MITT.ÖSTERR.MINER.GES. 160 (2014)

COMPARING BENEFICIATION METHODS FOR THE CONCENTRATION OF NB-TA-MINERALS IN THE HEAVY MINERALS FRACTION OF PEGMATITES FROM THE EASTERN ALPS

by

Stefan Ahrer & Johann G. Raith

Chair of Resource Mineralogy, Department of Applied Geosciences and Geophysics
Montanuniversität Leoben, Peter-Tunner-Straße 5, 8700 Leoben, Austria

Introduction

Niobium-tantalum minerals have been reported from several Permian pegmatites (MELCHER et al. 2010), which occur in medium to high-grade polymetamorphic rocks of the Austroalpine tectonic unit (SCHUSTER et al., this issue). For an ongoing master thesis four different pegmatite occurrences in the Wölzer Tauern (Lachtal, Hohenwart), Gleinalpe (Mitterberg) and St. Radegund area (Garrach) have been geologically mapped and sampled in order to check for the presence of Nb-Ta mineralization.

To extract Nb-Ta-minerals out of pegmatite bulk samples different methods of comminution and beneficiation were tested and compared. Sample size was between 1-2 kg. For comminution two different methods were applied: 1) Electric pulse dissaggregation (EPD), Chair of Resource Mineralogy, Montanuniversitaet Leoben; 2) Jaw crushing, Chair of Mineral Processing, Montanuniversitaet Leoben. The second step was separation of the heavy minerals using gravity and magnetic separation. Three different methods were applied: 1) Concentration with a gold washing pan; 2) Heavy liquid separation using sodium polytungstate (SPT) (ϱ = 2,95 g/cm^3) and 3) Magnetic separation using a Frantz-magnetic separator.

Results

The goal of the first experiment was to test the effectiveness of the gold washing pan compared to the other more laborous methods of heavy mineral concentration by SPT heavy liquid separation. Two samples of Mitterberg were crushed with EPD and then concentrated with the gold washing pan to less than 1 g. The remaining material left in the gold washing pan was treated with SPT. Polished sections were prepared from the concentrates and Nb-Ta-minerals (columbites) were microscopically determined and counted. The results show that the recovery for columbite minerals using the gold washing pan is good; for the two samples it is > 92 and 82 %, respectively (Table 1).

Sample	Sample size [kg]	EPD + gold washing pan [Col in the section, #]	Left material treated with SPT [Col in the section, #]	Recovery grade for Col [%]
MB0611	0,9	72	6	92
MB0203	1,1	99	18	82

Table 1

Results of the first experiment (Col … columbite minerals).

Different methods for separating the heavy minerals were compared in the second experiment. The two samples used are from Mitterberg and Lachtal. The samples were crushed with a jaw crusher to less than 1 mm and then a heavy mineral pre-concentrate of about 50 g was produced with the gold washing pan. With SPT the heavy mineral pre-concentrate was further concentrated to about 10-20 g. Then, this material was split into three thirds. The first third was not treated any further and a polished section was prepared directly from this material. The second third was once more panned with the gold washing pan to less than 1 g of material and the third part was additionally treated with the Frantz-magnetic separator before section preparation, mineral identification and counting (Table 2).

Sample	Sample size [kg]	Jaw crusher + gold washing pan (50g) + SPT (20-10g)					
		1/3	2/3	3/3			
		No further concentration	Gold washing pan, < 1g	Frantz-magnetic separator [A ... Ampere]			
				< 0,10A	0,10-0,25A	0,25-0,50A	> 0,50A
		[Col in the section, #]					
MB0611	1,3	6	49	32			n.a.
LA0205	1,4	2	21	3	17	3	n.a.

Table 2

Results of the second experiment (Col … columbite minerals).

The results (Table 2) reveal considerable differences between the three separation approaches, especially between the first one and the two others for which additional processing steps have been performed. The least number of columbite minerals was found in the not further processed material (1/3); obviously the material is too diluted and if there is too much material (> 1g) quantitative determination of coltan minerals by microscopy is also problematic.

Heavy liquid separation using SPT also has its limitations. The density of 2.95 g/cm^3 normally used for separating the heavy from the light mineral fraction is too low to remove minerals with higher densities like garnet, tourmaline and spodumene. Using higher density thresholds with SPT is hampered by the dramatic increase of the viscosity of the SPT solution making the physical separation of particles infeasible. For such samples a further separation step using the Frantz-magnetic separator was applied.

It gives good results, especially for separating the non-magnetic spodumene, which is enriched in the > 0.50 A fraction. Separating columbites from garnets and tourmalines in the fractions < 0.50 A depends very much on their composition, especially their iron content.

Conclusion

The most effective combination of methods for quick separation and enrichment of Nb-Ta phases from pegmatites is crushing the bulk sample with a jaw crusher and then concentrating the material to less than 1 g by gravity separation simply using a gold washing pan. This approach yields acceptable recovery rates that are similar to separation of Nb-Ta minerals with combined heavy liquid separation with sodium polytungstate (plus magnetic separation).

Acknowledgements

H. Mali is thanked for sharing his knowledge about pegmatites in the Eastern Alps and for his support during field-work and sampling. G. Rantitsch and K. Stocker are thanked for assistance with heavy liquid separation, F. Melcher for discussing various aspects of this project, O. Thalhammer for his advice with the EPD instrument, and H. Mühlhans for excellent sample preparation. The Chair of Mineral Beneficiation is thanked for giving permission and providing support in using the crushing equipment. This project is financially supported through FFG project number P062-F-01-05 to Johann G. Raith.

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