

Interactive comment on “Bromine monoxide/sulphur dioxide ratios in relation to volcanological observations at Mt. Etna 2006–2009” by N. Bobrowski and G. Giuffrida

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This paper presents a detailed time series of BrO/SO₂ ratios in the plume of Mount Etna, Italy. The data are clearly of a high quality, and the errors and limitations of the dataset are discussed thoroughly. The data are discussed with reference to meteorological conditions, and there does not appear to be any interdependence with temperature and humidity. In particular, the issue of whether this ratio might change downwind is discussed and at what plume age the ratio becomes stable. Although it is not so clear on figure 2 that these ratios correlate with volcanic activity, the statistical analysis in figure 6 shows that during non-eruptive periods the BrO/SO₂ ratio is

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high, and during eruptive periods it is low. Furthermore, the ratio appears to decline in advance of eruption, with ratios one month before an eruption lower than during non-eruptive periods. The interpretation of the data is a little speculative as it stands, and does not draw upon the relevant literature on bromine partitioning into vapour (see points below). Overall the paper is of a high quality and presents some very interesting observations and will no doubt form the basis for future studies on bromine behaviour in basaltic systems.

It has been found, from many studies, that the concentration of bromine in fluids and co-existing melts are proportional to one another and therefore the behaviour is discussed in terms of a fluid-melt partition coefficient. The authors cite the works of Bureau et al. (2000) but only in connection with sulphur and chlorine – this study actually looked at the behaviour of chlorine, bromine and iodine at 2 kbar pressure in the presence of a hydrous fluid. It was found that bromine partitions even more strongly into a hydrous fluid than chlorine, which is probably due to its larger ionic radius. Like chlorine, the pressure dependence of bromine partitioning is probably weak – the main control would be the degassing of H₂O and so decompression will effectively remove all the Br from the melt, if equilibrium were maintained (Bureau et al., 2010). For Etna, it is difficult to assess the relative exsolution behaviour of sulphur and bromine without melt inclusion data, experiments or thermodynamic modelling using this composition, but it would be straightforward to forward-model Br partitioning using the published partition coefficients, and similarly sulphur exsolution using the published data from Spillaert et al. (2006), observations of gas emissions (Aiuppa et al., 2005) and others and recent papers (Webster and Botcharnikov, 2011) and make a comparison with your gas emissions data. It might well be that, because partitioning of sulphur into vapour in basaltic systems is weak, sulphur might only dominate in the vapour during eruptive periods, when magma ascends to the surface. In order to test this hypothesis, it would be useful also to compare the BrO/SO₂ time series with a time series of SO₂ flux, which would show that when BrO/SO₂ decreases, SO₂ flux is increasing.

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