	EVENT
1230	Dave and I arrived State port Charleston, SC. Powell at pier, on + loaded 10 survival suits plus other gear, some scientists on site.
1400	Bob Wicklund indicated current meter and CTD not available.
1430	toured boat w/ J. Duggar, Frank Wiltse indicated 2400 departure

Mission Coordinator's Daily Log

Continuation Page ____ of ____

Cruise Day # 1 Date: 7 / 1 / 1990

TIME	EVENT
1857	All scientists on-board
1907	Pre-cruise meeting
	- NW → SE traverse for initial dives
	- first dive operational
	- no intervalometer
2140	- Safety briefing

Mission Coordinator's Daily Log

Mission Title: Charleston Bump

Mission Coordinator: Shepard

Principal Investigator/Chief Scientist: Popenoe

Other Participants: Same

Vessel Representative: —

Name of Vessel: R/V Powell

NOTE: Log should include dive location (LAT/LONG or TDs), personnel involved, tasks to be performed, times, deviations from Cruise Plan, interactions with personnel, problems, and other significant cruise events.

Cruise Day # 2 Date: 7 / 2 /19 90

TIME	230° EVENT
0800	Winds NSW 15 kts, partly cloudy, vis.
	10 nm, seas 3-6', seas 225°, 29.6 "Hg
	on station waiting to dive.
1157	launch Dive # 1977
	R. Wicklund / F Maakeim. Max D = 565'
	32° 36.25 78° 26.18
1254	end dive.

Mission Coordinator's Daily Log

Continuation Page ____ of ____

Cruise Day # 2 Date: 7 / 2 /19 90

TIME	EVENT
1327	Launch dive # 2 (1878) 32° 36.69 78° 23.96
	D= 590' Slater / Popenoe
1413	end dive
1434	Launch dive # 3 (1879), R. Wicklund, J. Henry
	Slurp sample (2) D= 595', 1 rock
	32° 36.61 78° 24.01'
1529	end dive
1556	Launch dive # 4 (1880) Slater / Wilson
	32° 36.53' 78° 24.20 D = 600', 1 slurp, 1 rock
1703	end dive
1727	launch dive # 5 (1881) Wicklund / Woolsey
	D=590' 32° 36.8' 78° 24.30, 1 slurp, 1 rock
1823	end dive
1840	launch dive # 6 (1882) Slater / Evans
	32° 35.51 78° 24.36 D= 568'
1920	end dive
	video (ext) did not work on dives
	1879-82. used int. video
1950-	set up seismic array, did not function
2200	Seismic traces of bottom but not enough
	power for sub-bottom

Mission Coordinator's Daily Log

Mission Title: 90 - OR - SCU - POPENOE

Mission Coordinator: SHEPARD

Principal Investigator/Chief Scientist: POPENOE

Other Participants: SAME

Vessel Representative: F Wiltse

Name of Vessel: R/V Powell

NOTE: Log should include dive location (LAT/LONG or TDs), personnel involved, tasks to be performed, times, deviations from Cruise Plan, interactions with personnel, problems, and other significant cruise events.

Cruise Day # 3 Date: 7 / 3 /19 90

TIME	EVENT
0723	Sunny, 2-3' seas, 10-15 kts ENE
0825	launch dive # 7 (1883) Wicklund/Popenoe
	obj.: to transect over ridge, on bottom = 640'
	sediment too hard, no sample
0842	32° 34.95 78° 23.98, transect to west
	0.5 kt current from east D = 665'
	32° 35.06 78° 24.70 sampling (1 slurp)
0911	coming up

