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Tectonic-paleogeographic implications of a detailed Cretaceous-Cenozoic exhumation history in the Richardson Anticlinorium, northern Yukon, documented by multi-kinetic apatite fission track modelling

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Summary

Multi-kinetic apatite fission track (AFT) modelling utilizing detailed elemental chemistry increases the resolution of thermal history models compared to conventional methods. Three Cambrian samples from the core of the southern Richardson Anticlinorium, one Devonian sample from its western flank and one Lower Cretaceous sample from the eastern flank, contain up to three AFT statistical kinetic populations. Different total annealing temperatures (<75ºC to >200ºC) for these kinetic populations extend the time-temperature range over which thermal histories can be resolved using AFT data. An inverse multi-kinetic AFT thermal model is used to obtain statistically acceptable, geologically constrained thermal solutions that fit the observed AFT ages and track length distributions, as well as vitrinite reflectance data. A controlled random search (CRS) algorithm applied to the initial result refines the best-fitting solution space. To the east, west and south of the anticlinorium, Cretaceous Cordilleran foredeep sedimentation, followed by Cenozoic exhumation, are recorded in the preserved stratigraphy and the AFT thermal histories. However, samples from the core of the anticlinorium record a different history, indicating cooling from high temperature since earliest Cretaceous time. Two samples from the middle Cambrian Slats Creek

Formation in the core of the range were thermally reset during burial and constrain subsequent cooling (~1ºC/m.y.) from earliest Cretaceous time until the present. These results indicate that the actively exhuming Richardson Anticlinorium was a positive paleogeographic feature since Early Cretaceous time. This result implies that the mid- to Late Cretaceous Eagle Plain restricted intermontane basin in the west was not directly connected to the Cretaceous Peel Cordilleran foredeep to the east, implying that direct stratigraphic correlations between Eagle Plain and Peel depocentres cannot be assumed. At the eastern margin of the anticlinorium, an early Cambrian Illtyd Formation sample, from a fault-bounded lozenge within the seismically-active Knorr Fault zone, experienced two-stage cooling starting in the Late Jurassic. Cooling at ~1.6ºC/m.y. from ~120 Ma to ~8 Ma was followed by rapid cooling, at ~12-13ºC/m.y. after ~8 Ma. We interpret this Neotectonic exhumation pulse as being directly related to Neotectonic reactivation of the Knorr Fault. This is consistent with active seismicity of the fault zone in this area, and with Late Miocene to Recent deformation in the adjacent Beaufort-Mackenzie Basin. These young deformations have been correlated previously with accretion of the Yakutat tectonic block in the Gulf of Alaska.