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Sb, As and W contents of magmas: insights from geochemical databases

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Magmatic heat sources allow hydrothermal fluids to transport and deposit various types of metals and metalloids. For instance, antimony (Sb) is frequently spatially associated with mafic intrusions, and may be associated with various amounts of other elements, such as Hg, As, W, Au and Ag. However, source-sink relationships in those settings remain poorly constrained. Whether mafic magmas contribute fluids, metals and metalloids to hydrothermal systems at the origin of Sb mineralisation remains uncertain. Spatial and chronological correlations between Sb ore deposits and mafic magmatism have been acknowledged in Variscan settings (i.e. the Armorican Massif and the Central Iberian Zone), but no causal processes have been established yet (Pochon *et al.*, 2019).

We herein investigated the Sb, As and W contents of magmatic rocks available in the literature, to assess mafic magmas as a potential source for metals and metalloids. The GEOROC database covers most of the rock types occurring in a TAS diagram (n = 7215, whole rock), whereas the Jenner and O'Neill (2012) database focuses on MORBs (n = 601, glass).

Sb, As and W are highly covariant, suggesting a common behaviour during magmatic processes. Sb, As and W concentrations in oceanic magmatic rocks increase with increasing K_2O content. This increase is up to two orders of magnitude in mafic compositions, and one order of magnitude through intermediate and differentiated compositions. Differentiated alkaline magmas therefore generally yield higher Sb, As and W concentrations. Variations in Sb, As and W with major and trace elements composition suggest a major role of mantle source processes, and a minor contribution from fractional crystallisation. In particular, Sb, As and W contents in mafic compositions show a good correlation with the La/Sm ratio, and an absence of correlation with the $^{87}Sr/^{86}Sr$ and the $^{143}Nd/^{144}Nd$ isotopic ratios, suggesting a crucial control of partial melting processes.

Continental magmatic rocks show a strong Sb, As and W variability, with values up to 3 orders of magnitude higher than oceanic rocks, suggesting the occurrence of crustal contamination. Post-magmatic alteration does not seem to have any effect on Sb, As and W concentrations.

We finally investigate mafic rocks spatially and temporally associated with Sb-Hg ± As-W-Au-Ag ore deposits, and discuss the possible processes at the origin of their enrichment.

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