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Cretaceous tectonism, mineralization & hydrocarbon trap formation in the northern Canadian Cordillera: results of zircon (U-Th)/He thermochronology

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The northern Intermontane terranes of the Canadian Cordillera are dissected by a series of diachronous dextral strike-slip faults, including the Cretaceous Teslin fault possessing moderate displacement (∼100 km) and the major Tertiary Tintina fault with >400 km displacement. The Teslin can be traced down to 7-8 seconds (∼20 km) in seismic profiles and likely originated as a SW-directed thrust fault during the Jurassic which has been reactivated as a strike-slip fault in the Cretaceous. Jurassic cooling and exhumation of the middle crust now exposed across the central Yukon Cordillera has been slowly coming to light. We suggest unroofing is likely more widespread and long-lived then previously documented. Thirty Paleozoic and Mesozoic granitoids from the northern termination of the Teslin fault were selected for (U-Th)/He zircon thermochronology and only samples that exhibited typical igneous zoning and lack metamorphic overgrowths were analyzed. Analyses yield robust and reliable ages for each sample, which can be divided into three fault-parallel corridors: 215-130 Ma, 115-90 Ma, and 70-55 Ma. No clear pattern emerges when comparing age versus elevation, grain size, or mineral chemistry. The Klondike Plateau and rocks directly west of the Tintina fault record Jurassic cooling. The youngest domainal ages are proximal to voluminous Early to Mid-Cretaceous plutons and fault splays of the Teslin system, where structures with overall small displacement are associated with gold and copper-gold deposits. The remaining structural-age corridor can be resolved into a SW-directed extrusion wedge geometry, exhuming a large portion of the Yukon-Tanana terrane during Albian-Cenomanian tectonism. In the Cordilleran foreland front range of the Northwest Territories, 500 km to the northeast, detrital ZHe ages from ten Neoproterozoic units record contemporaneous cooling during the Late Cretaceous. Moreover, a subset of these samples serves to resolve the timing of movement on the eastern-most Cordilleran thrust fault, the Plateau Fault, to be Cenomanian. This appears to correspond with a significant Late Albian-Early Cenomanian erosional event modeled through basin borehole AFT data. Our new ZHe dataset across the northern Canadian Cordillera demonstrate a strong coupling between hinterland and foreland tectonism during the mid-Cretaceous. Protracted terrane accretion and transpression / transtension drove the exhumation between the Tintina and Teslin faults which also resulted in mineralization. Synchronous and far-field convergence and thrusting inboard caused basin inversion and provided the structural traps required for hydrocarbon reservoirs.