

FINAL SUMMARY REPORT X-RADIOGRAPH AND RELIEF PEEL FINDINGS

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## INTRODUCTION

This is the third and final quarterly progress report describing work accomplished during the preceding quarter for the sediment studies portion of the environmental monitoring of the MAFLA lease area. This particular report is organized into three sections. The first section consists of a table which summarized all samples taken during the three cruises. Section two includes specific descriptions of all samples collected during sampling periods, I, II, and III, with regard to physical structures, biogenic structures, and degree of bioturbation (Table 1). Numerous stations were sampled twice during cruise III and, in these instances, it was the second set of data that was evaluated and incorporated in this report. Descriptions are based upon data provided by X-radiographs and relief peels. Section three is a concise final summary of the significance of these findings.

Table 1. Bioturbation Index Classification

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<u>Number</u>	<u>% of Bioturbation</u>	<u>Description</u>
0	0%	No observable burrowing
1	1-4%	Rare sporadic burrows with little bioturbation
2	5-30%	Burrows common, with up to 1/3 of core bioturbated
3	31-60%	Abundant. burrowing, up to 2/3 of core bioturbated
4	61-90%	Burrows very abundant with few primary layers visible
5	91-99%	Almost. complete bioturbation, only occasional primary layers visible
6	100%	No observable primary layers

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PART II

Cruise I

2101-K

No physical structures; bioturbation index classification (B.I.C.) #6,

2102-K

No physical structures; no distinctive biogenic structures; B.I.C. #6.

2104-K

No physical structures; 1 lined burrow (probably callinasa) in the lower left portion of the peel; BIC #6.

2105-K

No physical structures; 1 thickly lined arthropod burrow; BIC #6.

2106-K

No physical structures; BIC #6.

2207-K

No physical structures; numerous Polychaete burrows throughout; BIC #6.

2208-K

Faint-horizontal shell layering; some small Polychaete burrows; BIC 4-5.

2209-K

Shell concentration layer at a depth of 19 cm; no distinctive biogenic structures; BIC 5-6.

2211-K

No physical structures; BIC #6.

2212-K

Shell concentration layer at a depth of 3 cm; possible heart urchin traces and small Polychaete burrows; BIC #5.

2313-K

No physical structures; BIC #6.

2316-K

No physical structures; BIC #6.

2317-K

No physical structures; BIC #6.

2318-K

No physical structures; BIC #6.

2419-K

No physical structures; 1 long Polychaete burrow; BIC #6.

2420-K

Faint horizontal sandy laminations in the upper 1 -2 cm of sediment; a few small polychaete burrows; BIC #5-6.

2421-K

No physical structures; BIC #6.

PART I

Station Number

Samples Taken

	Cruise 1	Cruise 2	Cruise 3
2101	*	*	*
2102	*	*	*
2103		*	*
2104	*	*	*
2105	*	*	*
2106	*	*	*
2207	*	*	*
2208	*	*	*
2209	*	*	*
2210		*	*
2211	*	*	*
2212	*	*	*
2313	*	*	**
2314			*
2315		*	*
2316	*	*	**
2317	*	*	**
2318	*	*	**
2419	*	*	*
2420	*		**
2421	*	*	*
2422		*	*
2423	*	*	**
2424	*	*	*
2425	*	*	**
2426	*	*	**
2427	*	*	**
2528	*	*	**
2529	*	*	**
2530	*	*	**
2531	*	*	**
2532	*	*	**
2533	*		**
2534		*	**
2535	*	*	**
2536	*	*	*
2637	*	*	*
2638		*	*
2639	*	*	*
2640	*	*	*
2641	*	*	*
2642	*	*	*
2643	*	*	*
2644	*	*	*
2645	*	*	*

P

P

2423-K

No physical structures; BIC #6.

2424-K

An apparent shell concentration at a depth of 12 cm; no distinctive biogenic structures; BIC #5.

2425-K

Shell fragment concentration at 12 cm depth with gradational boundaries; no distinctive biogenic structures; BIC #5-6.

2526-K

Upper 15 cm consists of relatively shelly, coarse, sediment which is underlain by a much finer grained muddy sand; the boundary of these units is irregular and both beds intermingle at the contact zone; no biogenic structures; BIC #5.

2427-K

No physical structures; BIC #6.

2528-K

No physical structures; BIC #6.

2529-K

No physical structures; BIC #6.

2530-K

Some cross-bedded, coarse, carbonate material; no distinctive biogenic structures; BIC #4.

2531-K

No physical structures; 1 small Polychaete burrow; BIC #6.

2532-K

At 12-22 cm depth, partially bioturbated horizontal mud laminations are evident; several worm burrows; BIC #3.

2533-K

No physical structures; BIC #6.

2535-K

No physical structures; BIC #6.

2536-K

No physical structures; 2 small polychaete burrows, top left; BIC #6.

2637-K

No physical structures; numerous small worm burrows near the sediment surface; BIC #6.

2638-K

Faint-silt laminations truncated by burrowing activity; #5.

2639-K

No physical structures; BIC #6.

2640-K

At 10-14 cm depth, a wedge-shaped bed occurs which has a much higher shell content than the sediment above and below; no distinctive biogenic structures; BIC #4.

2641-K

No physical structures; 1 small polychaete burrow, BIC #6.

2642-K

Faint heavy mineral laminations; no distinctive biogenic structures; BIC #5.

2643-K

No physical structures; BIC #6.

2644-K

No physical structures; BIC #6.

2645-K

No physical structures; parts of two callinasa burrows are evident; BIC #6.

Cruise II

2101-K

No physical structures; some Polychaete burrows at the sediment surface; BIC #6.

2102-K

No physical structures; BIG #6.

2103-K

No physical structures; BIC #6.

2104-K

No physical structures; BIC #6.

2105-K

No physical structures; 1 thickly lined arthropod burrow; BIC #6.

2106-K

No physical structures; BIC #6.

2207-K

No physical structures; several small polychaete burrows; BIC #6.

2208-K

Several horizontal shell layers; some small polychaete burrows; BIC #4-5.

2209-K

No physical structures; 1 living pelecypos at 9 cm depth with siphons partially visible; BIC #6.

2210-K

No physical structures; a few small polychaete burrows; BIC #6.

2211-K

No physical structures; BIC #6.

221.2-K

Wavy-looking, silty laminations at a depth of 25 cm; no distinctive biogenic structures; BIC #4.

2313-K

No physical structures; some small-, thin polychaete burrows; BIC #6.

2315-K

Concentration of coarse shell hash material at 1.5 cm depth; BIC #6.

2316-K

No physical structures; no biogenic structures; BIC #6; ship log note - 2316-K (11) was significantly different from the other nine box core samples taken at that station in that it was much more fine-grained, better sorted, and less shelly; This sample is not as shelly as 2316-K (I) and also is finer grained.

2317-K

No physical structures; BIC #6; 2317-K (II) is finer-grained, less shelly, and better sorted than 2317-K (I).

2318-K

Shell concentration at 3 cm depth; part of 1 burrow is evident and is attributed to a siphunculid which was found in the peel; BIC #5-6.

2419-K

No physical structures; 1 long polychaete burrow; BIC #6.

2421-K

No physical structures; some small polychaete burrows near the sediment surface; BIC #6.

2422-K

No physical structures; 1 small worm tube in the lower left portion of the peel; BIC #6.

2423-K

No physical structures; 1 small polychaete burrow; BIC #6.

2424-K

No physical structures; BIC #6; 2424-K (11) is coarser than 2424-K (I) and contains more shell material.

2425-K

Upper 3. cm is slightly coarser than the underlying sediment with a fairly distinct boundary; 1 burrow which has been filled in with shell material is evident; BIC #5-6.

2426-K

No physical structures; 2 small worm tubes near the center of the peel and 2 large callinasa burrows at the bottom of the peel, 19 cm depth; BIC #6; 2426-K (II) is slightly coarser than 2426-K (I).

2427-K

At a depth of 29 cm, faint horizontal laminations are evident; no distinctive biogenic structures; BIC #5.

2528-K

No physical structures; BIC #6.

2529-K

No physical structures; BIC #6.

2530-K

Some cross-bedded coarse carbonate material; no distinctive biogenic structures; BIC #4.

2531-K

Faint horizontal layering with gradational boundaries; no biogenic structures; BIC #5.

253~y

No physical structures; BIC #6; 2532-K (II) resembles the upper 12 cm of 2532-K (I) but does not exhibit the partially bioturbated horizontal laminae that 2532-K (I) has.

2534-K

No physical structures; BIC #6.

2535-K

No physical structures; BIC #6.

2536-K

No physical structures; BIC #6.

2637-K

No physical structures; a few faint worm burrows; BIC #6.

2638-K

No physical structures; BIC #6.

2639-K

No physical structures; BIC #6; 2639-K (I) contains coarser and more abundant shell material than 2639-K (II).

2640-K

Several extremely thin cross-bedded laminae in the upper 5 cm; 1 very small worm tube at 14 cm depth; BIC #3-4; 2640-K (II) is considerably finer-grained than 2640-K (I) and contains much less shell hash.

2641-K

An inclined ("cross-bedded") thin shell concentration occurs near the sediment surface; 1 large worm tube at 18 cm depth; BIC #5; 2641-K (II) contains much more shell material than 2641-K (I) and is coarser grained.

2642-K

A near surface heavy mineral lamination; no biogenic structures; BIC #5.

2643-K

No physical structures; BIC #6.

2644-K

No physical structures; BIC #6.

2645-K  
No physical structures; BIC #6.

Cruise III

2101-K  
No physical structures, One well developed, long, shell-lined, polychaete burrow; BIC #6.

2102-K  
No physical structures; BIC #6

2103-K  
No physical structures "

2104-K  
No physical structures; BIG #6.

2105-K  
No physical structures; BIC #6.

2106-K  
No physical structures; BIC #6.

2207-K  
No physical structures; BIC #6.

2208-K'  
No physical structures; part of a polychaete burrow at a depth of 10 cm;  
BIC #6,

2209-K  
No physical structures; BIC #6.

2210-K  
No physical structures; abundant bivalves; BIC #6.

2211-K  
No physical structures; BIC #6.

2212-K  
No physical structures; BIC #6.

2313-KR  
No physical structures; BIC #6.

2314-KR  
No physical structures; BIC #6.

2315-K  
No physical structures; BIC #6.

2316-KR  
No physical structures; BIC #6.

2317-KR  
No physical structures; BIC #6.

2318-KR

Upper 8 cm is cross-bedded and underlain by 12 cm of totally bioturbated sediment; no distinctive biogenic structures; BIC 0 upper, lower BIC #6.

2419-K

No physical structures; BIC #6.

2420-KR

No physical structures; BIC #6.

2421-KR

No physical structures; BIC #6.

2422-K

Upper 6 cm are coarsely cross-laminated; underlain by bioturbated sediments; upper BIC 0-1, below BIC 6.

2423-KR

No physical structures; BIC #6.

2424-K

No physical structures; BIC #6.

2425-KR

No physical structures; BIC #6.

2426-KR

No physical structures; BIC #6.

2427-KR

No physical structures; BIC #6.

2528-KR

No physical structures; BIC #6.

2529-KR

No physical structures; BIC #6.

2530-KR

No physical structures; BIC #6.

2532-KR

No physical structures; BIC #6.

2533-KR

No physical structures; BIC #6.

2534-K

No physical structures; BIC #6.

2535-KR

No physical structures; biogenic structures possible heart urchin traces; BIC #6.

2637-K

Very faint, nearly totally bioturbated horizontal mud laminations; numerous burrow ; BIC #5.

2638-K

No physical structures; abundant burrows; BIC #6.

2639-K

No physical structures; BIC #6.

2640-K

No physical structures; BIC #6.

2641-K

No physical structures; BIC #6.

2642-K

No physical structures; BIC #6.

2643-K

No physical structures; BIC #6.

2644-K

No physical structures; BIC #6.

2645-K

No physical structures; no biogenic structures; BIC #6.

PART III

FINAL SUMMARY REPORT

Major objectives of this portion of the MAFLA study were to identify and describe animal.-sediment relationships and effect of benthic organisms on the sedimentary record. A total of 142 relief peels and 142 corresponding X-radiographs, collected during three sampling periods, has been described and examined for physical and biogenic sedimentary structures.

Analysis of relief peels and X-radiographs indicate a general lack of physically produced sedimentary structures. However, a few samples did exhibit physical sedimentary structures in the upper portion of the cores. For example, sample 2532-K (I) contained horizontal mud laminations and sample 2318-KR (III) showed distinctive cross-bedding. Lack of preserved physical sedimentary structures is attributed to the combined effects of a slow sediment accumulation rate and bioturbation infaunal organisms, i.e. , polychaetes, bivalves, gastropod, ophiuroides, etc. Most commonly, samples were represented by a bioturbation index number of 6 (Table 1), that is, no observable primary layers. Samples which have been 100% bioturbated (#6) are commonly churned to such an extent that distinctive biogenic structures (Lebensspuren) are not visible. Isolated Lebensspuren were observed in a few samples in which the bioturbation index value was less than 6 (5-1). For example, the X-radiograph for station 2638-K (III) exhibits abundant burrows, some of which were probably produced by Arthropods along with small numerous, well-defined, polychaete burrows. overall, the study area can be

characterized by a bioturbation index number of 6 regardless of depth, sediment type, etc. This statement is supported by Figures 1-2 and 3, which are maps indicating the distribution of bioturbation index numbers representing samples collected during the three cruises, Figures 4-9 contain photographs of the most representative relief peels and X-radiographs of stations along the 6 transects and also clearly support these findings.



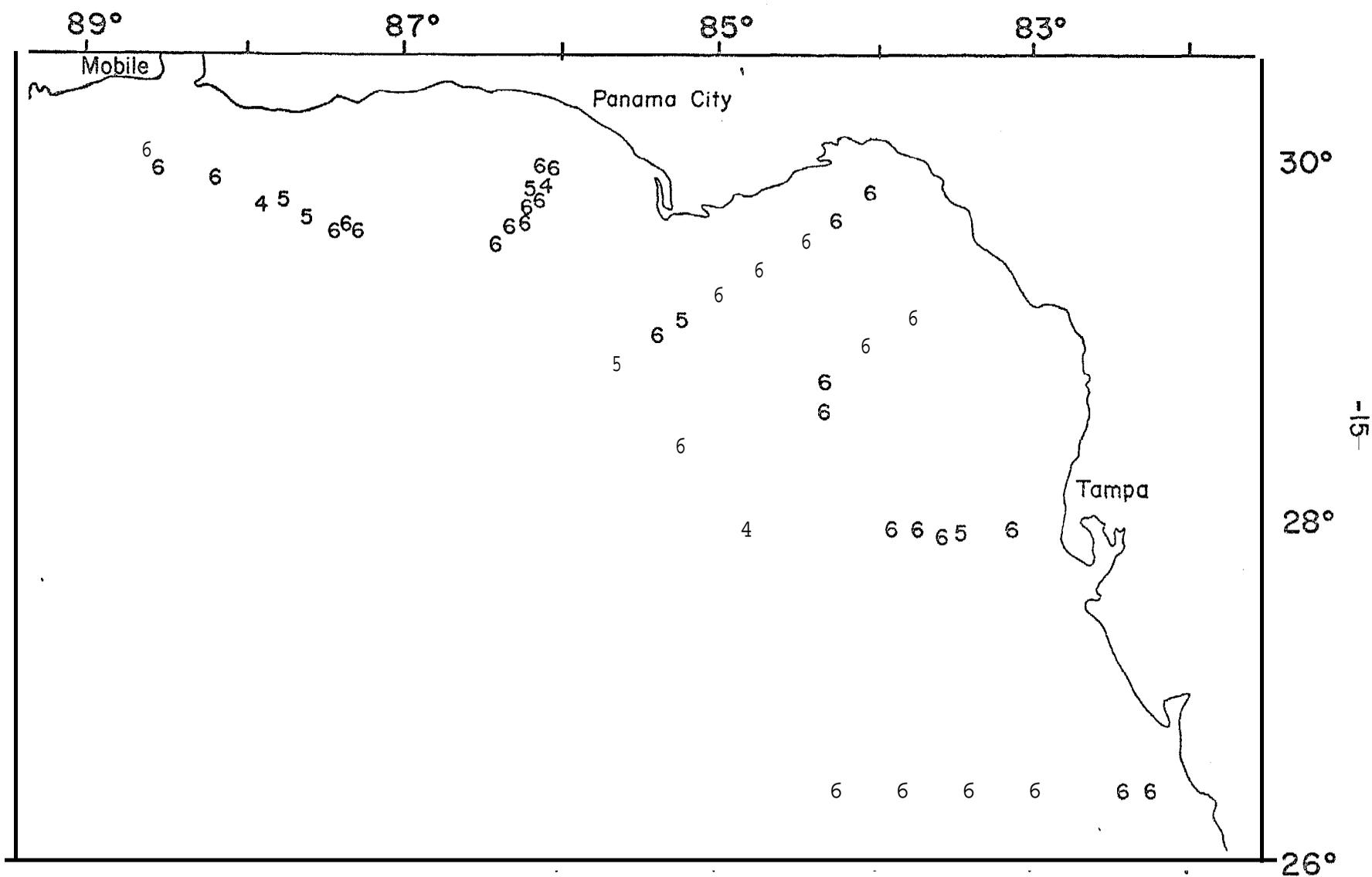
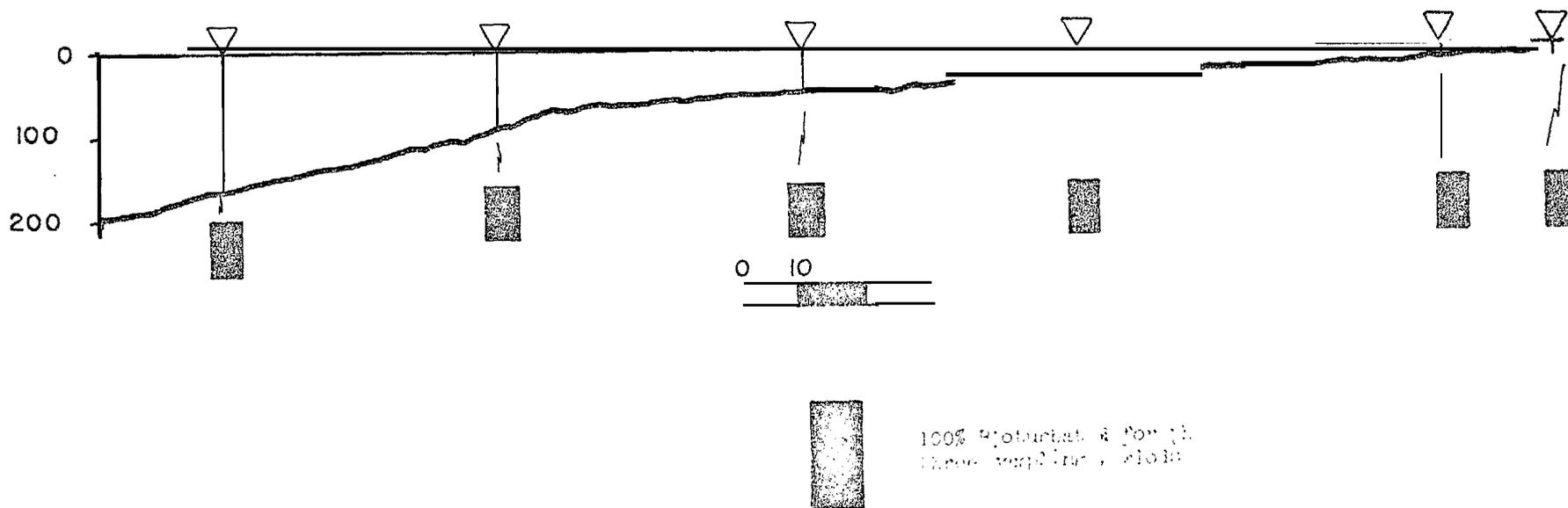


Figure 2. Boxcore Cruise 2. September - October 1975



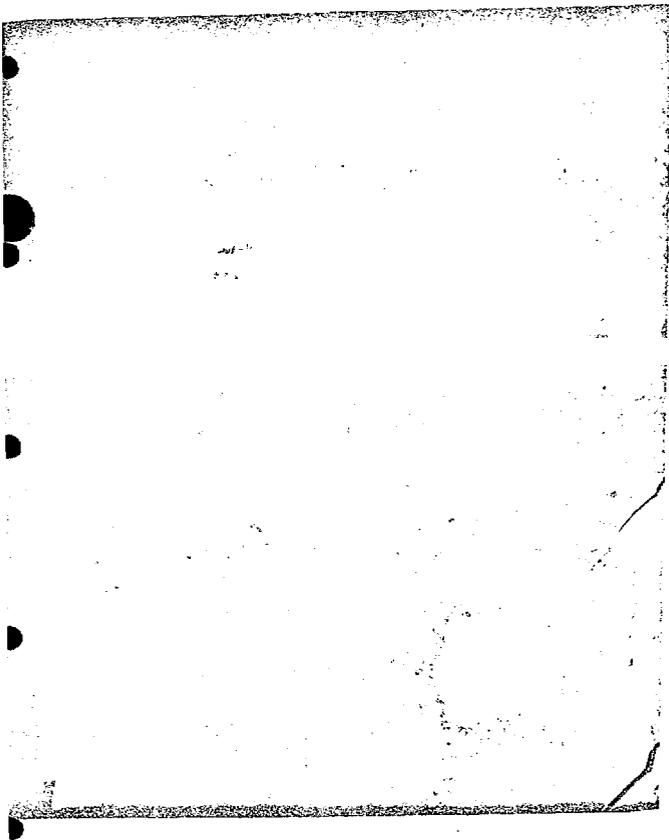
# BLM TRANSECT I

DEPTH IN METERS

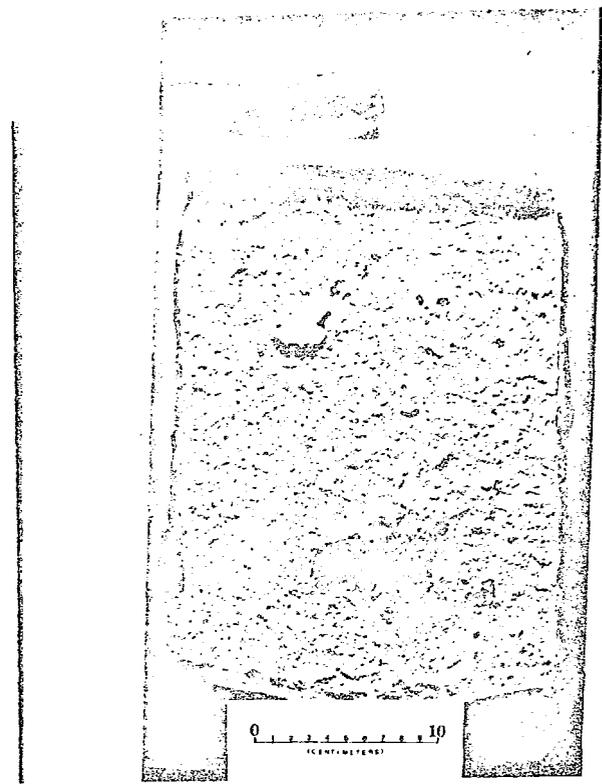


-17-

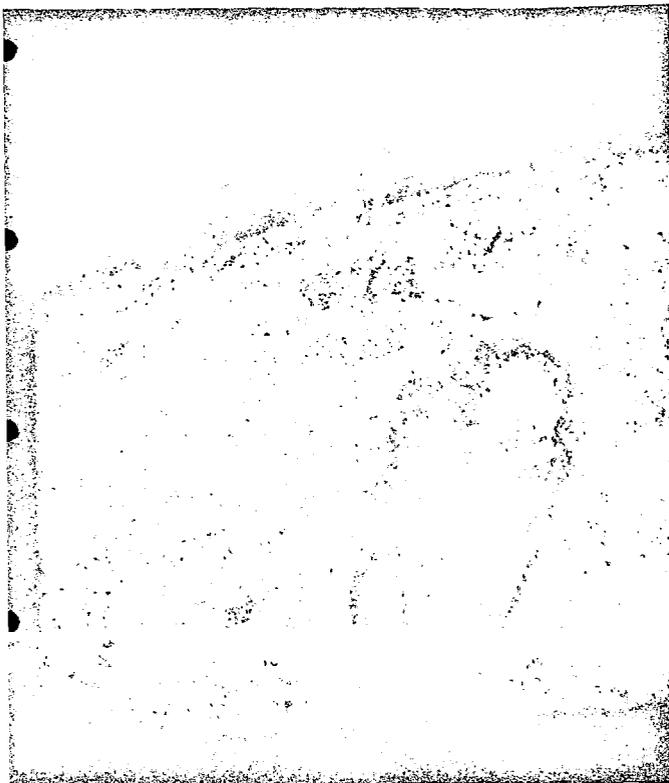
Figure Geophysical Profile of Transect 1 with Station Locations plotted against Depth and Distance. Rectangular Figure represents percent Bioturbation at Stations during three sampling periods.



