# Photochemistry of airborne dust produces nucleation events in the troposphere

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Dust particles acts as a sink for many gases, such as sulfur dioxide. It is well known that $SO_2$ reacts on dust particle surfaces leading to the production of $SO_4^{--}$.

It is known that light-driven reactions on dust particles containing $TiO_2$ or Fe(III) oxides produce OH radicals from water. These radicals can convert $SO_2$ adsorbed onto the particles into $H_2SO_4$, which stays on the particles.

Here, we show that OH radicals may leave the dust particles and go on to initiate gas-phase chemistry with gaseous $SO_2$.

To simulate such conditions, we shone light into a flow tube containing low concentrations of dust, along with water vapor and $SO_2$, and monitored the particle concentrations inside the tube.

Low dust concentrations are necessary for new particle nucleation; high dust concentrations would provide enough surface area for sulfuric acid to adsorb onto the dust, instead of nucleating aerosol. These findings are supported by recent field observations near Beijing and Lyon.

# Adsorption of D-Ribose and inorganic phosphate on clay minerals – molecular stabilization and phosphate condensation

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Nucleotides and more broadly DNA and RNA play a fundamental role in anabolic metabolism and are considered as "high-energy" compounds. For this reason, their prebiotic formation pose a particular problem since their synthesis is thermodynamically uphill in aqueous solution and therefore forbidden. This is a significant question in the frame of the "RNA world" models, which explain later stages of evolution, but require the previous synthesis of nucleotides and thus phosphorylations. The possible role of mineral surfaces in prebiotic processes has been considered at least since the work of Bernal (1951). This idea has been tested for several prebiotic reactions, especially the condensation of peptide bonds from monomeric amino acids, but also for phosphorylations and phosphate polymerization. Even if such reactions on mineral surfaces have a significant potential for the formation of high-energy coumpounds, there is little consensus as to the fundamental mechanisms that are involved. In this context, the aim of our work is to enlighten the mechanism of adsorption of nucleobases, D-Ribose, nucleosides and inorganic phosphate on different mineral surfaces, mainly clays such as montmorillonite, saponite, hectorite, Laponite (R) and also on high-surface non-porous amorphous silica. The first results obtained by XRD, TGA, $^{31}P$ and $^{29}Si$ NMR show that inorganic phosphate ions deposited on these surfaces condense to polyphosphates at considerably lower temperatures than in bulk $KH_2PO_4$. By co-adsorption of phosphate and a nucleoside, e.g. adenosine, it appears that some surfaces promote the phosphorylation of nucleosides in the same range of temperature. In separate experiments, D-ribose adsorption and stabilization were studied since the lack of stability of ribose is another problem for RNA world scenarii. Our results show a strong stabilisation of ribose by clays and amorphous silica. A similar stabilization has been previously observed with borate minerals, whose presence in prebiotic earth environnement is however open to doubt. Thus, our study shows the first example of ribose stabilization by prebiotic minerals. Phosphorylation of the sugar was also observed.

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DOI:10.1180/minmag.2013.077.5.7