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The Role of Partial Melting and Extensional Strain Rates in the Development of Migmatite-cored Metamorphic Core Complexes (McMCC)

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We present 2D thermo-mechanical experiments on the role of partial melting and extensional strain rates in the structural and thermal development of Migmatite-cored Metamorphic Core Complex (McMCC) in hot orogens. We show that the geometry of the rheological anomaly, originally responsible for strain localization and doming initiation, controls the final architecture of MCC. In particular, detachment faults shift the migmatite core toward the hanging wall. This leads to an asymmetry in the temperature field with the hanging wall growing warmer than the footwall near the detachment. The melt contributes to enhanced heat advection; in contrast, its buoyancy plays little role in the development of McMCC. The driving extensional strain rate plays a major role in the crystallization versus exhumation history of migmatite cores. At low strain rates, crystallization of migmatite cores occur deeper in the crust and migmatite cores are exhumed in a solid-state. At high strain rate in contrast, the bulk of the crystallization occurs at low pressure largely after the McMCC exhumation. Therefore, one may expect that highly deformed McMCC were exhumed at low extensional strain rate. In high strain rate experiments, sudden change in direction in flow paths from vertical upward to horizontal leads to PTt paths in which an episode of near-isothermal decompression is followed by an episode of near-isobaric cooling. Finally, our numerical experiments confirm that low-pressure high-temperature metamorphic assemblages and melting require high extensional strain rates.