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Environmental impact assessment of artisanal small scale mining in Rwanda: Prospect for soil rehabilitation

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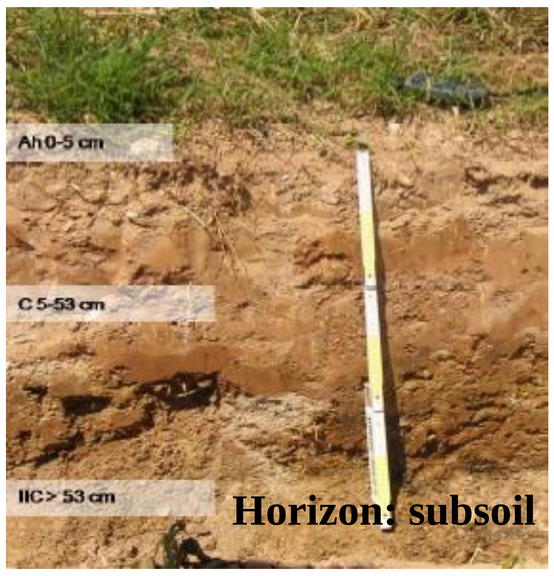
Introduction

The mining sector greatly contributes to national gross domestic product (GDP). The mining activities potentials leads to environmental and health risks. The accumulation of mining wastes on land surfaces could increase concentrations of heavy metals[1]. These increase toxicity to all living organisms including humans[2]. Nowadays, the main challenge is how to ensure environmental safety and minimizing its negative impact on various components of ecosystems. The mining sites are in contact with a daily activities of the neighbors people, and the trace elements could leach to water bodies. The purpose of the present baseline study was to assess the degree of soil physicochemical degradation as result of mining activities in Gatumba coltan mining located in highland zones.

Materials and Methods

Gatumba region located in highland zones in western part of Rwanda. The samples of soil have been classified in tree categories. First directly mining affected soil (Technosol on mining materials), second, soil indirectly influenced by mining activities, and the third one where the soil not influenced by mining activities as reference soil. In each area, soil sampled from different soil horizon, here surface soil and subsoil samples have been considered by using a shovel. At least three sampling points, have been considered and mixed so as to form one sample. The soil samples were air dried at ambient temperature.



The trace elements were extracted by microwave assisted aqua regia digestion and analyzed by inductively coupled plasma mass spectroscopy (ICP-MS) (Agilent 7700).

Key finding and recommendation

- ✓ Soil pH in the soil under direct influence of mining activities is more acidic
- ✓ The CEC values of the soil under direct influence of mining activities are very low compare to the soil not influence by mining activities.
- ✓ They are high concentration of Lithium, Uranium and Cesium in soil which is under direct and indirect mining influence.
- ✓ The concentration of Arsenic and Lead are not influenced by mining activities

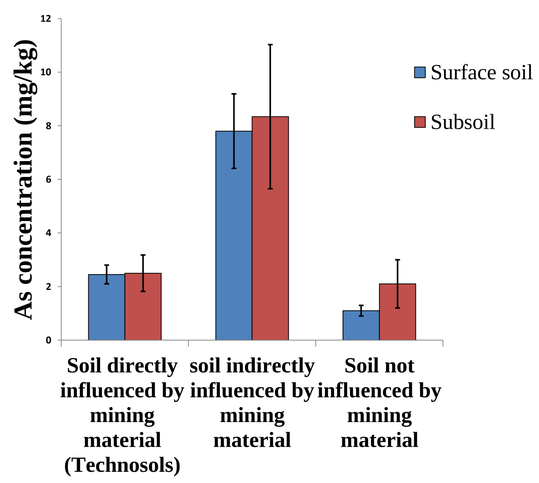
All concentrations of analysed trace metals in soil have low values compare to the standard values from Canada[3]. This suggests that soil is not really contaminated. However, mining activities have greatly modified soil physicochemical characteristics. The physicochemical degradation of mining environment calls for an urgent for land rehabilitation. This could be done by considering the socio-economic needs of the areas in which farming activity is dominant. With this regard, phytoremediation using would be an environmentally-friendly option.

