

## **New insights into the scavenging of fluoride by ash in volcanic eruption plumes**

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It is well established that gas-ash interaction in volcanic eruption plumes is the main source of soluble fluoride in ash deposits. The occurrence of fluoride in ash is often a cause of concern as elevated levels of fluoride in the environment may lead to negative environmental and health effects. However, the mineralogy of fluoride compounds on ash surfaces remain not well understood, thus impeding our capacity to assess the hazard posed by fresh or aged ash deposits. We combine the results of leachate, total fluoride and surface-sensitive (X-ray Photoelectron Spectroscopy, Field Emission Scanning Microscopy) analyses performed on ash samples from the 2010 eruption of Eyjafjallokull volcano, Iceland, to provide new insights into the scavenging of fluoride by volcanic ash. We show that soluble fluoride on ash surfaces exists in the forms of simple salts (e.g., sodium fluoride), silicon hexafluorides and/or silicon-fluoride bonds (i.e., Si-F). Calcium fluoride and aluminium fluoride may also occur in some ash samples. There is no evidence for the presence of fluoride in calcium fluorophosphate. Importantly, the eruption style governs the scavenging of fluoride by ash and the mineralogy of the secondary fluoride compounds deposited; magmatic eruptions favour the formation of soluble fluoride on the ash surface, while in phreato-magmatic eruption, fluoride is preferentially removed by the liquid phase of the plume. These results have significant implications for understanding the release of fluoride from and the geochemical reactivity of ash deposits upon exposure to environmental agents.