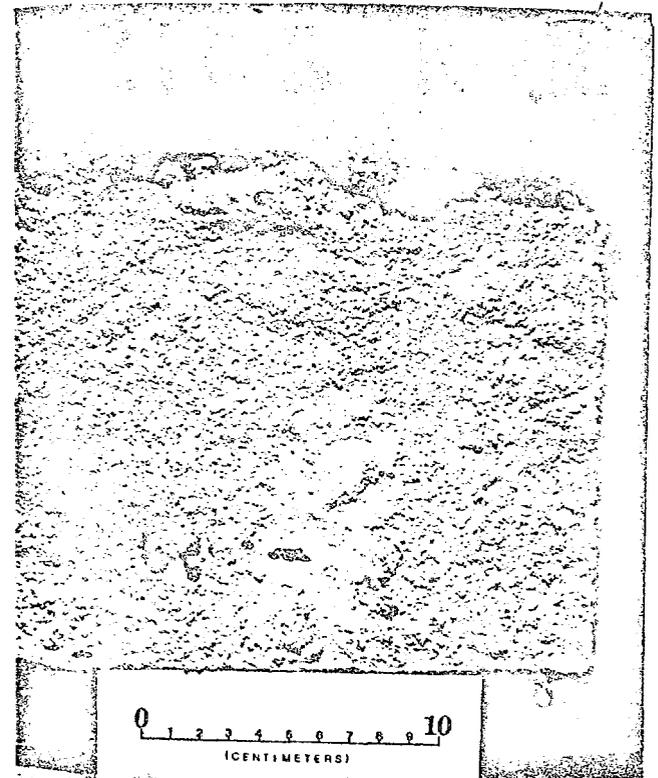
Radiograph Station 2106



Epoxy Relief Peel Station 2106

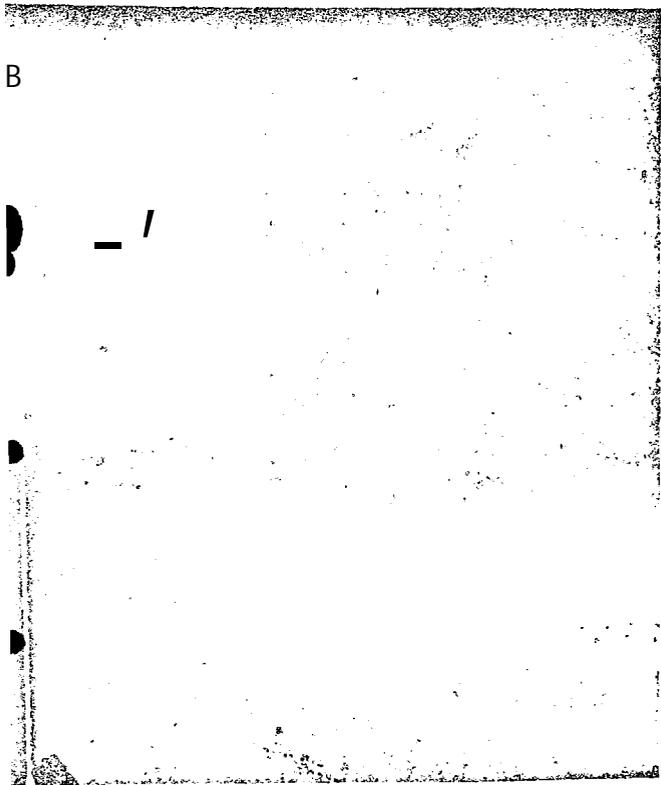


Radiograph Station 2105

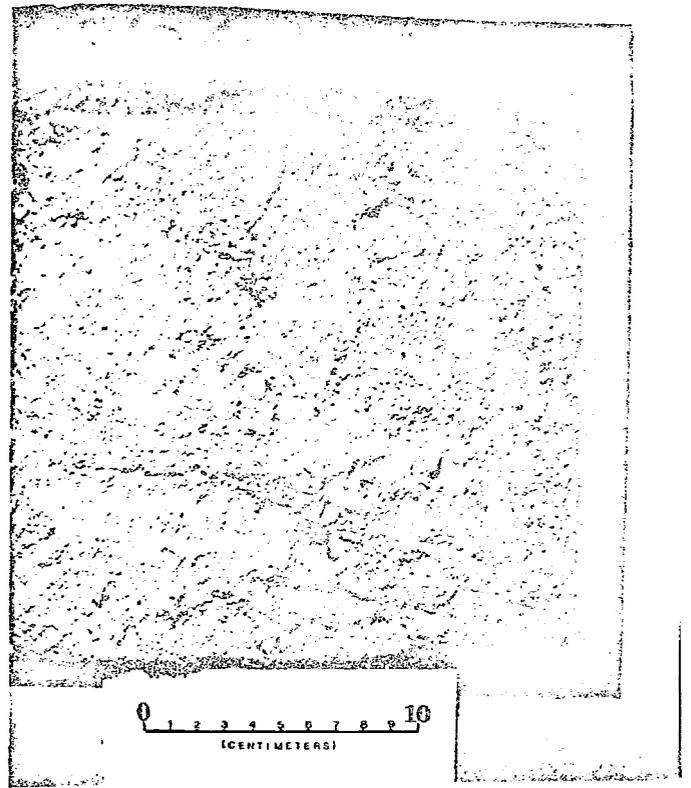


Epoxy Relief Peel Station 2105

Figure 4b. Radiographs and Epoxy Relief Peels from Stations 2106 and 2105.

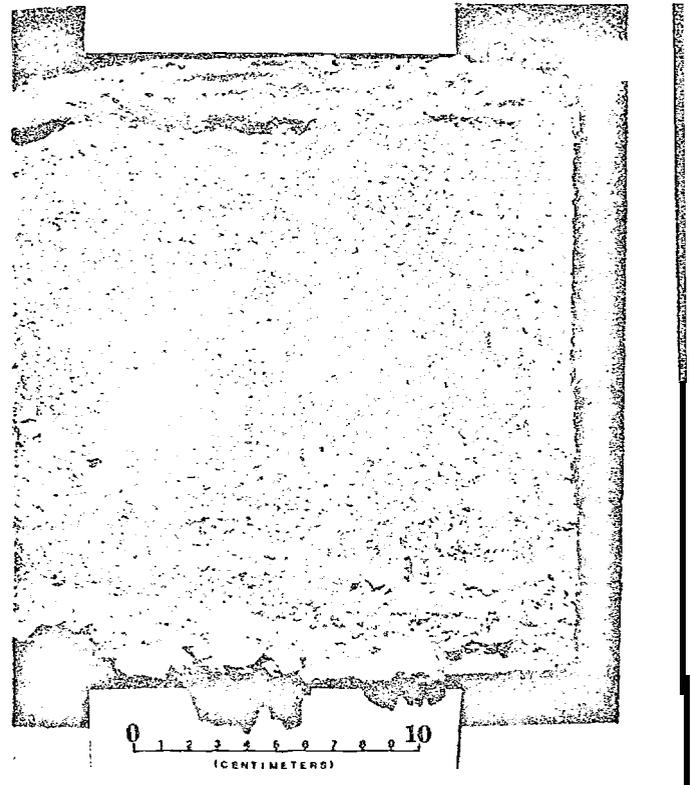
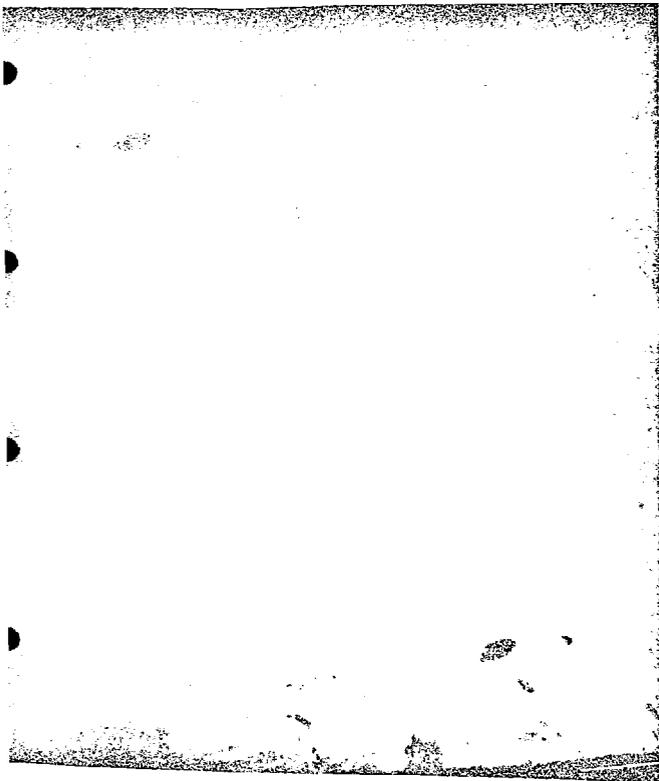


B



Radiograph Station 2104

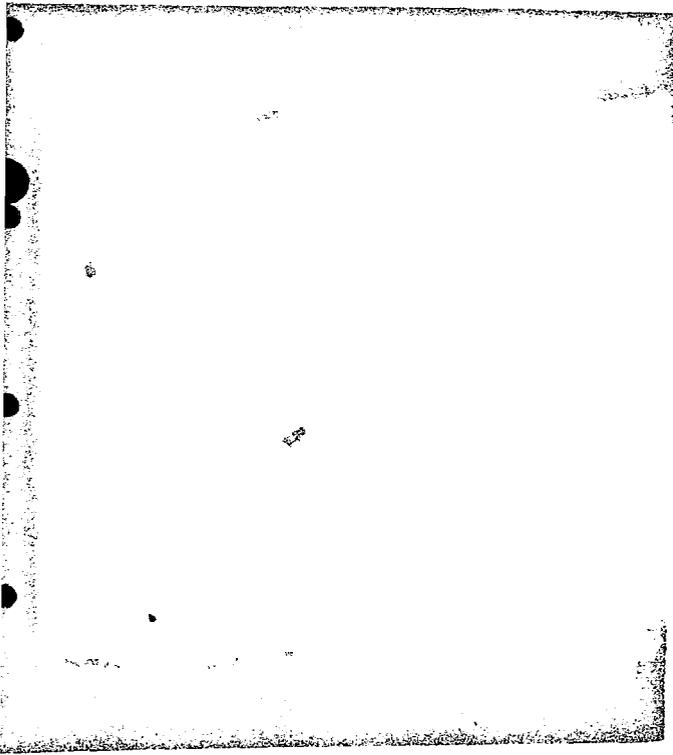
Epoxy Relief Peel Station 2104



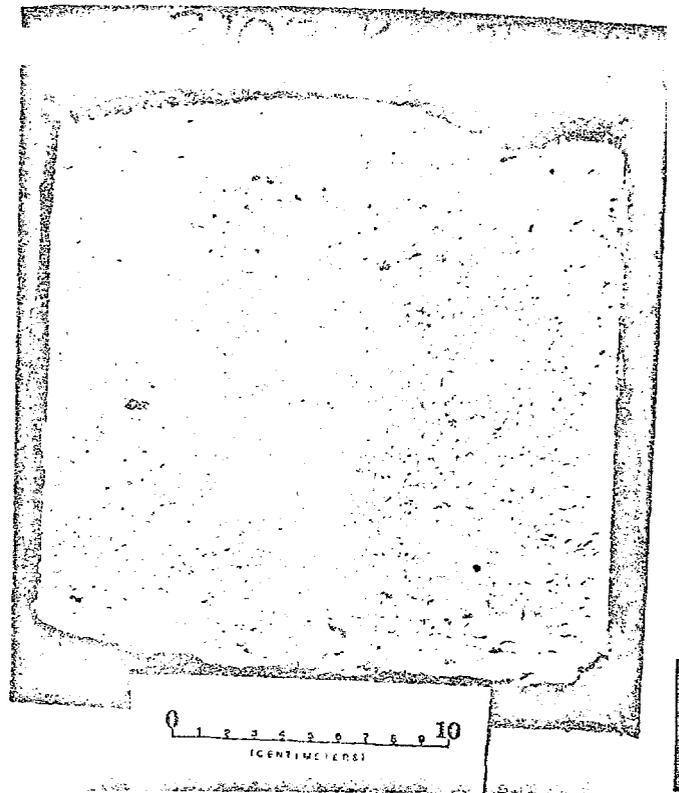
Radiograph Station 2103

Epoxy Relief Peel Station 2103

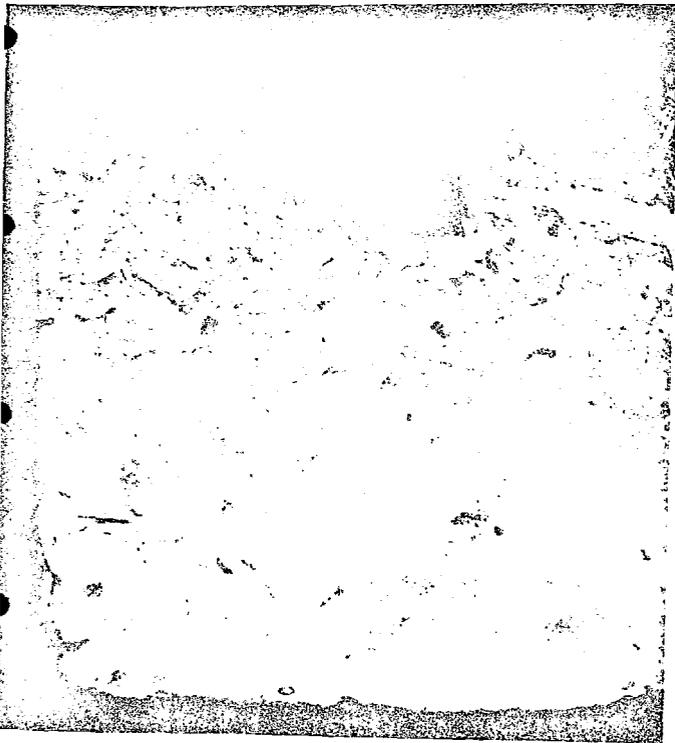
Figure 4c. Radiographs and Epoxy Relief Peels from Stations 2104 and 2103.



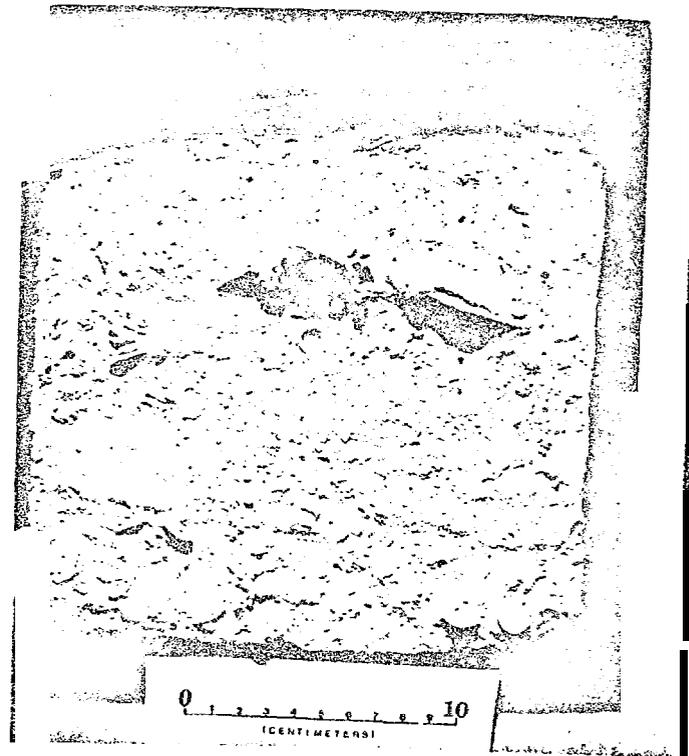
Radiograph Station 2102



Epoxy Belief Peel Station 2102



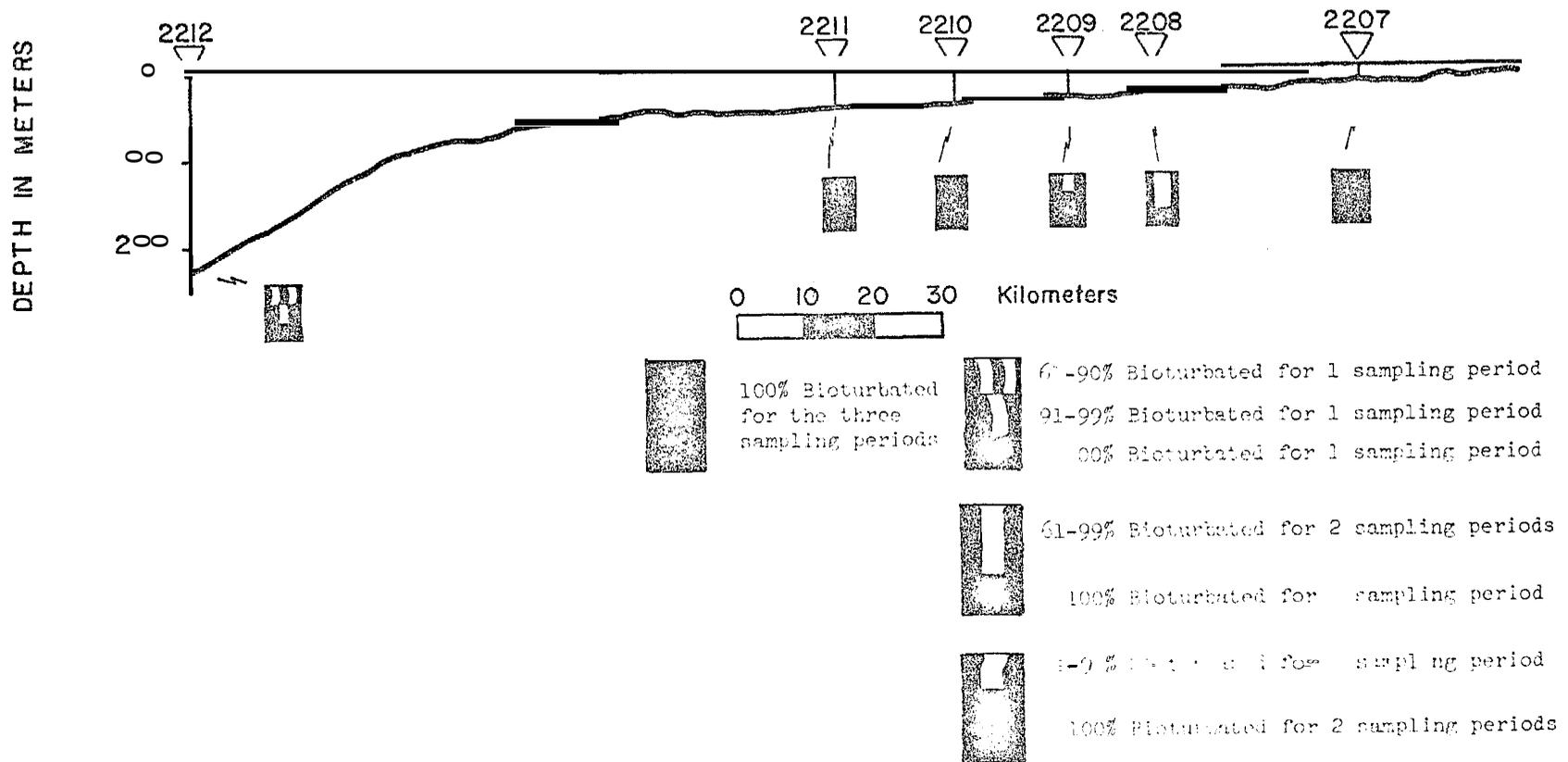
Radiograph Station 2101



Epoxy Relief Peel Station 2101

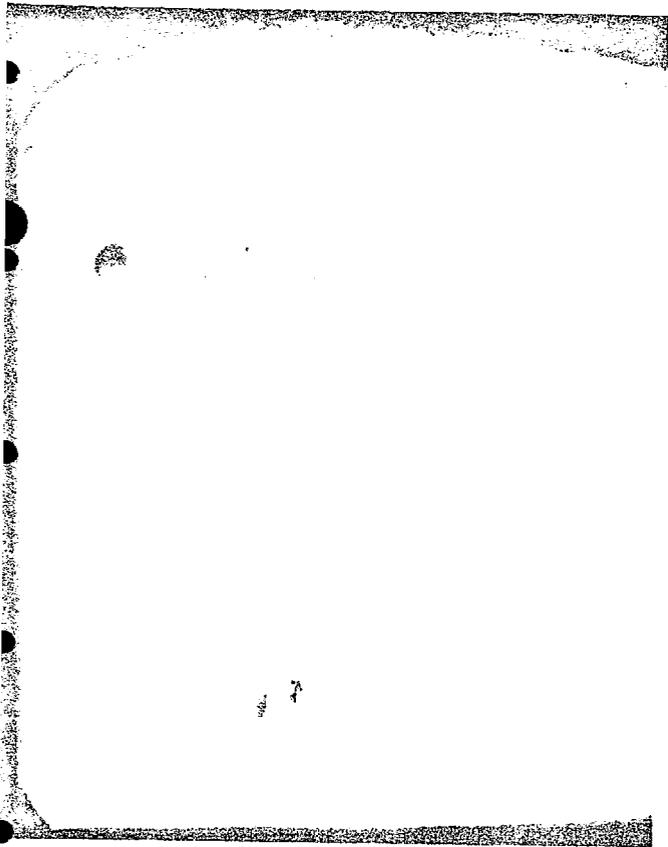
Figure 4d. Radiographs *and* Epoxy Relief Peels from Stations 2102 and 2101.

