Abstract

Metals of anthropogenic origin have consistently polluted the environment. This thesis focuses mainly on highly contaminated soils or tree rings near mines and smelters in Sub-Saharan Africa. However, Portuguese soils were also assessed to study Pb isotopes in post-fire soils. The tracing capabilities of Pb isotopic ratios were employed to determine contamination sources and to evaluate the potential of pine trees as an environmental archive.

Several analytical methods were applied, such as catalytic oxidation, Q-ICP-MS, ICP-OES, FEG-SEM/EDS, EPMA, XRD, etc.

Soils near smelters located in three different cities [Kabwe (Pb-Zn), Luanshya (Cu, Co), and Selebi Phikwe (Ni, Pb)] exhibited concentrations of metals greatly exceeding those deemed acceptable by the competent authorities. In Kabwe, for example, concentrations of Pb exceeded 16 000 mg kg^{-1}. In all sites, contamination was shown to be significant only in the upper ±15 cm of soil. Samples of soils taken in remote locations were always clear of contamination.

In Luanshya, metal(oid) bearing particles found in the soils were typically spherical and composed of rapidly cooled sulfides and oxides in the flue gas chambers of the local smelter. These were present only in the topsoil.

The tree ring record of pine trees in Kabwe was shown to mimic the historical production record of the local smelter within a shift of 5 – 7 years. Carbon isotopes were also used to predict stress in the trees. These moments were concurrent with peaks in smelter production.

Forest fires were shown to alter the Pb isotopic makeup of soils depending on burning temperature. We suggested that the Pb isotopic ratios of soils may be used to determine burning temperature, but more study is needed.

Additionally, Pb originating in the legacy of leaded gasoline burning was found in all studied systems, as shown by its isotopic signature.