Sources and concentrations of Highly Siderophile Elements in VHMS deposits through time

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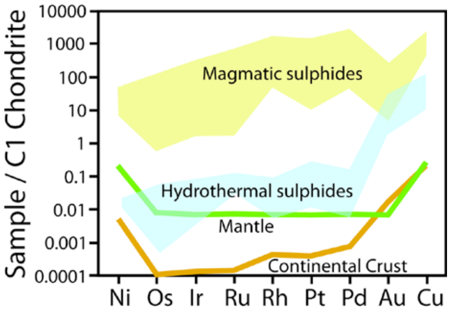
The seafloor hydrothermal acivity is an important mechanism of metals cycling between mantle and continental crust, producing Volcanogenic Hydrothermal Massive Sulphide deposits in various tectonic settings through time.

Concentrations and sources of Highly Siderophile Elemenets (HSE: Ru, Rh, Pd, Re, Os, Ir, Pt Au) were studied in VHMS deposits from Archean to present using new and published Re-Os isotopic data and the HSE concentrations.

In general, concentrations of HSE, as normalised to C1-chondrite, are situated slightly above the mantle values, with the exeption of higher Au contents; and approximately 3 orders of magnitude lower compare to magmatic sulphides.



Remarakably, the Re/(Common Os) ratio significantly increase from Archean deposits in intra-cratonic setting to the Palaeozoic VHMS deposits in island arc setting, reaching the highest values in modern sulphides from MORB setting, with simultaneous decrease in Common Os values. This observations may be related with the change in main metal sources relative to different tectonic settings through time.

Rhenium enrichment in modern VHMS deposits may be also related with higher Re contents in present day seawater, which is along with hydrothermal fluid is one of the main sources of metals in VHMS deposits. Modern seawater is characterised by high Re/Os ratio of ~730, whereas hydrothermal fluid has much lower Re/Os ratio. In general, the Re/Os ratio increases and Os contents decrease by 2 order of manitude from the stockwork toward the seafloor sulphides, reflecting the fluid - seawater mixing. The same pattern has been observed across hydrothermal chimneys, with higher Re/Os ratio and lower Os contents toward the outer part of chimney. This pattern is confirmed by $^{187}Os/^{188}Os$ isotopic mixing between these two end-members, as it was shown for modern and ancient VHMS systems.

Levels and distribution of traffic related metals in Israel; Pb, Zn and platinum group metals (PGM)

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Since 1993, automobile exhaust catalysts are compulsory in Israel which obviously lead to a great improvement in the emission of toxic gases to the atmosphere. However, as these convertors contain Rh, Pd and Pt, which belong to the platinum group metals (PGM), their utilization has introduced a new contamination source to the environment.

For characterizing the extent of PGM contamination in Israel, road side soils were examined in four locations adjacent to main roads. In all sites, Pt concentrations in soils were relatively low compared to published values [1] (mostly up to 20 ng/g) and could be detected only in top soils. While Rh concentrations were below limit of detection (10 ng/g), high concentrations of Rh and Pt were found in mixed soil and dust surface samples.

Road dust collected along a half km inclined road with heavy traffic yielded very high concentrations of both Pt and Rh (260 to 1480 ng/g and 80 to 440 ng/g, respectively). Remarkable difference was observed between the uphill and downhill at the same location where oncentrations uphill were 4-fold higher than downhill direction for both metals, indicating significant PGM emission with increased engine activity.

Elevated trace metal concentrations of traffic related metals (Cr, Cu, Ni, Pb and Zn) were noted for the road dust samples. However, only Zn concentrations exhibit a positive correlation with Pt and Rh concentrations and display a distinct 2-fold enrichment in the uphill direction probably due to tire friction. On a plot of $^{208}Pb/^{206}Pb$ vs. $^{206}Pb/^{207}Pb$ along with potential Pb sources, all samples are slightly shifted from a mixing line between the known Pb IC petrol values used in Israel and natural sources. No systematic hill slope pattern was observed.The slight shif of data points from mixing suggests an additional yet undefined, anthropogenic source. Hence, while PGM metals and Zn exhibit current contamination, Pb probably represents re-suspension of dust and soil surfaces that still carry the pre-unleaded petrol signature.

[1] Rauch & Morrison (2008) *Elements* **4**, 259-263.

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