The shape of the P-T path controls the solidus: An investigation of fully-hydrated, fluid-absent anatexis of an average metapelite.

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Phase equilibria modelling studies investigating the onset of anatexis in rocks are limited by the assumption of a fixed H_2O content in the bulk composition. This limitation is in conflict with the fact that the water content of fluid-absent subsolidus rocks change as a function of pressure and temperature. Rcrust [1] allows phase equilibrium modelling along *P*–*T* paths to be conducted with composition as a variable. This study uses this functionality to investigate the evolution of fully-hydrated but fluid-absent (*fhfa*) compositions along *P*–*T* trajectories that evolve towards granulite (at relatively high d*T*/d*P*) and eclogite (at relatively low d*T*/d*P*) facies peak metamorphic conditions. The H_2O content of the rock changes as it evolves along each path, as the modelling is set to remove any free phase water formed in the system. The results show that the H_2O content of the rock at the solidus varies by 1.4 wt.% and that modelled OH^- content of biotite varies strongly as a function of temperature and pressure. The *fhfa* solidus coincides with the wet solidus only at $P > 12$ kbar. At $P < 12$ kbar melting behaviour is strongly controlled by the subsolidus mineral assemblages. In fields where biotite coexists with phengite (12–7 kbar) and in fields where biotite coexists with cordierite (4.5–2.5 kbar), the *fhfa* solidus is located at temperatures lower than the wet solidus by up to 25 °C. Where biotite is the sole hydrous mineral in the subsolidus assemblage (7–4.5 kbar), the *fhfa* solidus is displaced by up to 50°C above the wet solidus. Additionally, the trajectory of the *P*–*T* path exerts a strong control on the shape of the *fhfa* solidus. Steep *P*–*T* paths of increasing pressure emnating from 650 °C and 5 kbar do not cross the solidus, which occurs at ~850 °C at 20 kbar. In contrast, paths of steeply decreasing pressure emnating from 650°C and 10 kbar document a less pronounced solidus step to higher temperature in the 7.5–5 kbar field. These results have important implications for anatectic systems and could provide a mechanism for rocks to remain melt absent until high temperatures after which small amounts of subsequent heating or decompression would produce large amounts of melting.

[1] Mayne et al. (2016) *J. Met. Geol*. **34**, 663-682.