Responses of Biota and Sediment to the 7-Mile Outfall Termination

In the SCCWRP 1986 Annual Report, the Hyperion Recovery Study was described briefly. At that time the researchers, Bruce E. Thompson of SCCWRP and John Dorsey of the Hyperion Treatment Facility, had started pre-termination sampling but did not report any data. Technical delays pushed back the projected date of shutoff, so the researchers postponed the sampling times accordingly. A revised sampling schedule is shown in Table 1. A third set of pre-termination samples was collected in the summer of 1987. Discharge from the Hyperion 7-mile sludge outfall was discontinued in November 1987, and quarterly post-termination sampling began in January 1988.

This report summarizes some of the data from the first set of pre-termination samples (February 1986), which show conditions in the bay under full sludge discharge.

Using dissolved sulfides in sediment interstitial (pore) water as an indicator of the sludge field, the scientists estimated that it exists mainly along the axis of the upper part of Santa Monica Submarine Canyon. Concentrations up to 284 mg/L of pore water were measured at the outfall terminus (Figure 1). Deep sediment cores, collected in October 1986, showed that the sludge field was about 50 cm deep, but cores collected in April 1988 showed that it was more than 140 cm deep.

Patterns similar to those in Figure 1 can be seen for such outfall-associated contaminants as polychlorinated biphenyl compounds (PCBs), polynuclear aromatic hydrocarbons (PAHs), and zinc (Figures 2a-2c), but peak concentrations were measured at sites deeper in the canyon, not at the outfall terminus. Additionally, elevated contaminant concentrations were measured farther from the outfall than sulfides were.

Infaunal indicator taxa such as the polychaete *Capitella capitata* were collected in highest abundances on the periphery of the sludge field; apparently, they are affected by high sulfide concentrations (Figure 1). Only about 10 species were collected from the sites near the outfall terminus. Most of these (mean, 655 organisms per square meter) were unusual polychaete taxa, such as *Ophryotrocha* spp. (three undescribed species), that are found only in highly contaminated areas. How they can exist in such areas is not understood. Exposures of most species to this sediment (see pp. 50, 58, and 65) caused death; however, another species found there, the gutless clam *Solemya reidi*, has biochemical mechanisms that can detoxify sulfide (Powell and Somero 1985).

Sites at intermediate distances from the outfall are dominated (abundance and biomass) by the clam *Parvilucina tenuisculpta* (560 organisms per square meter), and the reference sites are dominated by the ophiuroid *Amphiodia urtica* (760 organisms per square meter). *A. urtica* is the most abundant macrofaunal species at reference sites all along the southern California

Table 1. Schedule showing number of sites to be sampled at each time for each general category of samples. Discharge was terminated in November 1987.[a]

	Pre-Termination			Post-Termination				
	1986		1987	1988				1989
Tasks	Feb. W	Aug. Su	Sept. Su	Jan. W	Apr. Sp	Aug. Su	Nov. F	Jan. W
Sediments								
Grain size & chemistry	17	17	17	17	17	17	17	17
Coring		3			10			10
Biology								
Infauna	17	17	17	17	17	17	17	17
Epifauna & fish (non-canyon sites)	12	12	12	12		12		12
Tissue chemistry (Dover sole & Ridge-back prawn)		6	6	6		6		6
Oceanography								
CTD/DO profile	6	6	6[b]	6		6		6
Current meters	1			3		3		3
Sediment traps	3			3		3		3

[a]Abbreviations: W, winter; Su, summer; Sp, spring; F, fall; CTD, conductivity/temperature/depth; DO, dissolved oxygen.
[b]CTD failed; data not collected.

Table 2. Concentrations (ng/g, wet weight; ppb) of DDTs and PCBs in tissues of two species (February 1986).

	Sicyonia ingentis				Dover sole			
	hepatopancreas		muscle		liver		muscle	
Area (No. of stations)	DDT	PCB	DDT	PCB	DDT	PCB	DDT	PCB
Outfall (9)[a]	990	2854	9	<47	972	2035	109	254
Transition (4)[a]					1714	2864	45	<40
Reference (Malibu) (4)[a]	1141	<838	11	<34	1686	<91	<14	<53
So. Cal. average of mainland shelf (38)[b]	655	568			440	368		

[a]Locations of stations are shown in Figure 2.
[b]Thompson et al. (1987).

