

## Adsorption of hydrogen chloride on volcanic ashes

XOCHILT GUTIERREZ AND HANS KEPPLER<sup>1</sup>

<sup>1</sup>Bayerisches Geoinstitut, 95440 Bayreuth, Germany;  
hans.keppler@uni-bayreuth.de

Explosive volcanic eruptions release large amounts of hydrogen chloride, which under some circumstances may deplete the stratospheric ozone layer. However, the magnitude of this effect is unclear, because various processes in the eruption column could remove HCl from the volcanic plume. One potentially important, but poorly studied process is the adsorption on volcanic ashes. Therefore, the adsorption of HCl on volcanic ashes was experimentally studied from -76 to + 150 °C to simulate the behavior of HCl in the dilute parts of a volcanic plume. Finely ground synthetic glasses of andesitic, dacitic, and rhyolitic composition served as proxies for fresh natural ash. HCl adsorption is an irreversible process and appears to increase with the total alkali content of the glass. Adsorption kinetics follows a first order law with rate constants of  $2.13 \cdot 10^{-6} \text{ s}^{-1}$  to  $1.80 \cdot 10^{-4} \text{ s}^{-1}$  in the temperature range investigated. For dacitic composition, the temperature and pressure dependence of adsorption can be described by the equation  $\ln c = 1.26 + 0.27 \ln p - 715.3/T$ , where  $c$  is the surface concentration of adsorbed HCl in  $\text{mg/m}^2$ ,  $T$  is temperature in Kelvin, and  $p$  is the partial pressure of HCl in mbar. The data imply that adsorption of HCl on ash increases with temperature, probably because of the increasing number of accessible adsorption sites. This temperature dependence is opposite to that observed for  $\text{SO}_2$ , so that HCl and  $\text{SO}_2$  are fractionated by the adsorption process and the fractionation factor changes by four orders of magnitude over a temperature range of 300 K. The assumption of equal adsorption of different species is therefore not appropriate for deriving volcanic gas compositions from analyses of adsorbates on ashes. However, with the experimental data provided here, the gas compositions in equilibrium with the ash surfaces can be calculated. Our data also show that HCl adsorption on ashes is very efficient and under most circumstances greatly reduces the fraction of HCl reaching the stratosphere, so that the effect of volcanic HCl on stratospheric ozone is likely limited.