# BLN TRANSECT 2

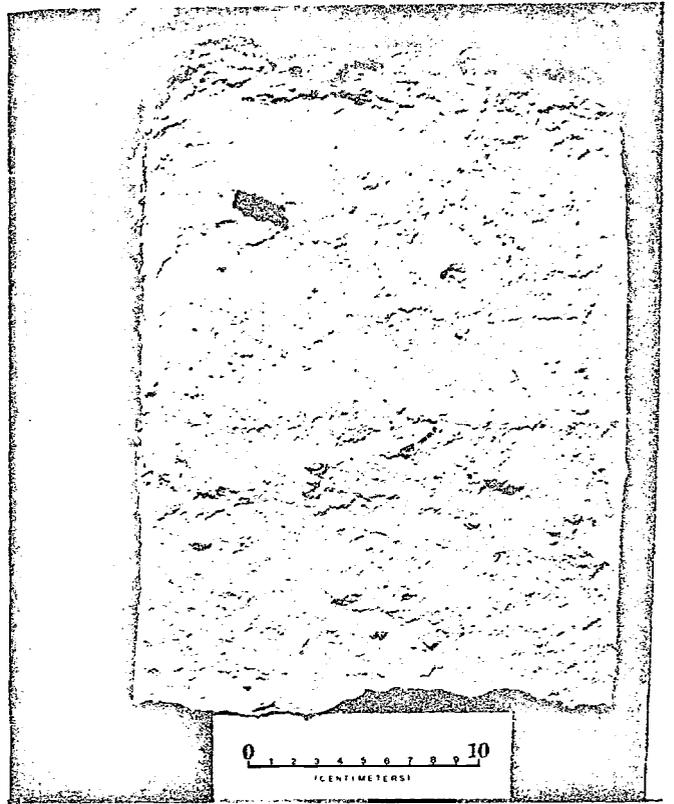


-21-

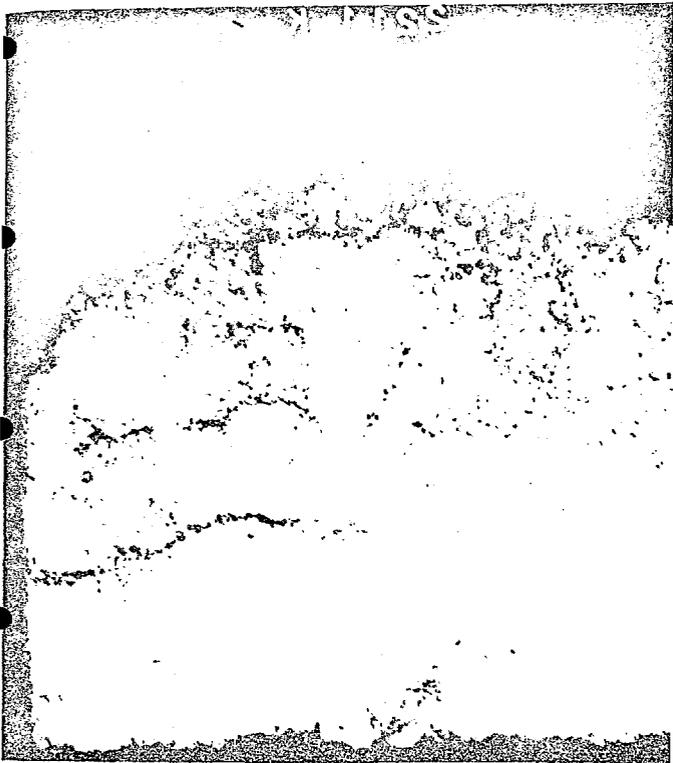
Figure 5a  
 Geophysical Profile of Transect 2 with Station Locations plotted against Depth and Distance. Rectangular Figures represent percent Bioturbation at Stations during three sampling periods.



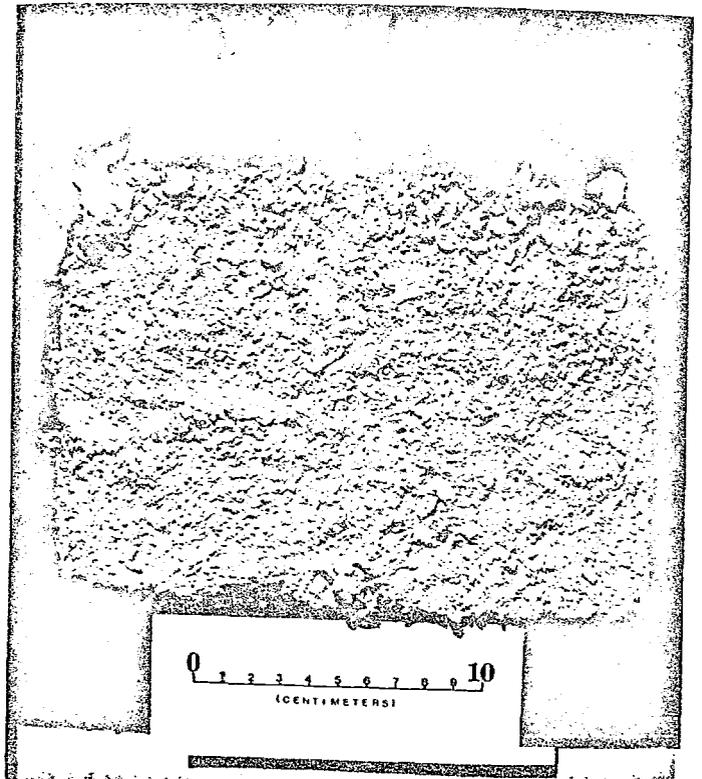
Radiograph Station 2212



Epoxy Relief Peel Station 2212

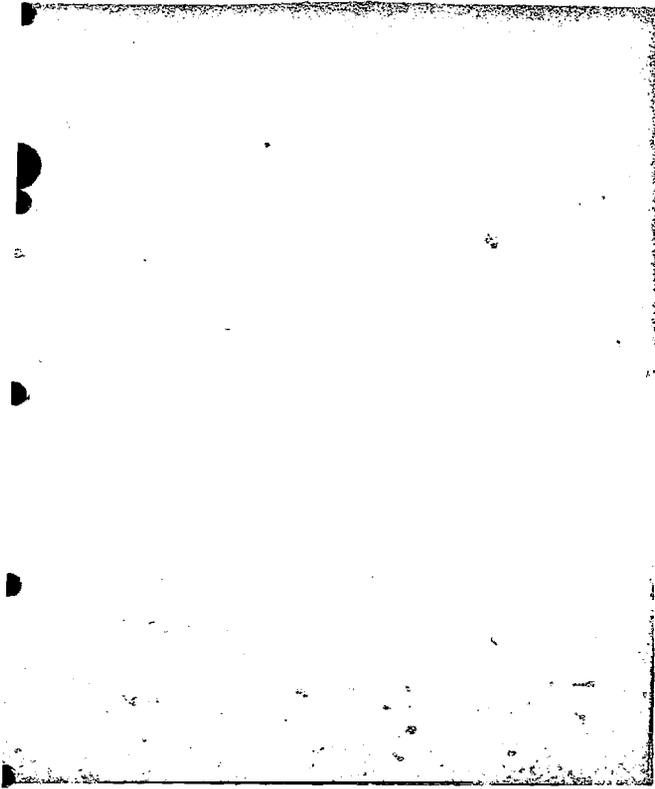


Radiograph Station 2211

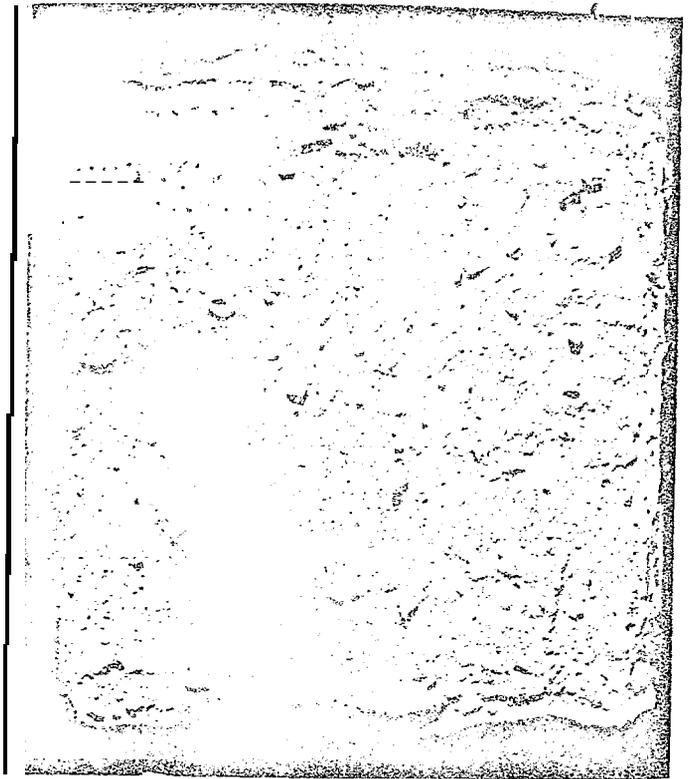


Epoxy Relief Peel Station 2211

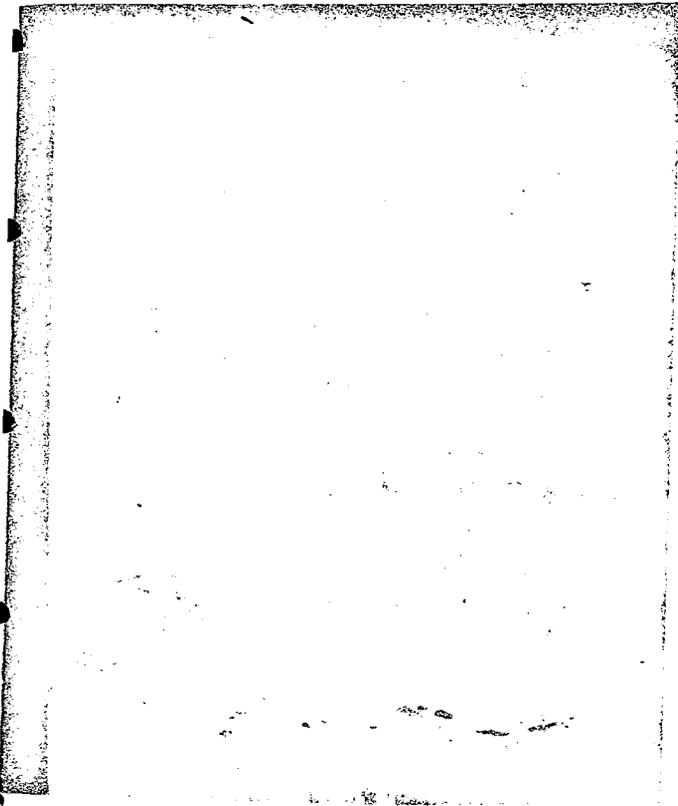
Figure 5b. Radiographs and Epoxy Relief Peels from Stations 2212 and 2211.



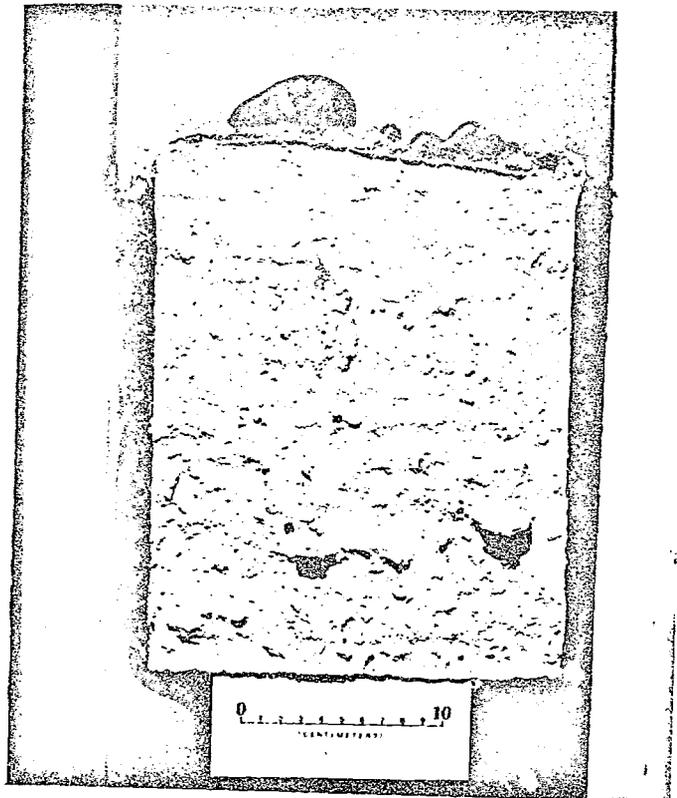
Radiograph Station 2210



Epoxy Relief Peel Station 2210

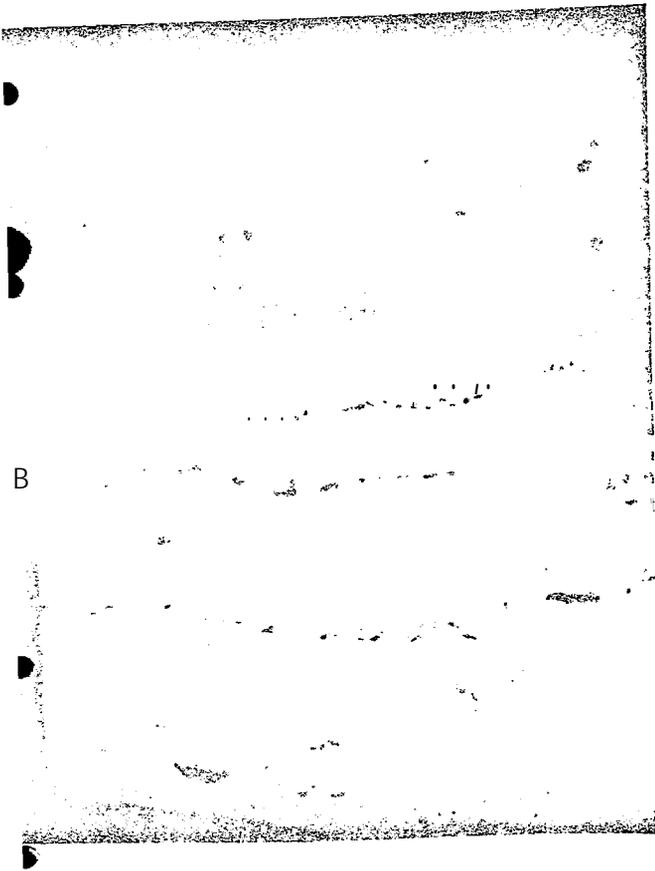


Radiograph Station 2209

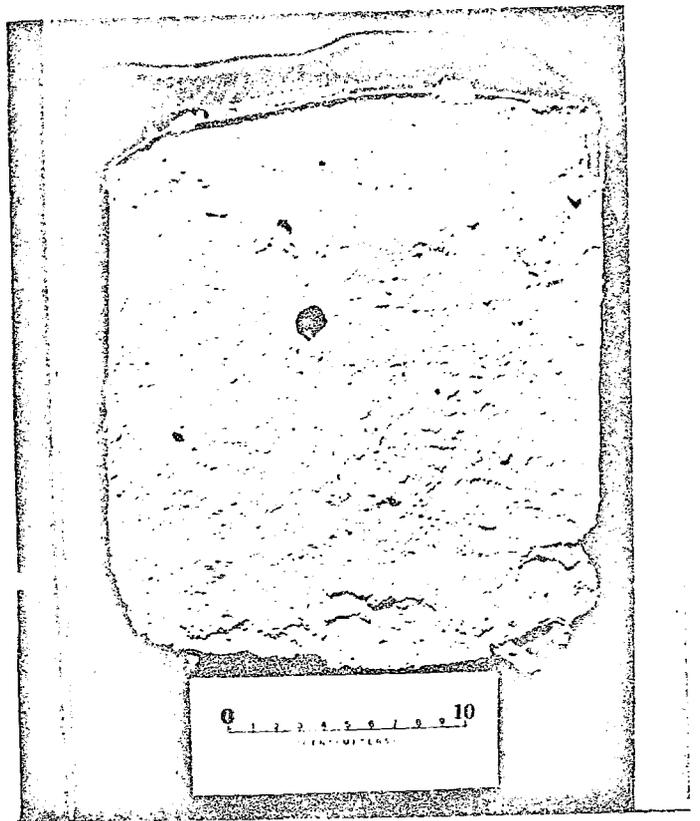


Epoxy Relief Peel Station 2209

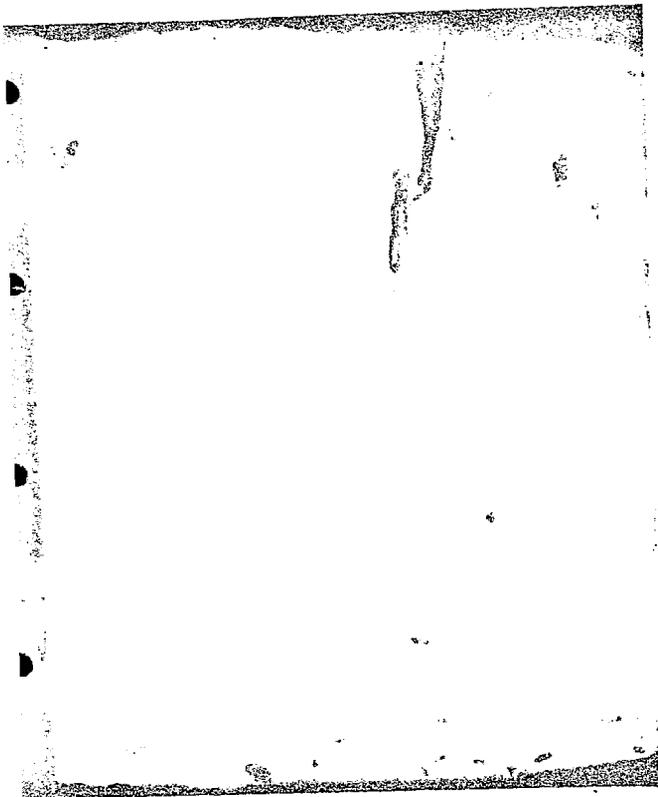
Figure 5c. Radiographs and Epoxy Relief Peels from Stations 2210 and 2209.



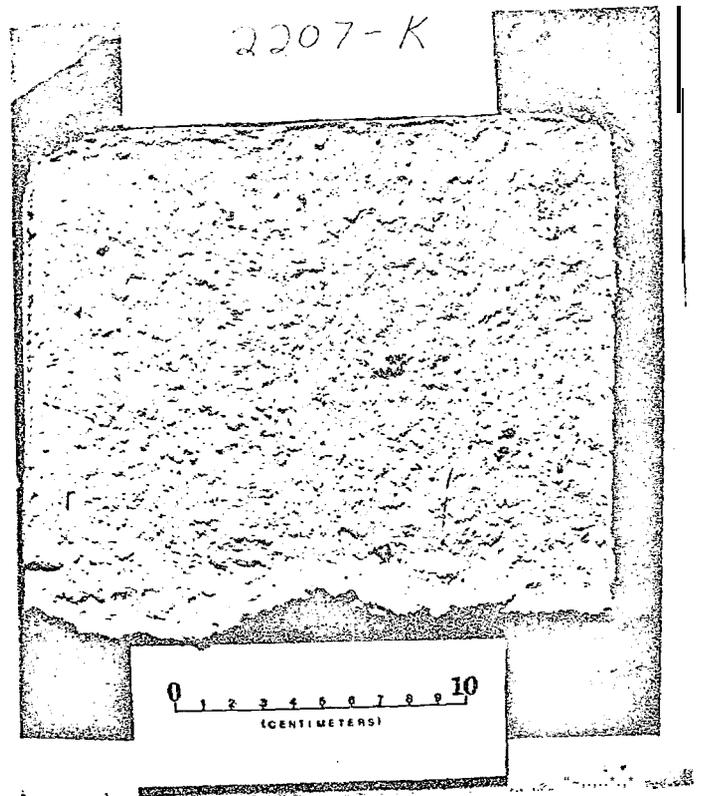
Radiograph Station 2208



Epoxy Relief Peel Station 2208



Radiograph Station 2207



Epoxy Relief Peel Station 2207

Figure 5d. Radiographs and Epoxy Relief Peels from Stations 2208 and 2207.

