**WRITTEN TESTIMONY OF**
**JOHN W FARRINGTON**
**INTERIM DEAN AND PROFESSOR**
**SCHOOL OF MARINE SCIENCE AND TECHNOLOGY**
**UNIVERSITY OF MASSACHUSETTS-DARTMOUTH**
**AND**
**SCIENTIST EMERITUS**
**WOODS HOLE OCEANOGRAPHIC INSTITUTION**

**AS SUBMITTED SEPTEMBER 24, 2010**
**TO THE**
**NATIONAL COMMISSION FOR THE BP DEEPWATER HORIZON OIL SPILL AND OFFSHORE DRILLING**
**(corrected final version October 1, 2010)**

Good morning Senator Graham, Administrator Reilly, and Commissioners. My name is John W. Farrington. Thank you for the opportunity to present testimony to the Commission and contribute to our nation's efforts to minimize loss of life due to accidents related to Outer Continental Shelf (OCS) oil exploration, production, and decommissioning, and to minimize economic hardship to people and ecological damage to marine ecosystems as a result of oil spills. I have served as Interim Dean and Professor of the School of Marine Science and Technology, University of Massachusetts-Dartmouth since August 2009 while a search has proceeded for a Dean. I am also a Scientist Emeritus at Woods Hole Oceanographic Institution from which I retired after a career there beginning as a postdoctoral investigator in 1971 and lasting until my retirement in 2006. From August 1990 until November of 2005 I served as Dean of the Institution. My research has focused on the biogeochemistry of organic chemicals in the coastal and ocean ecosystems with about fifty percent of the effort focused on oil pollution and concerns with other chemicals of environmental concern such as PCBs. Among my service at the science-policy interface, I have participated in various capacities in the preparation of the three U.S. National Academy of Sciences reports (1975, 1985, 2003) reviewing oil pollution in the marine environment. I Chaired the National Academy of Sciences Committee that reviewed the Minerals Management Service Environmental Studies Program, issuing six reports between 1986 and 1993.

I have been asked to testify today on: (1) scientific findings in the aftermath of the IXTOC I oil well blowout spill of 1979-1980 in the Gulf of Mexico and subsequent resilience of the Gulf Mexico based on my participation in a research cruise to that event, (2) research on other applicable oil releases and (3) direct experience related to and scientific recommendations regarding the Deepwater Horizon oil spill. My testimony represents my own point of view, conclusions and recommendations and does not reflect an official statement by either the University of Massachusetts-Dartmouth or Woods Hole Oceanographic Institution. However, I acknowledge with gratitude that my understanding of inputs, fates and effects of oil in the marine environment has benefited substantively from cooperative research and discussions with several colleagues, students, and coworkers at these institutions and several other institutions and organizations in the United States and elsewhere in the world. I have appended a list of references that are mentioned in my testimony.

Before addressing the specific issues stated above, I note for the record that one of your Commission members, Professor Donald Boesch, co-edited(with Professor Nancy Rabalais) an excellent review of the "The Long Term Effects of Offshore Oil and Gas Development" in 1987. More recently, that review has been updated and broadened to all aspects of oil inputs, fates and effects in the marine environment by the National Academy of Sciences report "Oil in the Sea III" published in 2003. This report provides an

excellent review supported by extensive scientific references. Using the knowledge contained in that report and our own experience, my colleague Dr. Judith McDowell and I wrote an article for the general lay person audience "Mixing Oil and Water" published in *Oceanus* magazine in 2004. While there has been progress since 2003-2004 in understanding the inputs, fates and effects of oil in the marine environment, I believe the *Oceanus* article and the 2003 National Academy of Sciences report are acceptable starting points with respect to the state of knowledge about oil pollution in the marine environment. I have appended a copy of the Farrington and McDowell *Oceanus* article in the hope that it may be helpful to the Commission and its staff as background literature.

**1) IXTOC I Oil well blowout spill.**

The IXTOC - I oil well was an exploration well being drilled by PEMEX (Petroleos Mexicanos) in 51.5 meters water depth in the Bay of Campeche, Mexican waters of the Gulf of Mexico at 19°24'29.418"N;92°19'36..690"W, about 80 km NNW of Ciuad del Carmen, when it suffered a blowout with resulting fire and collapse of some of the drilling platform to the sea floor and eventual towing away of the hulk of the remainder of the drill platform as described by S. L. Ross et al (1980). A detailed account of the IXTOC I event through November 1979 is available in testimony before the U.S. Senate December 5, 1979 Congressional Record 1980 Serial No. 96-66 –Campeche Oil Spill: Joint Hearings before the Committee on Commerce, Science and Transportation, and the Committee on Energy and Natural Resources. Eventually the IXTOC I oil well blowout was stopped by completion of two relief wells and cementing in March of 1980 after spilling 475,000 metric tons (tonnes) according to Jernelov and Linden (1981).

Oil from the IXTOC I spill was transported by normal water circulation for that season of the year around the Gulf of Mexico to the west , northwest, and then north, entering U.S waters and coming ashore on the coast of Texas by late July- early August. Shortly after that time, the United States government decided to seek permission from the Mexican government to send a NOAA research vessel on a cruise to the oil spill site, along the coast of Mexico, and then along the coast of Texas and into port in Galveston. This cruise was part of NOAA's and other federal agencies'(e.g. BLM-DOI, EPA,) and state agencies overall response to the oil spill. This involved over 200 scientists from a number of federal and state agencies, academic institutions, and private companies.

The efforts along the coast of Texas are documented in a report (Hooper, ed., NOAA, 1981). Since I was not directly involved in those efforts, I will not comment in detail other than to state that, in my opinion, from reading the report and related documents, the efforts were predominantly "state of the art-knowledge" efforts for that time or, in some instances, innovative and at the forefront of oil spill response from a scientific perspective. These efforts included:

- numerical modeling of slick trajectories,
- classification of sensitive shoreline areas in need of protection,
- deployment of oil containment booms where possible to protect sensitive areas,
- testing of dispersants in laboratory conditions with a resulting decision not to use dispersants because they were ineffective for dispersing the oil-water emulsions and somewhat weathered slicks coming to the Texas coastal areas,
- assessment by physical and chemical observations and measurements of the oil that did come ashore in Texas,

- biological assessment of effects of the oil on biota and ecosystems of the Texas coastal area.