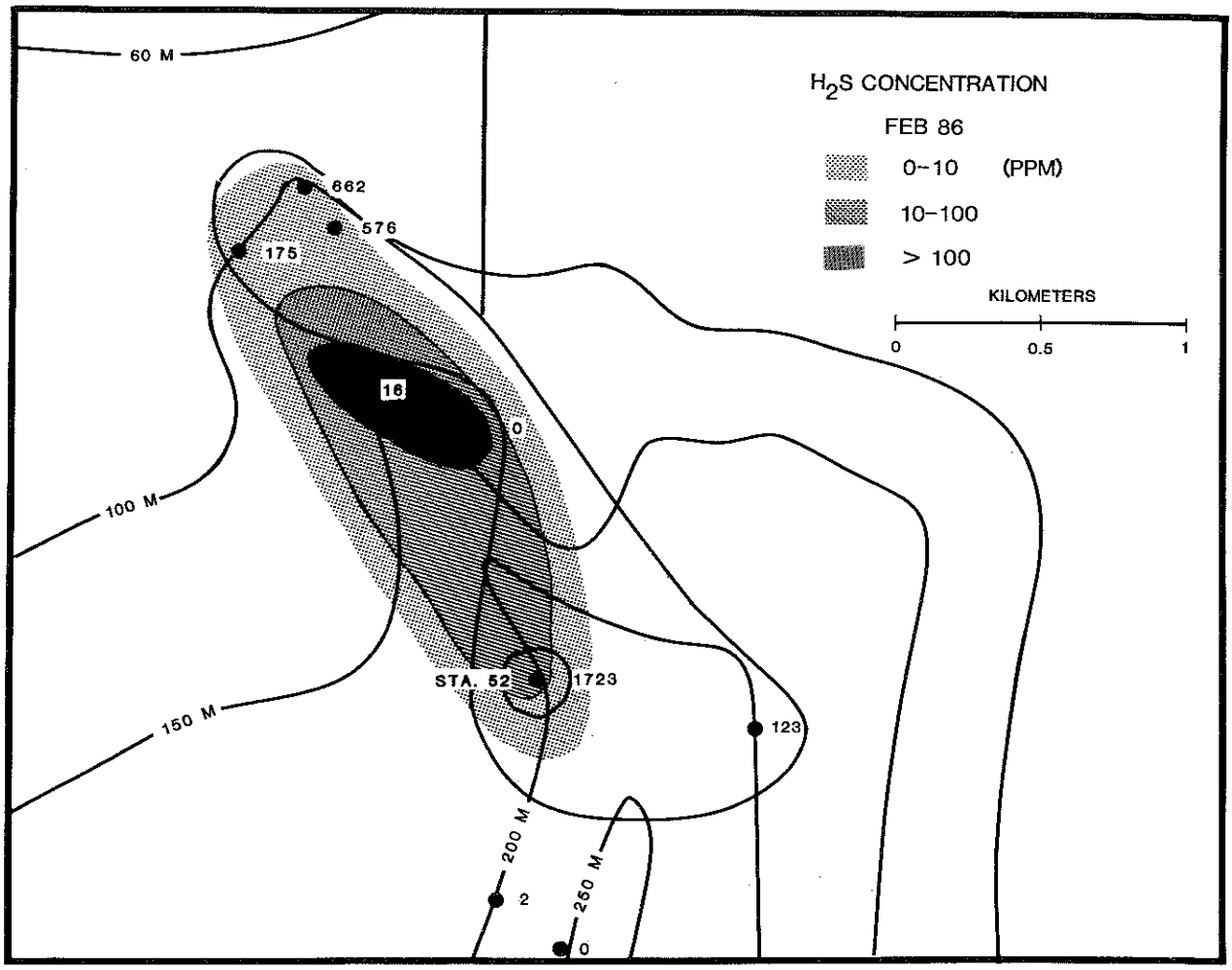


Figure 1. Plot of hydrogen sulfide (H_2S) concentrations measured in the sediments near the 7-mile outfall terminus. Numbers are numbers of the polychaete *C. capitata* (per grab) collected at each site (solid contours).

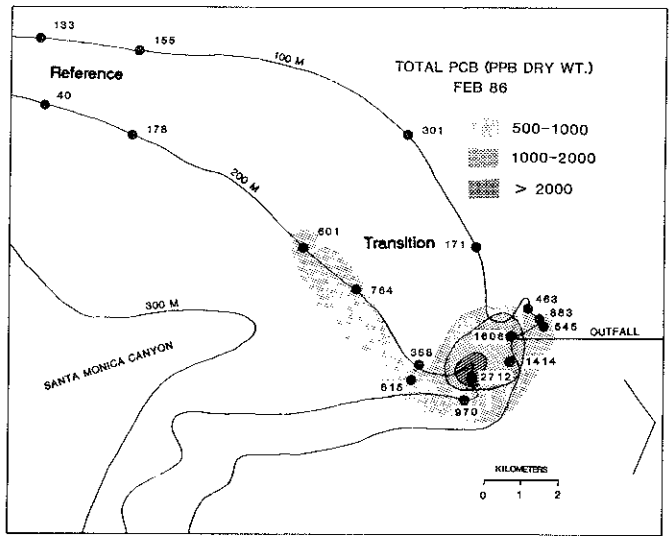
mainland shelf (Thompson et al. 1987). Similar patterns of species composition and abundance in Santa Monica Bay were shown by Bascom (1979) and Dorsey (in press).