# BLM TRANSECT 3

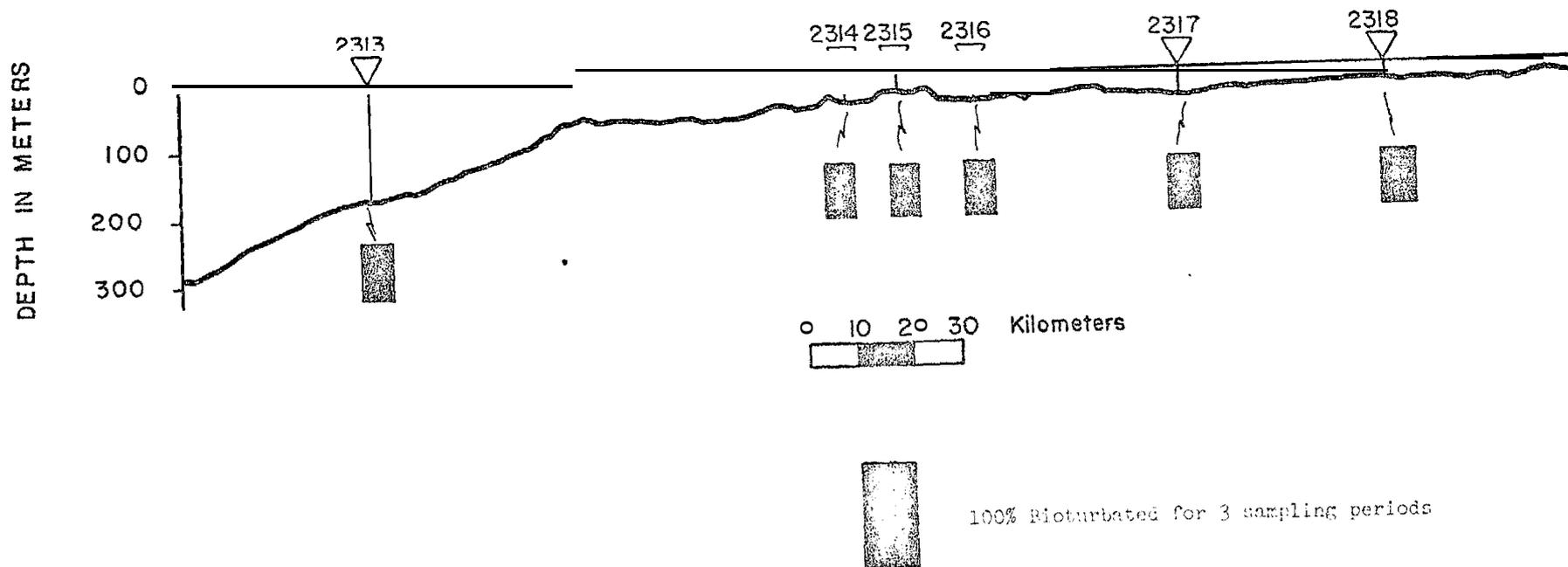
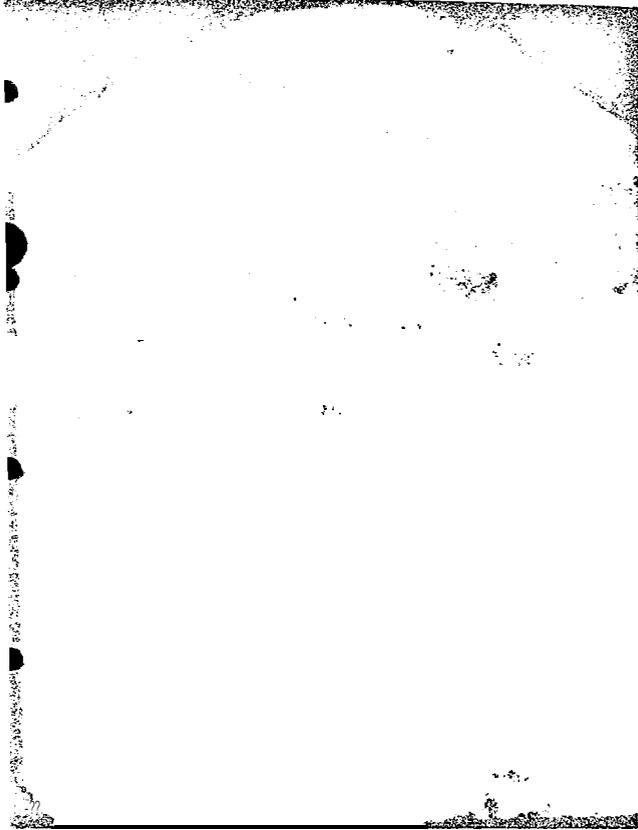


Figure 6a

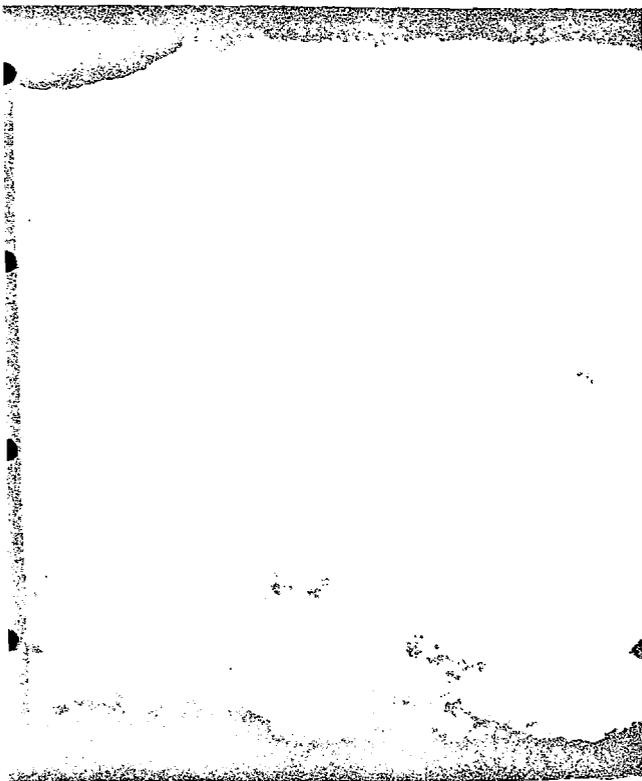
Geophysical Profile of Transect 3 with Station locations plotted against Depth and Distance. Rectangular Figures equal to percent Bioturbation at Stations during three sampling periods. Station 2314 was only sampled once.



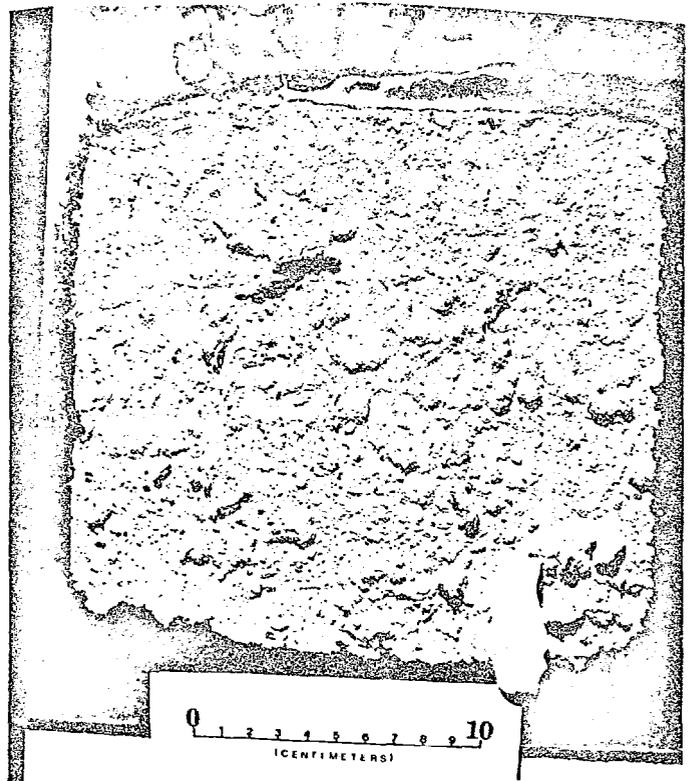
Radiograph Station 2318



Epoxy Relief Peel Station 2318

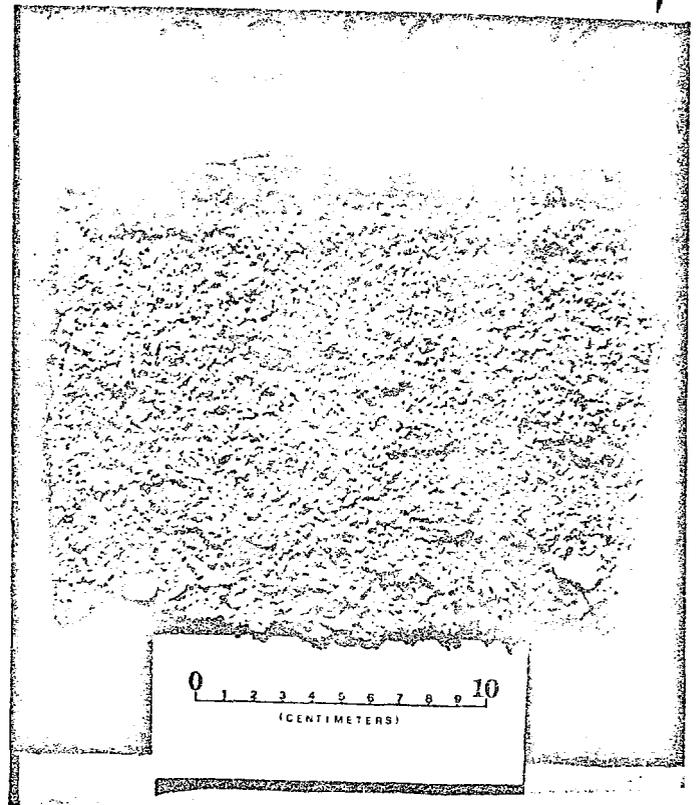
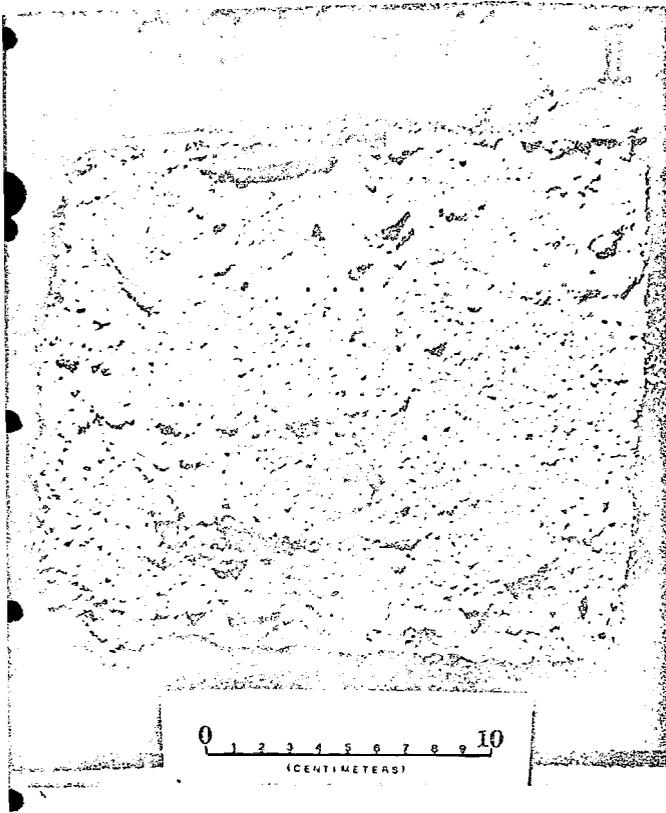


Radiograph Station 2317



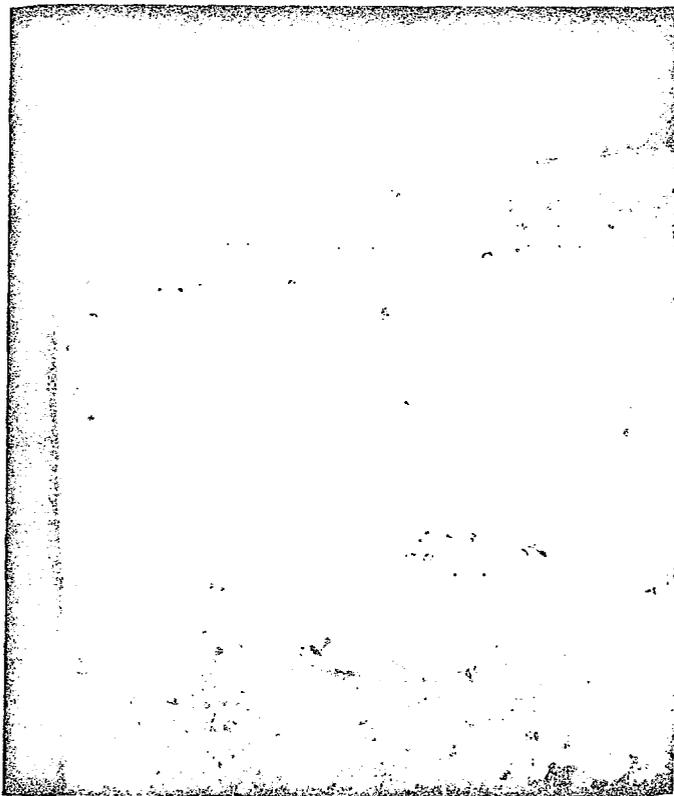
Epoxy Relief Peel Station 2317

Figure 6b. Radiographs and Epoxy Relief Peels from Stations 2318 and 2317.



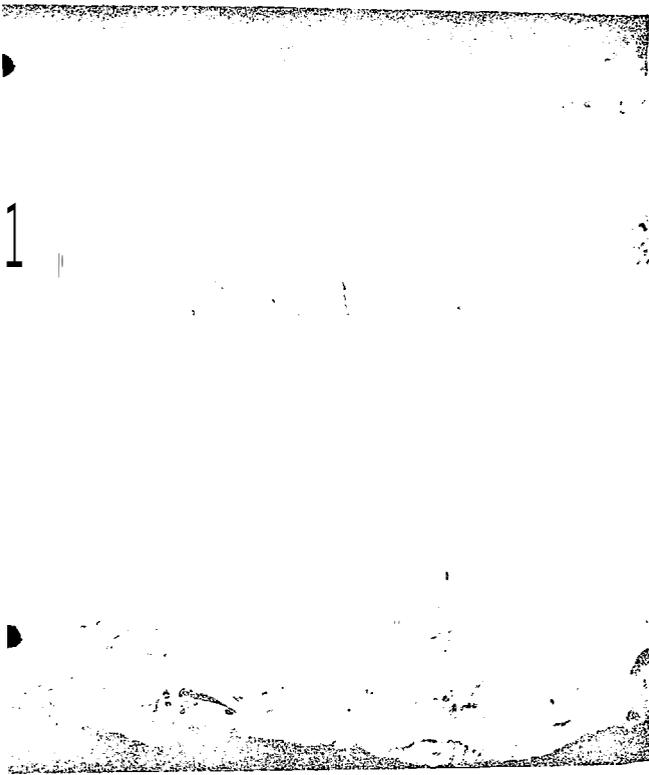
Epoxy Relief Peel Station 2316

Epoxy Relief Peel Station 2316.

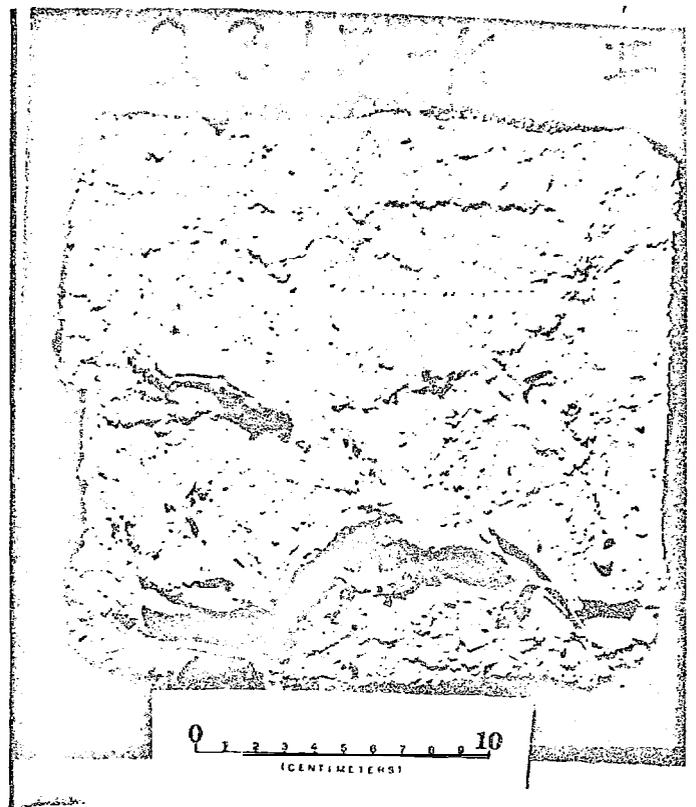


Radiograph Station 2316

Figure 6c. Radiograph and Epoxy Relief Peels from Station 2316.



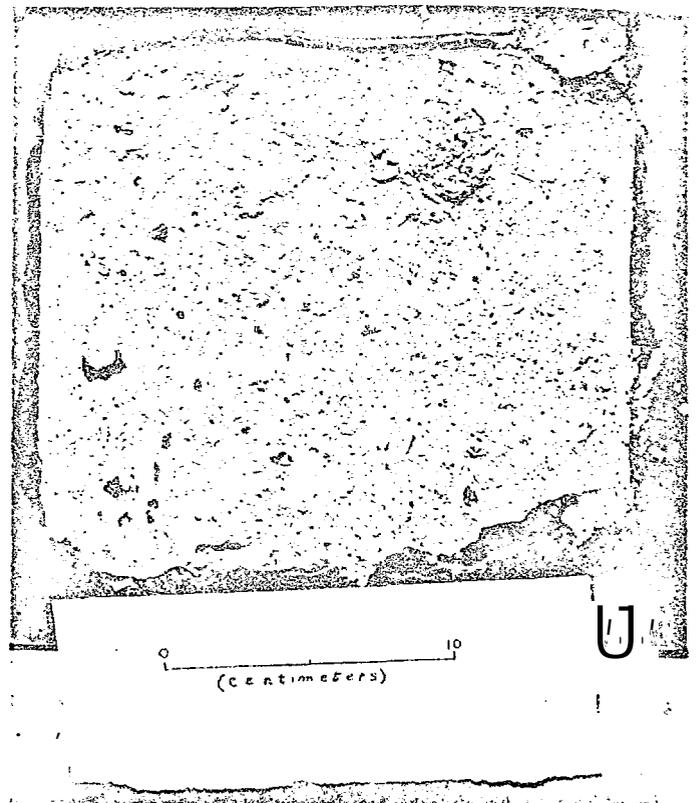
Radiograph Station 2315



Epoxy Relief Peel Station 2315



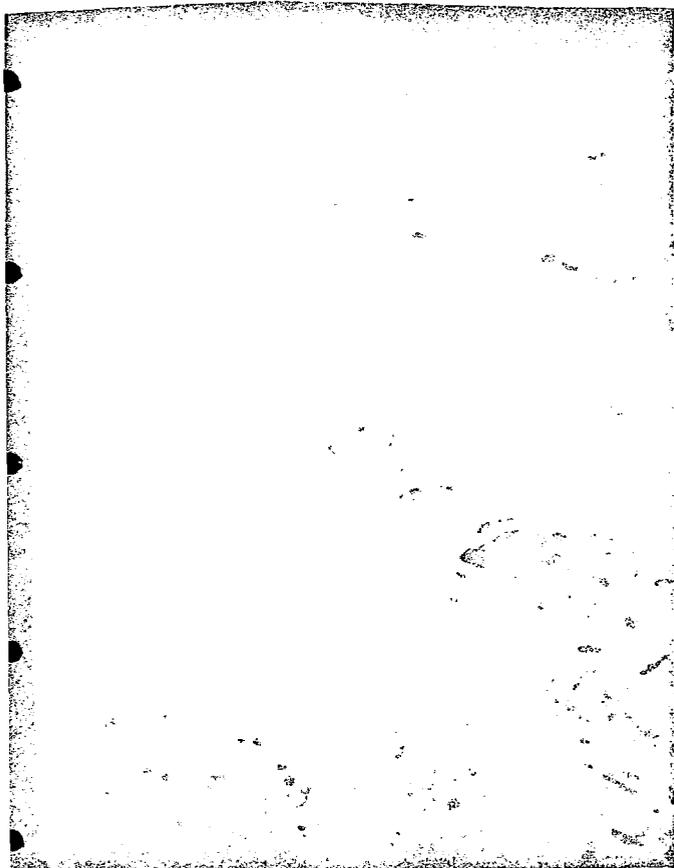
Radiograph Station 2314



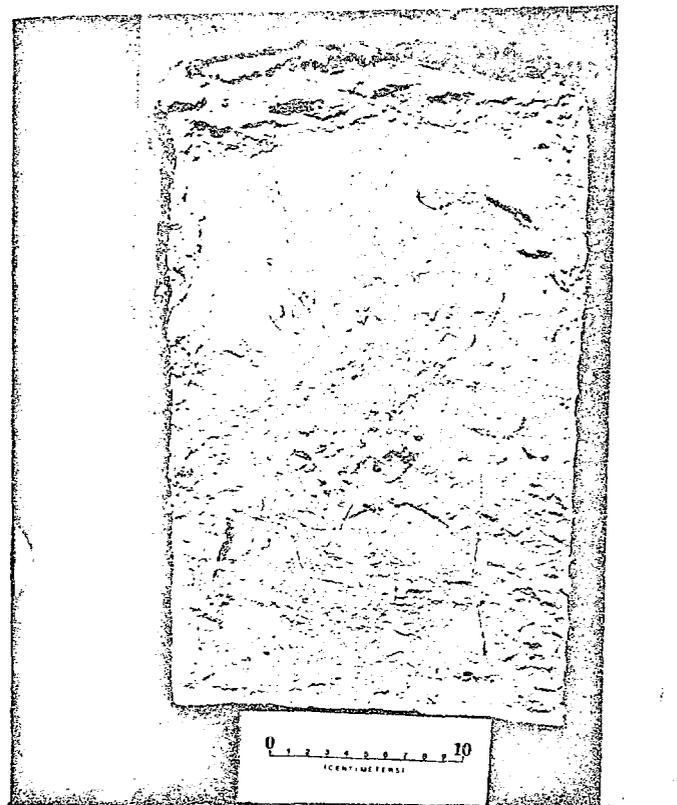
Epoxy Relief Peel Station 2314

B

Figure 6d. Radiographs and Epoxy Relief Peels from Stations 2315 and 2314.



Radiograph Station 2313



Epoxy Relief Peel Station 2313

Figure 6f. Radiograph and Epoxy Relief Peel from Station 2313.

