The investigation of surface soil geochemistry and mineralogical role in the heavy metal bioavailability of Sabzevar area

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Abstract: Surface soils of Sabzevar zone could be geochemically divided into two groups of serpentine (Se) and non-serpentine (Nse) soils. Serpentine soils have higher MgO, FeO, CaO, S, Ag, Co, Cr, Cu and Ni and lower SiO₂, Al₂O₃, Na₂O, K₂O, Be, Li, Sc, Ti, U and V than Nse. In other word, Nse samples have high REE content with fractionated LREE/HREE trends in REE diagrams (ΣREE = 31.89 - 58.3 ppm; LaN/YbN = 4.36 - 5.68); while REE content of Se soils is lower and REE trends show LREE depletion (ΣREE = 12.29 - 18.68 ppm; LaN/YbN = 0.69-0.77). All studied soil samples have higher Ni, Cr and Co concentrations than environmental standard limitations. Heavy metal extraction by DTPA method shows that Se soils have higher bioavailability relative to other soils. Heavy metal analyses of alfalfa plants cultivated in different soils approves higher bioconcentration of these metals in Se soil samples. All studied soils display similar physico-chemical properties (pH, TOC and CEC) and mineralogical differences are the main factors controlling heavy metal bioavailability of Sabzevar soils. The existence of resistant oxide minerals in NSe soils inhibits the release of heavy metals and reduce bioavailable concentration of these elements; while structurally more open minerals like serpentine and talc led to higher availability of heavy metals in Se soils.

Keywords: Sabzevar; surface soils; serpentine; non-serpentine; bioavailability; bioconcentration.