Mitt. Österr. Miner. Ges. 163 (2017)

NB-TA-SN MINERALIZATION IN PEGMATITES AND GRANITES

Frank Melcher

Chair of Geology and Economic Geology, Montanuniversität Leoben
Schillerstrasse 5, A-8700 Leoben

Dieser Vortrag wurde auf Einladung des Organisationskomitees im Rahmen der EMC2 (2nd European Mineralogical Conference) am 13. September 2016 in Rimini als Plenarvortrag gehalten.

Rare-metal granites and granitic rare-element pegmatites account for the majority of the production of tantalum, tin, niobium, lithium, beryllium, and other raw materials. Each period of rare-metal granite and rare-element pegmatite formation in Earth history is characterised by peculiar mineralogical and geochemical features. The major and trace element composition of Ta-Nb and Sn oxides is used here to characterise these periods and to distinguish ore provinces (MELCHER et al., 2015; 2016). Some of the largest rare-element pegmatite bodies are located within Archean terrains and intruded ultramafic and mafic host rocks. They are highly fractionated, of LCT (Li-Cs-Ta) affinity and yield complex mineralogical compositions. Many carry significant Li mineralization as spodumene, petalite, and amblygonite.

In the Paleoproterozoic, syn- to post-orogenic LCT-family pegmatites intruded variable lithologies within a variety of structural settings. Minor and trace element signatures in columbite-tantalite are similar to those from Archean pegmatites, although some are characterized by considerable REE enrichment along with Sc and Y, being transitional to NYF (Nb-Y-F)-family pegmatites. The Mesoproterozoic period is comparatively poor in rare-element pegmatites and rare-metal granites. Placer material from Colombia points to an unusual pegmatite source of NYF affinity, yielding high total REE, Sc and Th at low Li in columbite-group minerals.

A major period of pegmatite formation was the Early Neoproterozoic at

around 1 Ga. Pegmatite fields often display a zonal arrangement of mineralized pegmatites with respect to assumed "fertile" parent granites. They intrude metasediments, metabasites, gneiss and granite of middle to upper crustal levels and display a variety of mineralogical and chemical characteristics. Pegmatites of the Sveconorwegian and Grenville domains are usually of the NYF type. In contrast, the pegmatites of central and southwestern Africa are commonly of LCT affinity carrying spodumene, beryl, abundant Ta-Nb oxides and cassiterite.

The fourth major pegmatite-forming event coincides with amalgamation of Gondwana around 550 Ma ago. Pegmatites showing both LCT and NYF affinities often intruded high-grade metamorphic terrains. Rare-metal granites of NYF affinity are locally abundant. The Alto Ligonha and Madagascar provinces are characterized by abundant REE and Sc both within Ta-Nb-oxides and as separate mineral phases.

In the Phanerozoic, pegmatite formation was related to Sn-W mineralized granites during the Variscan and Alleghanian orogenies. Most of the pegmatites are of LCT affinity, although NYF and some mixed types are present as well. Nb-Ta oxides from Mesozoic pegmatites and rare-metal granites are invariably rich in REE, Sc, Y and Th. In all rare-metal granites, Ta-Nb oxides are characterized by high total REE concentrations and both, negative Eu and Y anomalies in chondrite-normalized REE diagrams.

References

MELCHER, F., GRAUPNER, T., GÄBLER, H.-E., SITNIKOVA, M., OBERTHÜR, T., GERDES, A., BADANINA, E., CHUDY, T. (2016): Mineralogical and chemical evolution of tantalum-(niobium-tin) mineralization in pegmatites, granites and carbonatites: Part 2: Worldwide examples (except Africa) and an overview of global metallogenic patterns. - Ore Geol. Rev., 10.1016/j.oregeorev.2016.03.014.

MELCHER, F., GRAUPNER, T., GÄBLER, H.-E., SITNIKOVA, M., HENJES-KUNST, F., OBERTHÜR, T., GERDES, A., DEWAELE, S. (2015): Tantalum-(niobium-tin) mineralization in African pegmatites and rare metal granites: constraints from Ta-Nb oxide mineralogy, geochemistry and U-Pb geochronology. - Ore Geol. Rev., 64, 667-719.

received: 02.06.2017
accepted: 03.06.2017