Mafic and ultramafic xenoliths from the Kaapvaal Craton (South Africa): trace element evidence for mantle magmatic and metasomatic processes.

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Kimberlite magmas from four well known kimberlite localities on the Kaapvaal craton (Bultfontein, Jagersfontein, Monastery and Premier) have sampled numerous mantle garnet lherzolites in addition to garnet harzburgites. The Bultfontein kimberlite has also sampled two main groups of phlogopite-rich mafic xenoliths which represent deep mantle segregations from high alkaline melts. The first group corresponds to MARID rocks characterised by the mineral association Mica-Amphibole-Rutile-Ilmenite-Clinopyroxene and the second group consists of PIC rocks characterised by the mineral association Phlogopite-Ilmenite-Clinopyroxene. The two groups are clearly distinguished from one another by the major element composition of their phlogopite and ilmenite, by the trace element content of their clinopyroxene and by their Sr and Nd isotope ratios. The combined major and trace element variations are interpreted to indicate a genetic relationship between the PIC rocks and Group I kimberlite magma, and between the MARID rocks and Group II kimberlite magma. The trace element compositions of clinopyroxenes of garnet lherzolites which are probably purely metasomatic are characterised by enrichment in LREE and LILE and by a relative depletion in Ti, Nb, Ta, and to a lessor extent Zr and Hf, i.e. the high field strength elements. But the LREE enrichment and the depletion in Nb and Zr (Hf) are less in the clinopyroxene of the group 1 variety than in those of the group 2 garnet lherzolites. Our study suggests that the melts responsible for the metasomatic imprints observed in the two groups of garnet lherzolites are probably high alkaline mafic silicate melts. Clinopyroxenes of group 1 that have trace element similarities to PIC rocks appear to have crystallized from, or been completely equilibrated with, a metasomatic agent related to Group 1 kimberlite magma. The case of the group 2 clinopyroxenes is more ambiguous and we consider three possible ways to explain their formation: 1. By an ancient metasomatic event, such as that recorded in harzburgitic inclusions in diamond or Mg-rich garnet peridotites, 2. By the remobilization of such ancient cratonic mantle in the form of low degree melts that may give rise to both MARID xenoliths and associated metasomatism, 3. By the infiltration and metasomatism of the lithosphere by MARID and/or group II kimberlite-like melts derived from external sources.

Antimony and lead pollution in the soil of shooting ranges

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Introduction

In Switzerland, virtually every village has one or several shooting ranges. In average, there is one shooting range per 3'000 inhabitants. Due to noise abatement regulations, many old shooting stands will be abandoned in the next years. Public concern arises with respect to future risks for soil, ground water, animals and humans. Most attention should be given to Pb and Sb in the gun bullets (approximately 75 and 2 % weight, respectively), which readily disintegrate in oxic soil environments. Polluted sites typically contain 10-50 tons Pb and 0.2-1.0 tons Sb.

Results

Among the resulting Pb(II), Sb(III) and Sb(V) species, $Sb(OH)_6^-$ is probably the most mobile species under typical soil conditions. However, a lot of Sb is found to be adsorbed to poorly crystalline iron hydroxides. Antimony can easily be mobilised when the iron solids are dissolved. We also found that elution of polluted soil material from shooting ranges with pure water causes substantial leaching, even after a series of 45 treatments with neutral water (Mergenthaler and Richner, 2002).

Conclusion

In general, we can state that Sb pollution in shooting ranges bears a higher long-term risk for the ground water quality than Pb pollution. However, lead contamination in the top soil of shooting ranges can acutely affect health of animals and humans upon oral uptake of contaminated soil material.

References

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