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The Subduction of Continental Crust, the Variscan Evolution of the Bohemian Massif, and the Origin of PO Granitoids

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Slices of continental crust subducted into the mantle during collisional orogeny may either undergo metamorphism and exhumation towards the surface as coherent slab-like or domal high pressure/ultrahigh pressure (HP/UHP) terranes or, if stalled or delayed in the mantle, melt and return towards the surface as magmas, or undergo a combination of exhumation and melting. Some exhumed HP/UHP terranes contain synorogenic granitoid bodies demonstrating melting does occur during exhumation. Therefore, crust that remains trapped in the mantle will also melt when temperatures reach the appropriate solidi through adiabatic decompression and/or conductive heating and/or radioactive decay. Subducted terranes with hydrous phases will undergo hydrate-breakdown melting and could melt during subduction, when stalled in the mantle or during exhumation. Terranes lacking hydrous phases probably require melting by adiabatic decompression as heated crust becomes ductile and rises as diapirs through the mantle wedge. The generated magmas will intrude through the overlying mantle wedge and into the overlying continental crust to form late orogenic and post orogenic (PO) granitoids depending on the time required to reach solidus temperatures. Geochemical characteristics will depend on P-T conditions, the age/chemistry/mineralogy of the subducted terrane (especially the presence or lack of hydrous phases), and the degree of melt interaction (i.e. the traverse length) with the mantle wedge. Melts that significantly traverse the wedge will acquire the hybrid mantle/crust nature of many PO granitoids. Melts generated by adiabatic decompression close to or within the continental crust will retain ancient crustal signatures. The Variscan evolution of the Bohemian Massif involved two episodes of subduction of continental crust: ([1]), the southward (present coordinates) subduction of Saxo-Thuringia beneath Bohemia (aka Tapla-Barrandia) along an east-west suture at 400-370 Ma followed by, ([2]), the east-northeast subduction of Moldanubia beneath Bohemia at 340-320 Ma1. The first subduction was followed by the intrusion of granitoids, including the Central Bohemian Batholith, between 370-340 Ma, all occurring south of the Saxo-Thuringian – Bohemia suture suggesting elements of the subducted Saxo-Thuringian continental crust melted and intruded the overlying Bohemian Craton. The second subduction event was accompanied and followed by multiple intrusions of granites (340 Ma synorogenic granitoids, 340-310 Ma post-orogenic S and high-K granitoids, and 310-290 I-type granitoids[2]) all occurring west of the of the Moldanubia-Bohemia suture suggesting elements of the subducted Moldanubian crust were melted and intruded the overlying Bohemian/Saxo-Thuringian Craton. Many of the HP/UHP terranes in the Bohemian Massif occur in domal structures suggesting exhumation and melting occurred in part by diapiric upwelling[3]. It is proposed that both the Saxo-Thuringian and Moldanubian terranes were exhumed by a combination of slab-return and diapiric upwelling and that elements of both terranes were stranded long enough in the mantle to heat up and melt to form most or all of the PO granitoids of the Bohemian Massif. This model involves successive re-distillation of the continental crust and may play a significant role in the evolution of both the continental crust and upper mantle.

1Medaris et al., 2005, Lithos 82.
2Finger et al., 1997, Min & Pet 61.
3Stípská et a., 04, J. Met. Geol. 22.