Magma chamber processes leading to the January 1835 eruption of Cosigüina volcano, Nicaragua

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Cosigüina volcano, in northwest Nicaragua, erupted violently in January 1835, producing pumice, scoria, and ash fall deposits, as well as pyroclastic flows for a total volume of ~6 km^3 [1]. Here, we present new geochemical data on bulk-rocks, matrix glasses, melt inclusions and minerals from the 1835 deposits, with the aim of shedding light on the magmatic processes that led to the eruption.

The deposits of the 1835 eruption are chemically zoned; a small volume of dacite pumice was erupted first, followed by silicic andesite scoria and andesite scoria, the latter representing by far the largest magmatic component. The dacite pumice is composed of microlite-free glass (65.6 wt.% SiO_2, 0.9 ± 1.6 (1σ) wt.% H_2O (by difference)), and scarce crystals of plagioclase (An_{50-65}, some with a An_{80} core), clinopyroxene (Mg#=64-68), orthopyroxene (Mg#=57-62), magnetite (14.6 wt.% TiO_2) and apatite that commonly occur as glomerocrysts. Rare melt inclusions are of dacitic composition and contain 4.0 ± 1.7 wt.% H_2O. In comparison, the andesite scoria comprises microlite-rich glass (62.1 wt.% SiO_2, 1.0 ± 0.8 wt.% H_2O), abundant crystals of plagioclase (An_{75-95}) and sparse clinopyroxene (Mg#=64-75), orthopyroxene (Mg#=59-72) and magnetite (8.4 wt.% TiO_2) generally occuring as individual crystals. Abundant melt inclusions trapped in An_{80} plagioclase are of andesitic composition and contain 3.3 ± 1.7 wt.% H_2O. Mineral-melt thermometry and hygrometry [2] suggest magmatic temperatures of 930°C and 1030°C and dissolved water contents of 4.5 wt. % and 3.3 wt. %, in agreement with H_2O-by-difference results, in the dacite and andesite magmas, respectively. Assuming water saturation, this translates into magma storage pressures of ~100-150 MPa. Parallel REE patterns for dacite and andesite show a negative Eu anomaly, particularly pronounced for the former. Yet, andesite bulk-rock Al_2O_3 contents depart from the glass and melt inclusion trend, implying that early extensive fractionation was followed by 15-30 % plagioclase addition in the andesite.

Together these observations suggest that the 1835 eruption was fed by a chemically and thermally zoned magma chamber and that the dacite and andesite magmas are closely related through crystal fractionation. However, the lack of plagioclase of intermediate compositions in the 1835 magmas requires efficient and 'sudden' separation (through e.g., gas-driven filter pressing [3]) of a dacitic melt, from which An_{50-65} plagioclase began crystallising. Accumulation of free gas at the top of the magma chamber may have led to the abrupt collapse of a foam layer, triggering the eruption and rapidly ejecting the dacite. Decompression associated with the eruption onset may have caused microlite growth in the andesite melt prior to its expulsion in the later stages of the eruption.

[1] Scott et al. (2006) *GSA Bull. Special Paper* **412**, 167-187. [2] Putirka (2008) *Rev. Mineral. Geochem.* **69**, 61-120. [3] Sisson and Bacon (1999) *Geology* **27**, 613-616.

Bacterial Interactions with radionuclides in Bentonite Samples from Spanish Clays

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A reliable performance assessment of radioactive waste repository depends on a better knowledge on the interactions of radionuclides and natural microorganisms of geological formations (salts, granitic rocks and clays) used as host rock candidate for these disposal systems. Microbes are able to interact efficiently with actinides affecting their transport and mobility in the environment [1] .The main goals of the current work are: a) to characterize the bacterial diversity of two bentonite samples (BI and BII), recovered from Spanish clay deposits considered in this study as host rock candidate for geological disposal of radioactive wastes, and b) to investigate how these bacterial community will respond to uranium toxicity.

Results and conclusions

16S rRNA gene sequence analysis was used to explore the bacterial community structure of the two bentonite samples which indicated that the sample BI showed a higher diversity than the sample BII. Bacteroidetes (*Flavisolibacter* spp.), Alfaproteobacteria (*Rhodobacter* spp.), Cyanobacteria (*Phormidium* spp.) for example were identified in the sample BI. In contrast, the sample BII was dominated by Betaproteobacteria (*Ralstonia* spp.). Bacteria belonging to Actinobacteria (*Arthobacter* spp.), Gammaproteobacteria (*Stenotrophomonas* spp.), Firmicutes (*Bacillus* spp.), etc. were isolated by culture dependent methods from both samples and assayed for their tolerance to uranium. *Stenotrophomonas* spp. (strain BII-R6r) presented the highest level of U tolerance, being able to grow up to 8 mM of this radionuclide.

Flow cytometry studies (live/dead staining) indicated that the cellular viability of the U-exposed cells of the strain BII-R6r was not affected by this radionuclide (85% viable cells at 3 mM U) compared to that of *Bacillus simplex* (strain BII-S2) wich was U-sensitive showing 60% viable cells at only 1 mM U. In addition, results on the behaviour of the cells of *Stenotrophomonas* spp. BII-R6r in response to the oxidative stress, in term of membrane potential activation alterations and ROS production, caused by uranium will be discussed. Microscopic analysis indicated that uranium precipitation as uranium phosphate mineral phases (e.g. meta-autunite) was involved in the mechanisms of bacterial tolerance to this radionuclide.

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[1] Merroun (2011) *Journal of Hazardous Materials*. **197**: 1-10.