



Genesis of Permian pegmatites and spodumene bearing pegmatites during regional scale, high temperature/low pressure metamorphism in the Austroalpine unit

Tanja Ilickovic^{1*}, Ralf Schuster^{1*}, Heinrich Mali^{2*}, Benjamin Huet^{1*}, Monika Horschinegg^{3*}

¹ – Department of Hard Rock Geology, Geological Survey of Austria, Vienna, Austria; ² – Department of Applied Geosciences and Geophysics, University of Leoben, Austria; ³ – Department of Lithospheric Research, University of Vienna, Austria;

* tanja.ilickovic@geologie.ac.at

Thousands of Permian pegmatites in the Austroalpine unit (Eastern Alps) form a more than 400 km wide pegmatite field. They formed during the Permian event that is characterised by lithospheric extension, causing crustal basaltic underplating, high temperature-low pressure metamorphism (HT-LP) and intense magmatic activity within the crust (Schuster and Stüwe, 2008). Fieldwork and detailed mapping revealed that Permian pegmatites are restricted to distinct complexes with typical lithological associations and petrological features. Three different domains can be distinguished. (1) In structurally lower parts, pegmatitic patches, narrow pegmatitic dykes and larger feldspar dominated pegmatites occur in aluminosilicate bearing, garnet-rich mica schists and paragneisses. Metamorphism in the surrounding mica schists and paragneisses indicate that during the Permian event this domain experienced upper-amphibolite facies metamorphic conditions (c. 0.4 GPa and 650°C; e.g. Stöckert, 1987; Habler and Thöni, 2001), corresponding to a depth of c. 15 km. (2) Structurally higher domains are characterized by frequent concordant barren pegmatites of several meters thickness. In some places (e.g. Martell valley, Uttenheim valley, Geißbrücken near Judenburg) associated inhomogeneous leucogranitic bodies with pegmatitic and aplitic striae parts occur. (3) Higher evolved, spodumene bearing pegmatites are present as partly discordant dykes in the structurally uppermost levels. According to the presence of contemporaneously formed garnet in surrounding mica schists and paragneisses these pegmatites intruded in upper greenschist facies (~0.3 GPa at 500°C) crustal levels, corresponding to c. 10 km depth. Sm/Nd garnet ages on barren pegmatites are in the range of 247 to 288 Ma (e.g. Thöni and Miller, 2000). New age data on three spodumene pegmatites yielded 263±8, 265±3 and 268±2 Ma whereas for leucogranites ages of 259 to 287 Ma were determined. Magmatic muscovites from more than 450 samples of barren pegmatites, spodumene pegmatites and leucogranites as well as cm-sized single muscovite crystals from migmatitic mica schist were investigated with respect to their chemical composition. With respect to the pegmatite classification diagrams of Černý and Burt (1984) muscovites from barren pegmatites and migmatitic mica schist mostly plot in fields of muscovite bearing (MSC) and muscovite barren (MSCB) pegmatite classes. Leucogranites plot together with higher evolved barren pegmatites, whereas spodumene pegmatites reach the fields of moderately evolved pegmatites. Even though the spodumene pegmatites are far away from highly fractionated pegmatites. All in all pegmatitic melts formed by regional anatexis during the Permian event. Melt accumulation and fractionation via crystallization of barren pegmatites and leucogranites lead to the formation of spodumene pegmatites. The quantification of Li enrichment from Al-rich metapelites to the pegmatite forming melt is going to be the topic of further investigations.

References:

- Černý, P., Burt, D.M., 1984. Paragenesis, crystallochemical characteristics, and geochemical evolution of micas in granite pegmatites. In Bailey, S.W. (ed.), *Micas, Reviews in Mineralogy* 13, Mineralogical Society of America, pp. 257-297.
- Habler, G., Thöni, M., Miller, Ch., 2007. Major and trace element chemistry and Sm-Nd age correlation of magmatic pegmatite garnet overprinted by eclogite-facies metamorphism. *Chemical Geology*, 241, 4-22.
- Schuster, R., Stüwe, K., 2008. The Permian Metamorphic Event in the Alps. *Geology*, 36/8, 303-306.
- Stöckert, B. 1987. Das Uttenheimer Pegmatitfeld (Ostalpinen Altkristallin, Südtirol) Genese und alpine Überprägung. *Erlanger geologische Abhandlungen*, 114, 83-106.
- Thöni, M., Miller, Ch., 2000. Permo-Triassic pegmatites in the eo-Alpine eclogite-facies Koralpe complex, Austria: age and magma source constraints from mineral chemical, Rb-Sr and Sm-Nd isotopic data. *Schweizer Mineralogische und Petrologische Mitteilungen*, 80, 169-186.