**NOAA Ship *Researcher* cruise to the IXTOC I oil spill**. The NOAA ship *Researcher* was chosen for the cruise and its research cruise schedule was altered to accommodate the need for the oil spill cruise. A second vessel, the Tracor Marine Inc. vessel *G. W. Pierce* (a keel-cooled vessel*)* was contracted to accompany the *Researcher* because (i) it had been determined early in the IXTIC I oil spill that the oil-water/water-oil emulsion type mixtures near the spill could block or reduce flow through the engine cooling systems for the type of power plant of the *Researcher,* and (ii) the desire to keep the *Researcher* free from oil contamination to sample control stations*.* Portable laboratory vans were placed on the *G. W. Pierce* to expand available laboratory space on that vessel.

The specific mission of this combined two-ship expedition, officially labeled ***Researcher/Pierce* Ixtoc –I Cruise**, was limited to conducting research on the biogeochemistry (i.e. the transport, chemical and microbial alteration/degradation and fate) of the spilled oil at or near the well site and along a cruise track in the western Gulf of Mexico up to the coast of Texas. Along the Texas coast sediments at samples of surface sediment at stations previously analyzed as part of the Bureau of Land Management's OCS studies program were obtained for purposes of assessing if IXTOC-I oil could be detected in sediments at these study sites.

The Mexican government did not grant permission for biological effects studies. A detailed physical oceanography study was not possible because of insufficient time to secure appropriate equipment for the cruise and also concerns about the irreversibility of oil damage to sensitive instruments or inability of the instruments to operate in the oil contaminated environment.

In addition to the two vessels, a four person contract helicopter from Crescent Airways was onboard *Researcher* for flight operations to facilitate surveillance of the slick and the locations of sampling by the vessels relative to the slick. The *Researcher* operated as the command center and provided more extensive laboratory space for analytical instruments and microbiology experiments. A U. S. Public Health Service MD was aboard *Researcher* and provided oversight for safety precautions for exposure to petroleum fumes for scientists and crew of both *Researcher* and *Pierce.* This was especially important for those on the *G. W. Pierce* since they operated frequently inside the oil slick and sampled close to the actually blowout site.

Dr. Donald C. Atwood, Head of the Ocean Chemistry Division of NOAA's Atlantic Oceanographic and Meteorological Laboratories (now retired) was Chief Scientist for the cruise. Dr. Randolph Fergusson of the National Marine Fisheries Laboratory, NOAA, Beaufort, North Carolina was Senior Biologist onboard. I served as Senior Chemist on the cruise and was supported in this effort by the Office of Naval Research grant I had for marine organic geochemistry research. A complete list of all scientific personnel and groups can be found in the report "Proceedings of a Symposium on Preliminary Results from the September 1979 Researcher/Pierce IXTOC-I Cruise, June 9-10, 1980."(NOAA, December, 1980, 591 pp). The report is available as a pdf at http://www.noaa.aoml.gov/ocd/ocdweb/petroleum.html. My testimony here will refer to the results of research and dedicated efforts of these people.

The cruise track for both ships and the sampling locations are detailed in figures 1 and 2. NOAA ship *Researcher*, vessel *G.W. Pierce*, and the Crescent Airways helicopter operations are exemplified in

figures 3, 4 and 5. The observations, sampling, and results of analysis and interpretations for samples from this cruise are detailed in the NOAA Symposium report.

I will highlight here and illustrate those findings that are the most germane to the Deepwater Horizon MC 252 spill and response. During August and early September 1979 there had been several tropical storms and a hurricane in the area of the spill or passing through contiguous areas. During our time sampling in the well area, tropical storm Henri came close to the area. We believe that this explains why we observed, during helicopter survey flights, various types of oil slick containment booms and moorings in various states of intense snarls and disarray spread throughout the Bay of Campeche area. When we arrived in the Bay of Campeche area on September 15$^{th}$ the slick was headed about northeast, away from the Mexican coast and not west and northwest along the coast of Mexico towards the Texas coast. This situation prevailed in a general sense throughout our time at the well site until September 18$^{th}$ when the slick began to bend around toward the east and east-southeast during our last two days and over flights on September 20$^{th}$ and 21$^{st}$ , after which we departed the well site area for the remainder of the cruise (Figure 1).

The situation in the immediate area of the well blowout site is shown in figure 6. Gas was bubbling to the surface along with an oil/water mixture. The gas was burning with flames varying from about 2 to 7 meters in height. Around this was a turbulent area of about 50 meters diameter in which the oil/water mix was coming to the surface. There was about a 1 knot current transporting an oil slick away from this area to the northeast.

A composite salinity transect to the northeast away from the well site alongside the slick measured by CTD (Conductivity, Temperature, Depth) instrumentation at several stations (Figure 7) documents a salinity of between 35.90 to 35.60 $^{0/00}$ until about 35 to 50 km along the transect where there is an incursion of less saline water of 35.00$^{0/00.}$. At 80 to 90 km along the transect, there is a relatively abrupt increase ins salinity to typical open ocean Gulf of Mexico water of 36.00 to 36.50$^{0/00}$. We believe that the less saline water incursion was the result of runoff from the coast which had received heavy rains from tropical storm Henri and previous tropical storms passing through nearby areas prior to the cruise. This hypothesis is supported by surface salinity measurements made during the cruise (Figure 8).

**<u>A Gas and Oil Plume underwater.</u> (Data from Brooks et al, Texas A&M University; Boehm et al, Energy Resources Company, Inc.; Payne et al, Science Applications, Inc.; Overton et al, University of New Orleans; all detailed in NOAA, 1980)**

Composites of measurements of methane, benzene, and an estimate of total oil by UV-fluorescence in samples along a transect to the northeast taken from the *G. W. Pierce* in the slick and *Researcher* outside the slick in “control” stations document an underwater excursion or “plume” of gas, benzene (a volatile petroleum chemical), and oil extending northeast under the slick to the less saline water incursion. We interpreted these observations and data as follows. The 1 knot current was transporting the gas and oil underwater to the northeast away from the main vertical plume. As this horizontal “plume” was transported away from the well site, gas and oil “bubbles” continued to rise to the surface and were incorporated into the overlying oil slick. An important point to consider is that the “background” or “control” sample concentrations for stations away from the slick and well site should not be considered as “pristine” ocean water concentrations because there were other oil and gas platforms operating at this time in the Bay of Campeche and discharging co-produced waters and mud as was clearly evident in visual observations from the helicopter over flights. It is probable that these chronic releases contribute methane and oil chemicals to the Bay of Campeche waters and ecosystems.

