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UC Irvine Researchers Discover How Airborne Sea Salt Particles May Influence Air Pollution Levels

ScienceDaily (Apr. 18, 2000) — Irvine, Calif., April 13, 2000 — UC Irvine researchers who study the chemistry of ocean/air interactions have discovered how airborne sea salt particles may be involved in helping to determine the levels of some greenhouse gases as well as air quality in coastal urban areas.

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In collaboration with other molecular scientists, Barbara Finlayson-Pitts, a UCI professor of chemistry, and Donald Dabdub, a UCI assistant professor of mechanical and aerospace engineering, have been able to show that sea salt particles—a common ingredient of coastal and ocean air—undergo a previously unrecognized chemical reaction in daylight to release chlorine molecules, which can influence ozone levels in the lower atmosphere.

Their findings appear in the April 14 issue of *Science*. In sunlight, these molecules decompose into highly reactive chlorine atoms. When these atoms are formed in the presence of pollutants emitted from fossil fuel energy sources such as oil, coal and gasoline, they may lead to the formation of ozone, which is recognized as an air pollutant. Because ozone has documented health effects at quite low levels, both state and federal authorities have established quality standards for this pollutant.

"The ocean is two-thirds of the earth's surface, so to

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needs to be taken into account in assessing levels of greenhouse gases and air pollutants such as ozone in the air."

In this study, UCI researchers observed the reaction of hydroxyl radicals (equivalent to water, H2O, with a hydrogen atom removed) with tiny particles composed of water and sodium chloride—the basis of sea salts. The hydroxyl radical is always present in air. The researchers found unique chemical reactions on the surface of the sea salt particles rather than inside the particles, as had been previously observed. Until now, it was believed that a reaction between hydroxyl and sea salt required that the hydroxyl radical be absorbed into the liquid particle before reacting. It also was believed that chlorine would not be formed unless the particles were acidic. Neither of these two activities was observed in this study. The discovery of hydroxyl reactions on the surface of sea salt particles further suggests that the creation of atmospheric chlorine through sea salt interaction may be greater than previously realized.

"This finding implies that this unique chemistry occurring on sea salt particle surfaces is yet another way of getting chlorine into the air," Finlayson-Pitts said. "Because they're so highly reactive, these chlorine atoms are important in the understanding of the formation and the fate of a number of trace gases vital to global climate issues."

In continuing this research, Dabdub will introduce this information on sea salt chlorine creation into a complex computer modeling program that analyzes and predicts the air quality of the South Coast Air Basin of California—a highly populated coastal area that records some of the highest levels of air pollution in the United States—to see its impact on levels of ozone and other pollutants.

Participating in this study with Finlayson-Pitts and Dabdub are Eladio Knipping of UCI's Department of Mechanical and Aerospace Engineering; Matthew Lakin, Krishna Foster, R. Benny Gerber and Douglas Tobias of UCI's Department of Chemistry, and Pavel Jungwirth of the J. Heyrovsky Institute of Physical Chemistry, Academy of Science in the Czech Republic. The study was funded by the U.S. Department of Energy, the National Science Foundation, the North Atlantic Treaty Organization (NATO) and the UCI Council on Research, Computing and Library Resources.

Adapted from materials provided by [University Of California, Irvine](#).

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