Geochemical mapping in urban area of an old mercury mining town (Idrija, Slovenia)

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Detailed soil geochemical survey tackles the urban area of Idrija, which is the oldest mining town in Slovenia with about 7000 population. Strong legacy of 500 years of mercury mining and ore processing in Idrija have resulted in widespread contamination. Environmental impacts on a regional scale caused by atmospheric emissions from the Idrija ore roasting plant were established in investigations of mercury spatial distribution in soil on regional scale [1, 2].

This study is part of the URGE project (Urban Geochemistry) and brings into focus urban area of Idrija town. Soil was systematically sampled (45 sampling sites) in 4 km^2 of Idrija urban area. Two soil horizons (0-10 cm and 10-20 cm) were sampled in order to distinguish between different metal sources. Samples were prepared and analysed according to URGE project. A sampling model grid was developed for collection of 9 soil samples per km^2. Due to higher population density, the density of samples was increased in the town centre. Contents of potential harmful elements were determined using aqua regia digestion. As expected, Hg contents were extremely elevated and ranged from 8 to 1210 mg/kg with a median of 60 mg/kg for upper soil horizon and from 7 to 1550 mg/kg with a median of 50 mg/kg for lower soil horizon. Spatial distribution analysis shows that higher contents appear along river banks, where ore residues were dumped in the past and in the part of the studied area, where soils overly rocks containing mercury ore. Other potential harmful elements didn't show critical elevations according to legislation. so the study was further directed into analysis of mercury species and their water-soluble and bio-accessible portions using different extraction methods.

[1] Gosar & Šajn (2001) *Geologija* **44**, 137-159. [2] Gosar *et al*. (2006) *Sci Total Environ* **369**, 150-162.

The Chronology of Dehydration

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The global geologic water cycle including the hydration and dehydration of the lithosphere during tectonic and metamorphic processes plays a first order role in shaping our planet. In subduction zones, dehydration is responsible for mantle melting, arc magmatism, seismic triggering, slab densification, and more. It is challenging to constrain the rate and timing of paleo-dehydration unless a passive mineral marker of the dehydration process can be identified and dated in the dehydrated rock residue. We use thermodynamic modeling to show that the growth of garnet may be used as a proxy for dehydration in diverse bulk rock compositions and tectonic contexts. Generally, as garnet grows in a subducting rock, fluid is produced due to metamorphic dehydration of hydrous precursor phases including chlorite, lawsonite, epidote, and amphibole. We quantify the proportional relationship between garnet and water production in common lithologies along three representative subduction geotherms [1]. Over the garnet growth interval ~400 to 700 ˚C (and corresponding depths for each geotherm) the average production ratio for altered MORB compositions is 0.52 (wt % water per vol % garnet) in cooler geotherms (Honshu and Nicaragua) and 0.27 in hotter (Cascadia) geotherms, with predictably lower ratios if the input basalt previously experienced less hydrous alteration. Over the same interval the water production ratios are approximately 50 % lower for pelitic sediment (0.24 and 0.13, respectively). Garnets can also be dated at high precision (<±1 Myr) with the Sm-Nd (or Lu-Hf) system, thus constraining the timing of dehydration by proxy. With large single crystals (>5mm diameter), concentrically growth zoned garnets may be microsampled and dated from core-to-rim, thus constraining the duration of dehydration. When coupled with thermodynamic analysis, a complete P-T-H_2O chronology can be extracted. Example P-T-H_2O chronologies from Sifnos, Greece reveal rapid, focused dehydration around 46 Ma spanning just hundreds of thousands of years [2].

[1] Baxter & Caddick 2013, Geology, in press, doi:10.1130/G34004.1 [2] Dragovic *et al*. 2012, Chemical Geology, v. **314-317**, p. 9-22.

DOI:10.1180/minmag.2013.077.5.2
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