How much magmatic water is transported by volcanic gases?

YURI TARAN[1] MIKHAIL ZELENSKI[2] AND ILYA CHAPLYGIN[3]

[1]Institute of Geophysics, Universidad Nacional Autónoma de México, México D.F., 04510, México
[2]Institute of Experimental Mineralogy, RAS, Chernogolovka, Moscow Dstr.142432, Russia
[3]Institute of Ore Deposits, RAS, Moscow, 119017, Russia

Gases sampled from volcanic fumaroles and from the surface of lava lakes and lava flows are characterized by temperatures from boiling point of water up to 1100°C. The main component of volcanic gases is water vapor with concentrations from ~50 to 99 vol% . The fraction of magmatic water in volcanic gases is estimated using the isotopic composition of volcanic vapor. For the highest temperature fumaroles of subduction-type volcanoes D/H ratios on average ~ -25‰ (V-SMOW) and $^{18}O/^{16}O$ are close to the corresponding values of the whole rock, usually from +6 ‰ to +9‰. In many cases volcanic vapors of arc volcanoes with t>800°C are represented by almost pure magmatic water. However, there are numerous exceptions from this rule when a >800°C volcanic gas is a mixture of magmatic water with up to 50% of meteoric or seawater vapors. Most of the arc fumarolic gases demonstrate a single trend of mixing between magmatic and meteoric end members in their chemical and isotopic compositions. Much more complicated are cases related to volcanic gases from hot spot and rift volcanoes with magmas much less water abundant that arc magmas. Low and medium-temperature fumaroles of Kilauea (Hawaii) and Sierra Negra (Galapagos) discharge gases with a low content of water vapor (50-70 vol%) but all these vapors apparently have meteoric origin and thus the real proportion of magmatic water and its isotopic composition in gases of these hot spot volcanoes is impossible to determine. The new data on the high-temperature (> 1000°C) volcanic gas from a hornito of the Erta Ale lava lake (Zelenski *et al*., submitted) make possible to estimate the isotopic composition of magmatic water for this continental rift volcano. The Erta Ale volcanic vapor derived from the liquid lava lake seems to be about half diluted by meteoric water and has the isotopic composition between that of local meteoric water and water with $\delta D < -60‰$ if to accept $\delta^{18}O = +6‰$, like in the Erta Ale whole rock samples. However, this suggestion assumes the absence of the oxygen isotope exchange between CO_2 and H_2O during sampling when the ~1:1 H_2O+CO_2 mixture is cooling from the vent to condensate temperature.

Important factors for geochemical research of stream sediments near storm water outflow sites

R. TARAŠKEVIČIUS, R.ZINKUTĖ* AND Ž.STANKEVIČIUS

Nature Research Centre, Akademijos 2, Vilnius LT-08412, Lithuania (*correspondence: zinkute@geo.lt)

Urban storm sewer system is an important pathway of transfer of contaminants to the hydrosphere. Presuming that each storm water outflow (SWO) can increase the content of potentially harmful chemical elements (PHE) in stream sediments, matched pairs of samples can be taken upstream and downstream from SWO. Water flow rate differences lead to variability of lithological composition (from clay to sand) and geochemical changes even within short distance. It is useful to find out the advantageous grain size fraction for revealing the geochemical changes due to influence of SWO.

Thirty nine samples of Neris river sediments including 12 matched pairs of samples near SWO sites of Vilnius city were taken. The contents of Pb, Zn, Cu, Ni, Cr (PHE) and rock forming elements Al, Ca, Mg, Na, K, Fe, Si, P, S, Ti, Mn were determined in the bulk fraction (<2.0 mm) and fractions <0.1 mm, 0.1-0.25 mm, 0.25-0.50 mm by x-ray fluorescence.

In most samples the fraction 0.1-0.25 mm (average is ~57%) and <0.1 mm (30%) prevails. In sequence of fractions <0.1 mm, 0.1-0.25 mm, 0.25-0.50 mm the contents of most elements decrease due to dilution by quartz and plagioclases.

Using Wilcoxon matched pairs test for the bulk fraction the differences between samples upstream and downstream from SWO are insignificant for all 5 PHE, meanwhile for the <0.1 mm fraction they are significant for Pb, Zn and Cu. The increase of Cr and Ni contents is insignificant, because they are not the main in pedogeochemical anomalies of Vilnius.

Analysis of <0.1 mm fraction seems to have advantages in comparison with the bulk fraction <2 mm for indicating places of storm water outflow. For refinement of results, not only enrichment factors should be calculated by normalising to clay-related (Al, Mg, K, Ti) or biophylic (S, P) elements, but also the dilution factor by sand (Si) taken into account.

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