Chemical imaging of individual salt particles advances aerosol research

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Scientists recently combined experimental approaches and molecular dynamics modeling to gain new insights into the internal structure of sea salt particles and relate it to their fundamental chemical reactivity in the atmosphere. They used laboratory-proxy sea salt composed of mixed sodium methanesulfonate and sodium chloride salts (CH3SO3Na/NaCl). Sea salt particles are emitted into the atmosphere by the action of ocean waves and bubble bursting at the ocean surface.

They are ubiquitous in the atmospheric environment. Airborne particles impact and drive atmospheric chemical reactions that are known to influence Earth's radiative balance and thereby physico-chemical processes that impact air quality and climate change. Using molecular dynamics simulations and surface tension measurements, the research team assessed the surfactant properties of CH3SO3- ions and their surface accumulation in wet, deliquesced particles. They investigated the internal structure of dry CH3SO3Na/NaCl particles using a combination of experimental chemical imaging techniques: scanning electron microscopy X-ray microanalysis and time-of-flight secondary ion mass spectrometry at EMSL and synchrotron-based X-ray microspectroscopy at Lawrence Berkeley National Laboratory.

The results indicate that the surfaces of aqueous (deliquesced) sea salt particles contain a substantial number of CH3SO3 ions, while in the dry (effloresced) particles, methanesulfonate salts form a coating layer that modifies the particles' ability to absorb atmospheric moisture and contribute to chemical reactions. This research shows that surface

enhancement or depletion of chemical components in marine particles can occur because of the difference in the chemical nature of the species. Because the atmospheric chemistry of the salt particles takes place at the gas-particle interface, understanding their complex surfaces provides new insights about their effect on the environment and climate change.

More information: Liu Y, B Minofar, Y Desyaterik, E Dames, Z Zhu, JP Cain, RJ Hopkins, MK Gilles, H Wang, P Jungwirth, and A Laskin. 2011. "Internal Structure, Hygroscopic and Reactive Properties of Mixed Sodium Methanesulfonate-Sodium Chloride Particles." *Phys. Chem. Chem. Phys.* DOI: 10.1039/c1cp20444k

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