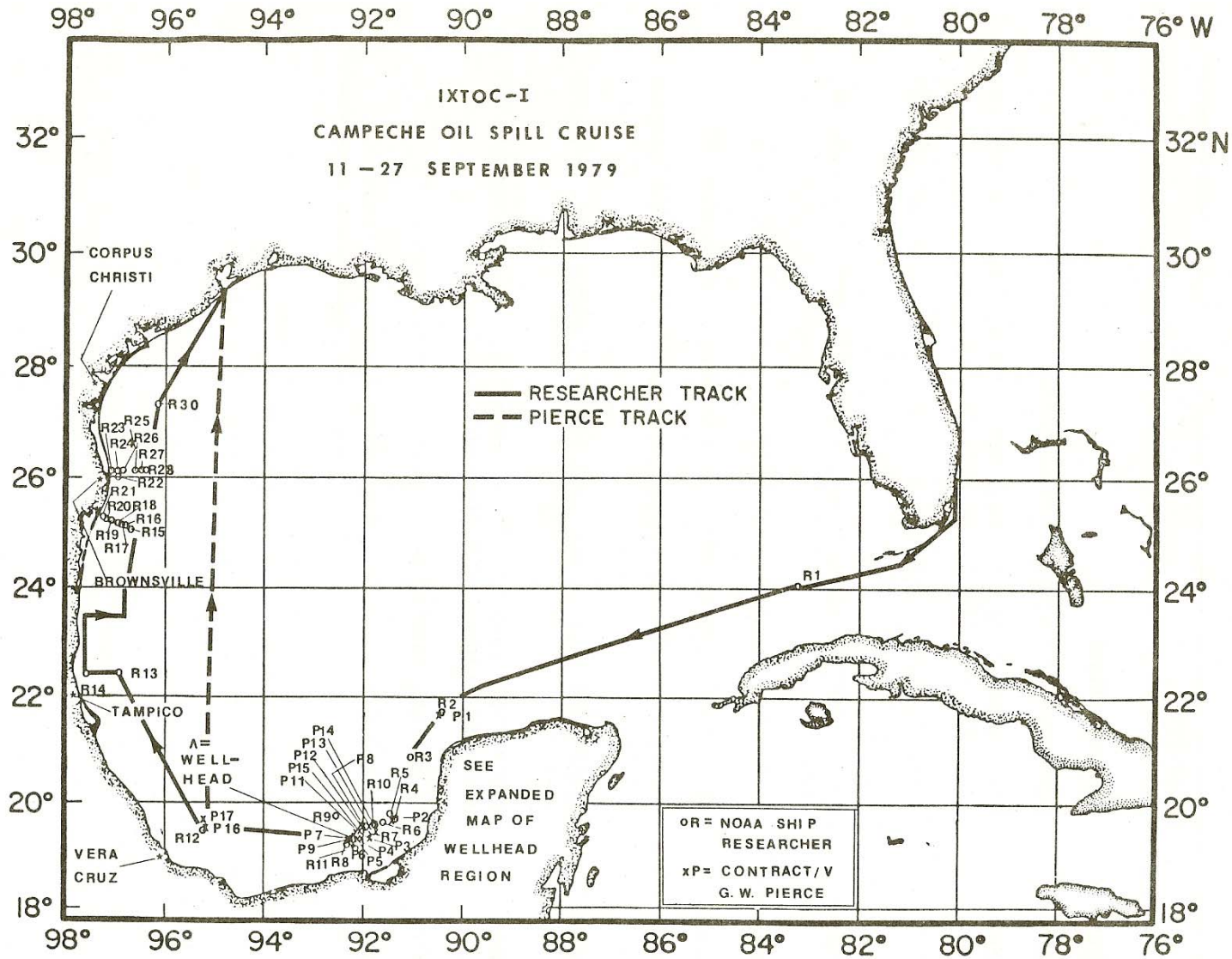


Figure 1. IXTOC-I Campeche oil spill cruise, 11-27 September 1979.