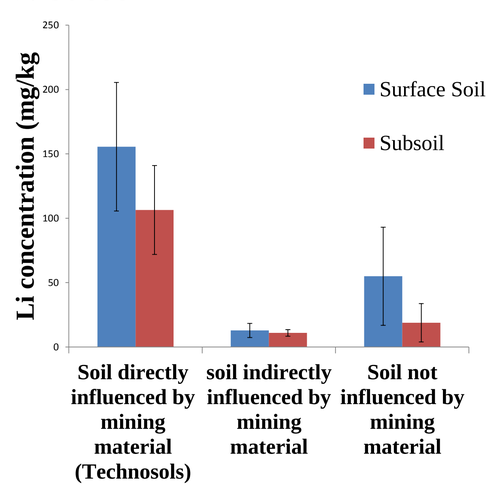
Results

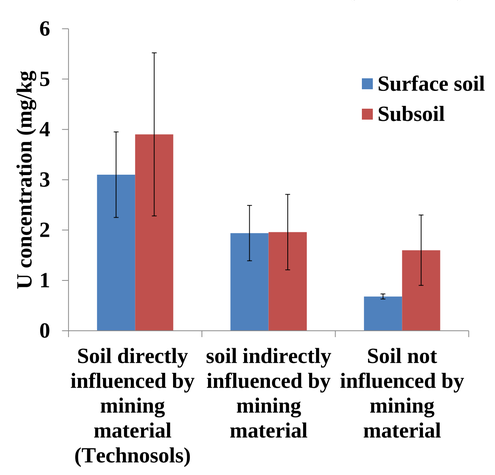
Table 1. Characteristics of soil profiles directly (Technosols), indirectly and not influenced by mining

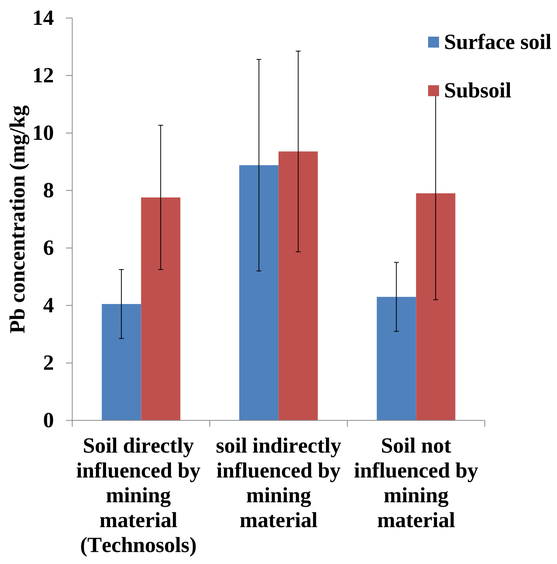
soil types	horizons	pH	C/N	CEC	Textures		
					Clay	Silt	Sand
Soil directly influenced by mining material (Technosols)	A	3,77	13,9	2,15	10	35	55
	B	3,94	10,8	2,2	15	34	51
Soil indirectly influenced by mining material	A	4,36	11,46	2,98	11,4	33,6	55
	B	4,28	11,12	2,58	12,8	27	60,2
Soil not influenced by mining material	A	5	11,3	9,3	19,3	32,3	48,4
	B	4,28	11,88	10,7	32	26,6	41,4

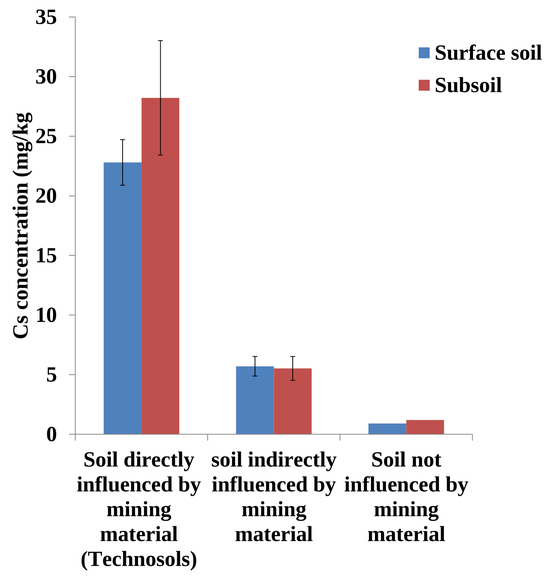
A: Surface soil, B: Subsoil











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