Rend. Online Soc. Geol. It., Suppl. n. 2 al Vol. 35 (2015) Congresso SIMP-SGI-So.Ge.I-AIV 2015

Chemistry and fluxes of major and trace element from worldwide passive degassing volcanoes: a critical review

Calabrese S.*[1], D'Alessandro W.[2], Aiuppa A.[1] & Parello F.[1]

1. Dipartimento di Scienze della Terra e del Mare, Università di Palermo. 2. INGV, Palermo.

Corresponding email: sergio.calabrese@gmail.com

Keywords: Trace elements, passive degassing volcanoes, fluxes.

Volcanic emissions represent one of the most important natural sources of trace elements (e.g. As, Cd, Cu, Hg, Pb, Sb, Tl and Zn) into the atmosphere, sequentially influencing the hydrosphere, lithosphere and biosphere. The human health hazard during episodic volcanic eruptions generally follows from deposition of coarse and fine particles (2.5-10 and < 2.5 μm) that produces effects such as asthma and lung and respiratory disease. Regarding passive degassing volcanoes, the harmful effects of fluorine fumigation are known both for vegetation (foliar necrosis) and human/animals (fluorosis), but only a few studies have been focused on the effects of potentially toxic trace elements. From a review published work on the metal output from active worldwide volcanoes, 52 publications (the first dating back to the 70's) were identified, 13 of which on Etna and the others from some of the world most active volcanoes: Mt. St. Helens, Stromboli, Vulcano, Erebus, Merapi, White Island, Kilauea, Popocatepetl, Galeras, Indonesian arc, Satasuma and Masaya. In general, the review shows that available information is scarce and incomplete. We compiled a database both for concentrations and fluxes of 59 chemical elements (major and trace), which allowed us to constrain the compositional and output range. In this study we also present unpublished results from Etna (Italy), Turrialba (Costa Rica), Nyiragongo (Democratic Republic of Congo), Mutnovsky and Gorely (Kamchatka), Aso Asama and Oyama (Japan). Concentrations of major and trace elements were obtained by direct sampling of volcanic gases and aerosols on filters. Sulfur and halogens were collected by using filter-packs methodology, and analyzed by ion chromatography. Untreated filters for particulate were acid digested and analyzed by ICP-OES and ICP-MS. Sulfur to trace element ratios were related to sulfur fluxes to indirectly estimate elemental fluxes. Etna confirms to be one of the greatest point sources in the world. Nyiragongo results to be an additional large source of metals to the atmosphere, especially considering its persistent state of degassing from the lava lake. Turrialba and Gorely also have high emission rates of trace metals considering the global range. Only Mutnovsky volcano show values which are sometimes lower than the range obtained from the review, consistent with its dormant (fumarolic) stage of activity.

The accurate estimation of individual and global volcanic emissions of trace metals is still affected by a high level of uncertainty. The latter depends on the large variability in the emission of the different volcanoes, and on their changing stage of activity. Moreover, only few of the potential sources in the world have been directly measured. This preliminary work highlights the need to expand the current dataset including many other active volcanoes for better constraining the global volcanic trace metal fluxes.