Mission Coordinator's Daily Log

Continuation Page ____ of ____

Cruise Day # 3 Date: 7 / 3 /1990

TIME	EVENT
1020	launch Dive # 8 (1884) Slater/Alexander
	D = 650' 32° 34.9 78° 25.4
	one rock and one slurp sample
1101	end dive
—	seas up to 3-6'
1410	launch Dive # 9 (1885) Wicklund / Huddleston
	32° 31.05 78° 20.43 D = 880'
	slurp sample (2), one rock, 12°C = BT
1515	end dive
1540	launch Dive # 10 (1886), Slater / Manheim
	traverse upslope looking for phosphorite pavement
	BT = 13°C, D = 870'
	32° 31.07 78° 20.62
1741	end dive - one rock, one slurp
1823	launch Dive # 11 (1887), Wicklund / Henry
	D = 760' 32° 30.52' 78° 20.33'
	slurp samples (2) max d = 780' 1 rock
1943	end dive
—	did test strip for external camera
	f-stop was at 8, shots underexposed on
	rolls 1 + 2 (dives 1877-87), will do another strip
	and reset camera to 5.6
2000	- seismic recorder deployed (not working, same as last night)

Mission Coordinator's Daily Log

Mission Title: 90-OR-SUB-Popenoe

Mission Coordinator: Shepard

Principal Investigator/Chief Scientist: Popenoe

Other Participants: Same

Vessel Representative: F. Wiltse

Name of Vessel: R/V Powell

NOTE: Log should include dive location (LAT/LONG or TDs), personnel involved, tasks to be performed, times, deviations from Cruise Plan, interactions with personnel, problems, and other significant cruise events.

Cruise Day # 4 Date: 7 / 4 /1990

TIME	EVENT
0915	launch dive # 11 (1888) Slater/Wilson
	78° 31.74 32° 22.26
-	sunny, winds 5-10 (E), seas 2-3, *
-	max D = 1020
(TO-DO):	make ½ copy of tape, for J. Henry
	send a copy for comparison to Teder
-	1 slurp, 1 rock 32° 22.65 78° 31.05

To-Do: Send Frank Wiltse blue hole lit.

Mission Coordinator's Daily Log

Continuation Page ____ of ____

Cruise Day # 4 Date: 7 / 4 / 1990

TIME	EVENT
1035	launch dive # 12 (1889), Wicklund/Manheim
	32° 22.63 78° 31.15 Max D = 970'
	1 rock - 32° 22.33 78° 30.06
1255	end dive
—	video (ext) not available for last part
	of dive 1886; checked before 1889,
	working fine
1327	launch dive # 13 (1890) Slater/Popenoe
	32° 23.32 78° 30.62, 1-slurp,
	D = 920' 20' vis. BT = 12°C
1844	end dive
	transit to new dive site
1637	launch dive #14 (1891) Wicklund/Henry
1659	32° 17.6' 78° 26.24, slurp samples (2)
	max D = 1120'
1806	end dive
1827	launch Dive # 15 (1892) Slater/Woolsey
—	problems w/ video (ext) because batteries
	were low 1140' = D on bottom
	32° 17.384 78° 27.143
	Surf. T = 26° BT = 12°, slurp sample
1954	end dive
2012	launch dive # 16 (1893) Wicklund/Evans
	32° 17.3 78° 27.0, 2 slurps, D = 1125'

Mission Coordinator's Daily Log

Continuation Page 3 of 3

Cruise Day # 4 Date: 7 / 4 /19 90

TIME	EVENT
2115	end dive
—	batteries in SVS will require 12 hr.
	charge, must delay tomorrow until 0900
7/5/90	
0800	attempted to take a core (2016 core)
	using winch from USGS (B. Halley)
—	winch could barely lift core off
	deck, so used capstan to deploy
	core, barely worked, retrieved about
	3 cm of sand

Mission Coordinator's Daily Log

Mission Title: 90 - OR - SUB - Papenoe

Mission Coordinator: Shepard

Principal Investigator/Chief Scientist: Papenoe

Other Participants: Same

Vessel Representative: F. Wiltse

Name of Vessel: R/V Powell

NOTE: Log should include dive location (LAT/LONG or TDs), personnel involved, tasks to be performed, times, deviations from Cruise Plan, interactions with personnel, problems, and other significant cruise events.

