

Fate and Transport of Planar and Mono-Ortho Polychlorinated Biphenyls and Polychlorinated Naphthalenes in Southern California Sediments

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Background

Treated sewage, storm water runoff and industrial waste are sources of chemical contamination in coastal sediments. Although studies of sedimentary chemistry have resulted in stringent laws on discharging toxic chemicals into the sea, the more toxic chemicals can have lasting effects on the environment.

Polychlorinated biphenyls (PCBs) are one example of a group of chemicals that were banned because of their extreme toxicity to wildlife, but nonetheless remain a long-term problem for human health and marine life. The Environmental Protection Agency, for example, estimates that 10 tons of PCBs remain in ocean sediments on the Palos Verdes shelf. PCB and DDT contamination have resulted in commercial fishing bans and recreational catch limits for white croaker in the area.

The most toxic of all PCB compounds are the “co-planar” or “non-ortho” PCB congeners. There are 209 congeners of the PCB molecule, representing the set of all possible arrangements of chlorine atoms in the molecule’s biphenyl ring. All 209 congeners are toxic, but the most toxic and least abundant are the co-planar ones.

The Project

The goal of this project is to investigate the distribution and fate of the different PCB congeners in sediments in the Southern California Bight. This will be the first study that attempts to isolate and analyze the co-planar component of PCB contamination on the West Coast.

For the project, Dr. M. Indira Venkatesan, a geochemist at the

University of California at Los Angeles, plans to analyze 8 sediment cores from San Pedro and Santa Monica basins, each of which records nearly a century of deposition. She will also analyze a large number of surface sediment samples collected in the Santa Monica Bay between 1997 and 2001.

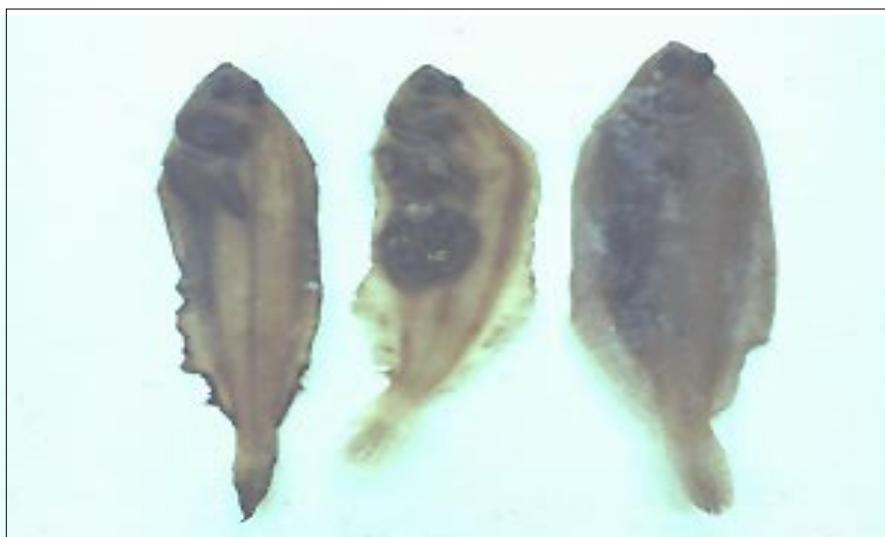
Despite the widespread belief that PCBs are not biodegradable and relatively stable, recent studies suggest that microbial processes may remove chlorine atoms from the highly chlorinated, non-ortho PCBs. Microbes thus seem to selectively remove chlorine atoms from the most toxic, co-planar, congeners. Dr. Venkatesan said that if this process works, it “should result in the detoxification and subsequent microbial degradation of PCBs with lower chlorine numbers.”

Dr. Venkatesan’s work will examine whether microbial processes do detoxify PCB congeners in marine sediments. Other objectives include:

- mapping the spatial and temporal distribution of sediment contamination in the Bight;
- mapping the distribution of polychlorinated naphthalenes (PCNs) in the Bight. PCNs are toxic industrial compounds that, in general, seem to be associated with PCB contamination; and,
- understanding the dispersal of PCBs and PCNs in the coastal zone.

Applications

The data gathered for this project can serve as a scientific basis for reconstructing a historical record of sediment contamination in the state. Such a record can be incorporated



Dover sole collected in the 1970s from coastal waters off Palos Verde in Los Angeles show the damaging effects of contaminants and parasites. The specimen on the far left suffers from severe fin erosion caused by pollutants such as DDT and PCB, the one in the middle has large tumors from parasites. The sole on the right is normal. Because of strict laws, diseased fish such as these are today rare. Photo: Southern California Coastal Water Research Project.

into the state's Ocean Plan, which calls for establishing sediment quality objectives. The State Water Resources Control Board adopted the first Ocean Plan in 1972 to set

water quality objectives for the state's ocean waters and to coordinate efforts to meet federal environmental laws.

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