

12.340x, aerosols. The word "aerosol" is defined as a suspension of particles in a gas. It is different than a colloid in that the medium is a gas, not a fluid. A suspended particle is often called an aerosol, although traditionally the term includes the gas phase medium. We will use the two terms interchangeably. We will discuss several particle types. One example is soot, which is an aerosol byproduct of combustion. Other examples include mineral dust, sea salt, and sulfate particles.

Aerosols have a variety of sources, but two main processes lead to their formation. These can be visualized on a plot of particle concentration versus size. Sub 0.1 micrometer particles, equivalent to 100 nanometers, are often formed through the condensation of vapors. These are often called Aitken particles, and the process is gas-to-particle conversion. Supermicrometer particles are often mechanically generated. Examples include windblown dust, sea spray, and biological particles. These are also referred to as coarse mode particles.

Between the two ranges lie accumulation mode particles. These particles originate from smaller aerosols that pick up gas phase species and coagulate with one another, thereby forming slightly larger particles. Like greenhouse gases, particles have an atmospheric lifetime, although their loss is most often not chemical but via gravitational settling or scavenging by rain and snow. We will learn more about this in the next lecture.

This figure, often called a banana plot, is a depiction of particle concentration versus time. It can be seen that numerous small particles coincide with high concentrations of gas phase sulfuric acid. This is one example of gas to particle conversion, where the sulfuric acid in the vapor is converted into small particles.

Combustion aerosols come from a variety of sources. These can be both natural, such as biomass burning, and anthropogenic, such as fuel combustion and industry. These particles are often condensed from vapors produced during the combustion process and are often complex agglomerates.

One common combustion particle is soot. Soot is often synonymous with black carbon, which reflects its optical property of being very absorbing. It is also often synonymous with elemental carbon, which defines its chemical structure as graphitic carbon. Soot and black carbon should not be confused with brown carbon, a term that is often used for a complex particle that contains both graphitic carbon and

organic carbon in its surface.

Sea salt aerosol forms due to bubble bursting at the ocean surface, not the commonly assumed process of windblown seawater. The reason is that wind action actually forms very large droplets, which quickly settle back to the sea surface. Bubbles, on the other hand, produce numerous small droplets that readily form an aerosol and remain in the gas phase for long periods of time.

Likewise, wind alone does not form mineral dust aerosol. High wind speed lofts large grains that rapidly fall. Instead, a critical wind speed leads to mineral grain chipping, a process that's often called saltation, or the formation of what is known as rock flour. This process leads to very small mineral dust aerosol, which again is readily suspended and remains in the atmosphere for a long period of time.