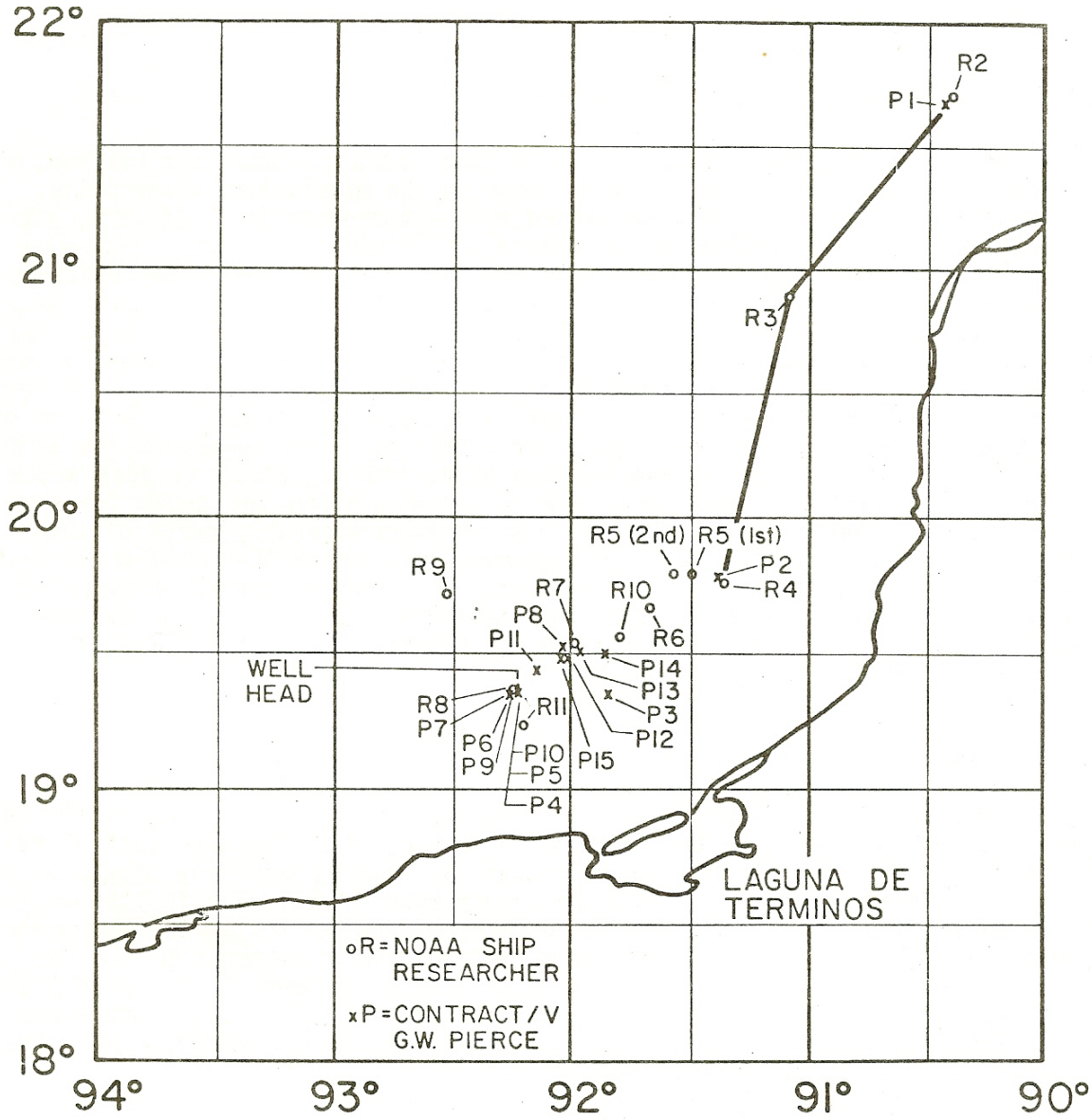


Figure 2. IXTOC-I Campeche oil spill cruise, 11-27 September 1979, expanded wellhead region.

**Figure 3. NOAA SHIP *RESEARCHER* IXTOC I Cruise.**

**Figure 4. Tracor Marine Inc. Vessel *G .W.PIERCE***

**Figure 5. Crescent Airways Helicopter aboard *RESEARCHER***

Figure 6. J. W. Farrington photograph of Ixtoc I oil well blowout from helicopter flight *RESEARCHER/PIERCE IXTOC I CRUISE* September, 1979. Facing Southwest with oil slick coming toward the viewer to the northeast. Platforms had been constructed by PEMEX for eventual test of an inverted cone "capping" procedure. Note relatively clean, oil-slick free surface water behind platforms.

These transects of data are composites and state of the art for the time of the cruise. However, they do not provide synoptic, three-dimensional assessments of underwater concentrations of methane and oil chemicals in the spill area. It is probable that the actual situation had more meanders and heterogeneity in the underwater horizontal "plume", similar to that observed for the surface slick.

Several days after arriving at the Bay of Campeche well site general area, and despite operating well outside of any visible slick area, the drinking water on the *Researcher* became contaminated with volatile petroleum chemicals as first detected by taste and then verified by UV-fluorescence measurements. The most likely cause was co-distillation of the volatile chemicals out of sea water into the drinking water as the ship made its drinking water from evaporative distillation of sea water.

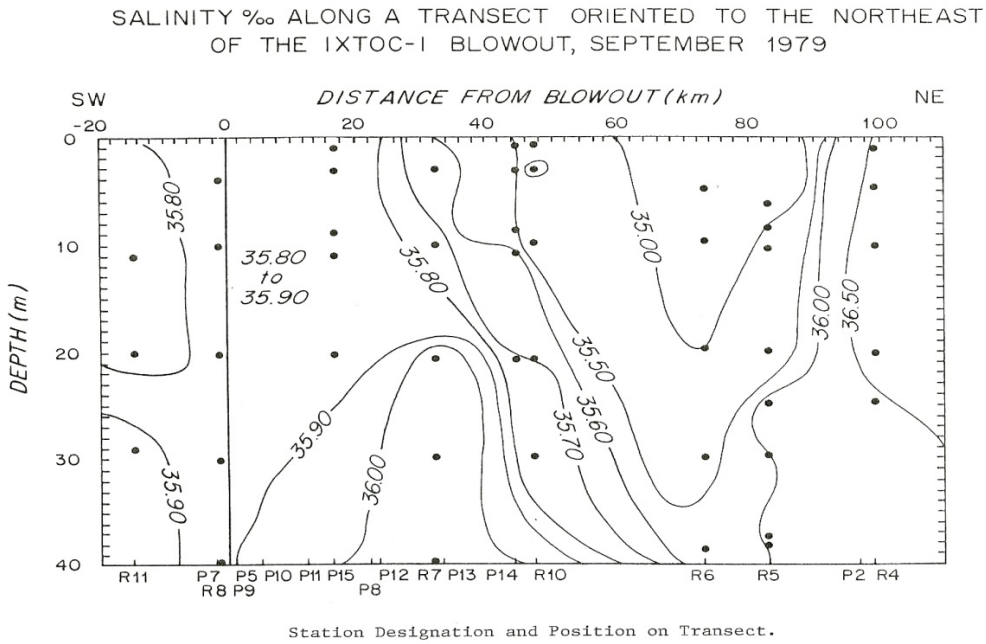


Figure 7. Salinity Transect to northeast from the well site.

