ВАРИАЦИИ СОСТАВА КОЛУМБИТА-ТАНТАЛИТА И ВОДЖИНИТА ИЗ ЭБЕЛЕКАНСКОГО РЕДКОМЕТАЛЬНОГО ГРАНИТА (Ц. АХАГГАР, АЛЖИР)

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COMPOSITIONAL VARIATION OF COLUMBITE-TANTALITE AND WODGINITE FROM THE EBELEKAN RARE METAL GRANITE (CENTRAL HOGGAR, ALGERIA)

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The Ebelekan rare metal granite (Nedjari *et al.*, 2001; Kesraoui & Nedjari, 2002) is representative of the late magmatic episode that took place at the end of the Pan-African orogeny in the Hoggar, part of the Touareg Shield. It belongs to the group of younger granites dated by $^{40}Ar/^{39}Ar$ in the 539-525 Ma age range (Cheilletz *et al.*, 1992). It is located in the extreme south eastern part of the Hoggar Central, in the Assodé-Issalane terrane and forms a small elliptical sheet-like body intrusive into a coarse-grained biotite granite enclosed with upper amphibolite-facies metasediments. Ebelekan massif crystallizes from a parental F-rich magma and is composed of a main zinnwaldite-albite topaze granite and an overlying banded aplite-pegmatite. The Nb-Ta oxides minerals generally occur as small (100-400 μm in size) subhedral tabular or prismatic inclusions within zinnwaldite, more rarely in K-feldspar, quartz or topaz, arguing for their magmatic origin. Their compositional variation was examined using back-scattered electron imaging and on Cameca SX50 Electron-Microprobe. The crystals are heterogeneous and show evidence of an intergrowth of two phases: a columbite-tantalite core and a rimmed wodginite. The BSE images of single crystal clearly show a complex chemical zoning mainly due to major element substitutions Nb↔Ta, Fe↔Mn, Ti↔Sn, reflecting in physical and chemical changes of the medium.

The columbite-tantalite is patchily zoned and corroded. Plotted in the $FeTa_2O_6$–$MnTa_2O_6$–$FeNb_2O_6$–$MnNb_2O_6$ quadrilateral, columbite-tantalite follow a distinguishable trend with progressive and simultaneous increase of Ta/Ta+Nb and Mn/Mn+Fe at once within crystals from core to rim and with the nature of the rocks. In the aplite-pegmatite, the main composition is manganotantalite. This trend represents the normal magmatic fractionation of Ta from Nb during the course of crystallisation leading to a Ta enrichment. The wodginite exhibit a typical oscillatory growth-zoning with limits parallel to crystallographic planes. Its structural formulae was calculated, according to the method recommended by Ercit *et al.* (1992) and Tindle and Breaks (1998), from the general formulae $A_4B_4C_8O_{32}$. Plotted on the classification diagram, MnA/Total A site versus

Ti/Total B site, the composition fall close to the $MnSnTa_2O_6$ corner (wodginite ss). The Ti/Sn ratio increases whereas Fe/Mn decreases from core to rim. In the aplite-pegmatite facies wodginite evolves towards titanowodginite. The presence of Sn and Fe^{3+} suggests an increase of the oxygen fugacity (f_{O2}) during its precipitation but the high Ti content is difficult to explain simply by the magmatic fractionation model, it is likely related to an interaction of pegmatite-derived fluids with countryrocks (Tindle and Breaks, 1998 and Uher *et al.*, 1998). The observed chemical zoning represents a primary magmatic trend. Partial resorption and replacement with more Ta-enriched phases result from the activity of an aqueous fluid with a build-up of fluorine. The addition of fluorine in the system enhances the solubility of columbite-tantalite and causes the dissolution of early minerals. This example is a good illustration of the concept of "chemical quench" (London, 1987).

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