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Cooling of Core Complexes: evidence from numerical modeling

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The cooling rate of Core Complexes is an important feature in the research of Metamorphic Core Complexes, which have been studied by chronology and geothermobarometer method. The cooling rate shows quit a wide range from above 200K/My to below 10K/My like Valhalla Metamorphic Core Complexes. It always shows both fast and slow cooling stage in single Core Complexes. For example, Yunmengshan Metamorphic Core Complexes, located in the Eastern Block of North China Craton, show a fast cooling in 125∼114Ma flowed by a slow cooling period in 113∼100Ma. However, the contributing factor in fast and slow cooling of Core Complexes remains poorly understood. Therefore, we investigated the parameters that likely control the thermal cooling evolution of core complexes: stretching velocity, density and depth of the Core Complexes via a series of two-dimensional thermo-mechanical numerical experiments. Modeling results show that even though the cooling rate of particles during welling up were higher variously, almost all of the Core Complexes experienced both fast and slow cooling state. The cooling of core complex was mainly controlled by boundary extensional velocity. The fast cooling rates of the core complexes experienced during stretch increased approximately in a line with the increase of boundary extensional velocity. The density and depth of core complexes could affect the cooling rate of core complexes to some extent but not the major factor. We also added a set of experiments with a thinner (10km thin) crustal thickness to verify whether the crustal thickness might have influenced the results. Results shows the maximum cooling rate increases slightly as crust thins. We hence presume that, to a certain degree, in nature, the value of the highest thermal cooling rate of the core complexes could act as a parameter to infer the strain rate or extensional velocity during lithospheric stretch.