

RIG MONITORING OF THE MAFLA AREA

University of Miami, Rosenstiel School of Marine and Atmospheric Science

Principal Investigator:
Wayne D. Bock

RESULTS & DISCUSSION

The rig monitoring samples were collected from the Mustang Island area, eight samples each from 100 m range, 500 m range and 1000 m range, and one from the rig site during November 1975 and March 1976 (no rig sample from January 1976). All the sediments from the rig monitoring samples are extremely fine. Of the approximately 15 ml samples collected for foraminiferal analyses less than one milliliter was retained on 63 μ m sieves from each sample. All the foraminifera present in the samples were less than 125 μ m in their smallest dimension with only rare exceptions; in most cases much less. The sediment greater than 63 μ m was composed of either fine quartz grains or polychaetes fecal pellets. The greatest abundances of foraminifera were always associated with the pellet-rich samples. Abundances vary seasonally, but species composition remained constant. Only four species occur consistently in abundances over one percent (three over five percent), and the stress indicator species, Ammonia beccarii, completely dominated every sample composing 55%-88% of the living fauna and somewhat less of the total fauna. The other three major dominate species, in order of abundance, Elphidium galvestonense, Buliminella cf. B. bassendorffensis and Nonionella atlantica, are also stress indicators. Only rarely do other species become more abundant than one percent, and then it was also species able to survive in stressed environments such as Buliminella elegantissima and Nonionella opima.

In normal marine shelf environments in a 24 m water depth (the sampling depth) a rather diverse benthonic foraminiferal fauna usually exists, generally supporting a population of 25-60 species with abundance dependent to some extent on grain size of sediment, the coarser the sediment the lower the

diversity and abundance and vice versa. Adult individuals usually attain close to maximum size for the major dominant species (here defined as those species comprising five percent or more of the foraminiferal population). At the sample sites for rig monitoring over ninety percent of the sediment was less than $63\mu\text{m}$, but species diversity was still very low, 8-18, with only the four species noted above consistently occurring in abundances over one percent. Of these four, Buliminella cf. B. bassendorffensis attained abundances of five percent or greater at only about one third of the stations, and Nonionella atlantica at about one fourth. Elphidium galvestonense usually comprised 6-20% of the population, rarely reaching thirty percent. Ammonia beccarii var. parkinsoniana and Ammonia beccarii var. tepida completely dominated the foraminiferal fauna, both varieties taken together comprised up to 88% of the population. This latter species is a world-wide indicator of stress conditions. In normal marine shelf environments with depths of 24 m it is unusual for it to comprise as much as one percent of the population. All the foraminiferal species were depauperate, only rare specimens attaining a size greater than $125\mu\text{m}$. Depauperate faunas have long been associated with stress conditions. Size alone, however, does not necessarily indicate a stressed environment, but associated with low species diversity and dominance of a stress indicator species, the evidence is conclusive.

Foraminiferal abundance was also unusually low for fine-grained sediments, generally much less than 100 specimens/ml of sediment. It is possible that these figures are considerably biased due to the small size of individuals. Almost all specimens encountered appeared to be adult despite their small size. Certainly most of the juveniles were not retained on the $63\mu\text{m}$

sieve. Abundances vary considerably from station to station, but considerably less so seasonally; stations with greatest abundances remained constant from sampling season to sampling season. Greatest abundances were always associated with pellet-rich sediment. The pellets were identified as polychaetes fecal pellets; numerous polychaetes were observed with fecal pellets contained within their body cavities. One must conclude that conditions which favor polychaetes growth and reproduction (at least for the species encountered at these stations) are also favorable to the Ammonia-dominant foraminiferal fauna. Polychaetes are well-known pollution indicators.

Almost all foraminifera observed, despite their snail size, appeared to be normally developed. No aberrant growths, malformed or thin-walled specimens were observed. Apertural development and pore size and distribution appeared normal for the size of the specimens encountered. Apparently the degree of stress had not reached the point where these abnormalities occur.

Variation in foraminiferal abundances occurs from pre-drilling to drilling to post-drilling conditions. The number of living foraminiferal specimens per sample decreased from F1 to F2 and then increased from F2 to F3 at every station except two, 510601 and 592501. And with the exception of these two stations the foraminiferal abundances never quite recovered to the pre-drilling (F1) levels. Stations 510201, 510301, 551001, 551701 and 551901 had the greatest degree of change, (see Table 1), and all are located northeast of the rig suggesting bottom currents carrying rig-associated pollutants to the northeast. The least change in degree of foraminiferal abundance is at the stations on the 1000 m range, and the most at the 500 m range; the former would be expected if drilling operations were a source of

deleterious pollution, but the latter is unexpected since the 100 m range "being closer" should theoretically be the most adversely affected. If the anomalous effects of station 510601, however, were disregarded, then there would be an aureole of greatest change from the rig decreasing outward.

On the species level, the species most tolerant of stress conditions, Ammonia beccarii, would be expected to increase in percentage of the total living population from pre-drilling to drilling time, if drilling operations were deleterious to the environment. It does at all but three stations. When again, after removal of the rig, A. beccarii should decrease in percentage. It does at all but five stations (Table 2).

CONCLUSION

The depauperate benthonic foraminiferal fauna, the low species diversity, the low foraminiferal abundance, the dominance of Ammonia beccarii and the association of high foraminiferal abundance with polychaetes fecal pellets indicate a highly stressed marine environment in the area of the monitored drilling rig. The cause of stress is almost certainly due to the phenomenon related to the creation of the nepheloid layer above the bottom sediments. Drilling operations appear to have further increased stress in the area, and after removal of the drilling rig the area appears to be on the way to restoring itself to pre-drilling foraminiferal abundance levels.

