Gulf oil threatens ecology, maybe climate

On or about Jan. 20, five oil supertankers berthed at the Kuwaiti port of Mina al Ahmadi began discharging an estimated 3 million barrels of crude oil into the Persian Gulf. At about the same time, an underwater pipeline carrying crude oil from storage tanks there to Sea Island, a tanker-loading terminal about 10 miles offshore, also began spewing oil into the Gulf.

U.S. Defense Department officials say "precision munitions" fired on Jan. 26 from an allied aircraft apparently halted the flow from the pipeline by sealing off its inlet pipes – but not before it had pumped out an estimated 7 to 8 million barrels of oil.

The two releases created the largest oil spill in history, sending a total of 10 to 11 million barrels of crude into the Gulf's shallow and relatively contained waters.

Though Iraqi President Saddam Hussein denies his forces caused the spill, governments allied against Iraq have condemned him for what they call an act of "environmental terrorism." Many scientists worry that the spreading slick threatens unprecedented damage to the ecology of the Persian Gulf.

Jeffrey Hyland of the Marine Science Institute at the University of California, Santa Barbara, says the best available estimates of global inputs of oil suggest that about 23.4 million barrels of oil enter the world's oceans each year from all sources. Using those estimates, Hyland calculates that this one slick may represent up to 47 percent of the oil ordinarily spilled globally in a year – "an incredible amount," he says. The spill contains more than 40 times the amount of oil released off Alaska two years ago by the *Exxon Valdez* supertanker.

The Persian Gulf spill was not unexpected, according to a report completed Jan. 9 by Sandia National Laboratories. Leaked summaries of this now-classified document warned that Iraq might attempt to pump as many as 20 million barrels of oil into the Gulf. The report, titled "Potential Impacts of Iraqi Use of Oil as a Defensive Weapon," also speculated that Saddam might set Kuwaiti oil fields afire, potentially initiating "measurable climatic effects on a regional level."

Environmental scientists have begun speculating on the spill's potential for wreaking long-term havoc.

Unlike the *Valdez* oil, Kuwait's crude is "light," says petroleum chemist Mahlon C. Kennicutt of Texas A&M University in College Station. In other words, he says, it contains more of the volatile aromatic compounds – "known to be toxic" – and less of the much heavier and relatively nontoxic hydrocarbons. "In that sense," Kennicutt says, "the Kuwaiti oil, weight for weight, would be more toxic than the *Valdez* crude."

On the other hand, the volatile fractions of the Kuwaiti oil evaporate quickly, he notes, and light oils leave less residue. Up to 50 percent of a *Valdez*-type crude may remain even after substantial "weathering" (photochemical breakdown and the loss of volatiles to the air and water), Kennicutt says, but with a Kuwaiti-type oil, "I would be surprised if more than 10 percent remained" to contaminate beaches and sediments.

Unfortunately, weathering may not detoxify all the surviving oil. As sticky, weathered residues form tar balls – which sink into sediments – they may encapsulate unweathered oil. If wave action later erodes these balls, the toxic unweathered oil may seep out to threaten coastal and sediment-dwelling organisms, Kennicutt notes.

A 1986 spill on the Caribbean coast of Panama, involving 50,000 barrels of oil, probably offers the most recent and applicable parallel to the Gulf disaster, according to oil-spill expert Edward S. Van Vleet at the University of South Florida in St. Petersburg and Kathryn A. Burns of the Bermuda Biological Station. Burns, who has studied oil pollution in the Mideast and Panama, notes that both areas are warm and very sunny, and that their shallow waters nurture related, sensitive ecosystems: coral reefs, mangrove forests and coastal seagrasses.

Burns says her studies suggest that although rapid weathering may remove the Gulf's surface slick fairly quickly – in weeks – sediment-dwelling organisms in the area may suffer ecological impacts for years. In Panama, she notes, the initial oiling not only killed corals, mangroves and intertidal seagrasses but also wiped out many organisms dependent upon these ecosystems.

Michael Marshall, who studied seagrasses at the Panama site, says sea urchins, starfishes and shrimp-like amphipods had failed to return to subtidal seagrass beds even after three years had passed. In the Persian Gulf, nine species of subtidal and intertidal seagrasses – and the animals that live among them – could prove similarly vulnerable to oil, says Marshall, a biologist with Continental Shelf Associates in Jupiter, Fla.

"Having studied oil spills in temperate zones, I thought oil would degrade fairly rapidly in this water," Burns says. "But in Panama we're still seeing high levels of oil in sediments even after five years." The oil appears to be leaching into water, she says, and that may explain why some aquatic species have been so slow to return.

Most researchers don't expect much from spill cleanup efforts. However, several nations have dispatched experts – including specialists in the use of disper-

News of the week continued on p.73

Starbirth may guide galactic chemistry

Stars in dwarf galaxies and the Milky Way apparently started out with the same chemical compositions and a similar range of masses. Yet the chemistry of these galaxies today shows a striking contrast: Compared with dwarf galaxies such as the Large Magellanic Cloud, our own galaxy features a much higher ratio of oxygen to iron.

Astronomers have proposed a variety of complex theories to account for this puzzling disparity. In the Feb. 1 ASTROPHYSICAL JOURNAL, two researchers suggest a simple solution, based on widely accepted scenarios for starbirth in the two types of galaxies.

Dwarf galaxies seem to form most of their stars in well-separated bursts, whereas the Milky Way churns out new stars more continuously, notes Rosemary F.G. Wyse of the Johns Hopkins University in Baltimore. That difference alone can account for the chemical parting of ways, according to Wyse and Gerard Gilmore of the University of Cambridge, England.

The chemical makeup of new stars depends on the life cycles of older stars, Wyse explains. Stars with masses more than eight times that of the sun last only a few million years before exploding as Type II supernovas. The gas ejected by a Type II supernova is rich in oxygen but poor in heavier elements such as iron, says Wyse.

In contrast, stars with less than eight solar masses persist for at least a billion years and then exit in the form of Type I supernovas. These explosions, distinguishable from Type II supernovas by their pattern of light emission, eject a more iron-rich gas, Wyse says.

She and Gilmore used this information to model how intermittent star formation would affect a dwarf galaxy's oxygen-to-iron ratio. In that model, they say, sporadic starbirth could not replenish the rapid loss of massive stars that exploded as Type II supernovas. As a result, Type I supernovas – which suffuse the interstellar medium with iron-rich gas – dictated the chemical composition of new stars, the researchers report.

Steady star formation, in contrast, constantly replenishes the supply of both types of supernovas. According to Wyse and Gilmore, this ensures a higher ratio of oxygen to iron in galaxies such as the Milky Way. *– R. Cowen*