Cruise Day # 5 **Date:** 7 / 5 /1990

TIME	EVENT
0903	launch dive #17 (1994) Slater/Huddleston
	32° 44.55 78° 09.14, SW winds 15-20 KTS
—	Sea state 3 (3-5'), sunny
.	Sand swells "30-40" Ft. high (32° 44.05 78° 09.24)
. —	2 slurp samples — 1 rock sample
1039	(HH: 1-16 4-28:DS.) ascent, max D = 620'
1045	sub up
1051	launch dive #18 (1995) Wicklund/Markheim

Mission Coordinator's Daily Log

Continuation Page ____ of ____

Cruise Day # 5 Date: 7 / 5 /19 90

TIME	EVENT
	32° 44.84' 78° 09.19' D = 580'
–	strongest current so far 1 knot
1125 –	2 slurps, Hand-Held rewind jammed, one rock in claw
1150	Ascent
1153	sub up, rock sample - older than Miocene
ext	TV rec'd viewed:

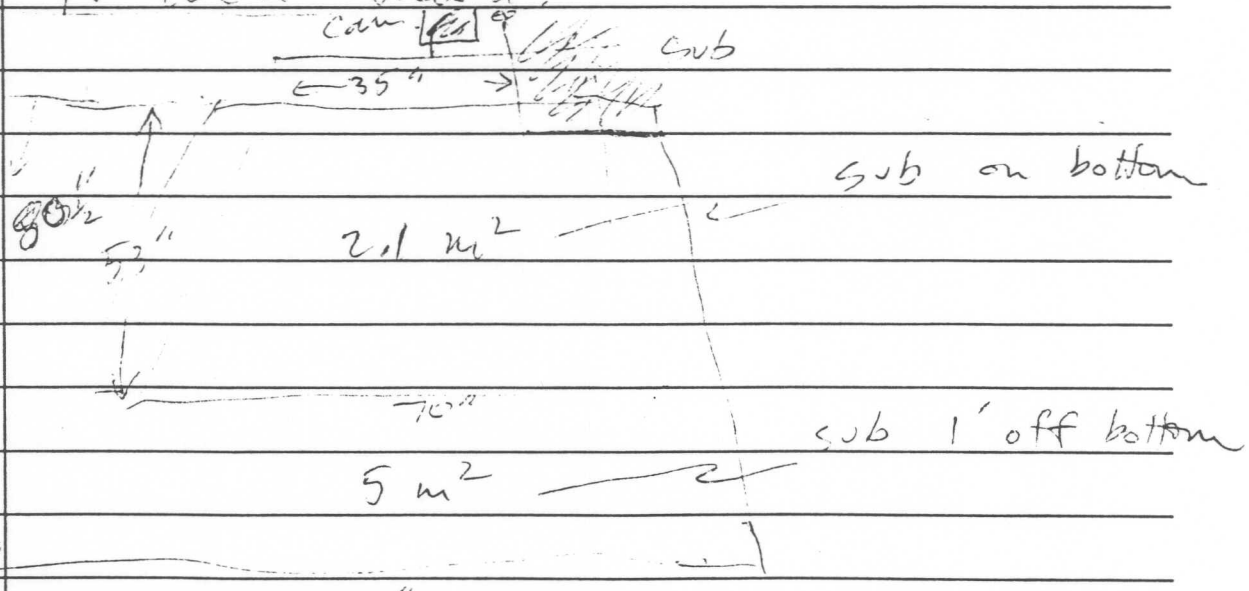


	photo data chamber – photo # date time
	x x x x x x x x x x
	still photo ext. camera – 1.25 m²

Mission Coordinator's Daily Log

Continuation Page ____ of ____

Cruise Day # 5 Date: 7 / 5 /19 90

TIME	EVENT
1340	launch dive # 19 (1896) Slater/Wilson
	Slurp 1 32° 40.97 78° 09.54
1422	9 m ridge 32 41.17 78° 09.60
	32° 41.33 78° 09.79 50' ridge
	slurp #2 max D = 690'
1500	ascent / end dive
1528	launch dive # 20 (1897) Wicklund / Pezzino
	32° 41.34 78° 09.76 D = 696'
	no samples
1635	end dive
	seas 3-6' wind ~ 20 kts
1633	launch dive # 21 (1898) Slater / Henry
	32° 41.35 78° 09.82 D = 688'
1654	32° 41.35 78° 09.82
	end dive
1730	Launch dive # ~~19~~ 22 (1899) Wicklund /
	Idris
	32° 41.35 / 78° 09.89 no pings
	32 41.34, 78 09.2701
1752	ascent
1800	Sub on deck
1930	en route to Morehead City

Appendix 4: NURC-UNCW Video Tape Log

NURC/UNCW VIDEO TAPE LOG (cont.)

