In-situ Analyses of Highly Siderophile Elements in Sulfides from Hawaiian Garnet Pyroxenite Xenoliths

I. Sen (Earth Sciences, FIU), M Bizimis (NHMFL-Geochemistry), G. Sen (Earth Sciences, FIU)

Introduction

We report on the first in-situ analyses of sulfides from garnet pyroxenite xenoliths from Salt Lake Crater, Oahu, Hawaii. These xenoliths are thought to be cumulates in the deeper (>60km) parts of the lithosphere and their compositions provide unique snapshots of the deep magma processes and sources of the Hawaiian plume volcanism. The main objective of this study is to evaluate the origin of the sulfides, their relationship with the surface Hawaiian volcanism and provide insights on the composition of the Hawaiian plume, including possible contribution of outer core material to the plume.

Experimental

The sulfides occur as globular inclusions (~10-90 microns) mostly within clinopyroxene and as interstitial phases (approximately 100 microns, some grains can be as large as 500 microns). The sulfides were analyzed for Highly Siderophile Elements (or HSE) and Platinum Group of Elements [PGE - Os, Ir, Ru, Rh, Pt, Pd], Re and Au, in-situ on polished “thick” sections by Laser Ablation ICPMS on the Finnigan ELEMENT 1 at the Geochemistry facility, NHMFL. For standardization we used the well-characterized iron meteorites Filomena and Hoba, and Fe as internal standard.

Results and Discussion

Compositionally the sulfides are monosulfide solid solution (MSS) plotting in the 1000°C – 1100°C MSS field in the Fe-Ni-Cu-S system. The sulfides are homogenous and the general absence of low temperature assemblages indicates that they represent high temperature equilibration. Both inclusion and interstitial sulfides have similar chondrite-normalized PGE patterns with \( \text{Pd}_{(0)}/\text{Ir}_{(0)} > 1 \) and \( \text{Re}_{(0)}/\text{Os}_{(0)} > 1 \), and lower PGE contents (by a factor of 10 to 100) than peridotitic sulfides. The positive correlation of \( \text{Pd}/\text{Ir} \) vs. \( \text{Re}/\text{Os} \) and \( \text{Ir} \) vs. \( \text{Os} \) indicates the PGE pattern to be primary and not a secondary feature. We interpret these sulfides to be immiscible from a silicate melt, and not residual after melting and that the PGE content of the sulfides essentially represents the composition of the melt they precipitated from. The PGE contents and patterns of the calculated melts in equilibrium with these sulfides overlap the compositions of the erupted Hawaiian lavas (Fig. 1), suggesting that the parental melts of these sulfides were similar to the erupted lavas. The more than one order of magnitude variability in the absolute PGE contents of both calculated melts and lavas (Fig. 1) can be accounted by limited (0.1%-0.2%) sulfide precipitation from a parental melt.

Acknowledgements

M. Bizimis acknowledges support from NSF grant OCE-0622827.

References