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## Mineralogy, Petrology and Geochemistry of Rare Metal bearing Pegmatites

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### Abstract

The objective of this paper is to provide a synthesis of petro-mineralogical and geochemical characteristics of rare metal bearing pegmatites in light of the current researches. In addition, historical developments on various issues related to subject matter since 18<sup>th</sup> century, after the term 'pegmatite' was coined first by Abbe Hauy, have also been briefly reviewed. Although the pegmatites show a large spectrum of ore and gangue minerals, the silicates, phosphates and oxides dominate over others. Silicates constitute the bulk of rare element pegmatites and are also the exclusive ore minerals of Li, Rb, Cs, Be, Zr, and Hf. Per-aluminous silicates, such as muscovite, garnet, tourmaline or aluminosilicates are typical of pegmatites with bulk  $Al_2O_3/(CaO+Na_2O+K_2O) > 1$ , but are scarce to missing in meta-aluminous pegmatites. The number of primary phosphates of Ca, Na, Li, Fe, Mn, and Mg in LCT pegmatites may or may not be limited, but generates numerous secondary phases. In contrast, NYF pegmatites are very poor in phosphates, whereas, mixed NYF + LCT suites either show transition from NYF into LCT pegmatites or combined signatures of the both. The high-valency cations of rare metals (Nb, Ta, Ti, Sn, U, Th) typically form oxide minerals. In general, most of the ore minerals of Li, Rb, and Cs are found in the primary and, particularly, in the intermediate and central zones. Early generations of Be, Nb, Ta, and Ti minerals also occur there but are mainly concentrated in late units, together with Sn, Zr, Hf, Sc, U, Th, Y and REE-bearing phases. Albitic, muscovitic and lepidolite units are their main carriers. The diversity of Nb and Ta minerals increases in more fractionated pegmatites, whereas, others (*e.g.*, Be and Cs) precipitate in a single primary species. Another typical feature of pegmatite mineralogy is the recurrence of many species at different stages of pegmatite crystallisation. Multigeneration species such as beryl, columbite-tantalite, tourmaline or microlite display distinct changes in physical properties and composition, which in turn, facilitates exploration and evaluation, and aid in petrological study.

**Keywords:** Mineralogy, Petrology, Geochemistry, Rare-metal pegmatites.