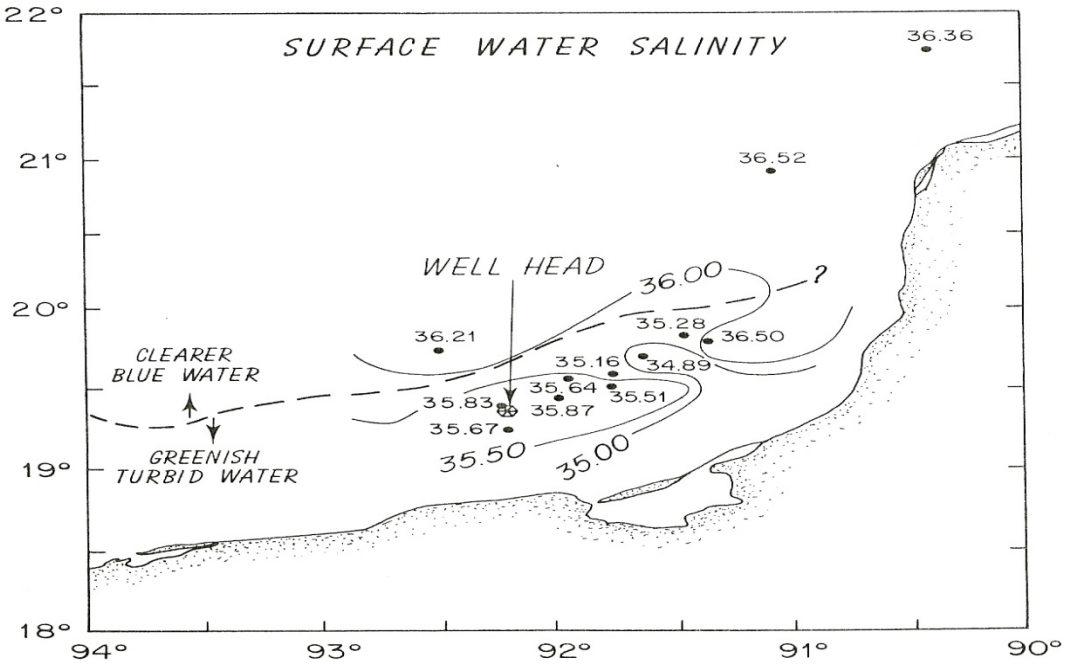


Figure 8. Surface water salinities.

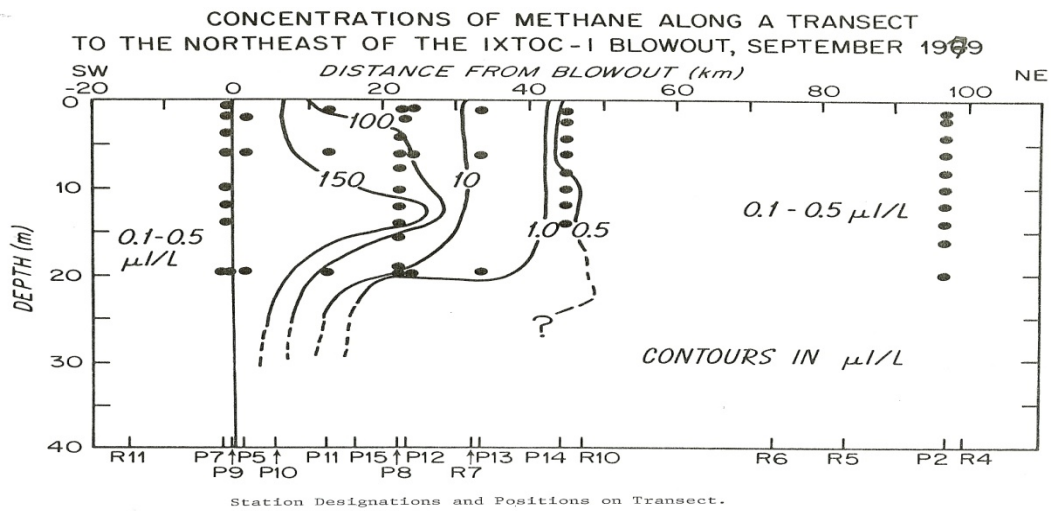


Figure 9. Data from Brooks et al (1980) Texas A & M

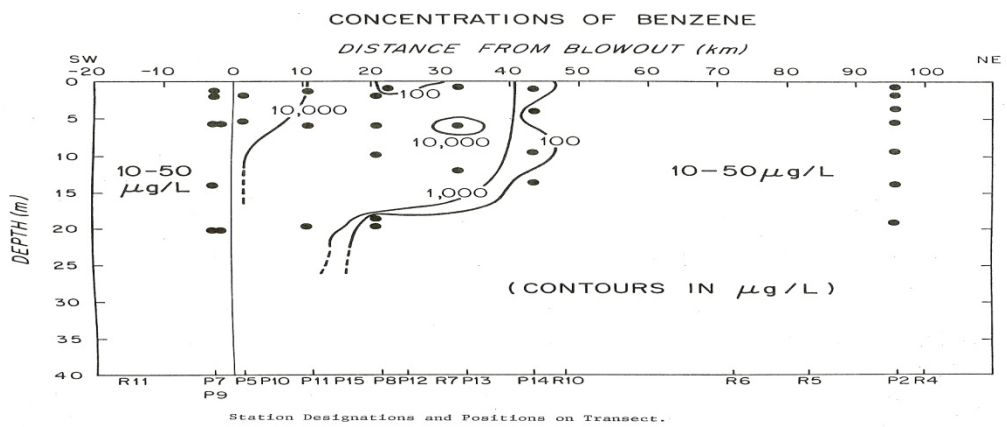


Figure 10. Data from Brooks et al (1980) Texas A & M and Payne et al (1980) SAIC

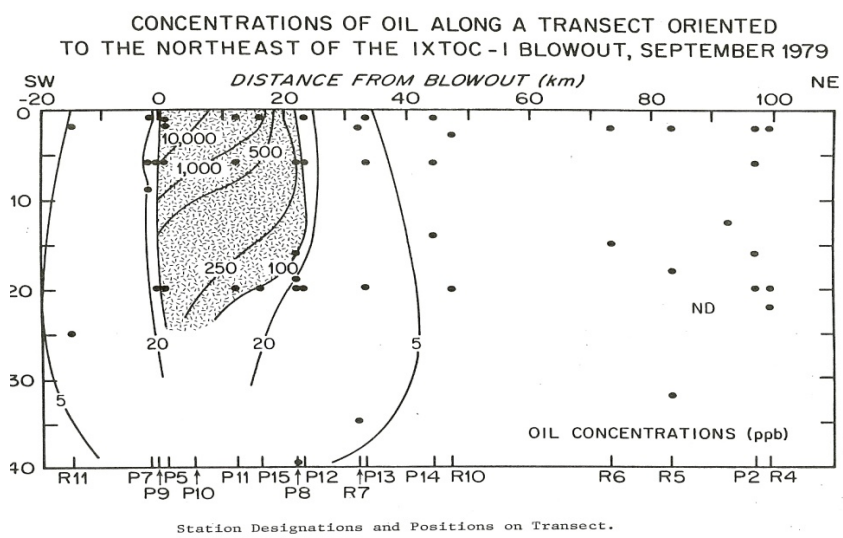


Figure 11. Fiest and Boehm (1980), Boehm and Fiest,(1982).

