



The zonal distribution of Nb in SnO₂ from the Kamativi pegmatite, Zimbabwe: Implications for the deposition of rare metal oxides.

Alan J. Anderson¹ and Robert A. Gordon²

¹ St. Francis Xavier University, N.S., Canada, ² Simon Fraser University, B.C., Canada



Cassiterite (SnO₂) from the Kamativi tin deposit, Zimbabwe, exhibits narrow parallel alternating light and dark growth zones (Figure 1). The substitution of Fe, Nb, Ta, W and Mn for Sn in cassiterite results in a darkening of color and intense pleochroism. Element maps of cassiterite from Kamativi (e.g., Figure 2a), obtained using the PNC-CAT x-ray micro probe, indicate that Nb is the dominant substituting element in the dark colored zones (Table 1) and that light colored zones are essentially pure SnO₂. Columbite (Fe,Mn)(Nb,Ta)₂O₆ inclusions (opaque phases in Figure 2b) occur within the light colored zones of cassiterite and are often situated near the contact of dark colored zones (Figure 2b). Backscatter electron (BSE) images of the columbite inclusions (Figures 2c and 3) reveal oscillatory zoning and resorption.

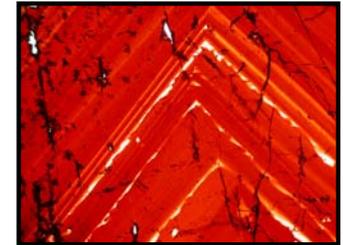


Fig. 1 Oscillatory zoned SnO₂

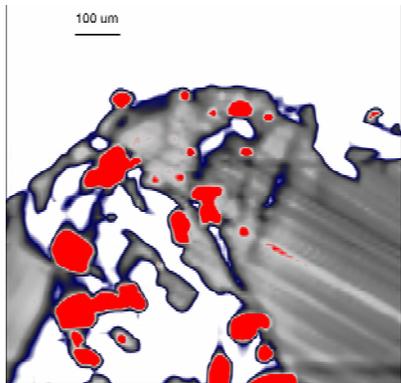


Fig. 2a Nb map of SnO₂ section



Fig. 2b Photomicrograph of SnO₂ section

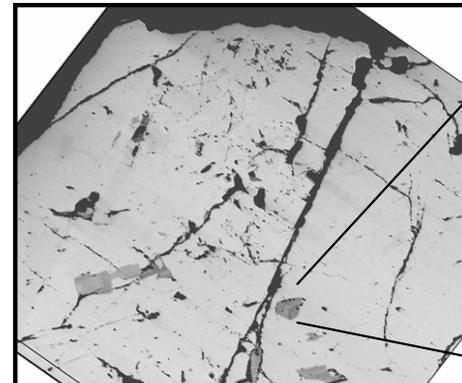


Fig. 2c BSE image of SnO₂ section

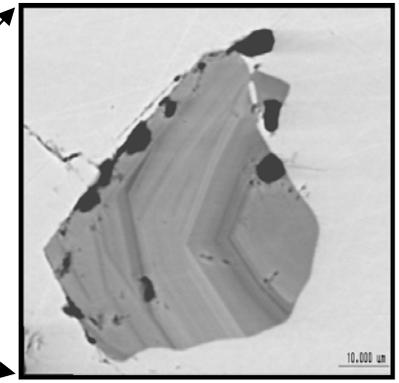


Fig. 3 BSE image of columbite inclusion

Table 1. Representative analyses of columbite inclusions and cassiterite zones

	Columbite		Dark Cassiterite		Light Cassiterite	
	Col-1	Col-2	D Cas-1	D Cas-2	L Cas-1	L Cas-2
TiO ₂ wt. %	0.43	0.62	0.00	0.00	0.00	0.00
FeO	16.50	15.93	0.41	0.00	0.00	0.00
MnO	1.60	2.34	0.00	0.00	0.00	0.00
Nb ₂ O ₅	44.76	44.00	1.27	0.99	0.00	0.00
Ta ₂ O ₅	36.82	36.67	0.00	0.00	0.00	0.00
SnO ₂	0.00	0.00	98.32	99.01	99.97	100.00
Total	100.12	99.55	100.00	100.00	99.97	100.00

Compositional zoning and the distribution of Nb-Ta oxide mineral inclusions provide a record of the changing environment during rare metal deposition, as well as a temporal framework needed to study entrapped fluid inclusions. Neiva (*Can. Min.* 1996), Masau et al. (*Can. Min.* 2000) and Suwimonprecha et al. (*Econ. Geol.* 1995) suggest that Nb-Ta oxide inclusions in cassiterite from some pegmatites are exsolution products. The textural and chemical data presented here indicate that dissolution of the dark, Nb-rich cassiterite was followed by the growth of columbite crystals. The columbite was then resorbed prior to the precipitation of the light colored, Nb-poor cassiterite. Primary fluid inclusions hosted by the different cassiterite zones are currently being studied to determine the temperature and fluid chemistry during rare metal deposition.

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