Heterogeneous reaction of sulphur dioxide on Eyjafjallajökull's volcanic ash from the 2010 eruption

Yoan Dupart[1], Laurence Burel,[1] Pierre Delichere,[1] Christian Geoage,[1] and Barbara D'Anna [1]
[1] Université de Lyon, Lyon; Université Lyon 1; CNRS, UMR5256, IRCELYON, Institut de recherches sur la catalyse et l'environnement de Lyon, , 2 avenue Albert Einstein, F-69626, Villeurbanne, France

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Presenting author email: barbara.danna@ircelyon.univ-lyon1.fr

Volcanic eruptions may induce important climatic and weather modifications. When volcanic ashes are emitted into the atmosphere they can travel for several weeks according to their size distribution and altitude of the ashes emission.

The Eyjafjallajökull eruption, between April 14th and May 23th, is considered as a medium-size eruption with injection of the ashes plume at relative low altitude (troposphere). However, ash was widely dispersed because of upper-level winds that advected the plume over the UK and continental Europe, as well as into the translattalntic flight routes.

During volcanic eruptions high amounts of SO_2 were injected into the atmosphere (from 50 to 200 ppbv) [1]. Previous literature showed that SO_2 could be convert into sulfate on mineral dust surfaces under dark conditions [2]. Sor far no conversion of SO_2 has been studied with real volcanic ashes and under day conditions (light exposure). The present study focuses on SO_2 kinetics on real Eyjafjallajökull's ash samples, collected the 20th of April 2010 at Seljavellir.

The kinetics was investigated using a flow-tube set up at atmospheric pressure and simulating atmospheric conditions. The ashes were deposited on a horizontal cylindrical coated-wall flow tube reactor surrounded by 5 fluorescent lamps (emission from 320-420 nm, λ_{max}=365nm). The kinetic studies revealed that the under UV-A irradiation conversion of SO_2 into sulphates is enhanced on these ash samples (as shown in figure 1 below).

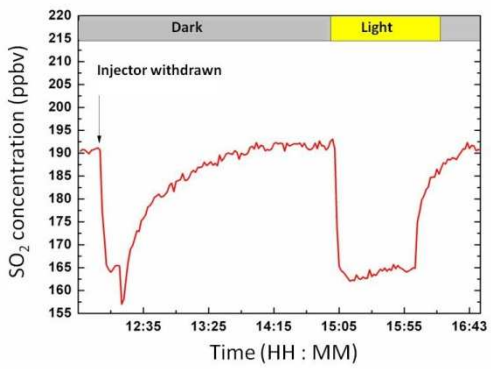

Figure 1. Uptake of SO_2 under darkness and weak UV-A irradiation on Eyjafjallajökull's ash sample.

Moreover chemical analyses as, Ion Chromatography (IC) and Scanning Electron Microscopy (SEM) coupled to energy dispersion spectrometry (EDS) were performed on volcanic ashes before and after exposition to gaseous SO_2. X-ray photoelectron spectroscopy (XPS) and ion chromatography (IC) analyses confirmed an enhanced SO_2 uptake under irradiation with conversion of SO_2 to sulphate. Beside SEM-EDS analysis suggested that the conversion takes place systematically on iron oxide site.

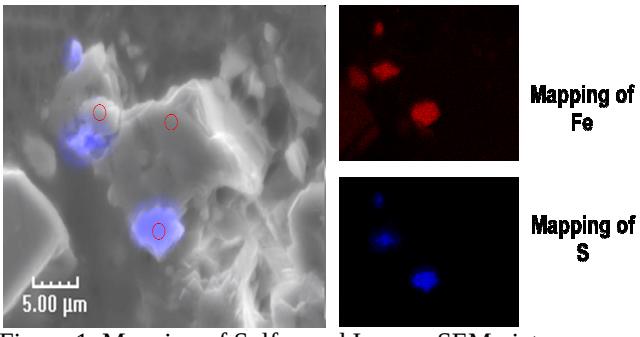

Figure 1. Mapping of Sulfur and Iron on SEM picture.

By combining kinetics and chemical analyses a new reaction mechanism for SO_2 conversion on volcanic ashes under light conditions is proposed.

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