# BLM TRANSECT 4

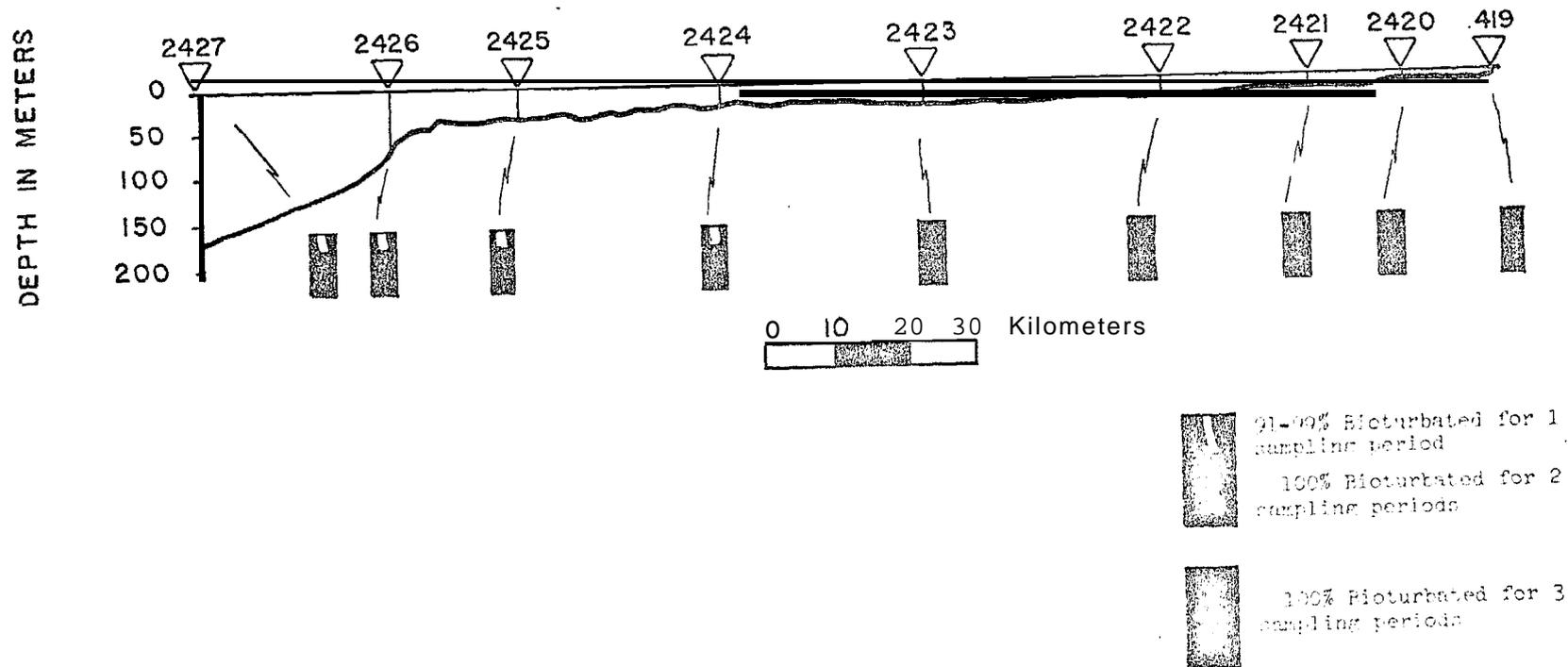
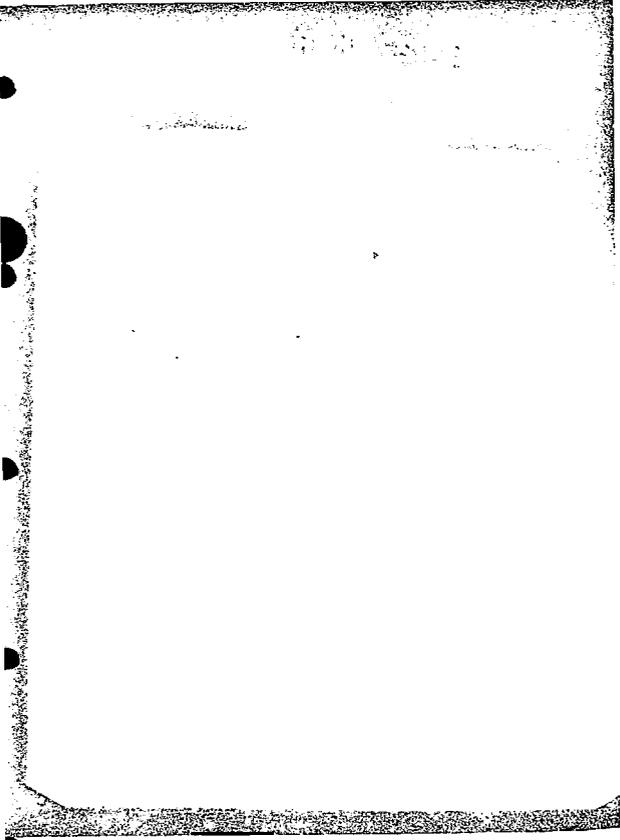
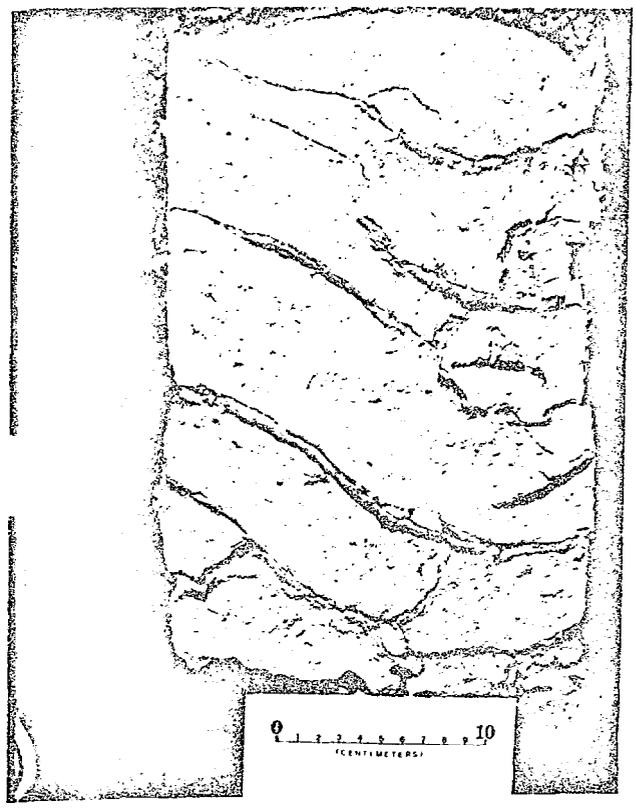


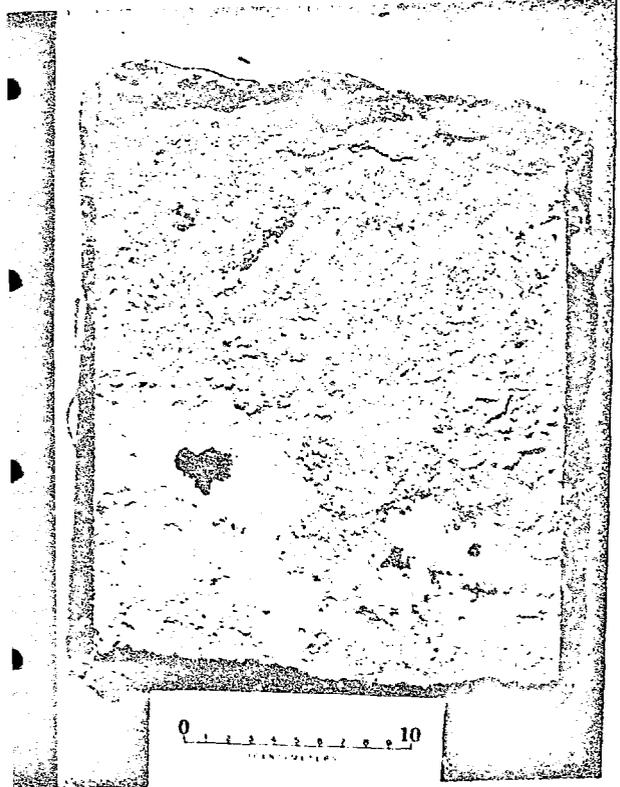
Figure 7a.  
 Geophysical Profile of Transect 4 with Station Locations plotted against Depth and Distance. Rectangular Figures represent percent Bioturbation at Stations during three sampling periods.



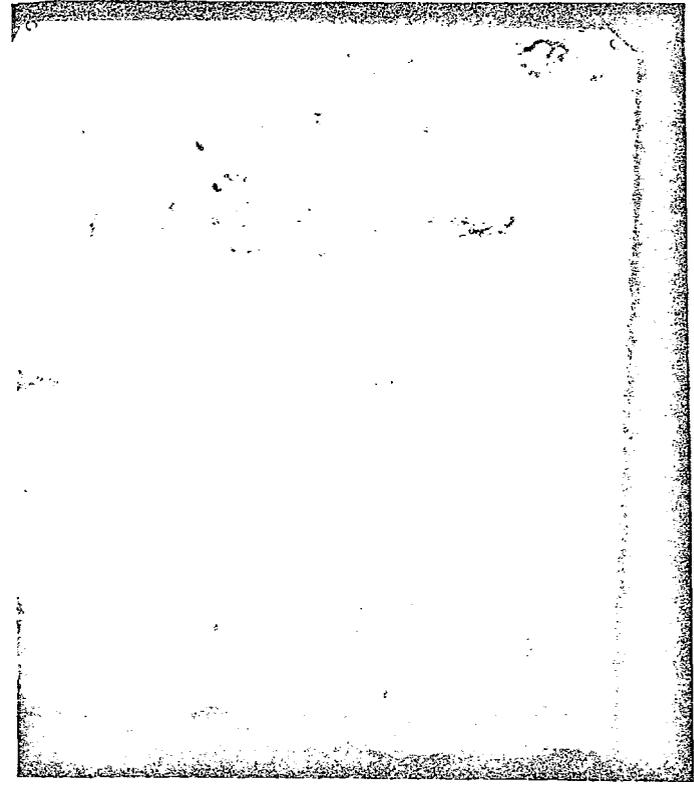
Radiograph Station 2427



Epoxy Relief Peel Station 2427

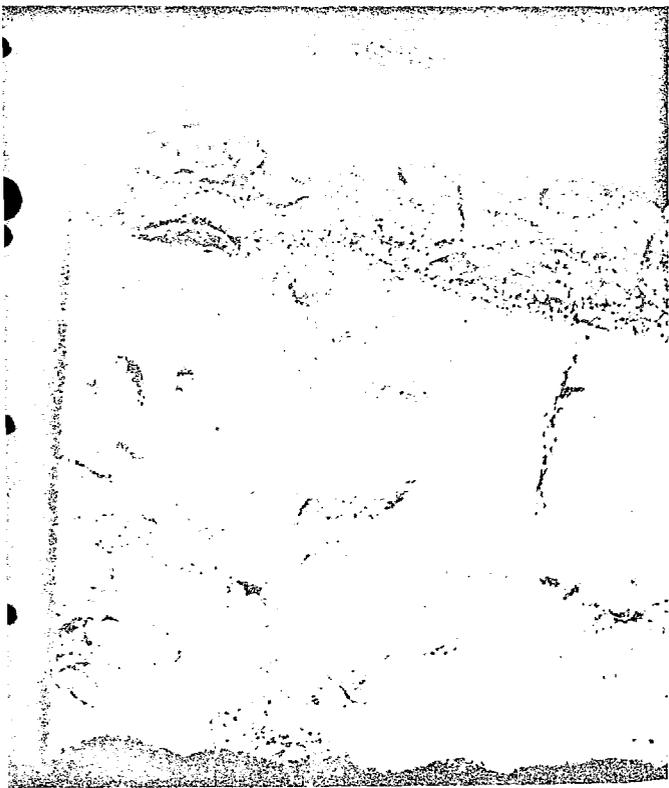


Radiograph Station 2426

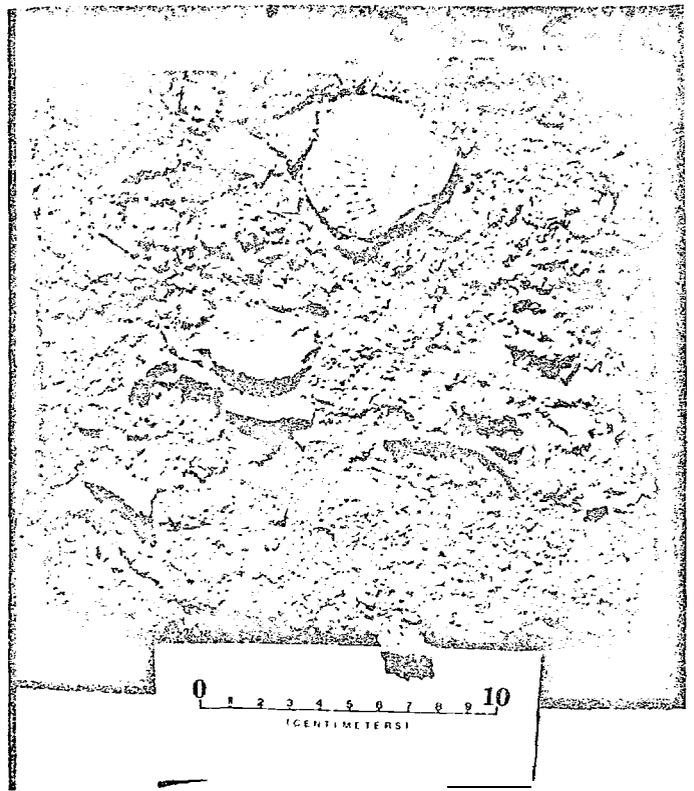


Epoxy Relief Peel Station 2426

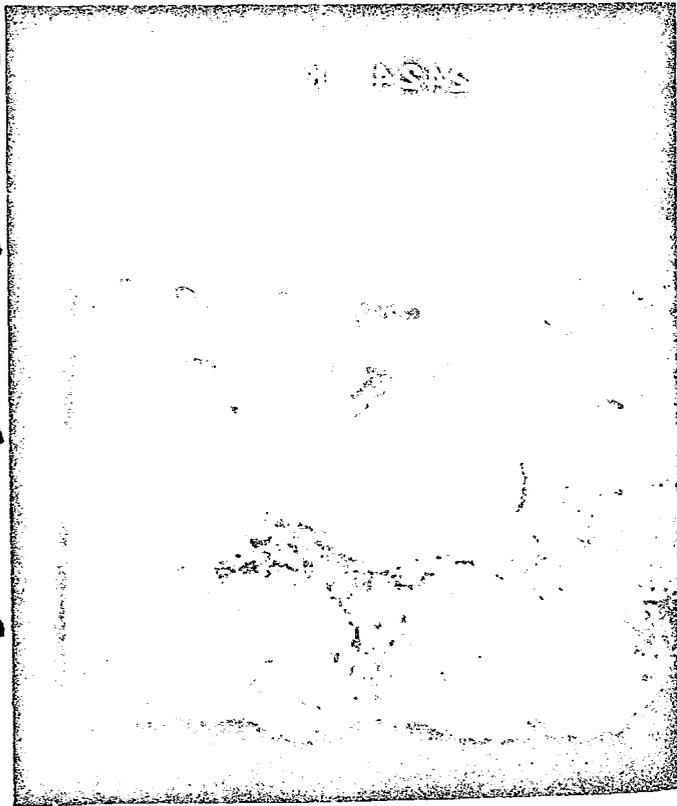
Figure 7b. Radiographs and Epoxy Relief Peels from Stations 2427 and 2426.



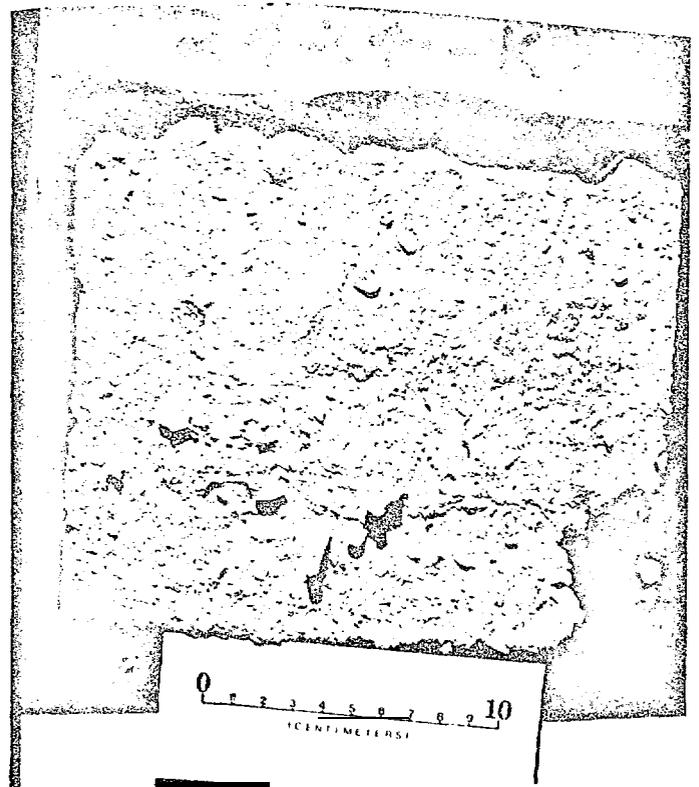
Radiograph Station 2425



Epoxy Relief Peel Station 2425

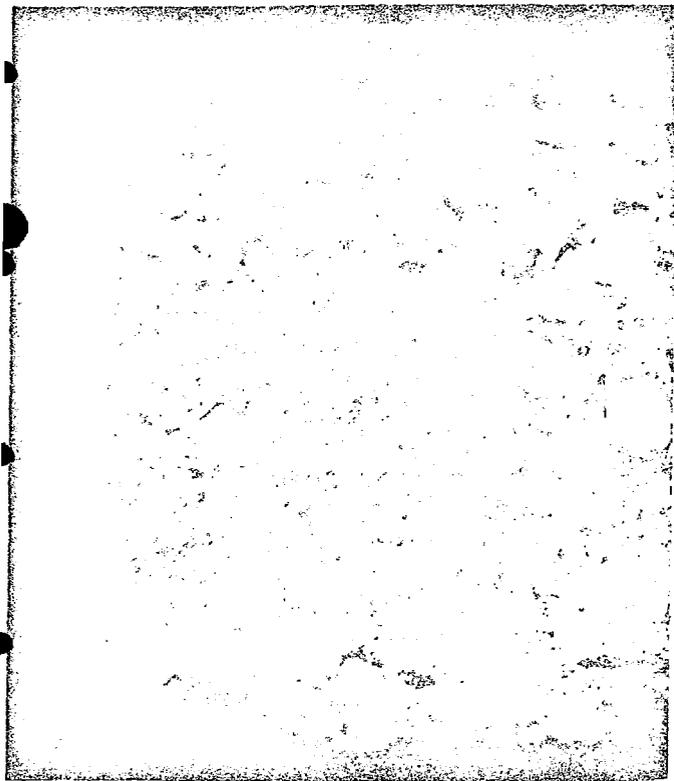


Radiograph Station 2424

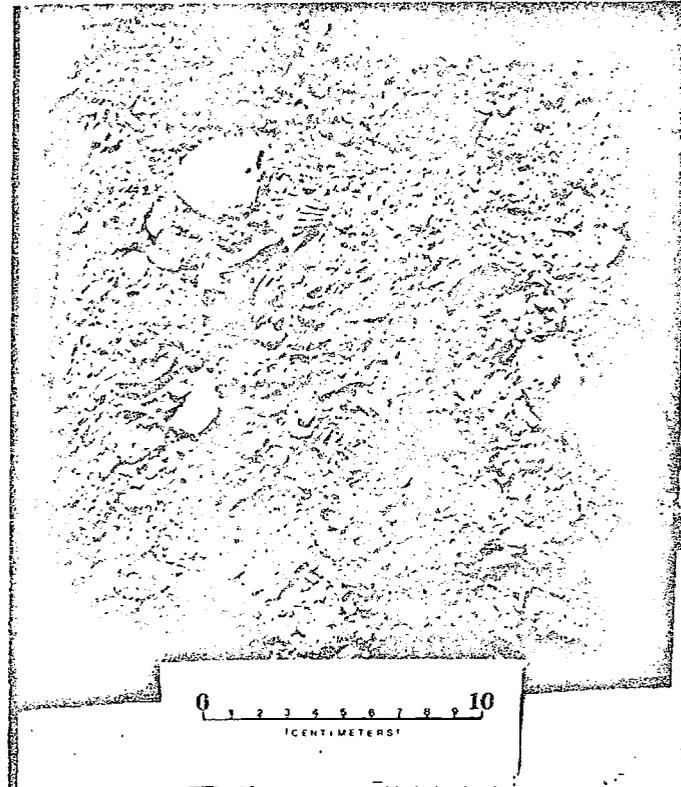


Epoxy Relief Peel Station 2424

Figure 7c. Radiographs and Epoxy Relief Peels from Stations 2425 and 2424.