Mission (PI): Browne **Dates:** 7/2 - 7/5/90

Dive System: Delta

Dive # (or surface)	Date(s)	Camera* (#-int. or ext.)	Recorder #*	Tape #(s)
1877	7/2	1-ext.	8 mm SONY WALKMAN	1-E
~~1878~~ "	"	1-int		1-I
1879	"	1E, 1I		1E, 1I
1880	"	~~1E~~, 1I		1I
1881	"	1E not working 1879-1882 + 1I		1I
1882	"	+ 1I		1I
1883	7/3	1E, ~~1~~ 1I		2E, 2I
1884	"	"		2E, 2I
1885	"	"		2E, 2I
1886	"	"		3E, 2I
1887	"	"		3E, ~~2I~~ J. Henry VHS
1888	7/~~4~~	"		4E, 4I
1889	~~7~~ "	"		5E, 5I
1890	"	"		6E, 6I
1891	"	"		6E, 6I
1892	"	"		7E, 7I
1893	"	"		7E, 7I
1894	7/5	"		8E, 8I
1895	7/5	"		8E, 8I
1896	"	"		9E, 9I
1897	"	"		9E, 9I
1898	"	"		"
1899	"	+ 1I		"

* Refer to cover sheets for numbers.

Film Roll Information

Date	Dive #	Leader (shot #)	Counter Start	Counter End	Total	Roll # ~~Devet.~~	Can #	Remarks
7/2	1877	Test strip	6	10	5	1	1	test strip off beginning appeared underexposed, test done on 7/3 so did not open (8 + 5.6) until roll #3
	78		11	13	3	1	1	
	79		53	86	34	1	1	f-9
	80		87	129	33	1	1	"
	81		130	147	18	1	1	"
	82		148	166	18	1	1	"
7/3	83		0	10	10	2	1	"
	84		11	14	4	2	1	"
	85		15	17	3	2	1	"
	86		18	47	30	2	1	"
	87		48	89	42	2	1	"
7/4	88	*	90	146	57	3	2	f 5.6
	89		147	162	16	3	2	"
	90		163	169	7	3	2	"
	91		170	230	61	3	2	"

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* Leader defined as the end of roll processor will encounter first.

* - counter not changed ? did not change after dive 1887, although first part of film was pulled off when f-stop was changed.

Appendix 5: UNRC-UNCW Submersible Photo Log

NURC/UNCW
SUBMERSIBLE PHOTO/VIDEO LOG COVER SHEET

Mission (PI): 90-OR-SUB-POPENOE **Dates:** 7/2/90

Dive System: Delta

External Still Camera(s):

No. I: Make/Model: Photo Sea (see Steve's notes)
Lenses (mm)/viewing angle:
Film type (mm):
Load capacity (ft):
Max depth (m):
Data chamber (Y/N):
If Y, what does code mean:

No. II: Make/Model:
Lenses (mm)/viewing angle:
Film type (mm):
Load capacity (ft):
Max depth (m):
Data chamber (Y/N):
If Y, what does code mean:

No. III: Make/Model:
Lenses (mm)/viewing angle:
Film type (mm):
Load capacity (ft):
Max depth (m):
Data chamber (Y/N):
If Y, what does code mean:

Strobe(s):

No. 1: Make/Model: Steve
Recycle time:
Energy output (watts-secs):
Max depth (m):

No. 2: Make/Model:
Recycle time:
Energy output (watts-secs):
Max depth (m):

No. 3: Make/Model:
Recycle time:
Energy output (watts-secs):
Max depth (m):

Use additional sheets as needed for other equipment.

