Simulating physical weathering of basalt on Earth and Mars

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Background

Despite its importance as a surficial rock type on Earth and other planets, few studies have been made of the response of basalt to physical weathering. Heating and cooling, with or without salts and moisture, may have severe impacts on basalt clasts in many extreme environments (Leask & Wilson, 2003). We report here on an integrated programme of simulations investigating physical weathering of basalt under Earth (hot desert) and Mars conditions using a Fison's Environmental Cabinet and a specially constructed Mars Environment Simulation Chamber.

Methods

Small blocks (9 x 2.3 x 2.5 cm) of basalt were cut, and two groups prepared: (1) thermally pre-stressed and (2) thermally pre-stressed and immersed in saturated Na₂SO₄ solution. Sample strength was assessed before and after experimental weathering using a Grindosonic, and thin sections were produced for detailed petrological examination. Ambient, block surface and internal temperatures were monitored throughout the experiments. The Earth weathering regime was set up to reflect Negev desert conditions cycling between 296K and 345K; whilst the Martian regime cycled from 190K to 277K . Cycle length was 8 hrs. in each case. Both weathering regimes also included an element of radiative heating via lamps coming on for part of the heating cycle. The Mars weathering regime was carried out in 100% CO_2 atmosphere at 9 mbar pressure.

Results and conclusions

After 36 cycles under Earth and Mars conditions, changes in strength (few %) were apparent and some microscopic cracking was observed, although no visible weathering was produced. Blocks subjected to Mars-like conditions reacted differently to those subjected to Negev desert conditions especially with regard to whether salts caused strengthening or weakening.

References

Leask, HJ and Wilson, L. (2003) Heating and cooling of rocks on Mars: Consequences for weathering. *Lunar and Planetary Science Conference* 34, abstract 1320.pdf

Arsenic in hydrothermal fluids from shallow vents in Baja California, México

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Introduction

Dissolved arsenic concentrations in hydrothermal fluids from submarine (BC1, BC4 and BC6) (5 to 15 m depth) and intertidal hot springs (LP1 and SAN1, MAN1) from Bahía Concepción (Prol-Ledesma *et al.*, 2004) are higher than the permissible limit established by the Mexican government (0.05 mg/l). In the intertidal vents, there are Mn-oxides while in the submarine vents Fe-oxyhydoxides occur (Canet *et al.*, 2005). Here, we try to model the occurrence of arsenic by chemical speciation and the relation with precipitate mineralogy. The results are presented in the next table.

	Temp (°C)	pН	As (III)	As (V)	As total
BC1	87	6.0	10.4	0.04	10.41
BC4	87	6.0	6.1	0.03	6.14
BC6	87	6.0	9.3	0.04	9.34
LP1	61	6.5	4.8	0.04	4.81
SAN1	66	6.2	3.6	0.02	3.60
MAN1	40	7.0	2.0	0.03	2.00

Discussion

According with the pH values, arsenic in the vent fluid is mostly present as As(III) (up to 98.6%). Manganese and iron are both in reduced form. Oxidation of these elements to form the observed Fe-oxyhydroxides and Mn-oxides could occur by mediation of microorganisms. This way, oxidation products could adsorb arsenic and prevent its release from the hydrothermal fluid into the sea water.

Conclusions

Mn-oxides and Fe-oxyhydroxides play an important role in arsenic mobility discharged in the Bahía Concepción vent fluid.

References

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