Nuclear microprobe studies of elemental distribution in nickel hyperaccumulating plants

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Some plants have a remarkable ability to accumulate and concentrate large amounts of metals in their tissues. This phenomenon, referred to as hyperaccumulation, is still poorly understood in spite of on-going research. One of the fundamental questions to answer is possible sites for metal storage, which can assist in modeling the detoxification mechanism.

Investigations with the aim of establishing storage sites for Ni have been conducted on four South African Ni hyperaccumulators (*Senecio coronatus, Senecio anomalochrous, Berkheya zeyherii and Berkheya coddii*), growing on ultramafic outcrops in Mpumalanga Province (South Africa). Specimens of roots, stems and leaves were cryo-fixed and freeze-dried, and next analysed using the nuclear microprobe at the Materials Research Group, iThemba LABS, South Africa. True elemental maps were obtained using GeoPIXE-I and GeoPIXE-II software, with matrix correction based on proton backscattering results.

Three plant species showed the highest amount of Ni in both the upper and lower epidermal layers. These results served as a starting point of some hypotheses attempting to explain the hyperaccumulation phenomenon. However, *Berkheya coddii*, the fourth plant species, demonstrated a distinctly different pattern of Ni distribution in the leaves, with increased concentration in the mesophyll. This suggests that this plant species has, at least partly, a different physiological mechanism involved in Ni transport, storage location and detoxification in comparison with other hyperaccumulators. Therefore no uniform model can be applied to explain this phenomenon. In addition, difference between mechanisms of elemental uptake has been found in two genotypes of *Senecio coronatus* (hyperaccumulating and non-accumulating nickel) from ultramafic soil. Correlations between distributions of Ni and major, minor and trace elements will be presented.

Hyperaccumulating plants could be applied in phytomining for extraction of metals from soils or tailings as an alternative to ore mining.

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