Timing of mantle depletion and enrichment from single subcalcic garnet grains (Finsch mine, SA)

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Subcalcic garnets are characteristic for the peridotitic inclusion suite in diamonds and constituents of clinopyroxene free harzburgites and dunites. The latter rock types are rare among the xenolith suite in kimberlites. The subcalcic garnets, however, are index minerals for diamonds in heavy mineral concentrates. In the absence of clinopyroxene, garnet is the main carrier of many trace elements and thus reflect the bulk composition. With this assumption we have identified and selected 21 subcalcic garnets out of 700 garnets from a heavy mineral concentrate from the Finsch Mine in South Africa (Kaapvaal craton). The grains were 3-5 mm sized. We have analysed major and trace elements by EPMA and LA ICP MS and Lu-Hf and Sm-Nd isotopes on the single grains by MC-ICP-MS.

The garnets have low CaO (1-6 wt%) compared to their respective Cr_2O_3 of 2-12 wt% and high Mg-values (Mg#=85-90). Their depleted nature is also shown by low Zr, Ti and LILE. The REE mostly show the sigmoidal pattern commonly observed in subcratonic peridotitic mantle lithologies. The HREE have a positive slope reflecting the original depletion event which must have occurred in the uppermost mantle [1]. Light to middle REE are bow shaped and enriched relative to primitive mantle. The range of Hf and Nd isotope signature is large in these low-Ca garnets. They have mostly radiogenic Hf isotope compositions with εHf up to 640. Nd displays mainly unradiogenic εNd down to -36 and only few have radiogenic εNd up to +25.

The results for the Lu-Hf isotopic system yield an isochron age of 2.529 ± 130 Ga. Since garnet is the major host for Lu and Hf in the clinopyroxene free harzburgites this garnet isochron should provide a similar age to that of a whole rock isochron. A minor correction for Lu-Hf in opx would slightly increase the whole rock age. We thus consider our Lu-Hf results on garnets as a minimum age for the timing of the final depletion of the subcratonic mantle which coincides with the final cratonization of the Kaapvaal craton.

The Sm-Nd system displays a large range of isotopic compositions with only weak correlations of εNd with Sm/Nd. However, corresponding ages are always younger than Lu-Hf ages, which may indicate various enrichment events during orogenic cycles within the Kaapvaal craton.

Reference

[1] Stachel T., Viljoen K.S., Brey G., Harris J.W., (1998), *EPSL*, **159**: 1-12.

Reduction of hematite nanoparticles by *Shewanella oneidensis* MR-1

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The ability of *Shewanella oneidensis* MR-1 to reduce hematite (α-Fe_2O_3) nanoparticles of different sizes was examined under anaerobic conditions. Hematite nanoparticles used in these experiments had a size range between approximately 11 nm and 99 nm. Particle surface area was determined by BET and size distribution, aggregation, and morphology was determined by TEM. *S. oneidensis* was grown in a defined anaerobic media and the different sized nanoparticles were added as the sole electron acceptor. Reduction of the nanoparticles was verified by analyzing the cell supernatant for Fe^{2+}. Experiments have shown that the reduction rates of the larger 99 nm particles are faster than the smaller particles when normalized to surface area. The greatest difference in surface area normalized reduction rates (one order of magnitude) were seen between the 11 and 99 nm particles. The two particles have similar morphologies (pseudo-hexagonal to irregular shaped) and they aggregate very similarly when suspended in the media. The variation in reduction rates are likely caused by differences either in size-specifc particle properties or the bacteria's cellular response to the two particle sizes. Internal and surface structural differences, exposed crystal faces, Fe^{2+} surface passivation, or decreased solubility of the smaller nanoparticles are potential size-dependent properties that could influence reduction rates, but evidence for the influence of these properties on nanomaterials in this system remains elusive. Testing whether actual cellular differences are evident between cells grown on the two particle sizes, however, can be done within the framework of a detailed knowledge of the genome of *S. oneidensis*. Ongoing work focuses on examining the genetic and proteomic response of *S. oneidensis* to the different sized hematite nanoparticles in hopes of elucidating the primary factors that influence size-dependent reduction rates.