Interaction between acidic geothermal waters and algae living in Pisciarelli (Naples, Italy)

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Introduction

Pisciarelli acidic environments are located in the central part of the Campi Flegrei caldera, a Quaternary volcanic complex of potassic alkaline affinity. The geothermal system is liquid-dominant with very low pH values (0-3), spring water temperature up to 90°C and rivulets of waters with lower temperatures (30-50°C). In this work we have examined the algal distribution in this area and the role of water and soil geochemistry on algal flora growth and development, by means of analyses of the main chemical elements.

Distribution of algae and water geochemistry

In Tab. 1 we report the analyses of waters coming from three different sampling sites:

Tab. 1: chemical features of the fluids from the Pisciarelli thermal system (concentration in mg/l).

Water type	pH	T°C	NH_4	SO_4	Cl	Al	Fe
1	2.33	92	810	4200	4.0	44.6	117
2	2.33	39.4	1060	4560	205	33.3	125
3	1.55	47.6	1270	4166	0.1	10.6	128

1: hot pool; 2: rivulet N° 1; 3: rivulet N° 2

Similar results were obtained on the acidic soils.

Samples of algae were collected from : a) acidic soils in the vicinity of hot springs; b) into the rivulets and in small depression of soils few meters far from the hot spring; c) into the rocks, covered by a thick layer of silica granules. First results have shown that algal distribution is clearly influenced by temperature, pH and by the presence of water. Red unicellular algae, *Cyanidium caldarium*, *Galdieria sulphuraria* and *Cyanidioschyzon merolae* were located both on the acidic soils near the hot springs and on the rocks, under the silica layer; few diatoms, such as *Pinnularia obscura*, were located exclusively in the rivulets, whilst green unicellular algae (*Chlorella protothecoides var. acidicola, Stichococcus bacillaris*, *Dunaliella acidophila* and *Pseudococcomyxa simplex*) were found only on soil near the rivulets.

Further investigations are necessary to identify other phisical and chemical parameters directly involved in the peculiar distribution of the algal species.

H_2O, S and Cl in Subduction Zone Magmas: Insights from Melt Inclusions in High-Mg Basalts from Central Mexico

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Despite a growing body of data on H_2O in arc magmas, there is still uncertainty about the relationships between H_2O and incompatible elements during enrichment of the mantle wedge by subduction processes. We report data for H_2O, other volatiles (CO_2, S, Cl), and trace elements in olivine-hosted melt inclusions from high-Mg basalts in central Mexico that exhibit varying degrees of subduction-related enrichment. Most of these melt inclusions were trapped at low pressure, but rare inclusions (Mg# 65-74, olivine hosts Fo_{85-90}) trapped at upper to mid crustal pressures (1 to 6 kb) contain high CO_2 (250-2120 ppm). The high pressure inclusions indicate primary magmatic H_2O concentrations that vary from 1.3 to 5.2 wt%. Dissolved S concentrations vary from typical values for basaltic magmas (~1000 ppm) to as high as 6000 ppm. The latter is among the highest ever measured in basaltic melt inclusions or submarine glasses, and is a clear indication of high oxygen fugacity. Cl concentrations are also relatively high (700-1900 ppm).

Enrichment of H_2O relative to Nb correlates positively with ratios such as Ba/Nb, La/Nb, and Th/Nb, indicating a clear link between H_2O and trace element enrichment of the mantle wedge. Our results demonstrate that fluxing of the wedge with an H_2O-rich component from the subducted slab is important in formation of magmas that are enriched in large ion lithophile (LILE) and light rare earth (LREE) elements relative to high field strength elements (HFSE). In contrast, magmas with low LILE and LREE relative to HFSE have low H_2O, and must have formed by decompression melting of unmodified mantle. Our data for volcanoes <50 km apart show evidence of significant variability in the composition of H_2O-rich subduction components that are added to the mantle wedge beneath central Mexico. We have modeled the compositions of endmember H_2O-rich components by using a method similar to that of Stolper and Newman (1994), yielding the following range of major element compositions: H_2O (48-50 wt%), Na_2O (23-36 wt%), K_2O (10-15 wt%), S (1.5-6.0 wt%), TiO_2 (3-4 wt%), P_2O_5 (2-5wt%), and Cl (1.0-1.6 wt%). One endmember is very similar to the H_2O-rich component that Stolper and Newman (1994) deduced to have been added to the Marianas back-arc mantle.

References

Stolper E.M., Newman S., (1994) *Earth Planet. Sci. Lett.* **121**, 293-325.