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How high to ultra-high temperature terranes form

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Long-lived high- to ultra-high temperature (HT-UHT) terranes formed mostly during the Paleo-Proterozoic and are often associated to supercontinent cycles. Yet the detailed processes and conditions involved in their formation remain largely unresolved. Here we highlight the importance of the specific geothermal conditions necessary to form migmatitic to granulitic crusts. An analytical resolution of the heat equation highlights the interdependency of the thermal parameters controlling the crustal geotherm, i.e. the Moho temperature, when deformation occurs at thermal equilibrium. We further perform thermo-mechanical experiments mimicking an orogenic cycle, from shortening to gravitational collapse, to study the effect of deformation velocity that affects the crustal thermal equilibrium. We show that the formation of HT-UHT terranes is promoted by an elevated radiogenic heat production in the crust. Finally, the interplay between the thermal parameters and the orogenic cycle duration explain the difference in orogenic style through time and why some terranes are preferentially granulitic or migmatitic.