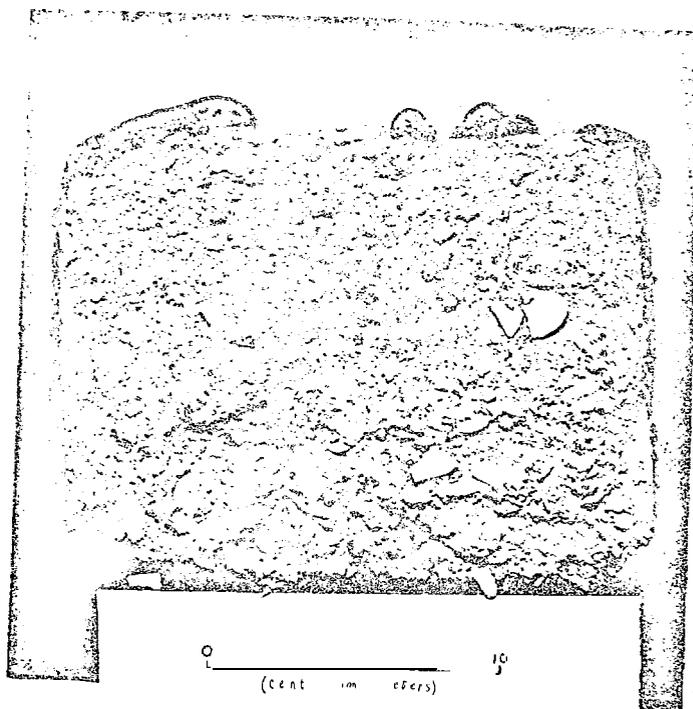
Radiograph Station 2423



Epoxy Relief Peel Station 2423

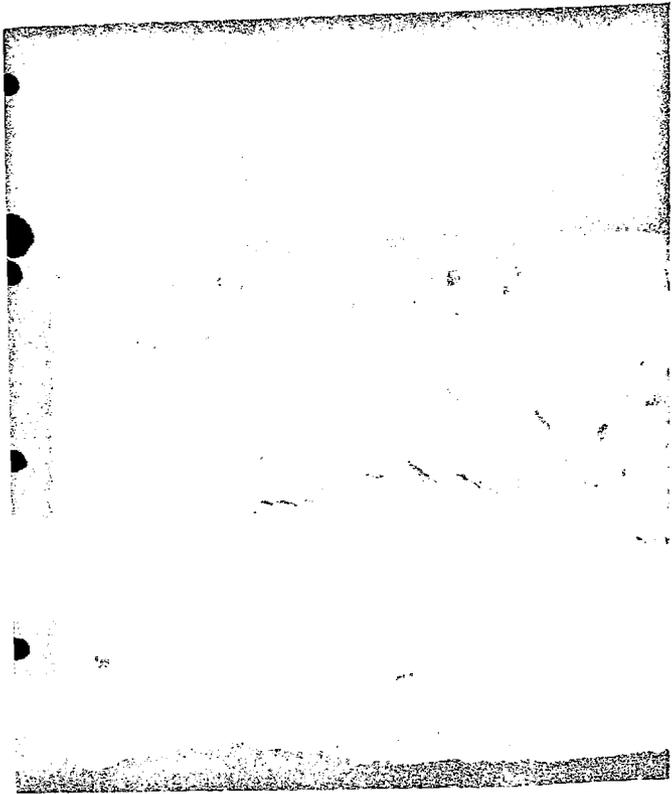


Radiograph Station 2422

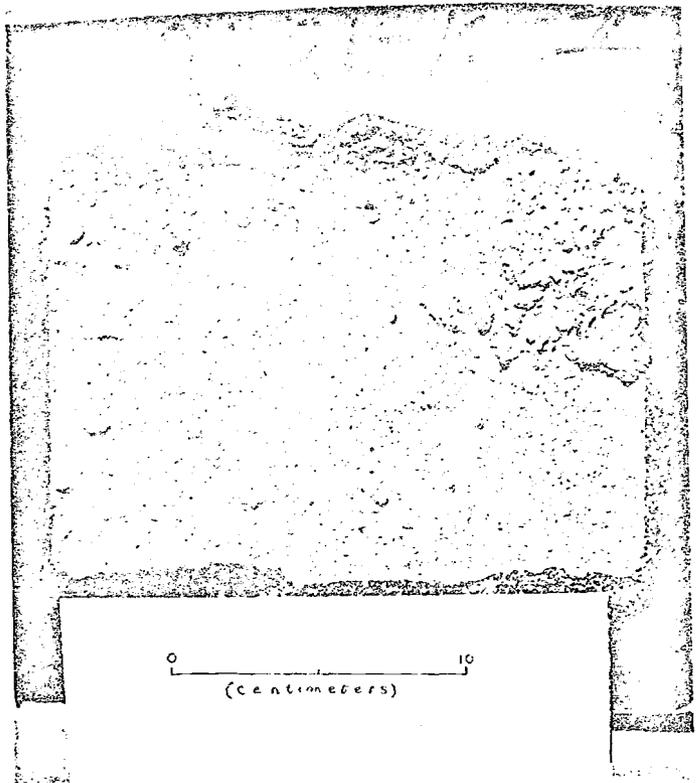


Epoxy Relief Peel Station 2422

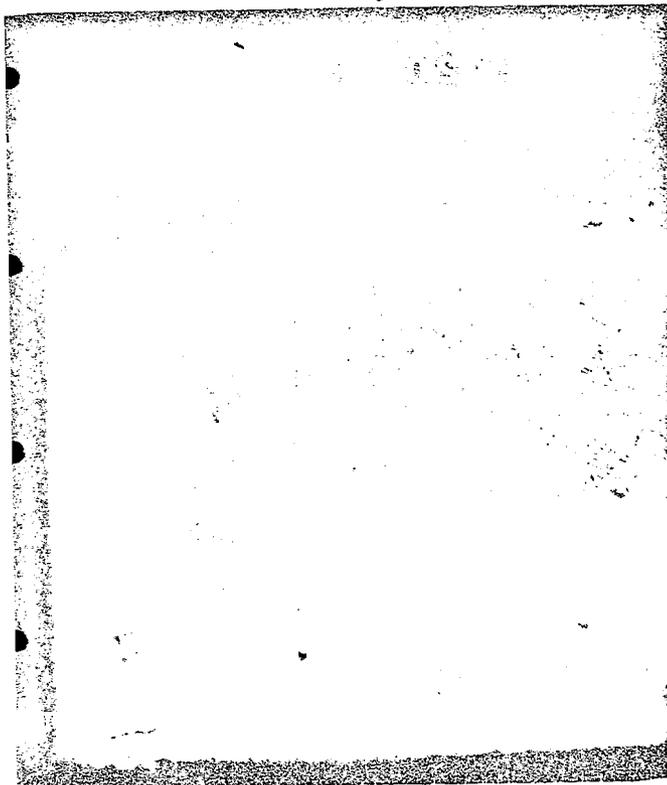
Figure 7d. Radiographs and Epoxy Relief Peels from Stations 2423 and 2422.



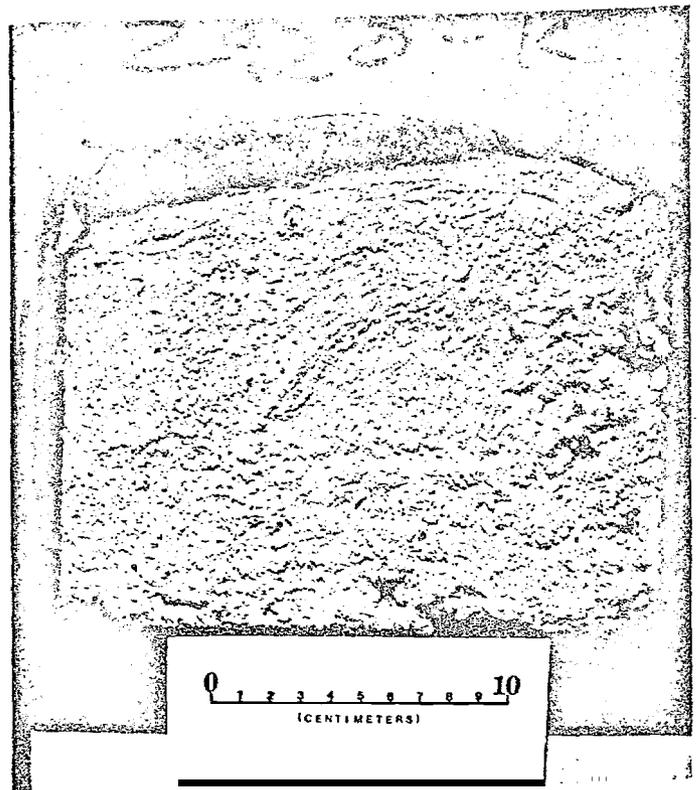
Radiograph Station 2421



Epoxy Relief Peel Station 2421

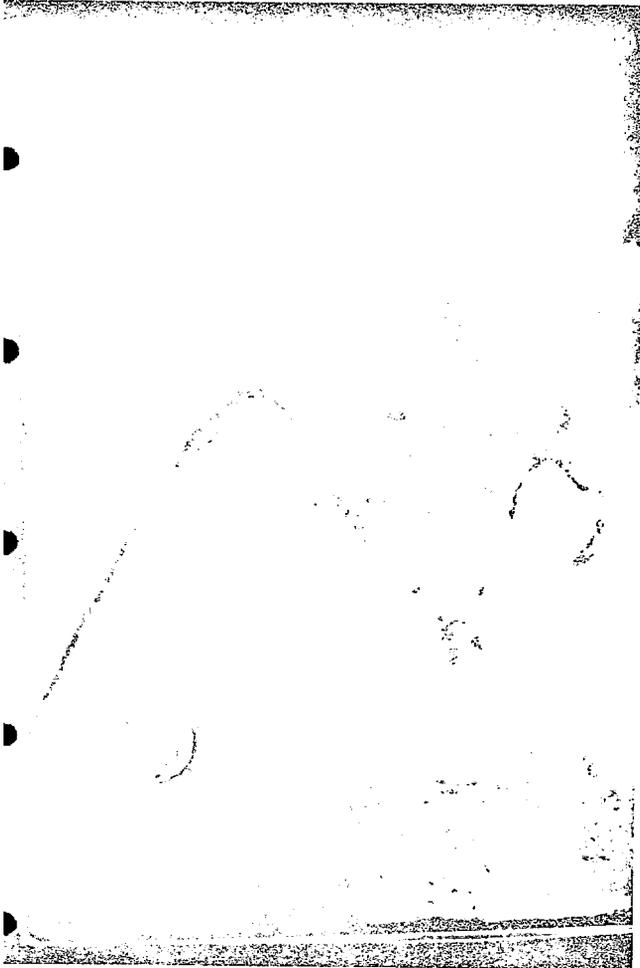


Radiograph Station 2420



Epoxy Relief Peel Station 2420

Figure 7e. Radiographs and Epoxy Relief Peels from Stations 2421 and 2420.



Radiograph Station 2419



Epoxy Relief Peel Station 2419

Figure 7f. Radiograph and Epoxy Relief Peel from Station 2419.

# BLM TRANSECT 5

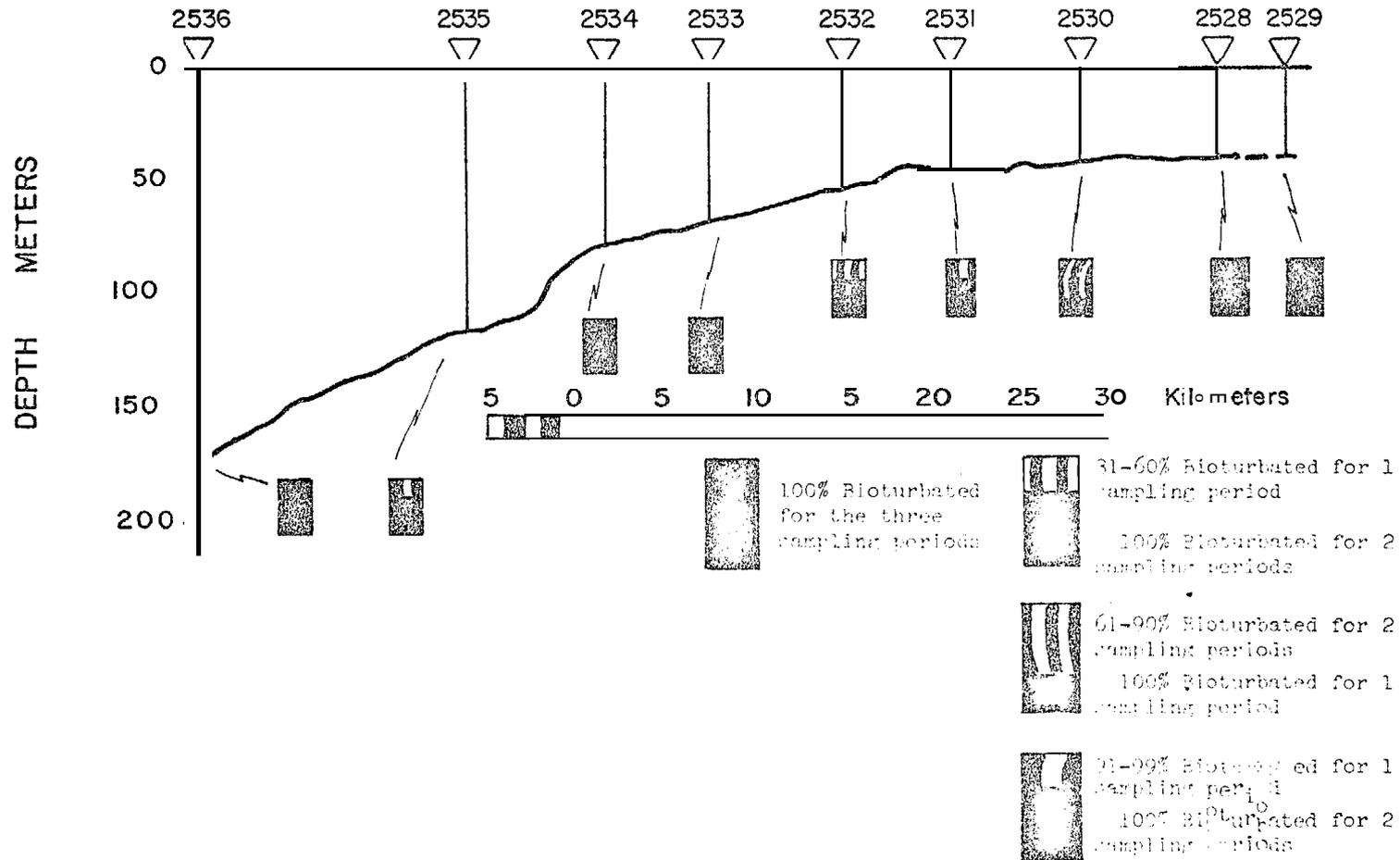
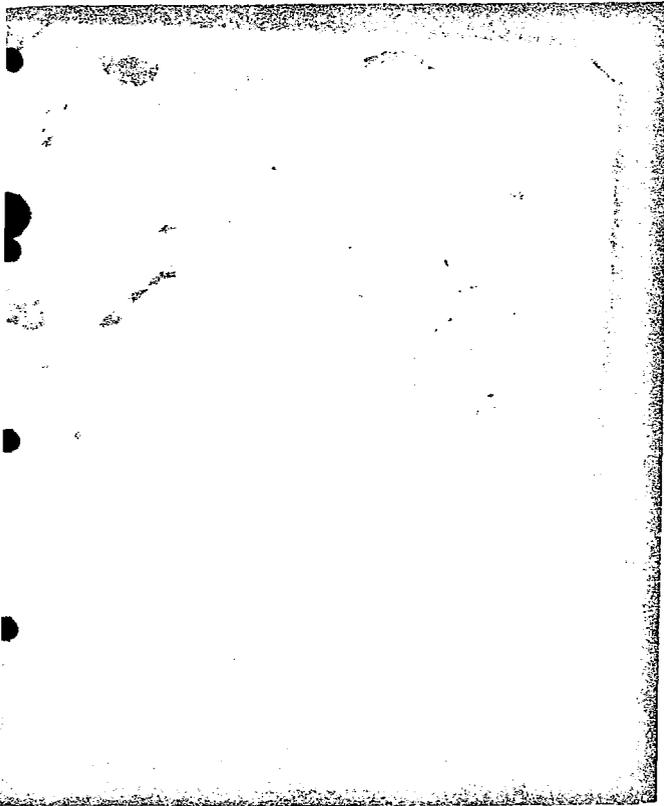
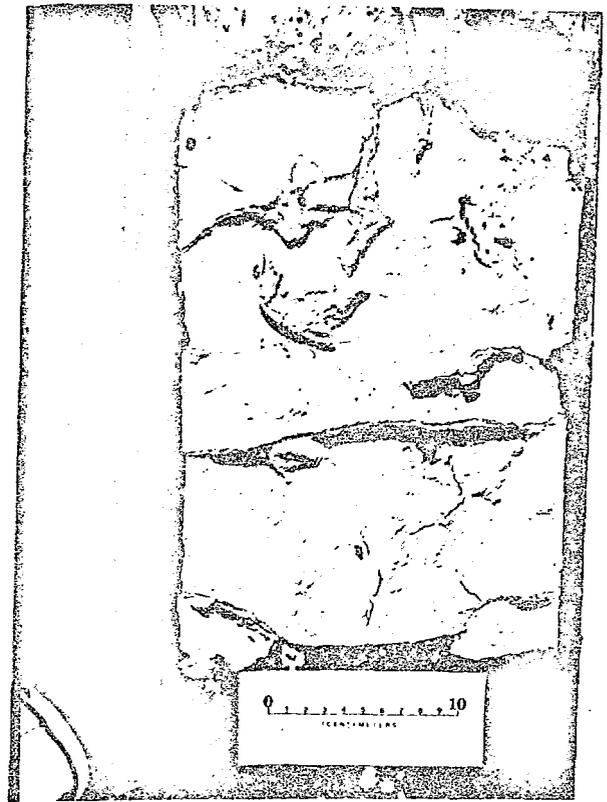


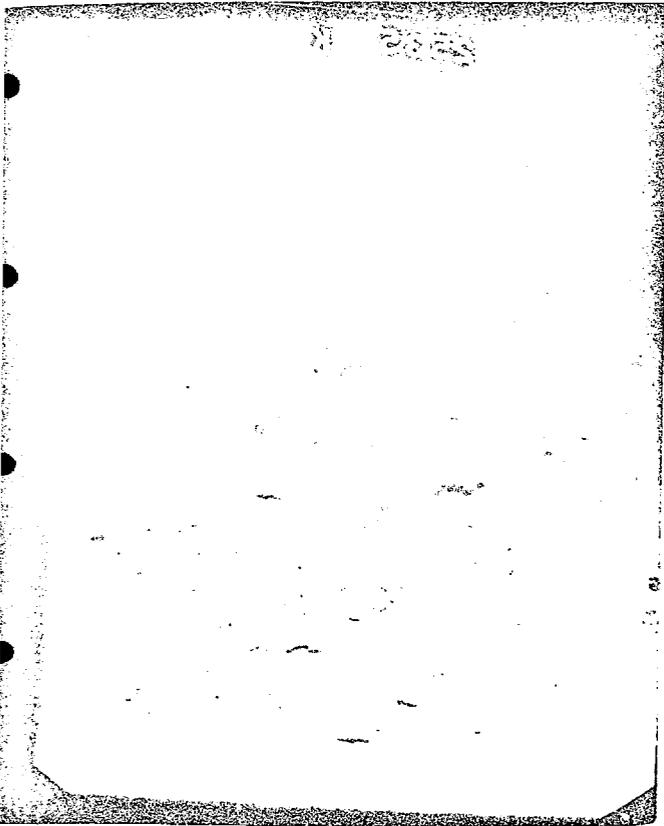
Figure 2. Geophysical Profile of Transect 5 with Station Locations plotted against Depth and Distance. Rectangular Figures represent percent Bioturbation at Stations during three sampling periods.



Radiograph Station 2536



Epoxy Relief Peel Station 2536



Radiograph Station 2535

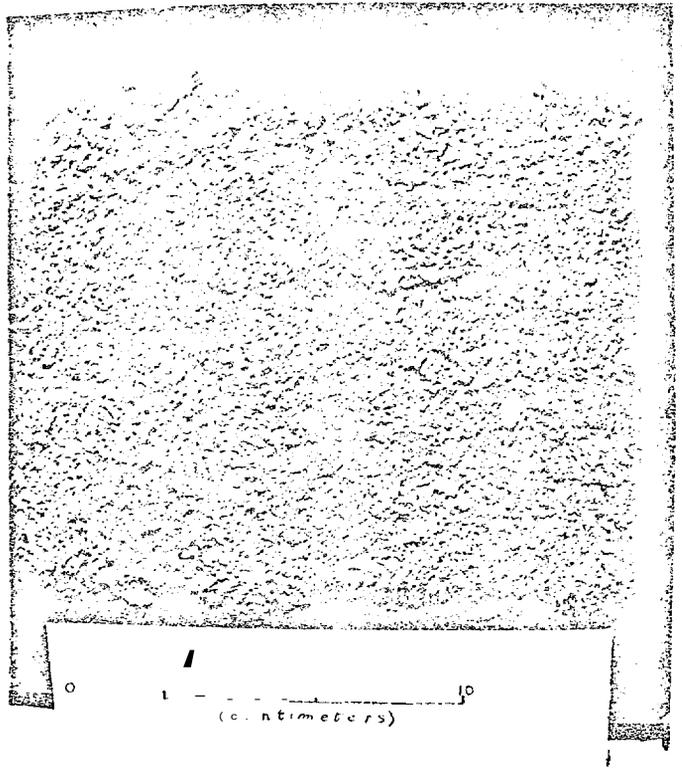


Epoxy Relief Peel Station 2535

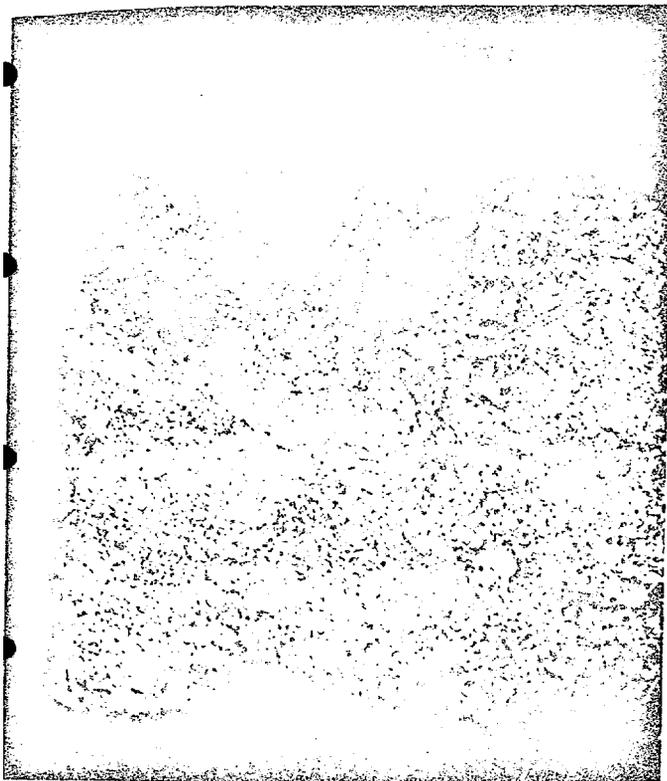
Figure 8b. Radiographs and Epoxy Relief Peels from Stations 2536 and 2535.