External Video Cameras:

No. 1-Ext.:
Make/Model: See Steve
Tube type:
Lens (mm):
Angle-of-view (diagonal):
Resolution (lines):
Sensitivity (lux):
Signal-to-noise (dB):
Max depth (m):

No. 2-Ext.:
Make/Model:
Tube type:
Lens (mm):
Angle-of-view (diagonal):
Resolution (lines):
Sensitivity (lux):
Signal-to-noise (dB):
Max depth (m):

External Video Lights:

No. 1:
Make/Model: See Steve
Power (watts):
Beam pattern (°X°):

No. 2:
Make/Model:
Power (watts):
Beam pattern (°X°):

Video Recorders Used with External Cameras:

No. 1:
Make/Model: See Steve
Format (inches or mm):
Resolution (lines):
S/N ratio (dB):

No. 2:
Make/Model:
Format (inches or mm):
Resolution (lines):
S/N ratio (dB):

Internal or Surface Video Camera:

No. 1-Int.:
Make/Model: See Steve
Camcorder or deck separate:
Tube type:
Resolution (lines on tape, i.e., lowest of camera or deck):
Sensitivity (lux):
S/N ratio (dB):

No. 2-Int.:
Make/Model:
Camcorder or deck separate:
Tube type:
Resolution (lines on tape, i.e., lowest of camera or deck):
Sensitivity (lux):
S/N ratio (dB):

NURC/UNCW
SUBMERSIBLE PHOTO LOG

Mission (PI): Popenoe **Dates:** 7/2 - 7/5/90

Dive System: Delta

Camera System Information

Camera:

(see cover sheet for specs): See Steve (prev legs)

* Position: Height-_____ Angle-_____

Forward/Aft-_____

* Lens(mm):_____

* Aperture (f-stop):_____

* Film Type: (e.g., Ektachrome)_____

Format (mm)_____ Speed (ISO)_____

Strobe:

(see cover sheet for specs): See Steve (prev. legs)

* Position: Horizontal distance from camera in ft _____

S = stbd from camera, P = port from camera,

F = forward from camera _____

Vertical distance from camera in ft _____

A = above, B = below_____

* Input roll #'s, or "all," if same for entire mission. Each still camera has a roman numeral assigned to it, as listed on the cover sheet above. Thus, each roll of film will have a unique number which consists of the camera #, followed by the roll #, i.e., I-1, I-2, etc., and II-1, II-2, etc.

Appendix 6: Submersible Photography Parameters

PHOTOGRAPHY FROM DELTA

The following information should allow each submersible user to maximize their success with obtaining photographic documentation using the submersible DELTA.

35mm Photography with Interior Hand-Held Cameras

1. Prior to your first dive of the season, get a briefing from the submersible pilot or the camera technician regarding which ports are best for photography (the lower or middle starboard ports are usually used), the area which is covered by the electronic flash and approximate exposure with the film you are using (exposure card is posted in DELTA). Be familiar with the camera operation before diving (i.e. loading, rewinding, settings, etc.).

2. Before taking photographs, check to make sure the camera is loaded, that film is moving through the system (rewind knob should turn when the film is advanced), that the shutter speed is properly set, and that the sync cord is plugged into the correct socket. Release the shutter and make sure the electronic flash fires properly. Make sure the front of the lens is covered with a plastic/rubber hood to avoid scratching the interior port surface.

3. While taking photographs, BRACKET YOUR EXPOSURES. That is, adjust the aperature up to 2 f-stops around the basic exposure, expecially for valuable shots. Film and processing are cheap compared to the cost of your submersible time. The following exposure table is also posted in DELTA for your use; w/strobe, speed 1/250,

ASA 64	f2.8 - 4	Dark surface or over 7' away
	f4 - 5.6	Light surface
ASA 100	f4	Dark suftace or over 7' away
	f5.6	Light surface
ASA 200	f5.6	Dark surface or over 7' away
	f8	Light surface
ASA 400	f8	Dark surface or over 7' away
	f11	Light surface
ASA 1000	f11	Dark surface or over 7' away
	f16	Light surface

4. Near the beginning of the cruise, shoot about 1/2 of a roll of Ektacrome on the seafloor, with the flash, and the remainder on the ships deck (using a light meter for exposure). Process the film on board to insure everything is functioning properly (the camera, flash, exposure, etc.).

