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Timing of exhumation and deformation across the Taimyr fold and thrust belt from apatite fission track dating and balanced cross-sections

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The Taimyr fold and thrust belt underwent a series of geological events in the late Paleozoic to Mesozoic, including Uralian collision, Siberian Trap magmatism and Mesozoic transpression. The exhumation and shortening history associated with the Taimyr fold and thrust belt is investigated using apatite fission track (AFT) and balanced cross-section analysis in order to understand the relationship of deformation of Taimyr fold and thrust belt with these regional tectonic events.

Eighteen samples from across northern, central and southern Taimyr were used for AFT analysis and include granite, meta-arenite, and sandstone ranging from late Proterozoic to Early Cretaceous in age. Based on the AFT central age and mean track length (MTL), the AFT data are grouped into three types. Type I contains 13 samples with AFT central ages much younger than the emplacement or deposition age of the host rock, indicating that a distinct reduction in single-grain age has occurred in respond to thermal annealing after the rock was deposited or crystallized. The fairly long MTL of type I with narrow distributions is indicative of a rapid cooling history. The weighted mean AFT central age of c. 215 Ma for these samples approximates time of cooling. Type II includes the Early and Middle Triassic samples with AFT central ages equivalent to or slightly younger than their stratigraphic ages. The long MTL with broad track-length distributions is evidence of partial annealing at 60 – 80 °C before most tracks formed and slow cooling thereafter to below 60 – 80 °C. Type III includes Early Jurassic and Early Cretaceous samples with the AFT central age older than the stratigraphic age (c. 216 Ma), demonstrating no significant thermal annealing after the host rock was deposited. The short MTL with wide length distribution and less than ¼ of the tracks longer than 14 µm suggests exposure to burial temperatures of 60 – 80 °C in the middle to late stage of Type III sample history, followed by slow cooling to ambient temperatures. The resulting fission track lengths and central ages were used to model the thermal history of the region and indicate that the Taimyr fold and thrust belt underwent three distinct episodes of cooling in the Early Permian, earliest Triassic, and Late Triassic.

Two balanced cross-sections were constructed across Northern, Central and Southern Taimyr using field data obtained over several field seasons and geological maps. One section across eastern Taimyr is about 250 km long and the other across central Taimyr is about 170 km long. The regional style of deformation is characterized by a thick-skinned thrust system and c. 15% shortening (minimum estimate). The thermal history is integrated with the two balanced regional cross-sections, revealing thickening during early Permian Uralian orogenesis. Later heating, uplift, and cooling resulted from Siberian Trap magmatism and/or Mesozoic transpression.