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# Bushfires as a possible explanation for the chromium impregnation of the population in New-Caledonia

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Soil heating related to bushfires is suspected to participate to trace metals mobilization towards freshwater systems, where they can represent major environmental and health issues [1]. This question is of particular concern in New Caledonia where slash-and-burn practices are commonly used by the indigenous population [2] and a large health survey showed a significant impregnation of the population with trace metals [3]. Among those trace metals, chromium is especially suspected to erase from bushfires since a large set of soils from New Caledonia are enriched in this element [4,5] and recent studies demonstrated the oxidation of insoluble Cr(III) to toxic hexavalent Cr(VI) species upon heating of synthetic Cr(III)-doped Fe-(hydro)oxides [6,7].

In the present study, surface soils from three categories (ultramafic bedrock, calcareous and volcano-sedimentary) collected across New Caledonia were studied for their capacity at releasing chromium after heating at 200, 400, 600°C for two hours, followed by chemical extractions with $CaCl_2$ (0.01 M), EDTA (0.05 M) and $KH_2PO_4$ (0.1 M). The results of the $CaCl_2$ extraction showed a dramatic increase of chromium leachability from 400°C (Figure 1). Spectrophotometry analyses indicated that all chromium leached occurred as Cr(VI). Finally, the fraction of bioavailable chromium was found to highly correlate ($R^2$ = 0.97) with total hexavalent chromium (Figure 2). Fire-induced transformation of Cr-bearing soil minerals is thus suspected to be one of the main drivers of the chromium impregnation of the population in New Caledonia through transfer of leachable Cr(VI) towards freshwater, but also because of the possible assimilation of Cr(VI) by vegetables and tubers that are commonly cultivated in indigenous subsistence farming [8].

[1] Abraham et al. (2017) *Total Environ*., 599–600, 1740–1755. [2] Toussaint (2020) *Forum*, 30, 157–173. [3] St-Jean et al. (2018) *Int*., 118, 106–115. [4] Houles et al. (2018) *Ecol*., 76, 964-975. [5] Vincent et al. (2018) *J. Soil Biol*., 86, 52-62. [6] Burton et al. (2019) *Pollut*., 247, 618–625. [7] Burton et al. (2019) *Chemosphere,* 222, 440–444. [8] Thery et (2021) *Environ. Pollut*., in prep.

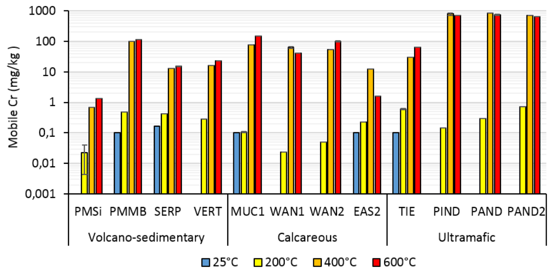


Figure 1 : Chromium mobility (*i.e.* 0.01 M $CaCl_2$ extraction) in the twelve studied soils as a function of heating temperature.

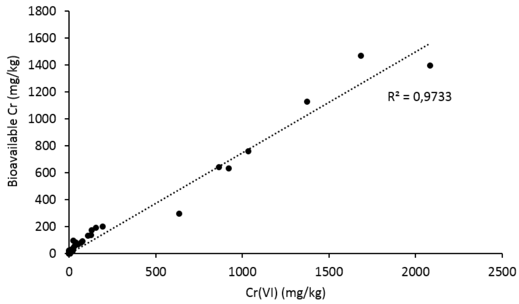


Figure 2 : Bioavailable chromium (*i.e.* 0.05 M EDTA extraction) as a function of total hexavalent chromium (*i.e.* 0.1 M $KH_2PO_4$ extraction).