13. # VEGARD'S LAW APPLICATION TO SELENIUM-BEARING DIGENITE OF MUSONOÏ MINE, KATANGA, RDC

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The Cu-Co Musonoï Mine, in the western part of the Katanguian Copperbelt, is famous for very rare minerals as selenides, selenites and other Cu-Co-U bearing minerals. These secondary minerals are produced by oxidation of seleniferous digenite, $Cu_9(S,Se)_5$, and sulphur-bearing berzelianite, $Cu_2(Se,S)$. This study presents the X-ray powder diffraction and chemical data which have been obtained for these minerals.

Electron microprobe chemical analyses were performed on several digenite samples from Musonoï, and indicate Se/(Se + S) ratio between 8 and 38 %. The unit-cell parameters of these samples, calculated from the *d* values measured on the powder X-ray diffraction patterns (λ FeK_α = 1.9373 Å), are 5.581(4) and 5.629(3) Å, respectively.

The compositions and unit-cell parameters of these minerals have been plotted in a diagram showing the variation of the unit-cell parameters along the digenite-berzelianite series. Other Se-bearing digenite and berzelianite samples from Lake Athabasca and Martin Lake, Saskatchewan (1) and from Moravia (2) have also been included in the diagram. As expected, the replacement of sulphur (effective ionic radius 1.84 Å (3)) by selenium (effective ionic radius 1.98 Å (3)) produces an increase of the unit-cell parameter of digenite, following Vegard's Law (4).

Previous investigations have already shown the application of Vegard's Law to galena-clausthalite, PbS-PbSe, (5) and to sphalerite-stilleite, (Zn,Fe)S-ZnSe (5). New data from Musonoï Mine seem to confirm that digenite-berzelianite could correspond to an isomorphous series, which exhibits a complete solid-solution between the two end-members. A linear correlation can be developed to explain the behaviour of seleniferous digenite: $[Se/(Se + S)] = 1.8*10^{-3}x + 5.5687$, with $R^2 = 0.9855$. However, the S – Se replacement is much better explained by a cubic equation: $[Se/(Se + S)] = -2*10^{-7}x^3 + 4*10^{-5}x^2 + 4*10^{-4}x + 5.5757$, with $R^2 = 0.9986$. This equation could indicate that the S-Se replacement along the digenite-berzelianite series does not exhibit a behaviour of ideal solid solution.

Finally, a sample from Musonoï shows unit-cell parameters reaching 5.693(9) Å, thus indicating a Se/(Se + S) ratio of 70%. This mineral can consequently be considered as sulphur-rich berzelianite, a new mineral species for the Musonoï Mine.

References

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