5. Be sure to have extra rolls of film in the sub on each dive. Keep all film sealed in containers while in the sub or while warming it up to ambient air temperatures after a dive to prevent condensation and avoid damage from moisture. A camera loaded in an air-conditioned room on the ship will fog up when put directly into the sub when diving in the tropics. Give camera and film plenty of time to warm up or cool down to ambient temperatures before diving. Label all film with date, dive number, scientist and exposure information; fill in similiar data on diving log.

35mm External Camera Photography

1. For the Photosea 35mm camera, add a 10-20 exposure leader to a new roll of film before starting actual photography on the seafloor. Check with camera technician or pilot to ascertain if the operation has been completed. There is no need to do this between dives but 2 or 3 exposures on the surface will separate dives on the same roll. Take picture of hand held camera information board before each dive.

2. Aiming the external camera is difficult. During transect photography, exact aiming is usually irrelevant. For documentation photography, however, it is critical. A series of overlapping photographs will help to insure one or several have the subject in the field of view. The area in each picture, when DELTA is sitting on the seafloor, is 1.25 sq. meters and the center of each picture is just aft of the observers starboard ports.

3. When starting operations in a new area, or if visibility changes dramatically, or with the camera in a new configuration, it is advisable to process a test strip on board the ship. This will confirm proper camera operation, focus, and exposure. SAVE and label the test strip with the same information on the film can.

4. Be sure the sub in very near or on the seafloor when taking photographs, unless the focus is fixed for other ranges or the depth-of-field allows for a wide latitude of distance.

5. LABEL all film containers with dates, dive numbers, scientists, number of exposures for each dive, exposure data, and if a test strip was processed. Fill in similiar data on diving logs after each dive.

6. Data on each photograph will include photo number (first three digits), dive date (next two digits) and time (24-hour clock - the last four digits).

