Ni and Fe bearing phases and redox during the weathering of the New Caledonia ophiolite

MANUEL MUÑOZ[1], MARC ULRICH[2], MICHEL CATHELINEAU[3], OLIVIER MATHON[4]

[1] Univ. Grenoble Alpes, ISTerre, France, manuel.munoz@ujf-grenoble.fr
[2] Univ. Strasbourg, EOST, France, mulrich@unistra.fr
[3] Univ. Nancy, Géoressources, France, michel.cathelineau@univ-lorraine.fr
[4] ESRF, Grenoble, France, mathon@esrf.fr

We investigate the mineralogy and crystal chemistry of a boulder (~20 cm diameter) sampled in the saprolite rocks of the Koniambo massif (New Caledonia), which reflects early stages of bed-rock weathering. A polished cross-section of the boulder reveals radial weathering profile. “Fresh” serpentinized-harzburgite is localized in the center (zone 1), while a gradually increasing alteration degree is observed from the center to the edge (zone 2 to 3). Large-scale μXRF maps performed on the polished surface reveal a dense network of Ni-rich mineral veins in the external part of the boulder. Thin sections corresponding to the different alteration zones were characterized by optical microscope, electron microprobe (BSE, micro-analyses, X-ray maps), and Raman spectroscopy. In addition, Fe and Ni-K edge XANES spectra were collected in order to determine, respectively, the oxidation state and the speciation of these two cations.

In zone 1, lizardite – most likely formed during oceanic hydrothermal alteration – is observed, including ~0.2 to 0.4 wt% of NiO and a ferric-to-total iron ratio (i.e., XFe^{III}) of ~0.5. In zone 2, oceanic lizardite is still observed, together with partially recrystallized/neoformed lizardite enriched up to ~1.5 wt% of NiO ; XFe^{III} increases up to 0.6-0.7. Zone 3 shows a dense network of phyllosilicate veins, mainly composed of three different types of lizardite with various chemical composition, i.e., 0.8 to 5 wt% NiO, and 0.4 to 2 wt% Al_2O_3. Petrological observations show a reactivation of the lizardite network through the precipitation of highly concentrated Ni-talk-like (kerolite) in the central part of the veins. A first generation concentrates nickel up to ~20 wt% NiO, which appears to be subsequently replaced by a kerolite vein with ~36 wt% NiO; both minerals are highly depleted in iron (0.4 and 0.1 wt%, respectively). XFe^{III} ranges from 0.8 to 1 in those veins, showing a clear correlation between the occurence of Ni-bearing phases and the XFe^{III} ratio in neoformed phyllosilicates.