Weathering effects on the mineralogical and geochemical composition of the New Caledonia ophiolite

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Since its complete obduction (at ~34 Ma), the New Caledonia ophiolite has experienced strong weathering due to tropical conditions. This alteration is expressed as laterization affecting the serpentinized peridotites located at the upper part of the massif. This weathering does not macroscopically affect the serpentinites located in the lower part of the ophiolite, but previous studies showed that these serpentinites display anomalous chemical composition relative to the others (silica enrichment, strong Ce negative anomaly).

Our study focuses on the determination of the processes responsible of (a) the chemical variability of the serpentinites and (b) the formation of new mineral phases in the different parts of the ophiolitic sequence. First, mineral phases (including the polymorphs of serpentine) were identified by Raman spectrometry. Second, the relationship between mineral phases in finely-divided assemblages were characterized using an original method, based on micro-beam X-ray fluorescence mapping of cm-scale samples. Third, the chemical exchanges between the different parts of the ophiolitic sequence were estimated from the compositions of major elements and REE in serpentinites, peridotites and laterites.

Our results demonstrate that the chemical and mineralogical transformations of the basal serpentinite are directly linked to the laterization process occurring at the top of the ophiolite. Laterization leads to leaching of silica, magnesia (~80g/100g of protolith) and REE. Only the cerium, which is immobile in oxidyzing conditions, remains immobile in the laterites. Leached elements are transported by percolation of meteoric fluids to the bottom of the ophiolitic sequence where they accumulate and precipitate by supersaturation. New phases such as magnesite and amorphous silica are formed. In the laterites located at the top of the sequence, the leaching process leads to the concentration of transition metals of economical interests such as iron and nickel.

Determining the porosity of analcime by X-ray reflectometry

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X-ray reflectometry represents the method of research based on measurement of reflective ability in x-ray range of lengths of waves and using the phenomenon of full external reflexion of X-rays. The given technique last years is used in chemistry, the physicist and materials technology for definition of physical and geometrical properties of surfaces, thin films and multilayered structures.

In the presented work as a method x-ray reflectometry porosity of a mineral - analcime $Na_2 [Al_2Si_4O_{12}] (H_2O)_2$ is investigated. Reflectogram the given mineral is on fig. 1.
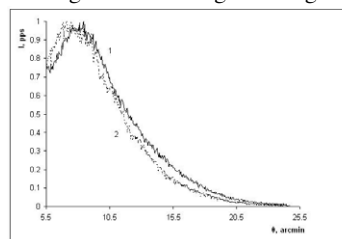
On reflectogram we find a critical angle for each curve ($\theta_{exp. cur}$) which corresponds to a point with the intensity equal to half of the maximum size (I = 0.5). From fig. it is visible that a critical angle initial mineral: $\theta_{exp. cur} = 11, 9$ argmin. For this purpose, what to define porosity it would be necessary to know still a critical angle calculated theoretically under the formula of Frenelja $\theta_{theor. cur} = 13, 37$ argmin.

Knowing experimental and theoretical critical calculate angles porosity under the formula $P = 1-(\theta_{exp.cur}/\theta_{the.cur})^2$ [1].

Porosity of the initial sample has made 21 % (an error of 1 %).

Let's consider reflectogram annealed analcime (a curve 2). In drawing distinctions of curves 1 and 2 are well visible. Annealing has led to displacement critical angle towards smaller corners ($\theta_{exp. cur} = 11, 5$ argmin). Porosity annealed a mineral has made 27 %.. Thus, annealed has led to porosity increase. At present while there is no strict explanation of this effect. It is possible to assume that during time annealed there was a partial phase transition in surface mineral areas. It can be assumed that during annealing occurred partial phase transition in the surface region of the mineral.

[1] A.A. Lomov, V.A. Bushuev, V.A. Karavansky. (2000) Kristallografija 45(5), 915–920.