**“Rafts” of emulsified oil and water.**

Another important and unexpected finding from the cruise was a distribution in various areas outside the main slick of conglomerates of emulsified oil and water or “mousse” as it is commonly designated in the oil spill literature because of its similarity in appearance and consistency to the chocolate mousse dessert. We designated them “mousse rafts” – ranging in size from about that of an ordinary zodiac raft to sometimes ten times as big. A picture of several of these “rafts” taken from an helicopter over flight (Figure 11)and then comparison of one of those rafts with a zodiac at the bottom for scale (figure 12) provides examples of several we noted during the over flights. The zodiac raft from the *Researcher* went into one of the rafts of mousse to sample the interior, and analyses of this sample by gas chromatography and computerized gas chromatography-mass spectrometry document a chemical composition that indicated that the oil in the interior of the “mousse raft” was not extensively weathered. These “mousse rafts” can be as much as 0.5 meter thick in the center and some had the appearance of being agglomerations of smaller lumps or “balls” of mousse, e.g. see Figure 13.

The exact mechanism of formation was not discerned during our observations. These rafts of mousse may provide a means for transporting only slightly weathered oil long distances because of the protection from dissolution, volatilization, and microbial degradation afforded to oil at the center of the “raft”. Amos (1980) in a report from the University of Texas Marine Science Institute, Port Aransas, Texas noted a few instances of mousse coming ashore in Texas, although the predominant form of oil in Texas coastal waters seemed to be tar balls, windrows of tar balls and oil slicks. Similar observations were reported in Hooper (ed. NOAA, 1981).

Figure 12. “Mousse Rafts”. Several indicated by black arrows. Photograph taken from helicopter about 800 ft. by J. W. Farrington. RESEARCHER/PIERCE IXTOC I CRUISE September, 1979. Outside the oil slick, Bay of Campeche.

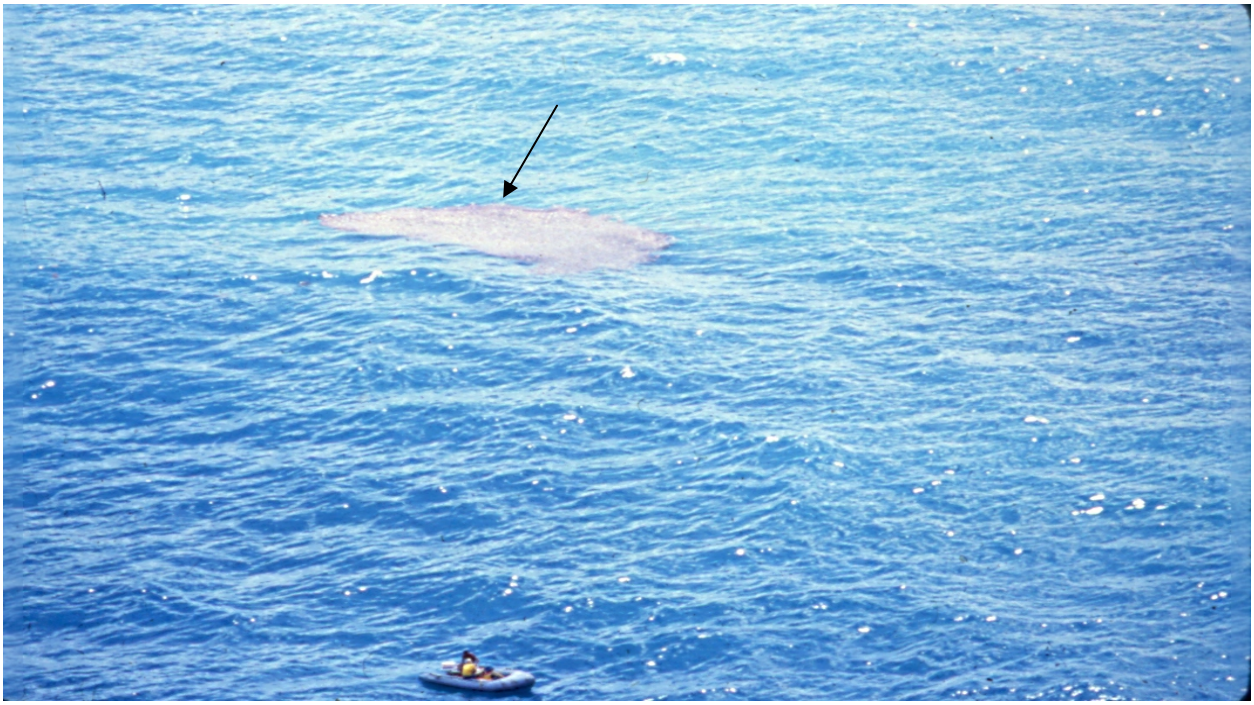

Figure 12. Large raft of “mousse” (black arrow) and Zodiac raft (bottom) for size comparison.

Figure 13. Close up of edge of a “mousse raft ” from Figure 12. J. W. Farrington photograph from helicopter. RESEARCHER/PIERCE IXTOC I CRUISE September 1979. Note clumps around the edge and clump appearance of the surface.