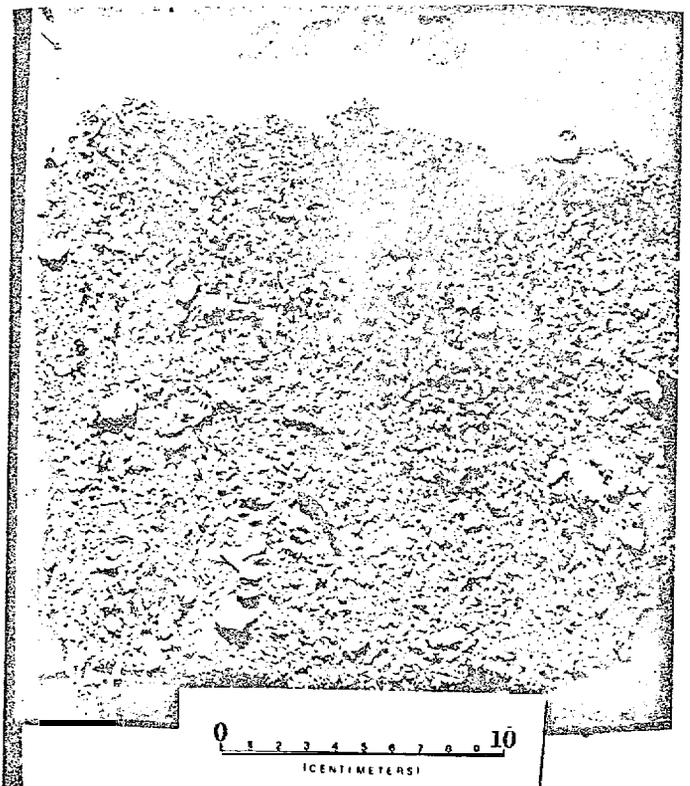
Radiograph Station 2534



Epoxy Relief Peel Station 2534



Radiograph Station 2533

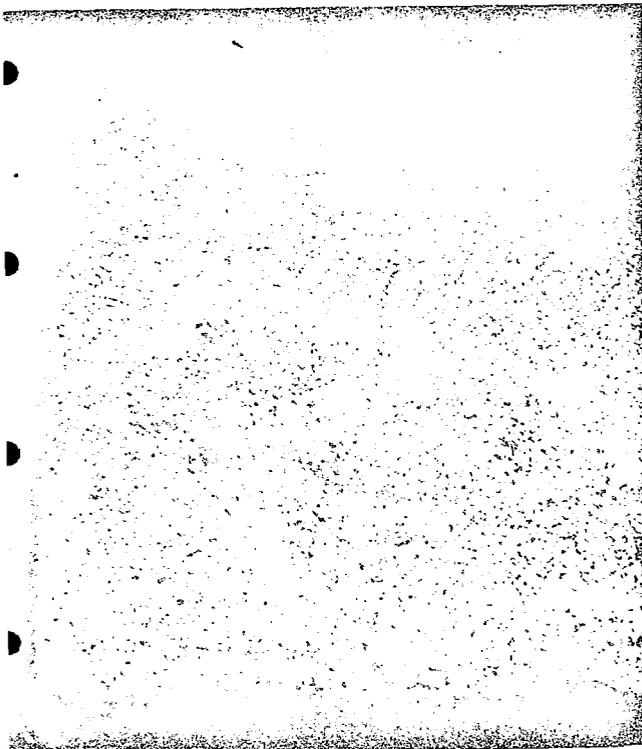


Epoxy Relief Peel Station 2533

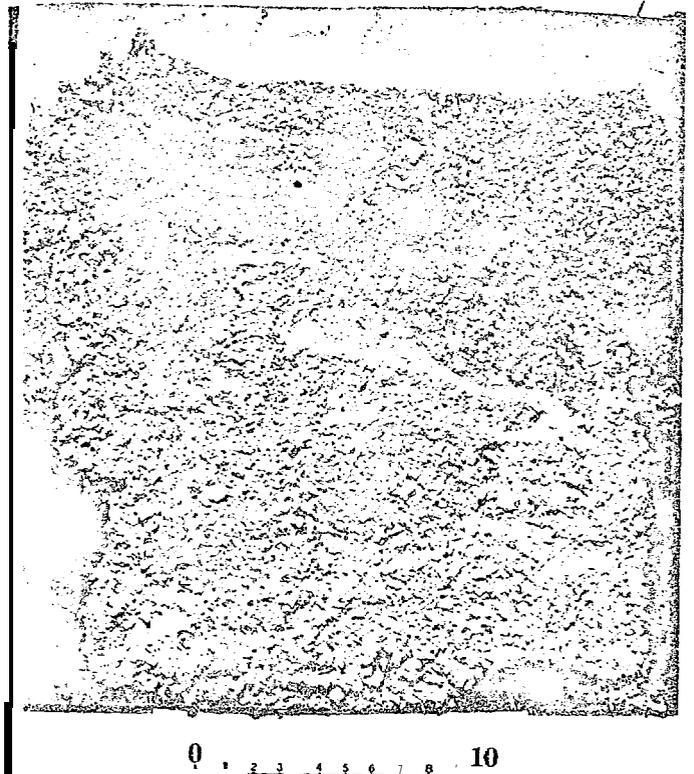
Figure 8c. Radiographs and Epoxy Relief Peels from Stations 2534 and 2533.



Epoxy Relief Peel Station 2532

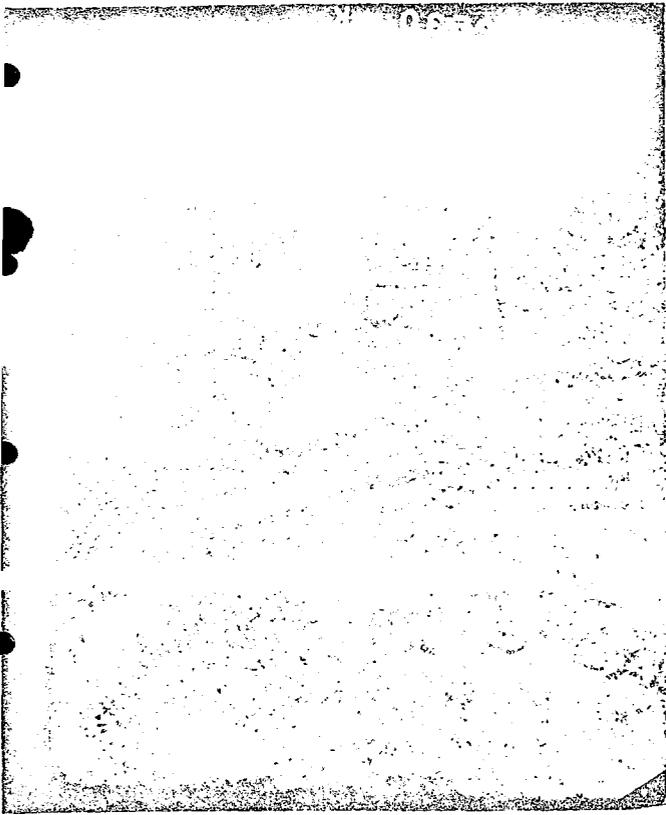


Radiograph Station 2531

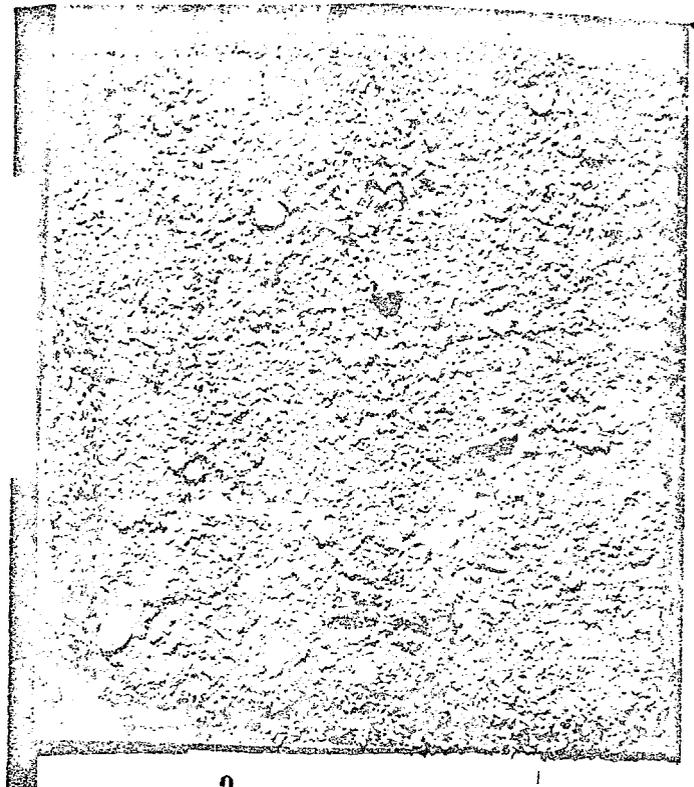


Epoxy Relief Peel Station 2531

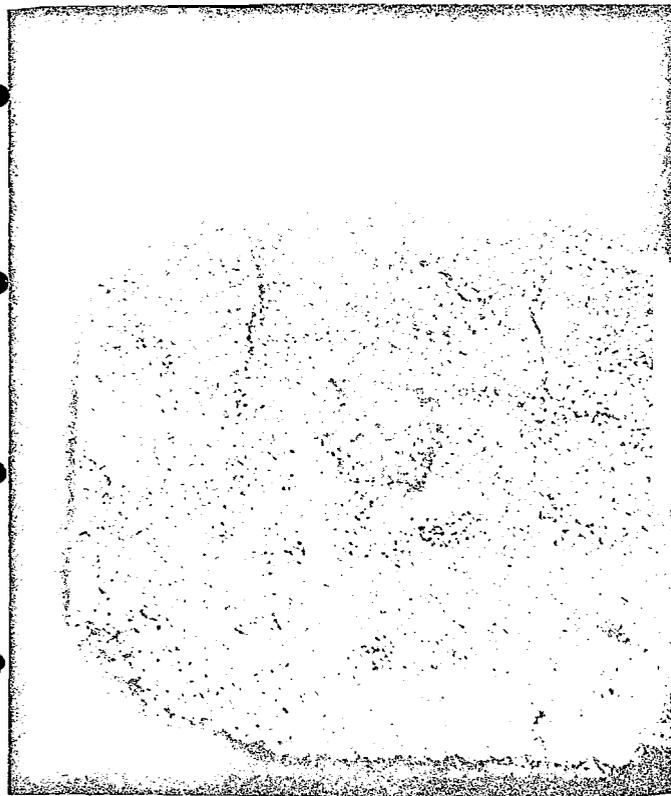
Figure 8d. Radiograph and Epoxy Relief Peels from Stations 2532 and 2531.



Radiograph Station 2530



Epoxy Relief Peel Station 2530

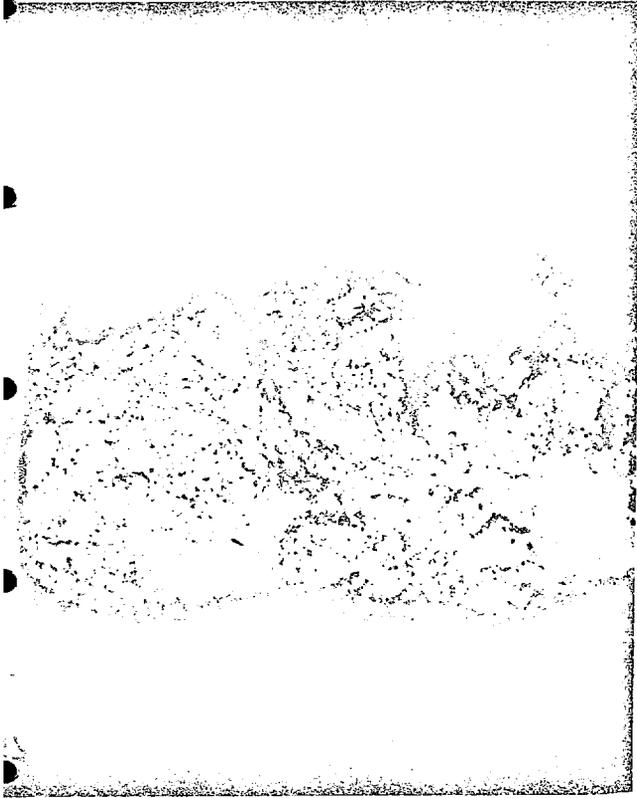


Radiograph Station 2529

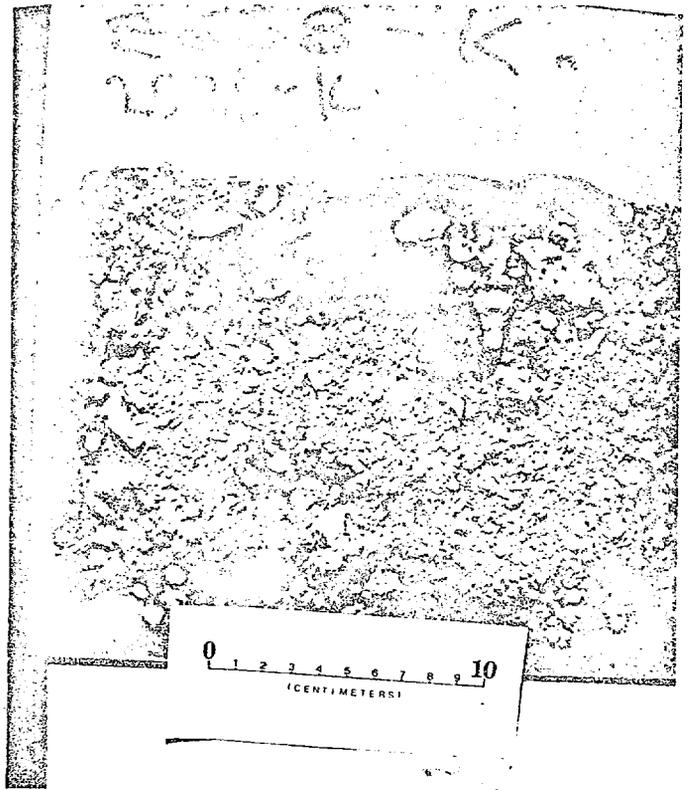


Epoxy Relief Peel Station 2529

Figure 8e. Radiographs and Epoxy Relief Peels from Stations 2530 and 2529.



Radiograph Station 2528



Epoxy Relief Peel Station 2528

Figure 8f. Radiograph and Epoxy Relief Peel from Station 2528.

# BLM TRANSECT 6

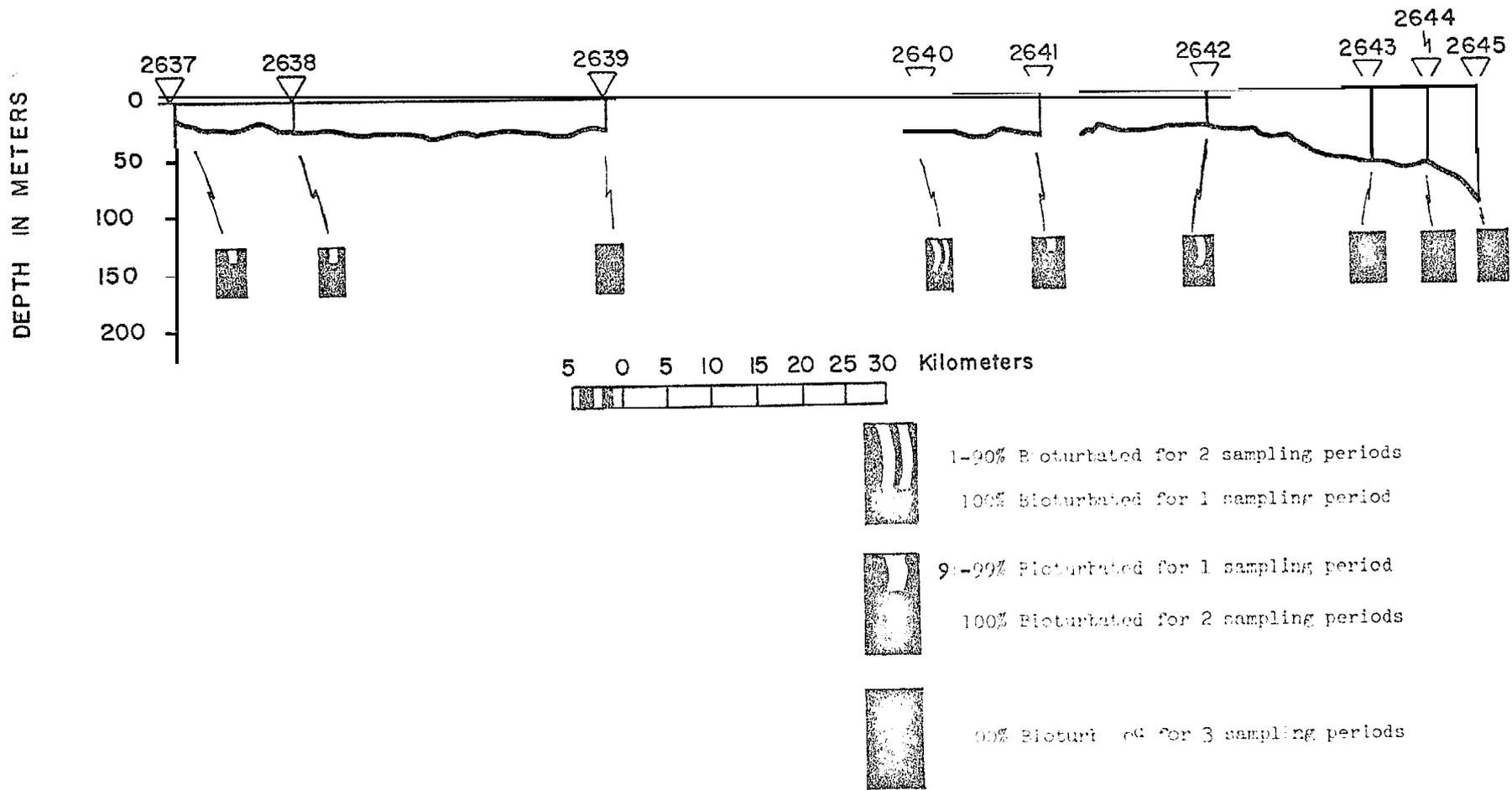
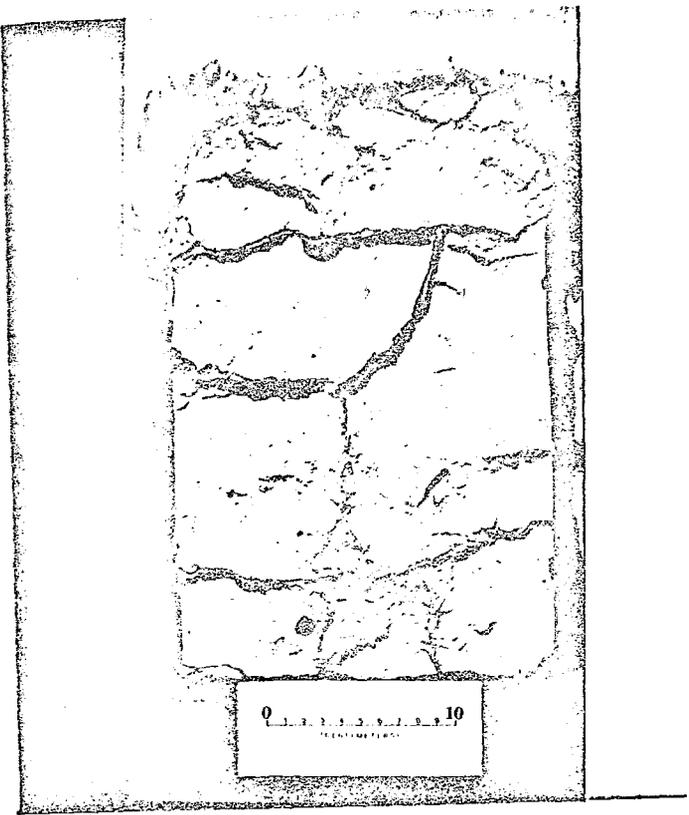
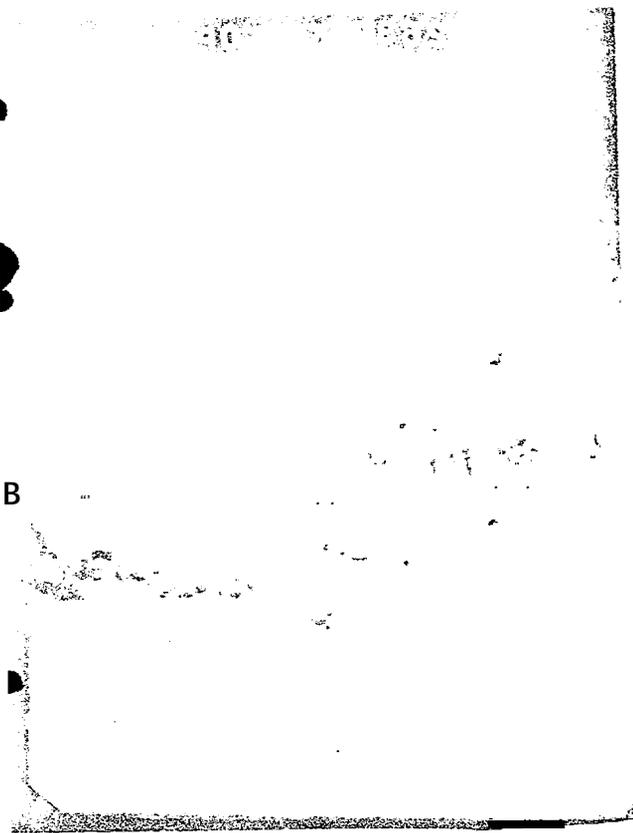
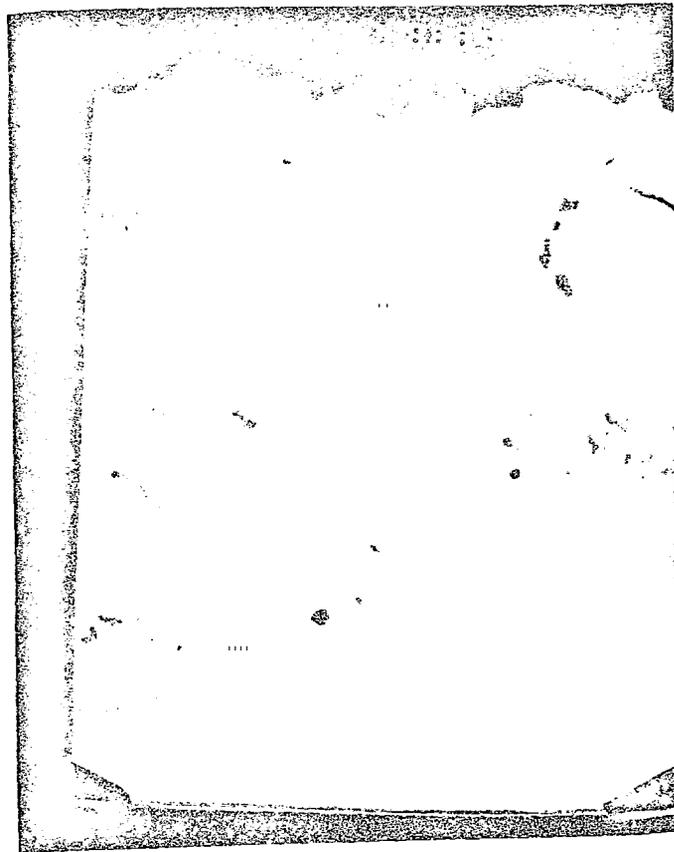


Figure 9a Geophysical Profile of Transect 6 with Station Locations plotted against Depth and Distance. Rectangular Figures represents percent Bioturbation at Stations during three sampling periods.