Table 1. Foraminiferal abundance and per cent living - Mustang Island Rig Monitoring area.

SAMPLE #	TOTAL/SAMPLE			LIVE/SAMPLE			% LIVE		
	F1	F2	F3	F1	F2	F3	F1	F2	F3
500102	11248	- - - -	8438	658	-----	532	5.8	-----	6.3
510201	3485	1029	2267	2259	379	815	64.8	36.0	36.0
510301	3308	267	1721	2833	195	1142	85.6	76.0	66.4
510401	800	353	578	360	236	303	45.0	66.9	52.4
510501	1034	655	806	591	348	452	57.2	53.1	37.6
510601	827	2057	2535	488	1263	1518	59.0	61.4	59.9
510701	1051	306	527	348	109	163	33.1	35.6	30.9
510801	1205	415	601	466	155	245	38.7	37.3	40.8
510901	10000	497	742	2008	294	393	20.1	59.2	53.0
551001	3000	878	1898	1200	189	689	40.0	21.5	36.3
551101	1800	497	1136	274	185	215	15.2	37.3	18.9
551201	2400	800	1648	848	493	693	35.3	61.6	42.1
551301	1149	339	724	234	60	182	20.4	25.6	25.1
551401	1974	870	1376	726	299	549	36.3	41.2	39.9
551501	1200	796	973	600	411	508	50.0	51.6	52.2
551601	2764	810	1775	1032	326	626	37.3	40.3	35.3
551701	725	200	525	231	74	153	31.9	36.9	29.1
591801	600	380	490	193	134	162	32.2	35.2	33.1
591901	1200	354	774	701	213	453	58.4	60.3	58.5
592001	1054	465	765	432	205	317	41.0	44.1	41.4
592101	1187	751	951	514	342	430	113.3	45.6	45.2
592201	1406	1054	1262	450	351	401	32.0	33.3	31.8
592301	4800	4080	4440	2480	2158	2348	51.9	52.9	52.9
592401	527	295	397	145	92	122	27.5	31.2	30.7
592501	616	761	596	225	288	255	36.5	37.8	42.8

F1 = November 1975
 F2 = January 1976
 F3 = March 1976

Table 2. Per cent distribution of the three major living dominant foraminiferal species - Mustang Island Rig Monitoring area.

Sta. No.	<u>Ammonia beccarii</u>																								
	001	102	103	104	105	106	107	108	109	510	511	512	513	514	515	516	517	918	919	920	921	922	923	924	925
F1	55.3	69.0	60.0	61.0	73.0	73.7	73.3	62.3	75.0	70.7	87.6	64.7	66.7	67.0	83.6	68.0	78.8	80.8	74.3	83.0	72.0	84.7	75.0	73.1	73.3
F2		68.0	83.1	86.0	83.0	79.0	74.3	80.0	84.7	64.0	86.5	83.0	71.7	75.6	84.0	71.0	81.1	82.1	75.1	84.9	73.7	88.0	77.0	73.9	74.7
F3	58.3	68.0	65.3	64.3	78.3	76.3	71.8	76.3	79.3	75.0	87.0	75.0	64.8	71.3	84.0	69.7	83.0	82.1	77.3	85.7	76.3	86.7	76.3	72.1	74.5

Sta. No.	<u>Elphidium galvestonense</u>																								
	001	102	103	104	105	106	107	108	109	510	511	512	513	514	515	516	517	918	919	920	921	922	923	924	925
F1	15.3	14.0	30.3	11.0	16.7	12.0	10.7	9.3	12.0	8.0	5.8	11.0	17.5	15.0	10.3	16.7	10.0	10.3	12.0	9.3	10.3	7.0	13.7	4.8	12.4
F2		15.7	8.2	7.6	8.7	13.0	15.6	14.8	11.2	16.9	4.9	5.0	15.0	14.0	9.0	14.7	9.5	7.5	11.7	9.8	9.7	6.3	12.3	6.5	10.4
F3	15.0	15.0	20.7	10.3	12.7	12.7	12.8	14.3	11.3	9.3	4.7	8.0	11.5	14.7	9.7	15.7	9.8	9.3	10.0	8.0	10.0	6.7	13.0	4.1	11.4

F1 = November 1975
 F2 = January 1976
 F3 = March 1976

Table 2 continued

Sta. No.	<u>Buliminella c.f. B. bassendorfensis</u>																								
	001	102	103	104	105	106	107	108	109	510	511	512	513	514	515	516	517	918	919	920	921	922	923	924	925
F1	9.0	5.0	1.3	7.7	3.7	4.0	6.0	7.0	3.7	2.3	0.7	5.0	5.0	3.3	1.3	6.0	2.6	6.2	4.0	4.0	11.7	3.3	2.0	7.6	4.9
F2		2.0	4.1	2.5	4.0	0.0	9.2	3.2	4.1	9.5	5.4	8.7	5.0	4.3	0.7	5.0	4.1	3.7	7.0	3.9	11.0	2.7	2.7	9.8	5.2
F3	8.3	3.3	2.0	7.0	5.0	2.0	9.2	4.1	4.0	4.0	4.2	6.7	6.6	3.7	1.0	5.7	2.6	5.6	4.3	3.3	11.3	3.0	2.3	8.2	5.1

F1 = November 1975

F2 = January 1976

F3 = March 1976