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Seabed Disposal

Over 70% of the earth's surface is covered by water. The coastal zone—the boundary between the ocean and land—is under the primary influence of humans, while the rest of the ocean remains fairly remote from human activity. This remoteness has in part led scientists and policy makers to examine the deep ocean, particularly the seabed, as a potential location for waste disposal.

Much of the deep ocean seabed consists of abyssal hills and vast plains that are geologically stable and have sparse numbers of bottom-dwelling organisms. These areas have been characterized as oozes, hundreds of meters thick, that are in effect "deserts" in the sea. Other attributes of the deep ocean seabed that have led scientists and policy makers to consider the sea bottom as a repository for waste include the immobility of the interstitial pore water within the **sediment**, and the tendency for ions to adsorb or stick to the sediment, which limits movement of elements within the waste. Another important factor has been the lack of known commercial resources such as **hydrocarbons**, minerals, or fisheries.

The deep seabed has been studied as a potential disposal option specifically for the placement of **high-level radioactive waste**. Investigations on the feasibility of disposing radioactive wastes in the seabed were carried out for over a decade by a host of scientists from around the world. In 1976, the Organization for Economic Cooperation and Development (OECD) and the Nuclear Energy Agency coordinated research at the international level and formed the Seabed Working Group. Members of the group included Belgium, Canada, France, the Federal Republic of Germany, Italy, Japan, the Netherlands, Switzerland, United Kingdom, United States, and the Commission of European Communities. The Seabed Working Group focused its investigation on two sites in the Atlantic Ocean, Great Meteor East and the Southern Nares Abyssal Plain, and one site in the Pacific Ocean, known as E2. The Great Meteor East site lies between 30.5°N and 32.5°N, 23°W and 26°W, approximately 1,865 mi (3,000 km) southwest of Britain. The Southern Nares Abyssal Plain site lies between 22.58°N and 23.17°N, 63.25°W and 63.67°W, approximately 375 mi (600 km) north of Puerto Rico. Site E2 in the Pacific Ocean lies between 31.3°N and 32.67°N, 163.42°E and 165°E, and is approximately 1,240 mi (2,000 km) east of Japan.

This working group pursued a multidisciplinary approach to studying the deep-ocean sediments as a potential disposal option for high-level **radioactive waste**. High-level radioactive waste consists of spent nuclear fuel or byproducts from the reprocessing of spent nuclear fuel. It also includes transuranic wastes, a byproduct of fuel assembly, weapons fabrications, and reprocessing operations, and **uranium** mill **tailings**, a byproduct of mining operations. **Low-level radioactive waste** is legally defined as all types of waste that do not fall into the high-level radioactive waste category. They are made up primarily of byproducts of nuclear reactor operations and products that have been in contact with the use of radioisotopes. Low-level radioactive wastes are characterized as having small amounts of **radioactivity** that do not usually require shielding or heat-removing equipment.

One proposal to dispose of high-level radioactive waste in the deep seabed involved the enclosure of the waste in an insoluble solid with metal sheathing or projectile-shaped canisters. When dropped overboard from a ship, the canisters would fall freely to the ocean bottom and bury themselves 33–44 yd (30–40 m) into the soft sediments of the seabed. Other proposals recommend drilling holes in the seabed and mechanically inserting the canisters. After emplacement of the canisters, the holes would then be plugged with inert material.

The 1972 international **Convention on the Prevention of Marine Pollution by Dumping of Waste and Other Matter**, commonly called the London Dumping Convention, prohibits the disposal of high-level radioactive wastes. In the United States, the **Marine Protection, Research and Sanctuaries Act** of 1972 also bans the ocean disposal of high-level radioactive waste. However, Britain has recently considered using the continental shelf seabed for disposal of low- and intermediate-level radioactive waste. The European countries discontinued **ocean dumping** of low-level radioactive waste in 1982. In the United States, the ocean disposal of low-level radioactive waste ceased in the 1970s. Between 1951 and 1967, approximately 34,000 containers of low-level radioactive waste were dumped in the Atlantic Ocean by the United States.

Another important aspect in the debate about seabed disposal is the risk to humans, not only because of the potential for direct contact with wastes but also because of the possibility of accidents during transport to the disposal location and contamination of fishery resources. When comparing seabed disposal of high-level radioactive waste to land disposal, for example, the **transportation** risks may be higher because travel to a site at sea would likely be longer than travel to a location on land. Increased handling by personnel substantially increases the risk. Also, there is a statistically greater risk of accidents at sea than on land when transporting anything, especially radioactive wastes, although such an accident at sea would probably pose less risk to humans.

It is also a concern that the seabed **environment** may be more inhospitable than a land site to the metal canisters containing the radioactive waste, because corrosion is more rapid due to the salts in marine systems. In addition, it is uncertain how fast **radionuclides** will be transported away from the site. The heat associated with the decay of high-level radioactive waste may cause convection in the sediment pore waters, resulting in the possibility that the dissolved radioactive material will diffuse to the sediment-water interface. Predictions from calculations, however, indicate that convection may not be significant. According to laboratory experiments that simulate subseabed conditions, it would take roughly 1,000 years for radioactive waste buried at a depth of 33 yd (30 m) to reach the sediment-water interface. Other technical considerations adding to the uncertainty of the ultimate fate of buried radioactive waste in the seabed involve possible **sorption** of the radionuclide cations to clay particles in the sediment, and possible uptake of radionuclides by bottom dwelling organisms.

The Seabed Working Group concluded from their investigation that seabed disposal of high-level radioactive waste is safe. Compared to land disposal sites, the predicted doses of possible **radiation exposure** are lower than published radiological assessments. However, there are political concerns over deep-ocean seabed disposal of wastes. Deep-ocean disposal sites would likely be in international waters. Therefore, international agreements would have to be reached, which may be very difficult with countries without a **nuclear power** industry, particularly for disposal of radioactive waste.

In 1991, the Woods Hole Oceanographic Institution held a workshop to discuss the research required to assess the potential of the abyssal ocean as an option for disposal of sewage **sludge**, incinerator ash, and other high volume benign wastes. The disposal technology considered at this workshop entailed employing an enclosed elevator from a ship to emplace the waste at or close to the seabed. One issue raised at the workshop was the need to

investigate the incidence of benthic storms that may occur along the deep ocean seabed. These benthic storms, also called turbidity flows, are currents with high concentrations of sediment that can stir up the sea bottom, erode the seabed, and redistribute sediment further downstream.

Woods Hole held a follow-up workshop in 1992. Included were a broader array of scientists and representatives from environmental organizations, and these two groups disagreed over the use of the ocean floor as a waste-disposal option. The researchers supported the consideration and study of the seabed and the ocean in general as sites for disposal of wastes. The environmentalists did not support ocean disposal of wastes. The environmentalists' view is consistent with the law passed in 1988, the **Ocean Dumping Ban Act**, which prohibits the dumping of sewage sludge and industrial waste in the marine environment. In 1993, a ban on the dumping of any radioactive materials into the sea was put into effect at the London Convention and will be enforced until 2018.

See Also

Convention on the Law of the Sea; Dredging; Hazardous Waste Siting; Marine Pollution; Ocean Dumping; Radioactive Pollution

Resources

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