Video Photography

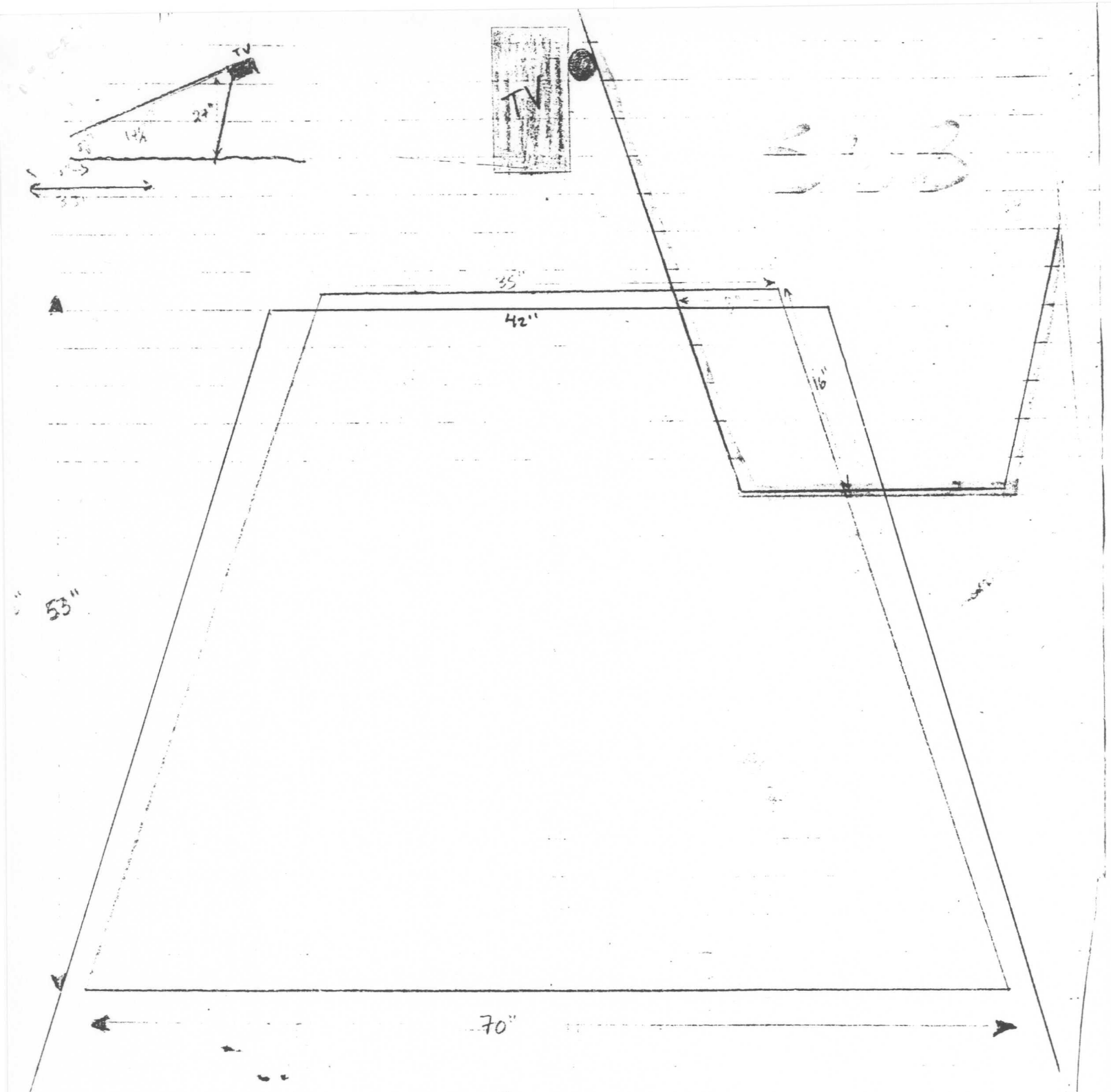
1. Each video system is unique. Check with the submersible pilot for proper operation of system being used. DELTA has both 1/2" and 8mm hand-held systems used within the submersible and an external 1/2" system. Use the internal system on the ships deck before diving to familiarize yourself with the controls.

2. During taping, occasionally check to insure that the cassette spindles are moving. Playback the tape occasionally to insure the system is working properly. An internal TV monitor can be viewed during a dive to insure proper focus and a good picture.

3. Hand-held system. Sharpest pictures are taken through the lower port or starboard portholes with both of the subs side-lights on. Any object more that 5´ away is difficult to see using the sub lights only. If upper portholes are used to photograph a flat seafloor, be sure to point the video camera down sharply. Cameras work best on manual vocus as the automatic focus keeps trying to focus on the port. DO NOT ADJUST CAMERA SETTINGS.

4. TALK on the video tape. At the beginning of each tape, record the date, time, dive number, location, and other critical information. Throughout the tape, note time, depth, position, and other observational information.

5. Label all tapes and remove tabs to insure they cannot be re-recorded. Fill in data on diving logs after each dive.



2.5 yd^2 or 2.1 m^2 (AREA OF TV COVERAGE WHEN SUB IS ON THE SEAFLOOR)

6 yd^2 or 5 m^2 (AREA OF TV COVERAGE WITH SUB IS 1' OFF THE SEAFLOOR)

91"

Photosea
SYSTEMS INC.
11120 ROSELLE STREET • SUITE J • SAN DIEGO, CA 92121
(619)452-8903 • TELEX 181797

PHOTOSEA CAMERA SYSTEM
PRE-DIVE/POST-DIVE
CHECK LIST

Dive No._____ Date _____

Description _____

_____

_____

Photo Technician _____

This check list is designed to provide offshore photo technicians a systematic procedure to make last minute checks of the PHOTOSEA camera system before a dive, to insure a successful photographic operation. The check list assumes that the technician has thoroughly studied the manual and is familiar with the equipment.