**<u>Microbiological Studies</u>. (Atlas et al, University of Louisville, and Pfaender et al University of North Carolina-Chapel Hill).**

The studies of Professor Atlas and his group at the University of Louisville and those of Professor Pfaender and his group at the University of North Carolina-Chapel Hill provided valuable insights into the microbial community and its activity in the spill area as reported in their papers in the report from the Symposium on RESEARCHER/PIERCE IXTOC I Cruise (NOAA, 1980). In summary, the microbial community in the spill site waters changed in community structure and function compared to control sites. The numbers of hydrocarbon degrading bacteria increased in the oiled areas but the total microbial biomass was not a simple function of the presence or absence of oil. There was sufficient oxygen for microbial degradation of the oil, but onboard experiments suggested that there were insufficient nutrients present in the water column in the oil slick area to promote extensive oil degradation at the time of the *Researcher/Pierce* research cruise.

**<u>Other interesting Findings.</u>** Time and space for this testimony does not permit more extensive discussion of other aspects of the research findings such as those related to weathering of the oil -- including photochemical reactions; difficulty in detecting any oil deposition to surface sediments in the Bay of Campeche area due to prior contamination of the sediments from drilling and production operations; and research to use acoustic methods to detect subsurface oil and gas in the water column. All of these are discussed in the NOAA (1980) report. One of our conclusions was that we were not prepared to adequately sample the various physical chemical forms of the oil-water and water-oil emulsions present in the well site area and we recommended research to develop sampling methodology for these forms of oil during future oil spills.

**<u>Overviews.</u>** Waldichuk (1980) and Jernelov and Liden (1981) provide overviews of the Ixtoc I oil spill from their perspectives as scientists with extensive experience in marine environmental quality assessments for various United Nations organizations. Waldichuk (1980) provides quote and commentary.

"***It has been stated by oil-well drilling experts: 'the damage to lives, equipment, and the environment can be of great magnitude. Yet this risk must be accepted if we are to extract the energy we need from the depths of the earth.'(see Rhodes, A. F. 1979. The ultimate control problem – a wild oil or gas well. Mechanical Engineering, June, 1979, 21-26). One wonders, nevertheless, why the oil industry does not put higher priorities into developing a fully fool proof blow-out prevention system."***

Jernelov and Linden(1981) reviewed the biological resources and ecosystems of the Bay of Campeche area and noted the importance of economically valuable shrimp and oyster fisheries. They then went on to state:

***"Thorough studies of the long-term biological effects of the spill have either not been carried out in Mexican waters, or the results of such studies are not yet available."***

To my knowledge, the situation remains the same today.

Jernelov and Linden (1981) provided some valuable comments about the potential for biological effects using sound reasoning based on laboratory studies of toxicity and field measurements of the concentrations of oil in the water column.

***"Laboratory experiments exposing larvae and adults of other crustaceans, including shrimp, to crude oil show the acute toxicity levels are in the range of 0.1 to 10 ppm total oil. If we assume 0.1 ppm was the acute toxicity concentration (Ixtoc I oil is particularly rich in the highly toxic, low boiling aromatic fraction); a mixing depth of 25 m; a five day persistency of the toxic oil fractions in the water solution; and a required concentration of 0.1 ppm to cause damage to shrimps: then an area of 15,000 km$^2$ can be regarded as poisoned by the Ixtoc I oil. This is equal to 2.5 percent of the Mexican part of the Gulf."***

Jernelov and Linden (1981) go on to note the difficulties in assessing long term effects on fisheries and ecosystems – a fact of the current state of the art and knowledge repeated in 2003 by the National Academy of Sciences Report "Oil in the Sea III" (NAS, 2003).

## 2. Research on Other Applicable Releases

I believe that the NAS (2003) report and the Farrington and McDowell (2004) article accurately portray my view of the current lessons learned from other oil releases. I note in particular that in Farrington and McDowell (2004) we stated in the next to last paragraph:

***"We also need to expand research on oil pollution in deeper waters. Most concerns and research have traditionally focused on coastal waters. Yet new concerns arise as oil production moves offshore. We can only speculate on the impact of oil exploration and production in deeper waters until we have more detailed knowledge of the biological organisms in these habitats and the biogeochemical processes that govern their lives."***

I chaired the National Research Council Committee on the OCS Environmental Study Program 1986 to 1993. We noted in our last of six reports that with Congressional and Executive Branch Moratoria in place for several years, there was a "window of opportunity" to quote our report, to gain essential new knowledge about OCS environmental concerns. This would have allowed the United States to move forward with wise management and use of OCS oil and gas resources, including appropriate environmental protection with continued moratoria in some areas if warranted. Instead, both the Executive Branch and Congress reduced funding to the Environmental Studies Program of MMS. In my opinion, stated in my letter of July 15, 1993 to the late Senator Robert C. Byrd, then Chairman of the Subcommittee on Interior and Related Agencies, Committee on Appropriations, " By reducing the Environmental Studies Program funding, Congress jeopardizes wise use and management of the nation's OCS oil and gas resources by denying orderly and cost effective acquisition of vital new knowledge. "

I recognize that there are many competing priorities for federal funding. However, I would be remiss in my duty to my scientific colleagues and, through them, to our nation, not to note that carefully thought out and peer reviewed scientific advice sometimes gets shunted aside in the political process because of political and financial concerns and competing priorities. Then some crisis emerges, and science is asked to respond on an emergency basis. Such responses are often less cost effective and less efficacious than would be the case if there had been steady attention to the potential of problems to be encountered. Having stated this, I realize that there is a delicate balance of competing priorities that has to be taken into account within the Executive Branch and the Congress.

