Title:	Anatectic Origin of Degana Granite in NW India: Seeking Insights from Open-System Phase Equilibria Modeling
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Abstract:	Peraluminous S-type granites are often linked with the W (±Sn) mineralization worldwide. The origin of these granites is linked with the anataxis of compositionally matured metasedimentary rocks (like metapelite and metagreywacke). However, the effect of partial melting on the origin of these granites and ore metal (W) fertility of these granites has been underexplored. This study focuses on the anatectic origin of Degana granite (DG), a peraluminous granitic intrusion linked with tungsten mineralization in the Degana region of northwest India. To evaluate the anatectic origin and ore metal fertility of DG, open-system phase equilibria modeling and trace element modeling have been adopted. Two isobaric prograde paths have been employed to imitate the anataxis of metapelites at 5 kbar and 7 kbar. At 5 kbar, anataxis is attributed to the biotite- dehydration reaction predominates at 705–790°C, generating ~5 wt.% melt. The cumulative melt shows elevated content of Si, K, Al, Fe, and Mg and low content of Ca and Na. However, at 7 kbar, anataxis occurs via dehydration melting reaction of muscovite and biotite from 710–735°C and 740–855°C, respectively. These melting reactions produce ~11 wt.% and ~12 wt.% of melt. The cumulative melt generated during anataxis shows a similar elevated content of Si, K, Al, Fe, and Mg and a low content of Ca and Na. During both prograde paths, the peritectic garnet remains stable at high temperatures (>780 °C). For anataxis at 5 kbar and 7 kbar, the cumulative melt extracted up to 795°C and 860 °C was considered as parent melt to model the isobaric cooling at 2 kbar. During the cooling process of both parent melt, the fractional crystallization is considered up to the residual melt in the system is ~10 wt%. The fractionating melt initially showed an increase in peraluminosity until 725°C, after which it declined gradually with continued cooling. The resulting fractionated (residual) model melt corresponds with natural DG in terms of peraluminosity and major (W) and trace element (Lu, Er, Yb, Tm, and Tb) when ~10 wt.% of melt remains in the system. We argue that the origin of DG arises from the high-temperature (>750°C) anataxis at 5 kbar of Degana metapelites, followed by the fractional crystallization of the parent anatectic melt at 2 kbar. Therefore, it can be stated that the high-temperature anatectic origin of granites parental to W deposits might be more widespread than previously thought.
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