Otter trawl catches contained similar species and abundances at sites near the outfall and at the reference sites. The prawn *Sicyonia ingentis* and the urchin *Lytechinus pictus* were the most abundant megabenthic invertebrates collected. These species were also reported to be the most abundant species all along the mainland shelf. The plainfin midshipman and stripetail rockfish were the most abundant fish collected in the trawls.

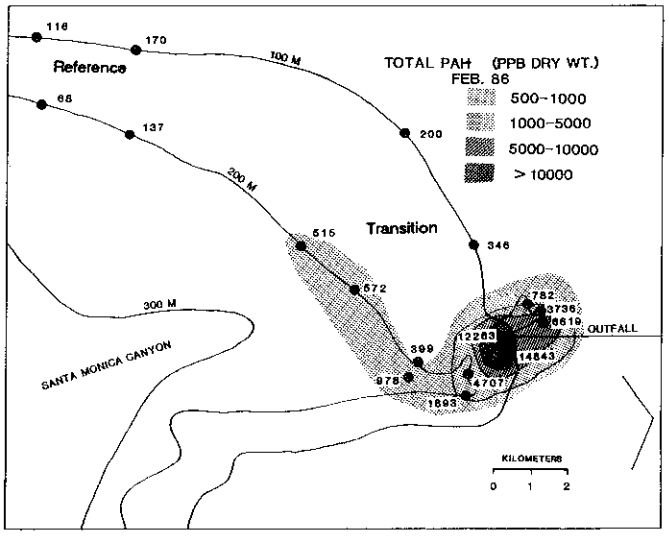
Contaminant concentrations in tissues of two species were measured. Table 2 shows that the highest PCB concentrations were in *S. ingentis* hepatopancreas and Dover sole livers collected near the outfall. Concentrations of DDT and other contaminants in muscle tissue were all low and showed no obvious outfall-related trends. These results show that only a small area (about 3 to 4 km^2) was observably affected by sludge discharge.

During the April 1988 cruise, the scientists noticed that some of the canyon sites on the periphery of the sludge field had changed. At station 52 (Figure 1), pre-termination samples had the highest contaminant concentrations and the most *C. capitata*. In April, that station contained mostly *P. tenuisculpta* and *Pectinaria californiensis*, organisms more common in the

(a)



(b)



(c)

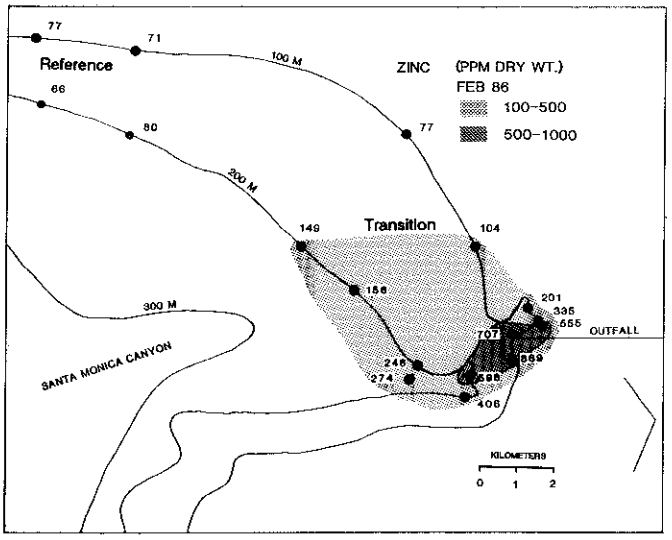


Figure 2. Plots of sediment contaminant concentrations measured near the 7-mile outfall terminus: (a) PCBs, (b) PAHs, and (c) zinc.

transition sites. Thus, it appears that recovery has begun at some sites on the periphery of the sludge field. Sites at the outfall terminus, however, were still as described above during February 1986.

Quarterly sampling will continue through next January (1989). Depending on the progress of recovery, sampling will probably continue semi-annually for another year. We expect that the transition sites and sites on the periphery of the sludge field will recover the fastest. As sediment conditions improve, more infaunal species normally found in reference areas will move into those areas. Recovery at the outfall terminus will probably take longer. Recovery at any site will be defined as occurring when parameters measured are not statistically different from those at the reference site.

Upon completion of analyses of all pre-termination samples, a summary of that information will be prepared. Researchers anticipate that will occur in the fall of 1988.

Acknowledgment

This work was funded by City of Los Angeles Contract No. C-65692.

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