Thermal state transition from cold to warm mid-lower crust in central Tibet since 28 Myr

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The formation and rapid surface uplift of plateaus is commonly considered be related to a thermal state transition (TST) from cold to warm of the underlying mantle and crust. To date, however, the timing and cause of TST remains enigmatic. Here we report on a series of rare mid- to lower-crust xenoliths contained in 28, 3.8 and 2.3 Myr (million years) igneous rocks from central Tibet. Our new results document the progression evolution of mid- to lower-crust beneath central Tibet from relatively cold and H_2O-rich at 28 Myr to increasingly hotter and dryer at 3.8–2.3 Myr. Furthermore, our results provide the first definitive evidence for a cold to warm TST between 28 and 21 Myr in the mid- to lower-crust beneath central Tibet. We suggest that the abrupt transition (28–21 Myr) is most consistent with hot asthenosphere upwelling owing to lithospheric mantle delamination, which triggered the early stage rapid uplift of central Tibet. As the geothermal gradients rose after the TST, the formerly H2O-rich mid-lower crust could have produced huge melt volumes (> 25 vol. %) until 2.3 Myr, which would gave rise to widespread flow and drove the plateau's further growth outward between 21 and 2.3 Myr.