

The relationship between spodumene pegmatites, pegmatites and leucogranites from the Austroalpine Unit (Eastern Alps)

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Thousands of Permian pegmatites are distributed over more than 400 km in the Austroalpine Unit (Eastern Alps). They formed during the Permian event characterized by lithospheric extension, causing crustal basaltic underplating, high temperature-low pressure metamorphism (HT-LP) and intense magmatic activity within the crust. Highly fractionated spodumene (LiAlSi₂O₆) pegmatites occur in spatial association with less fractionated leucogranites and simple pegmatites. Based on a combination of mapping, analysis of field relationships, major and trace element analysis of whole rock and single phases as well as geochronology, we suggest that the pegmatites formed by anatexis of their metapelitic country rocks. This is consistent with the virtual absence of huge co-genetic fertile granites.

Mapping indicates that units of migmatitic mica schists with densely interlayered simple pegmatites represent areas with aborted melt generation, whereas relatively small, inhomogeneous leucogranitic bodies with aplitic to pegmatitic textures represent zones of melt accumulation. Areas with spodumene-bearing pegmatites and other highly fractionated pegmatites represent structurally higher levels. The magmatic assemblage of simple pegmatites and leucogranites consists of Kfs+Qz+Pl+Ms+Grt+Trm. Accessory minerals such as beryl or Nb-Ta phases are very rare. Sm/Nd garnet ages on simple pegmatites, leucogranites and spodumene pegmatites yield ranges 247-288 Ma, 263-268 Ma and 259-287 Ma, respectively.

Magmatic muscovites from more than 500 samples of simple pegmatites, leucogranites and spodumene pegmatites as well as cm-sized single muscovite crystals from migmatitic mica schist were measured with LA ICP-MS and plotted in classical classification diagrams. Muscovites from simple pegmatites and migmatitic mica schists mostly plot in fields of muscovite bearing and muscovite barren pegmatite classes. Muscovite from leucogranites plot together with those of highly evolved simple pegmatites in field of moderately evolved classes. Muscovite from spodumene pegmatites reach the fields of moderately to highly evolved pegmatites but never the one of the spodumene pegmatite class. All muscovite analyses plotted together indicate a common linear trend that is interpreted in terms of magmatic fractionation. Whole rock major element analyses indicate a peraluminous felsic composition for all three rock types. Whole rock trace element analyses are consistent with magmatic fractionation.

All in all migmatites, simple pegmatites, leucogranites and spodumene pegmatites are contemporaneous and cogenetic. Pegmatitic melts formed by anatexis during regional metamorphism in the Permian. Melt accumulation and fractionation via crystallization of simple pegmatites and leucogranites lead to the formation of spodumene pegmatites.