Lab study indicates feldspar dominates ice nucleation in clouds with mix of water and ice

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Cloud in Nepali sky. Credit: Wikipedia

(Phys.org) —A team of researchers at Britain's Institute for Climate and Atmospheric Science, University of Leeds, with assistance from Australian Matthew Woodhouse of Commonwealth Scientific and Industrial Research Organization has found that feldspar minerals play a far larger role in ice formation in clouds than has been realized. In their paper published in the journal *Nature*, the team describes their lab studies that revealed the important nature of feldspar in ice nucleation in clouds.

Feldspars are a group of minerals that are believed to make up as much

as 60 percent of the Earth's crust. The name comes from the German words "field" and Spath (rocks that don't have any ore in them.) Prior research has shown that they make up on average just 3 percent of the dust found in clouds, which has led scientists to conclude that they play a minor role in ice formation. In this new effort, the researchers found just the opposite to be true.

The amount of ice that forms in clouds is important because it determines how large clouds grow, how long they last and their radiative properties. Because they make up so much of the mass of dust (about two thirds) in clouds, scientists have believed that clay minerals were responsible for most ice nucleation—where water adheres to dust particles kicking off the formation of ice crystals. Now it appears that feldspars play an inordinately important role.

To find out what really goes on inside of clouds, the researchers used special cooling chambers in their lab along with various mixtures of dust created to simulate that found in the natural atmosphere. Water vapor in the chamber formed droplets on slides allowing the researchers to study the ice crystals that grew on the minerals that were in them. By watching the process as it happened, the researchers were able to see that most ice nucleation occurred on feldspars rather than clay mineral material.

The findings by the team suggest that human activities may be having a larger impact on cloud formation and their properties than has been previously thought—the amount of feldspars in the atmosphere has been rising consistently over the past several decades due to landscape changes in arid areas. Prior research has shown that dust that winds up in clouds comes predominately from arid regions such as the Sahara desert. An increase in feldspars in the atmosphere, the researchers conclude, may be having a still unknown impact on global climate.

More information: The importance of feldspar for ice nucleation by

mineral dust in mixed-phase clouds, *Nature* (2013)
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Abstract

The amount of ice present in mixed-phase clouds, which contain both supercooled liquid water droplets and ice particles, affects cloud extent, lifetime, particle size and radiative properties1, 2. The freezing of cloud droplets can be catalysed by the presence of aerosol particles known as ice nuclei2. One of the most important ice nuclei is thought to be mineral dust aerosol from arid regions2, 3. It is generally assumed that clay minerals, which contribute approximately two-thirds of the dust mass, dominate ice nucleation by mineral dust, and many experimental studies have therefore focused on these materials1, 2, 4, 5, 6. Here we use an established droplet-freezing technique4, 7 to show that feldspar minerals dominate ice nucleation by mineral dusts under mixed-phase cloud conditions, despite feldspar being a minor component of dust emitted from arid regions. We also find that clay minerals are relatively unimportant ice nuclei. Our results from a global aerosol model study suggest that feldspar ice nuclei are globally distributed and that feldspar particles may account for a large proportion of the ice nuclei in Earth's atmosphere that contribute to freezing at temperatures below about −15 °C.