Geophysical Research Abstracts
Vol. 14, EGU2012-4527, 2012
EGU General Assembly 2012

Geochemical features of nutrients and dissolved gases in the volcanic lake of Averno (Phlegrean Fields, southern Italy)

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The Averno crater, formed about 3.7 ka BP (Rosi & Sbrana, 1987), is located in the north-western part of the active volcanic system of the Phlegrean Fields (Campania, Italy). It hosts a volcanic lake that stores a considerable amount of gas (mainly CO_2 and CH_4) at depth, which is responsible of a relatively pronounced vertical thermal and chemical water stratification. In addition, seasonal-dependent anoxic conditions establish at variable depths. The δ^{13}C-CO_2 values, between -13.4 and -8.2 ‰ V-PDB, are likely referred to a mixing process between a deep-seated CO_2 that enters the lake and an organic source, whilst those of δ^{13}C-CH_4 and δD-CH_4, as low as -67 ‰ V-PDB and -279 ‰ V-SMOW, respectively, indicate bacterial methanogenesis. The input of a deep source is also supported by Caliro *et al.* (2008), who suggest that the Averno Lake waters are affected by both a shallow (meteoric water) and a Na–Cl (hydrothermal) component.

The present study is aimed to demonstrate that biogeochemical processes related to the activity of different populations of aerobic and anaerobic bacteria in both the bottom sediments and lake water may play a fundamental role in regulating the vertical distribution of SO_4, S^{II-}, CO_2 and CH_4 concentrations, as well as those of N-bearing ions (NH_4, NO_2 and NO_3), H_2 (Bianchi *et al.*, 2010) and P. Thus, it is possible to speculate that distinct bacteria are colonizing different water layers of Averno Lake and this distribution may be responsible of different thermochemical conditions of the hosting environment, implying a competition among the various microbial species.

As a consequence, bacteria speciation may be regarded as an important tool for detecting possible changes in the chemical-physical conditions of volcanic lakes. Possible implications for volcanic surveillance by investigating this “organic” parameter are thus to be evaluated.

References

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