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A mechanism of post-depositional processes affecting chlorine in the upper snowpack of Antarctic plateau

Content

We propose a mechanism of post-depositional processes affecting chlorine in the upper snowpack of Antarctic plateau. As discussed in previous studies, we suggest that the observed decrease of total chlorine content in the upper meters of the snowpack is due to a progressive release of the HCl content from ice. But we propose a consistent framework, combining diffusion processes and snow microstructure. The observation of the low content of chlorine in ice at depth leads to the robust hypothesis that the chemical equilibrium of chlorine between the ice and the snowpack interstitial air (SIA) is close to zero. The HCl species is thought to diffuse in ice, and to be progressively released in the SIA, and finally exported to the Antarctic atmosphere by the wind-ventilation. The time required to expel all the mobile species of chlorine from snow depends on the diffusion coefficient of chlorine in ice combined with the snow grain size and its evolution with de pth. This work is synthesised in a model combining the microstructure evolution of the upper meters of a snowpack (changes in mean snow grain size) and the diffusion of chlorine in ice applied to single spherical grains. The variability observed in chlorine concentration profiles with depth, at a same site but different sampling time or different snow pits, or among different sites in Antarctica, would be mostly due to the variations in initial concentration in HCl and NaCl species and the snow grain size evolution. This model offers a common framework for understanding the fate of chlorine in Antarctica, from coastal to inland locations, including low accumulation sites on the plateau, far from the ocean.

Primary author: GIRAUD, Xavier (Aix-Marseille Université)

Co-author: BARONI, Mélanie

Presenter: GIRAUD, Xavier (Aix-Marseille Université)

Track Classification: Progress in proxy development