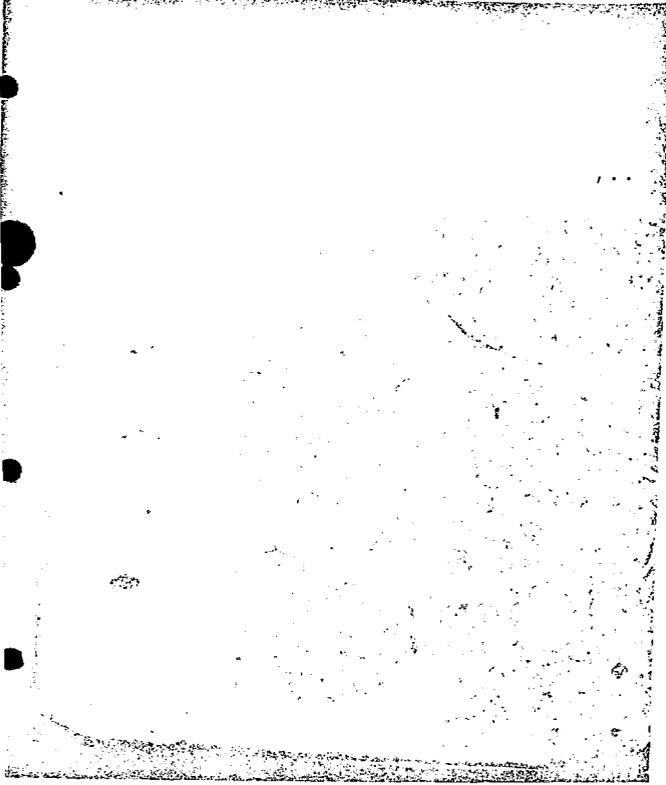
Radiograph Station 2637

Epoxy Relief Peel Station 2637

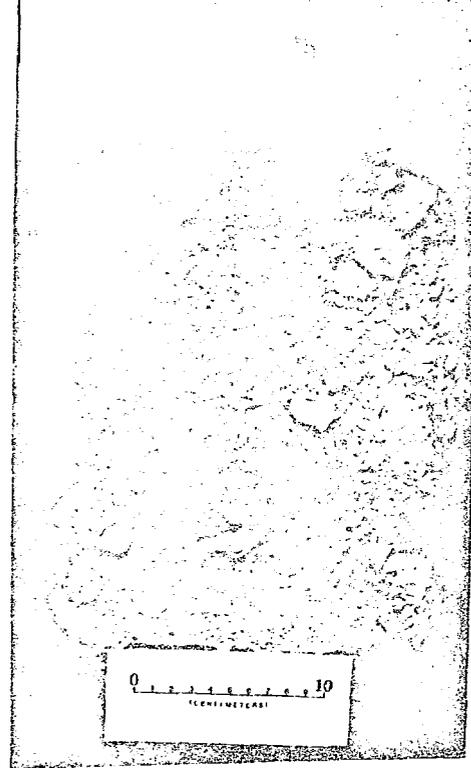


Radiograph Station 2638

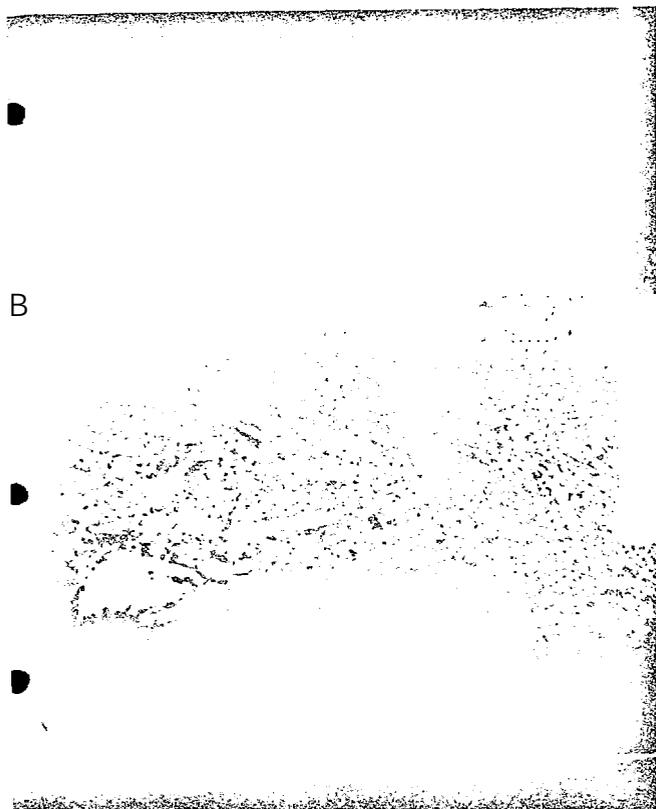
Figure 9b. Radiographs and Epoxy Relief Peels from Stations 2638 and 2637.



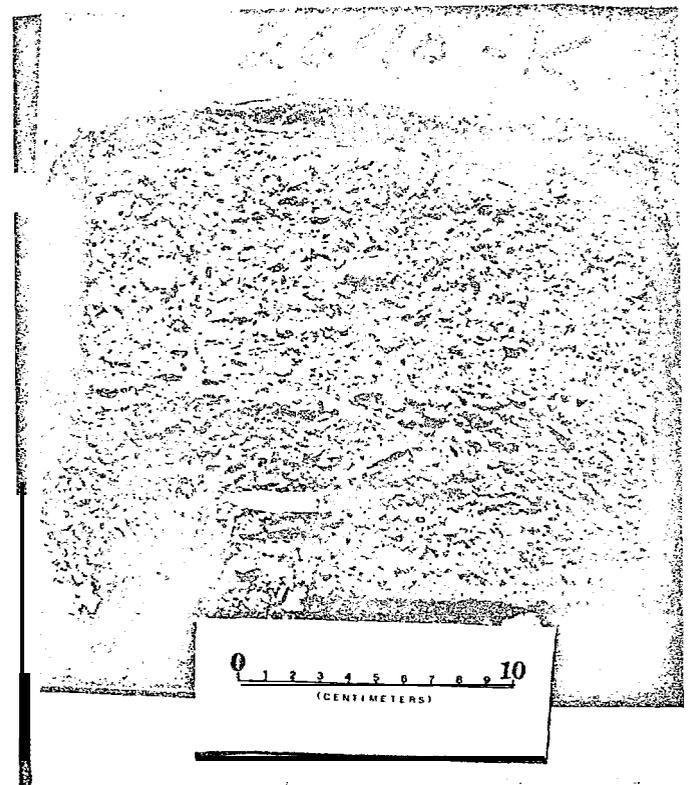
Radiograph Station 2639



Epoxy Relief Peel Station 2637

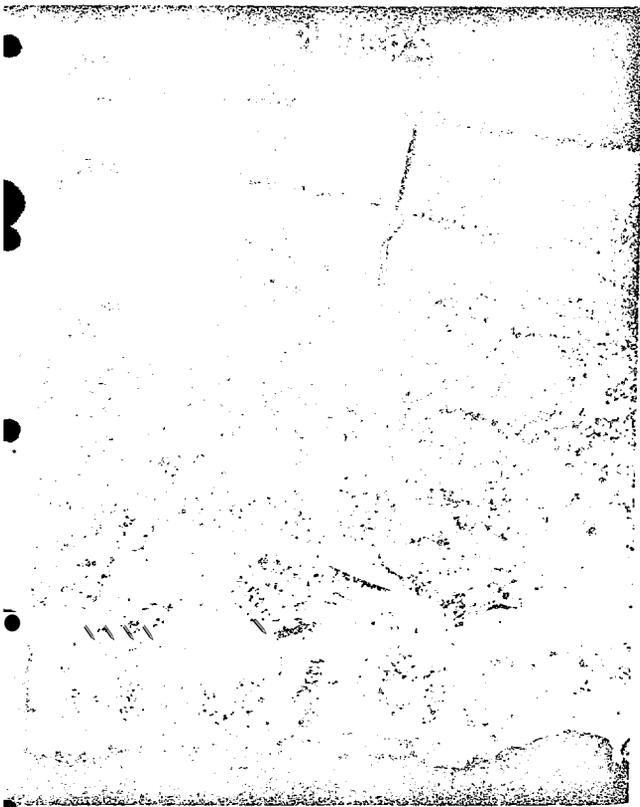


Radiograph Station 2640

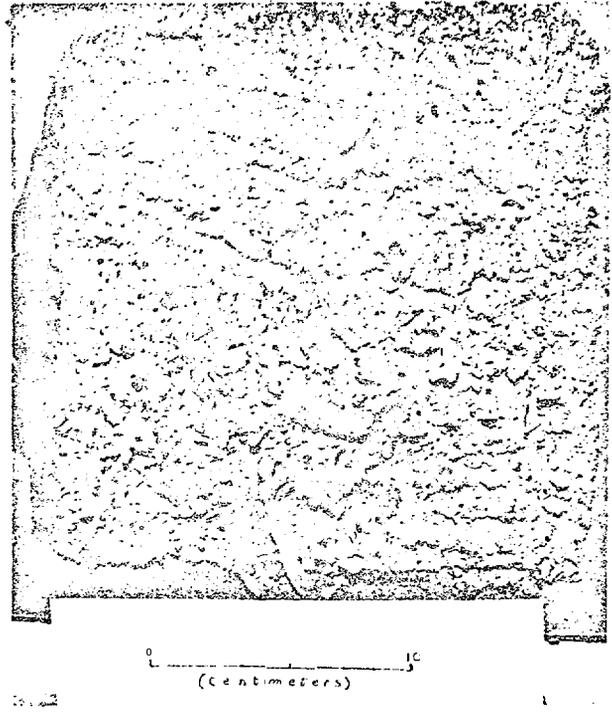


Epoxy Relief Peel Station 2640

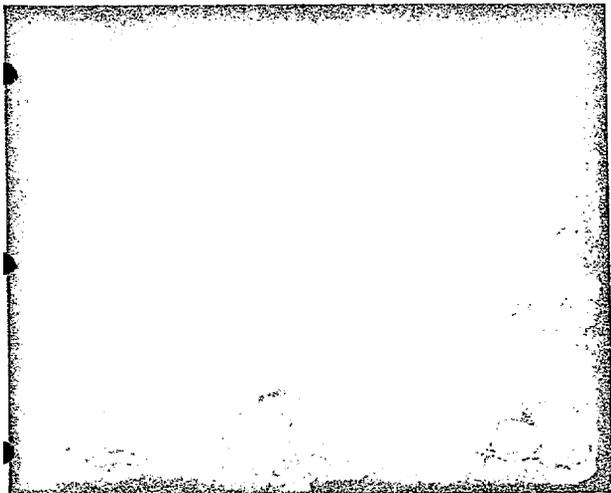
Figure 9c. Radiographs and Epoxy Relief Peels from Stations 2638 and 2637.



Radiograph Station 2641



Epoxy Relief Peel Station 2641

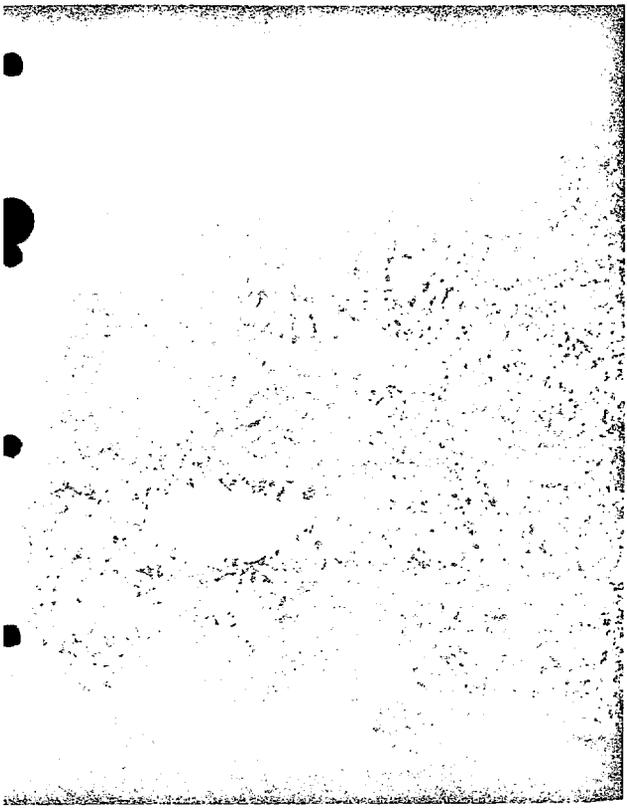


Radiograph Station 2642

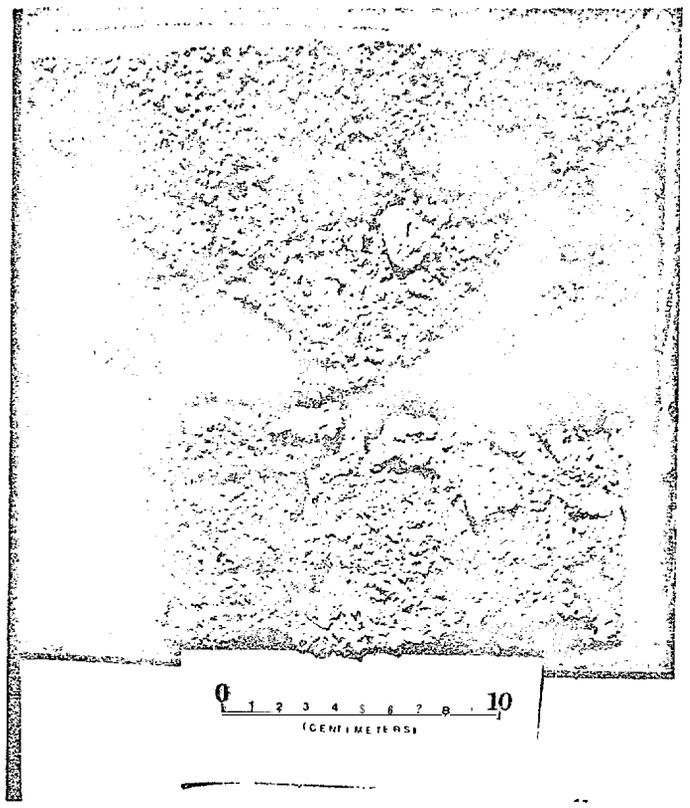


Epoxy Relief Peel Station 2642

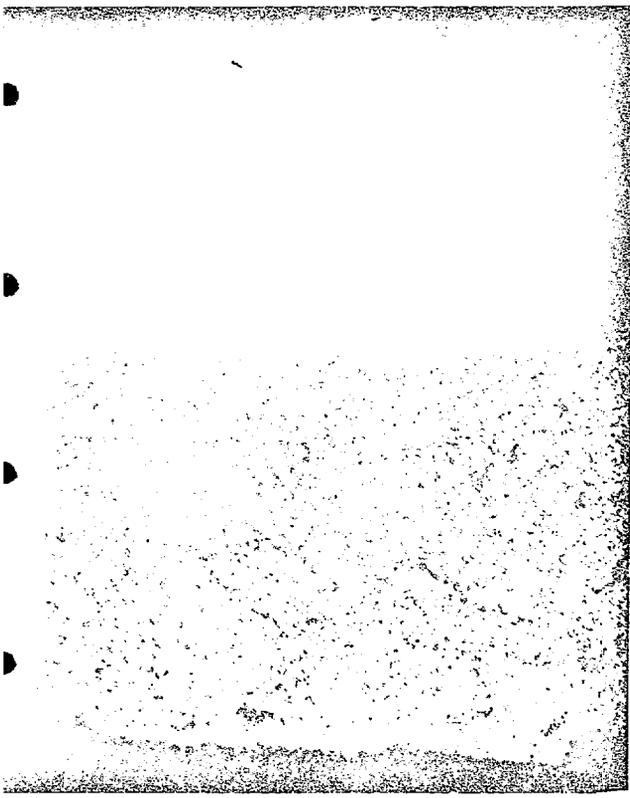
Figure 9d. Radiographs and Epoxy Relief Peels from Stations 2641 and 2642.



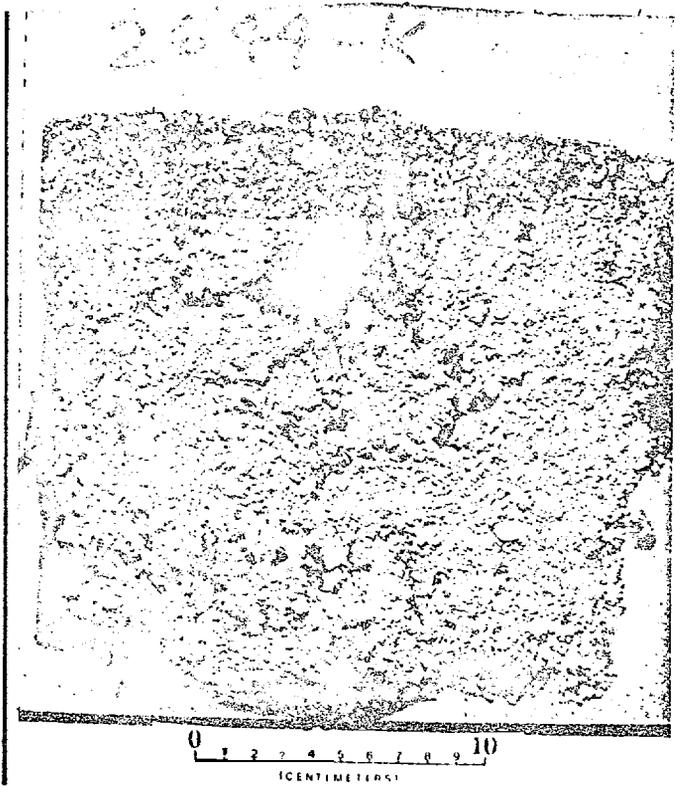
Radiograph Station 2643



Epoxy Relief Peel Station 2643

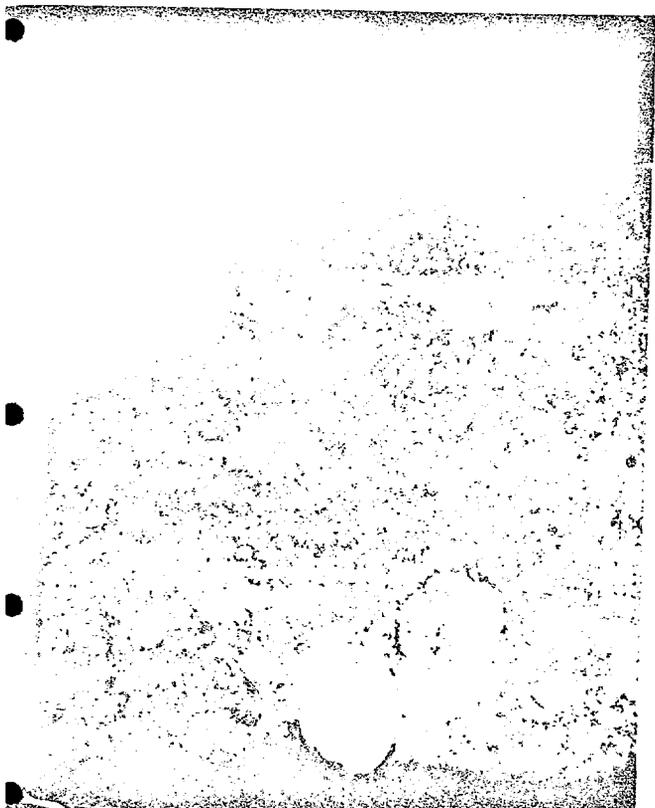


Radiograph Station 2644

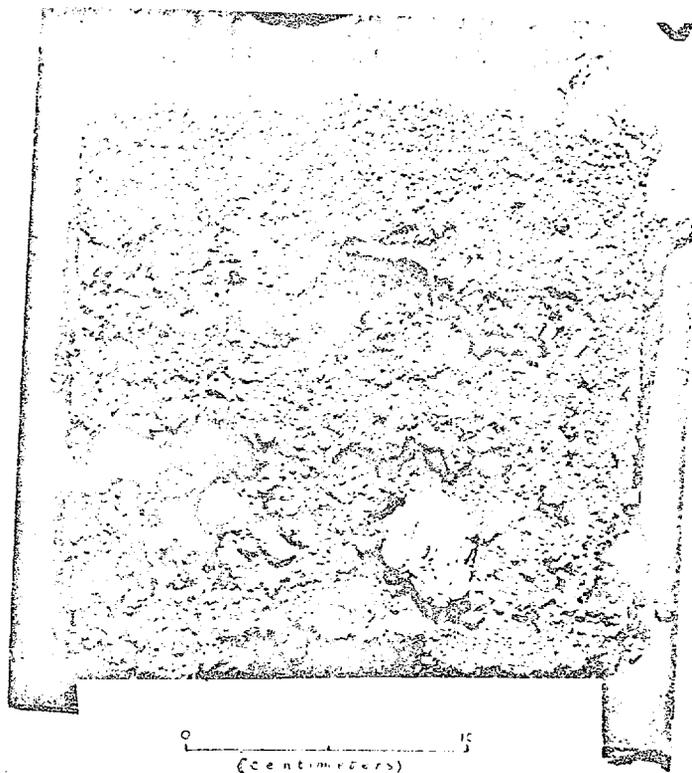


Epoxy Relief Peel Station 2644

Figure 9e. Radiographs and Epoxy Relief Peels from Stations 2643 and 2644.



Radiograph Station 2645



Epoxy Relief Peel Station 2645

B

Figure 9f. Radiograph and Epoxy "Relief Peel from Station 2645.