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Geochemical monitoring of Chichón volcano (México) trough sulfur speciation of the crater lake's water

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Monitoring of El Chichón volcanic activity is a very important given its eruption of March 28th, 1982 that was the worst volcanic disaster of the modern era in Mexico.

To help mitigation of volcanic risk, we intend the establishment of an analytical methodology for the determining various sulfur species (S2-, SO_3 2-, S4O6 2-, SO4 2-) occurring in the crater lake which was formed after the 1982 eruption. These species were determined through HPL Chromatography with the aim of establishing links between their presence and concentrations, the general physical and chemical characteristics of the lake, seasonal variations and the activity of El Chichón volcano. Besides, knowledge of sulfur species behavior will contribute to have a better knowledge of the state the hydrothermal system, and the internal dynamics of the volcano, and provide more information to determine periods of increasing hazard. This paper presents advances in the development of the methodologies for the analysis of the above mentioned sulfur species.

We have identified the analytical procedures for sampling and analysis of these species (preservation, operating conditions of the equipment, number of samples, dilution, etc.) according to various studies in different volcanoes with crater lakes (Volcano Poas, Costa Rica; Kusatsu-Shirane, Japan). Water samples collected at various locations of the lake on March 29th, and July 11th and October 3rd, 2014, have been analyzed for major ions and sulfur species. Results are being related to the volcanic behavior.

Results obtained:

Average concentrations (mg/L) at one sampling site:
• Sulphide: 1.75 in March, 1.82 in July and 4.99 in October
• Sulphite: 4.16 in March, 1.89 in July and 25.23 in October
• Tetrathionate: 236.88 in March, 247.46 in July and 152.96 in October
• Sulphate: 618.51 in March, 609.91 in July and 620.18 in October

Preliminary conclusions:

• The proposed Chromatographic method has been successful to separate these sulfur species from the water lake matrix.
• The average concentrations of the overall sulfur anions show an increase in the last samples results (October). The gases H2S and SO_2 (coming from the aquifers below the lake) seem to influence the abundance of the sulfur anions in the lake.
• The determination of sulfite (SO_3 2-) has not been done before and shows an anomalous behavior from the other species, which could indicate the location of a main site of H2S or SO_2 input. Tetrathionate determination (S4O6 2-) has not also been done before and is an ion that (along with other polythionates)has proven to be an important indicator for the detection of changes in volcanic activity.