Geochemical assessment of serpentinite heavy metals and fluvial ingress in tropical settings

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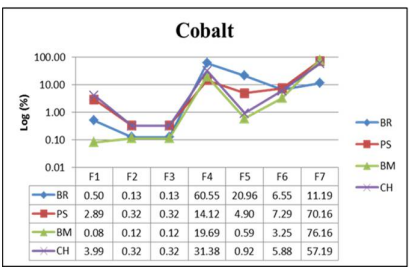
The serpentinized source and extractability of heavy metals in a tropical climate has been investigated from four serpentinized-ultramafic massifs in Peninsular Malaysia. Petrographic observations confirmed serpentine with primary mineral trails and a predominance of opaque minerals in all samples. Mineralogical studies by X-ray diffraction analysis confirmed Cr-spinel, chromite, magnetite and clinochlore. X-ray fluorescence revealed < 45% SiO_2 and low CaO and Al_2O_3 contents. All serpentinite rocks yielded significant geochemical quantities of chromium, nickel and cobalt. Similarly, 15 serpentinite derived soils yielded exceptional enrichments of Cr, Ni and Co, concentrated 72, 17 and 21 times that of global soil averages respectively, and 120, 15 and 21 times Malaysian soil reference values for heavy metals respectively. Hence, the soils may be classified as heavily contaminated by ANZECC/NHMRC [1] and G.L.C guidelines [2]. Nevertheless, despite expectations, surface fluvial waters flowing over extensive serpentinite massifs contained low levels of these metals, indicating very minimal influence of regional mafic geology on flowing surface water metal quality, in unspeciated metal terms. Mineralogical findings from soil division by modified seven steps selective sequential extraction [3], yielded insights to speciation, and explained the strong association of Cr, Ni and Co with resistant mineral-bearing phases in these soils. Results are discussed in terms of variability between metals and potentially higher ingress in seep verses fluvial waters.



	F1	F2	F3	F4	F5	F6	F7
BR	0.50	0.13	0.13	60.55	20.96	6.55	11.19
PS	2.89	0.32	0.32	14.12	4.90	7.29	70.16
BM	0.08	0.12	0.12	19.69	0.59	3.25	76.16
CH	3.99	0.32	0.32	31.38	0.92	5.88	57.19

Figure 1. The line charts of extracted cobalt from 7 fractions of two serpentine soil samples

[1] ANZECC/NHMRC. (1992). [2] Great London Council. (2001). [3] Silveira, M.L. et al. (2006) *Chemosphere* **64** (**11**): 1929-1938.