

Origin of S-type granitic pegmatites: a Li and B isotopic study of muscovites and tourmalines from Gangpur Group granitoids, India

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The geochemical fractionation processes and the crystallization conditions of granitic pegmatites has been a topic of considerable interest and debate [1]. In this study we use the trace element chemistry and Li-B isotope composition of muscovite and tourmaline from S-type pegmatites and granites from the Gangpur Schist Belt in eastern India to constrain the petrological processes involved during the evolution from granites to pegmatites. Two types of pegmatites namely internally zoned (differentiated) and homogeneous (undifferentiated) associated with the Gangpur granites were studied. The differentiated pegmatites are usually characterised by three internal zones: wall (W), transitional zone (T) and core (C). The muscovites from the three zones have distinct trace element compositions and plot as clusters in bivariate diagrams with several incompatible element (B, Be, P, Cs, Rb, Ga, Ge, Sn, Zn, Nb, Ta) concentrations increasing and Ba, Sc, Ti, V, Sr concentrations decreasing from the wall (W) to the core (C). The muscovites from the granites tend to have composition intermediate between the wall zone (W) and the transitional zone (T). The tourmalines show similar trends, albeit less pronounced, with Li, Be, and Zn higher in the T- and C-zones relative to the W-zone and the host granite. The $\delta^7\text{Li}$ of the muscovites show a gradual decrease from the W-zones (c. 26.3‰) to the C-zones (c. 20.1‰) while the $\delta^{11}\text{B}$ of the tourmalines become consistently lighter from the W-zones (c. -12.0‰) to the C-zones (c. -12.7‰). In contrast to the zoned pegmatites, muscovites from the undifferentiated pegmatites have much lighter $\delta^7\text{Li}$ (c. 12.4‰) relative to their granite hosts (c. 27.5‰). The $\delta^{11}\text{B}$ of tourmalines from the zoned pegmatites (c. -11.4‰) are also lighter compared to those from the granites (c. -10.8‰). These observations suggest that the undifferentiated pegmatites may have crystallized from melts previously undergone rapid fluid exsolution whereas the zoned pegmatites crystallized from granitic melts exsolving fluids gradually while undergoing progressive differentiation.

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