

Non-Magmatic, Volcanic Ash Fragments and Aerosol Particles From the Passively Degassing Plume of Popocatepetl Volcano, Mexico - Indicators of Active Contact Metamorphism and Related Degassing ?

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Magma-wall rock interaction can contribute gases to the magmatic system as well as absorb volatiles to the country rock. These processes are happening at depth being far away from direct observation. Besides isotopic composition of gases, if it is possible to sample gases, the micro-analytical investigation of xenoliths is a potential instrument to study the mineralogical products of related chemical reactions. Plume-derived aerosols can be another source to obtain information about these processes. At Popocatepetl volcano the very high resolution FESEM/EDS could analyse contact metamorphosed particles as part of the volcanic ash and aerosol particles from the passively degassing plume. Wollastonite, hercynite, sphene and glass (buchites) of contact metamorphism-related origin is present in the ash. Condensates from the passively degassing plume are rich in phosphorus, indicating a possible non-magmatic source for this element. Micro- and nanometer-sized particles of volcanic origin are transporting various chemical elements into different layers of the atmosphere, according to the energy of an eruption. These particles can act as a nucleus for further condensation processes or can trigger heterogeneous chemical reactions in the atmosphere. The abundance of chlorine in the studied particles, especially in crystallites on spherical particles, can be an undervalued contribution to volcanogenic ozone destruction.

Airborne sampling of the plume in spring 1997 utilizing an impactor equipped with a teflon filter permitted an analytical field emission scanning electron microscope (FESEM) study of the collected particles. At 5640 masl the volcanic plume was detected by COSPEC yielding sulfur dioxide burdens as high as 236 ppm•m. Every line of measurement had a length of 12.7 km perpendicular to the plume's direction. The spectrum of particles comprises crystal fragments, mostly plagioclase, volcanic ash fragments, aggregated, fluffy and spherical aerosols. Fluffy and spherical aerosols are interpreted to be the product of complex condensation processes, leading to the formation of fluffy, semi-solid or spherical, solid particles. The latter ones are sometimes coated by crystallites of a complex Mg-Cl-sulfate.

The crystallites are the remains of an evaporated fluid. Spherical particles occur as single spheres or as coagulated spheres. The size of spherical particles varies about 1 μm in diameter, coagulated spheres can have diameters of up to 10 μm . The size of fluffy particles varies from 1.5 to 10 μm . According to the limits of EDS and the C- and F-content of the teflon filter we could characterize the chemical composition of individual aerosols. Elements detected in fluffy aerosols are Si, Al, Ca, Na, Mg, K, Fe, Ti, P, Cu, Zn, Bi, Pb, Mo, S, Cl, O. Most of the spherical particles do not show internal mixing as the surfaces appear smooth and none of the studied particles showed breakage. Only one particle contains Ti-, Pb- and Cr-rich crystallites inside the sphere. Elements detected in spherical particles are Si, Al, Ca, Na, K, Mg, Fe, Ti, P, Mn, Cu, Zn, S, V, Ni, O, (Pb, Cr). Individual spheres show also individual chemical composition. According to our study the variety of chemical composition indicates different microenvironments in the plume and/or at the zone of mixing with the surrounding atmosphere.

FE SEM images can be viewed at <ftp://fempc17.tu-graz.ac.at;obenholzner>; password: popocatepetl. File names start with letter P. EDS data can be obtained from Obenholzner and Schroettner.