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Chemistry of Li-bearing micas (zinnwaldite): clues to magmatic-hydrothermal evolution of granite-hosted W-mineralization at Degana, India

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Li-rich micas have often been used to characterize the magmatic and hydrothermal evolution of granites. This study highlights the suitability of Li-micas as tracers of hydrothermal W-mineralization associated with the Neoproterozoic Degana granite in western India. Based on micro-textural relations and mineral chemical zoning, muscovites in the mineralized granites can be grouped into three types: 1) igneous muscovite, formed during the granite crystallization, 2) hydrothermal muscovite formed from alteration of the K-feldspar, 3) hydrothermal muscovite occurring in mineralized quartz veins. Some of the muscovites show further post-mineralization alteration possibly in response to regional tectonothermal events. The major and trace element chemistry of hydrothermal muscovite indicates different substitution mechanisms such as, Si_2LiAl_{-3} and $SiLiAl_{-1}R_{-1}$ where R = (Fe^{2+} + Mg + Mn) that controlled the incorporation of Li. Ti-in-quartz temperatures of 319°C to 362°C were obtained from hydrothermal quartz in the mineralized quartz vein which is slightly lower than the maximum temperature obtained from fluid inclusion study (420°C; [1]). The high Rb, Li, Nb, Ta and F composition of the altered mica along with the presence of fluorite suggest a fluorine-rich late fractionated magmatic hydrothermal fluid source. The major and trace element composition of mica (intermediate compositions between phlogopite-zinnwaldite-muscovite) from granite, greisen, and the different stages represented in the veins are studied in details and their chemistry indicate a potential mixing of endmember fluids fluid from different sources. A reactive transport model is attempted to model the chemical evolution of the hydrothermal system during the interaction of the Degana granite by the ore-bearing fluid. The approximated model is then compared with the petrographic evidences.

[1] Krylova, Pandian, Bortnikov, Anand S, Gorelikova, Gonevchuk, and Korostelev (2012), Geology of Ore Deposits, 54, 276–294.