PRE-DIVE CHECK LIST BY

1. Camera/Strobe batteries full 12-hour charge . . . . . _____

2. Open strobe, turn 'ON' and make operational check if desired (using internal 'TEST' switch). Turn rear end bell switch 'OFF'. 'O' ring clean, lubricated, and housing closed using bench grip and strap wrench (or two strap wrenches).
   NOTE: Do not overtighten bench grip when holding strobe. Remember, it is only necessary to seat the 'O' ring when tightening housing threads. Overtightening can eventually damage the threads (see manual) . . . . . _____

3. Camera opened using bench grip or strap wrenches. Do not overtighten bench grip or housing threads (see manual) . . . . . _____

4. Camera data chamber set. All switches except data chamber switch 'OFF' . . . . . _____

5. Film loaded and 'TEST' actuation made to insure proper film advance (using 'TEST' switch). If 250 exposure cassette is used BE SURE INDEX TAB FITS INTO SLOT IN MAGAZINE OR FILM COULD JAM (see manual). Install film pressure plate. Install magazine cover . . . _____

6. If 250 exposure cassette is used with new 1000A or 2000A camera be sure knob on magazine cover assembly is turned to 'CASSETTE OPEN' position. Make another 'TEST' actuation. Turn rear end bell switch 'OFF'. . . . . _____

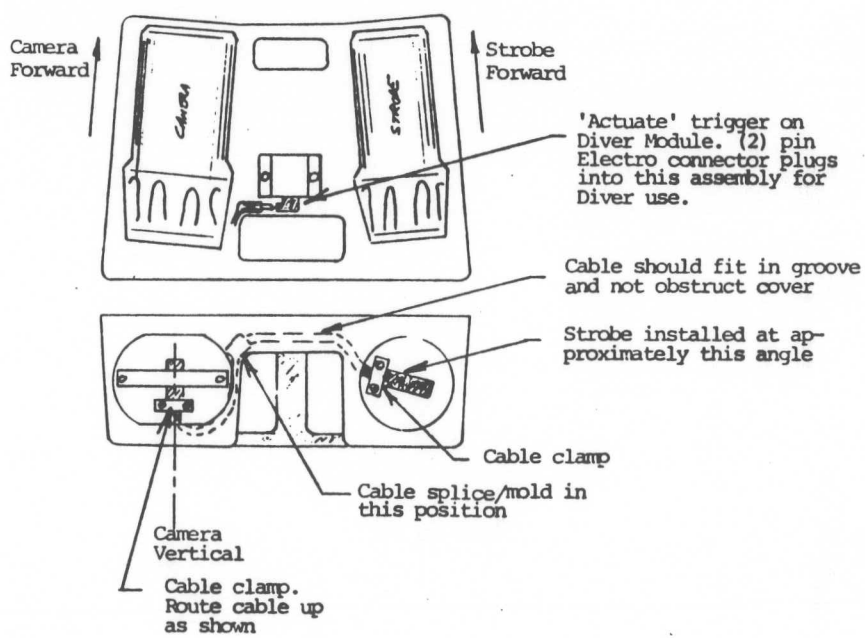
7. Set lens iris/focus. (NOTE: Be sure setting of both lenses is identical on stereo system) . . . . . _____

8. Window/lens(es) clean, 'O' ring clean and lubricated, and housing closed . . . . . _____

9. System cable connected to each unit and rear end bell cable clamps installed . . . . . _____

10. System Test - (If Diver RCV Module is used see below) Turn camera and strobe end bell switches 'ON' and make system test from remote 'actuate' contact closure (if operation o.k. turn switches 'OFF' until dive). . . . _____

11. Model 2000 Diver/RCV Module (if used)
    (A) Install camera into molded compartment with unit vertical and all the way forward. Be sure cable is routed up and not 'pinched' (see below) . . . . . _____



- Over -