Mixing of Contrasting Silicate Melts: preliminary Raman Spectra

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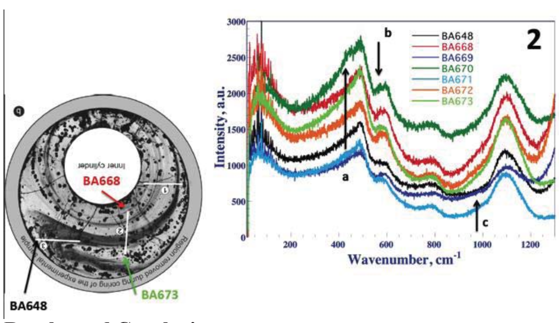
Glasses melts and magmas

A widely debated question in Geosciences is how viscous magmas with extreme viscosity contrast mix under natural conditions. In order to study how chaotic dynamics may control chemical interactions, and therefore timescales of hybridization during magma mixing, we developed a modified Journal Bearing System device [1] for experiments on chaotic mixing silicate melts at high temperature [2]. In this work we focus on preliminary Raman spectra of mixed glasses obtained by mixing two end-members at 1,673K: (i) a peralkaline haplogranite melt (HPG8N5K5), and (2) a haplobasaltic melt corresponding to the 1-atm eutectic composition of the Anorthite-Diopside (An-Di) binary system. These two compositions are intended to act as analogues for natural dry granitic and basaltic magmas. Raman spectra were obtained along two transects along filaments from the resultant glasses, next to the same points analysed for major and trace elements (microprobe and Laser Ablation ICP-MS) [3]. Experimental conditions were kept 'extreme', since most of melt fraction consisted of a high-viscosity melt (95%) and small amounts of lower viscosity mafic melt (5%).

Figure 1: Raman spectra along two transects crossing filaments of mixed haplogranite and An-Di



Results and Conclusion

We observe some changes, in particular the arrows a, b and c show changes in the Raman spectra, and they can link at changes in the polymerization network. Spectra 648 is probably more polymerized than spectra 666 (not shown in Figure 1). This observation is also confirmed for the spectra 670, consisting of the more polymerized melt. Although the changes are still subtle, these point towards changes in the polymerization degree, which are due to differential hybridization of the two stating compositions. For the preliminary results peak-changes vary with the geometry and interaction degree among filaments. Results are consistent with those obtained from microchemical studies along the same lines [3].

[1] Ottino etal. (1988) *Nature* **333**, 419-425; [2] De Campos et al. (2011) *Contrib. Mineral Petrol* **161**, 863-881; [3] Perugini et al. (*in prep.).*

Case study of an abandoned Zn-Pb mine: Ingurtosu (Sardinia, Italy).

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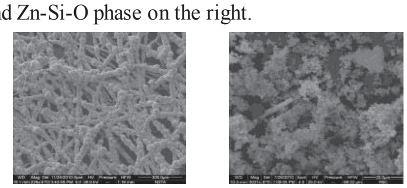
Ingurtosu mine characterization

The Ingurtosu Pb-Zn mine (S-W Sardinia) was in production for about a century until 1968. Huge amounts of tailings were abandoned, resulting in long-term heavy metal dispersion in both stream sediments and waters. Downstream from the mine wastes, the Naracauli waters discharge directly into the Mediterranean Sea. At least two biomineralization processes (Fig. 1) are known to be effective in the abatement of Zn and other heavy metals transported in solution.

In this work, many different techniques were used to study the mineralogy and geochemistry controlling the biomineralization processes. Microbial consortia within biofilm associated with seasonal precipitation of an amorphous mineral made of Si, Zn and O were examined. In addition, the load of metal dissolved in the Naracauli waters was measured using hydrologic tracers with synoptic sampling.

The results presented in this work show that a) the consortium of bacteria changes along the river, creating a cascade of processes that results in biologically mediated formation of different Zn-bearing minerals [1]; b) the changes in water chemistry along the river are moderate for the major constituents, but large changes in trace-element concentrations are observed [2]; c) the heavy metals load derives from the interaction between mine wastes and Naracauli water, and about half of the metal load comes from tributaries with high water flow but relatively low heavy metal concentrations.

Figure 1. SEM images of Naracauli biominerals: hydrozincite on the left, and Zn-Si-O phase on the right.



Conclusion

This work indicates that any remediation plan for the Ingurtosu abandoned mine must take into account the whole Naracauli basin, and water treatment is needed before river water is allowed to discharge to the sea. Finally, biomineralization processes could offer a way for a natural abatement of Zn and some other heavy metals.

[1] De Giudici et al. (2009) *American Mineralogist* **94**, 1698-1706. [2] Medas et al. (2011) in Soil Biology- Kothe and Warma eds. **31**, pp-pp.113-130.