STABLE CHLORINE ISOTOPE COMPOSITION OF VOLCANIC GAS CONDENSATES. C. Wahrenberger; C.J. Eastoe; T.M. Seward; V. Dietrich. Institute for Mineralogy and Petrology; ETH Zurich; Zurich Switzerland. Department of Geosciences; University of Arizona; Tucson, USA

This study presents \( \delta^{37}\text{Cl} \) values measured in condensates of volcanic gases from Kudriavy (Iturup Island, Kuriles, Russian Federation) and from Vulcano (Sicily, Italy). Condensates were used to circumvent the possible problem of fractionation during sampling with Giggenbach bottles [1]. Samples were made alkaline and later processed and analyzed by procedures described elsewhere [2]. Results are given in the table below.

Both volcanic systems show a linear correlation between \( \delta^{37}\text{Cl} \) and sampling temperature. In the case of Kudriavy, this is interpreted in terms of mixing between two endmember components: a high \( \delta^{37}\text{Cl} \) (i.e. positive) component at high temperatures and a low \( \delta^{37}\text{Cl} \) (i.e. negative) component at lower temperatures. The former tends to have the higher total Cl concentrations in the gas phase then the latter. The high \( \delta^{37}\text{Cl} \) endmember is attributed to a magmatic source on the basis of temperature, stable isotope composition and general gas chemistry (our unpubl. results and [3]). The latter is attributed to meteoric water. Two processes could explain the shift of this endmember to negative \( \delta^{37}\text{Cl} \) values: water/rock interaction at elevated temperatures, in accordance with a corresponding shift in the \( \delta^{18}\text{O}/\delta\text{D} \) system [3], and/or the dissolution of \( \delta^{37}\text{Cl} \) depleted chloride minerals by meteoric water. This is in accordance with the matching \( \delta^{37}\text{Cl} \) for halite and the low \( \delta^{37}\text{Cl} \) endmember. The maximum value of \( \delta^{37}\text{Cl}=+1.9\%e \) brackets the values determined for porphyry copper deposits [4].

The interpretation of the data from Vulcano may be more complex. \( \delta^{37}\text{Cl} \) values are higher compared to those of Kudriavy inspite of the much more hydrothermally influenced gas composition and lower temperature. Even though the maximum value is still within the range expected for a potential gas source [5], secondary processes are likely to influence the measured fractionation. A possible process leading to elevated \( \delta^{37}\text{Cl} \) values is the sublimation of chloride minerals such as halite. Preliminary ab initio calculations indicate a positive fractionation factor for \( \delta^{37}\text{Cl} \) the gaseous HCl-NaCl system. The low \( \delta^{37}\text{Cl} \) endmember is interpreted to be an isotopically shifted sea- or meteoric water in accordance with the total gas chemistry and the \( \delta^{18}\text{O}/\delta\text{D} \) values of [6].

References:


<table>
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<tr>
<th>Origin</th>
<th>Sample type</th>
<th>Gas temperature (°C)</th>
<th>( \delta^{37}\text{Cl} ) (‰)</th>
<th>Cl_total (mol%)</th>
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<tbody>
<tr>
<td>Kudriavy 1995</td>
<td>condensate</td>
<td>920</td>
<td>+1.9</td>
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<td>-0.8;-1.0</td>
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<td>-1.1;-1.2</td>
<td>0.10</td>
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</table>

Table 1: Stable chlorine isotopic composition of gas condensates and salt sublimate from Kudriavy and Vulcano. Values for \( \delta^{37}\text{Cl} \) are given relative to SMOC. Total chlorine composition as HCl measured on the corresponding total gas. Double determinations were carried out on separate batches of the same sample. Analytical precision is determined to be +/- 0.075‰.
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8:30 a.m.  Finger Rock

Chairs:  J. W. Valley
         D. Cole

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