Important Lesson Learned from other Oil Spills from 1960s to the present:

- Each oil spill is unique in several ways: type of oil spilled, receiving ecosystem, weather conditions, season of the year, clean up and containment attempts.
- If oil gets into low energy marshy or muddy environments (sub tidal or inter-tidal), then persistence and longer term impacts are more likely than for high energy environments such as a rocky inter-tidal coastal ecosystems.
- Volatile components will evaporate.
- Soluble components dissolve in sea water and are subject to dispersion.
- Certain oil compounds such as n-alkanes are more susceptible to microbial degradation. However, the degradation of these compounds does not mean that the oil is being totally degraded. Other oil compounds such as the cycloalkanes and certain of the polycyclic aromatic hydrocarbons (PAH)can persist for long periods of time – decades in some cases.
- Oil compounds can be taken up from water by marine organisms across gills or by feeding on particulate matter and contaminated prey. Concentrations of a few ppm in sea water can be biomagnified by marine organisms by factors of 1,000 to 100,000. Thus low concentrations in sea water should not lead to conclusions that there will be no adverse effects on marine organisms.
- Bivalves such as mussels and oysters have limited capacity to metabolize petroleum hydrocarbons.
- PAH can be metabolized by fish, crustacean, marine mammals and birds. In some instances the metabolites are excreted. In other instances they may cause harm to the organisms.
- There is a large range of toxicity and long term sub lethal effects/responses to varying concentrations of petroleum hydrocarbons in given ecosystems.
- Large oil spills attract media attention and attention of the public, and various branches of federal, state, and local governments. There is a burst of initial interest and funding, or promise of research funding.
- Once an oil slick goes away, attention/interest of most people decreases despite the fact that petroleum hydrocarbons may still be present in the sediments and biota of an ecosystem. In some respects this is the old cliché “Out of sight, out of mind”.

## 3. Direct Experience related to and scientific recommendations regarding the Deep Water Horizon Oil Spill.

I participated in the May 19th, White House Science Summit convened by the Office of Science, Technology and Policy and hosted by the Environmental Protection Agency that identified the science that should be addressed in the DWH MC 252 oil spill. I also participated in the Deepwater Horizon Oil Spill Scientific Symposium at Louisiana State University June 3, 2010 and presented a lunch seminar, “Conducting Oil Spill Research in a Regulatory Framework.” I am not a paid consultant to any government agency, private organization or industry with an interest in this DWH MC252 oil spill. I have provided advice to colleagues at the Woods Hole Oceanographic Institution regarding their research at sea and in the laboratory with respect to the DWH MC252 spill. I have also provided comments when asked about a NOAA Joint Analysis Group report. I have responded to numerous news media requests for background information and interviews.

The fact that there is a Presidential Commission speaks to the seriousness of the matter. I believe numerous academic, government, and industry and consulting company scientists and engineers have been exerting substantive effort to stop the spill, contain and clean up the spilled oil, assess the fate and effects of the spilled oil. Much needed new knowledge has been gained that will assist in preventing a future spill or, if a spill of this magnitude occurs, to be better prepared to deal with it.

Hindsight is always 20/20 or better, and I have not been directly involved in the daily crisis management science that is pursued in this type of situation. Much of what I have observed and learned from the distance of my office, via emails and telephone conversations, and discussions at meetings seems familiar to me in terms of what has happened at other oil spills. The following are a few thoughts that I wish to bring to your attention:

- Scientific research often gets tangled with debates about: "Who is to blame for the spill? Who will get credit for being the lead federal agency? The legal requirements of NRDA.
- The delays and confusion with respect to allocations and release of the research funding from BP to consortia of academic institutions resulted in missed opportunities for research on the fate and effects of the spilled oil – missed opportunities that cannot be recaptured at this late date.
- Advances in numerical modeling and the application of floats, gliders, and other modern physical oceanographic instrumentation, coupled with various remote sensing capabilities provided excellent assessments and projections about where the oil slick was and would go. This was a significant application of the nation's emerging Coastal Ocean Observing System and, in my opinion, it was a significant success.
- The deployment of an in situ mass spectrometry coupled with an Autonomous Underwater Vehicle (AUV) demonstrated the advances in "cutting edge" analytical chemistry and engineering technology now available for assessing oil chemicals in waters of oil spill areas, and in deep water depths (Camilli et al, 2010).
- The application of the latest molecular biology/microbiological methods in genomics and proteomics provided tools for rapid and relatively thorough assessment of microbial populations in the spill area and control stations, allowing an assessment for the potential of microbial degradation of the oil (Hazen et al, 2010).
- Too much attention was focused initially on comparisons to the *Exxon Valdez* oil spill and not the more relevant Ixtoc I oil spill or other oil spills that have occurred along the Gulf of Mexico coast of the United States.
- Scientists today are encouraged to communicate effectively with the media. This is a good thing. However, there needs to be some careful post assessment by both scientists and the media about why initial scientific hypotheses, based on first interpretations of field data aboard ship by admittedly somewhat exhausted scientists, was parlayed into seemingly contradictory findings by various press reports.
- The DWH MC252 spill had several unique aspects such as being a very deepwater blowout, use of dispersants pumped into the vertical plume, with admixture at the bottom of drilling mud when there was an attempt to stop the flow by pumping mud into the well and the mud flowed out.
- Clearly, too little attention had been given to the real potential for a deepwater blowout. Statements that this was unexpected contradict the fact that such a spill scenario at 1,500 meters water depth was diagrammed and discussed in the National Academy of Sciences 2003 report "Oil in the Sea III", pages 106-108.

- There are numerous other sources of oil inputs to the Gulf of Mexico in the US Exclusive Economic Zone as noted in the NAS(2003) report. Adding up ten to fifteen years of estimated inputs for some of the sources such as natural oil seeps and runoff from land and normal operations of large and small ships/boats in coastal areas yields amounts of oil in the same total range as that released by the DWH MC252 spill. Obviously, chronic inputs such as those other sources and acute inputs such as the DWH MC252 spill are not strictly comparable. However, given these other sources of input, it will be a significant analytical chemistry challenge to accurately assess the contributions of DWH MC252 oil contamination of water, sediments, and living marine resources in several locations.

## CONCLUDING REMARKS/RECOMMENDATIONS

I have two overarching recommendations:

**1)** The nation should not let the lessons from the DWH MC 252 fade from memory as time goes on and the visible presence of slicks from the spill disappear. This has happened too often in the past.

**2)** I hope the Commission can recommend, as soon as practicable, the allocation of the funds that BP set aside for research. These funds should be allocated through some type of rapid peer review process in a manner that maximizes the very best scientific research. I am concerned that there seems to be a move towards "centralized" cooperation in the research on the DWH MC252 spill. Coordination is fine. However, my experiences suggest to me that centralized control often has the unwanted effect of stifling creative scientific research.

Thank you again for the invitation and opportunity to share the preceding with the Commission

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