VALIDATION of Volcanic FLUX MEASUREMENTS.

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The fluxes of volcanic gases and aerosols including HCl and HF are worldwide estimates in using a remote measurement of SO_2. This measurement is carried out on the volcanic plume after cooling and mixing of the magmatic gases in the atmosphere. Studies undertaken at the magmatic source showed out that the sulfur chemistry is very complex and variable from the initial magmatic gas source to the cold plume. In volcanic fumeroles H_2S and SO_2, both contained in the magmatic gases, interact to produce solid sulfur condensates. The amount of residual H_2S or SO_2 depends on the initial mixture composition. On Mt St Helens: H_2S is predominant in the magmatic gases: SO_2 is reduced to form metallic sulfur covering the entire volcano with a black dust of sublimes. On Mt Etna SO_2 is predominant, H_2S is oxidized in S_x condensing partly in metallic sulfur and mainly in solid sulfur covering the volcano with a thin yellow dust. In a 2200m^3 industrial sulfur distillation reactor we were able to calculate the equilibrium composition of sulfur vapor condensation and compare it to the partial pressure actually measured. This simulation showed that the mixture attained inerting conditions for high O_2 partial pressure (11%).

The behaviour of the volcanic gas phase depends on the initial magmatic gas composition and change from one volcano to another, and on a same volcano from one phase of activity to another. H_2S can be a residual sulfur species predominant in the plume as demonstrated on Mt St Helens: this has to be taken into account when interpreting COSPEC results. In order to validate the fluxes evaluations we used three different methods on three different volcanoes: Mt Erebus (Antarctica) Mt Satsuma Iwojima (Japan) and Mt Etna (Italy). On each one we operated the correlation spectrometry and at the same time we injected a tracer gas. On Etna in June 1996 we were able to operate an infra-red spectrometer.

On Mt Erebus (Antarctica) the results obtained using COSPEC from a distance gave a SO_2 flowrate of 120 to 150 T/day: i.e. an average of 75 T/day of Sulfur. Using the SF_6 method we obtained 50 to 80 T/day of Sulfur, 150 T/day of Cl and 50 to 80 T/day of F., indicating that the COSPEC method is accurate on this volcano probably because the SO_2 concentration in the plume is little affected during the cooling of magmatic gases in the atmosphere.

On Mt Satsuma Iwojima SF_6 method gave 620 T/day of SO_2 when COSPEC gave 430 to 900 T/day. Flux of metals were in tons per day: Al: 1.2 to 1.5; Fe: 0.6 to 1.2, Zn 0.15 to 0.22, F: 900T/d anf Cl: 135T/d.. In that case a part of the plume sulfur content could be H_2S, not measured by COSPEC but taken into account in the SF_6 method.

On Mt Etna in June 1996 we carried out the three methods on the actively degassing Bocca Nuova. The results obtained using COSPEC from a distance gave a SO_2 flowrate of 2,100-2,300 T/day, and 500-700 T/day for HCl. Using the SF_6 method we obtained 1,600 T/day of SO_2. A field measurement using an infra-red spectrometer across the plume (MIDAC) gave 1,800T/day of SO_2 and 500T/day of HCl. The method shall be presented and we shall discuss the difference in the results obtained.