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GENESIS OF SPODUMENE-BEARING PEGMATITES WITHIN THE AUSTROALPINE UNIT (EASTERN ALPS): ANATECTIC VS. MAGMATIC DERIVATION

by

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In the Austroalpine unit of the Eastern Alps pegmatites containing the Li-pyroxene spodumene ($LiAl[Si_2O_6]$) occur heterogeneously distributed over a distance of more than 400 km. They are spatially associated with barren pegmatites lacking rare element mineralizations.
There is a debate about the genesis of the pegmatites: Mining geologists argue for a development of spodumene bearing pegmatites by fractionation of granitic parent plutons (GÖD, 1989; MALI, 2004), whereas metamorphic petrologists consider barren pegmatites as products of anatexis of metapelitic country rocks (STÖCKERT, 1987; THÖNI & MILLER, 2000; ERTL et al., 2010). In the first case the absence of co-genetic fertile granites render the model problematic, whereas in the second case the formation of suitable Li-enriched pegmatitic melts is not yet understood.

A new understanding of the Austroalpine basement and mapping during the past years gives the opportunity to reinvestigate this problem: The pegmatites developed in Permian time when the area was affected by lithospheric extension, causing basaltic underplating, high temperature / low pressure metamorphism and intense magmatic activity (SCHUSTER & STÜWE, 2008). The Permian P-T-t path is characterized by heating at slightly decreasing pressure. Mapping revealed units of migmatitic mica schists with lots of interlayed barren pegmatites, representing areas with aborted melt generation. Other areas with spodumene bearing pegmatites and other enriched pegmatites represent structurally higher levels, where fractionated melts crystallized. Some of the dykes can be traced over several hundred meters and allow to study processes of internal fractionation.

Due to these facts we would like to investigate the genesis of the spodumene-bearing pegmatites in a research project. Even if we will go on searching for potential Permian parent granites we think it is possible to create Li-rich pegmatitic melts by anatexis and we want to investigate this problem starting with a petrological and geochemical approach, based on the new field geological data. In our working hypothesis we propose the following model for melt genesis: As source rocks for the pegmatitic melts we expect Al-rich metapelites derived from marine shales. During their metamorphic evolution these rocks passed through mineral assemblages including paragonite/muscovite, albite, quartz, chlorite, staurolite and minor biotite and plagioclase. During the Permian event a temperature increase at more or less constant pressures caused melting of white mica, feldspar and quartz with additional H_2O at 650-700°C and 0.4–0.6 GPa, within the sillimanite stability field. Breakdown of staurolite served as additional source for Li in the primary melts. Subsequent internal fractionation lead to further Li-enrichment and crystallization of spodumene from the most evolved melts, whereas less enriched/fractionated melts formed co-genetic barren pegmatites.

The validation of our working hypothesis would contribute to our understanding of (1) the regional (Austroalpine) evolution that is still considered as “non-anatectic”, (2) the alternative formation modes of rare element pegmatites and (3) the strategies of exploration of these economically valuable rocks.

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