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Taking Stock of Terrane Accretion in the Canadian Cordillera: The Record of a Continental Bulldozer

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Summary

Our contribution draws inspiration from the tireless efforts and research of Philip Simony that have provided fundamental underpinnings for understanding Cordilleran orogenesis. In this vein, we examine linkages established by many workers over nearly five decades that show all major terranes in the Canadian Cordillera had been accreted (somewhere) along the western North American craton margin by the Middle Jurassic (~174 Ma). These linkages, when considered in conjunction with other major lines of evidence (e.g., Lithoprobe seismic profiles, palinspastic restoration of the Foreland Belt, westernmost exposures of North American basement) preclude the possibility of a major terrane boundary within the Canadian Rockies that separate North American from exotic non-North American rocks.

We also examine the driving force of northern Cordilleran orogenesis and the role played by terrane accretion. Some models of northern Cordilleran tectonic evolution propose, or imply, that Cordilleran orogenesis resulted from collision of terranes with the western margin of the stable continental interior (or craton). In these models, the craton acted as a passive "backstop" that fielded terranes carried by plates flooring the ancestral Pacific Ocean. However, isotopic and relative ages demonstrate that all large terranes in the Canadian Cordillera were associated with one another and the craton margin by earliest Middle Jurassic time (~174 Ma). As the entire ancestral Cordillera did not emerge until about 100 Ma, what caused orogenesis?

The alternative model proposed herein is based on (1) the possible trajectory of the North America craton and (2) analysis of Mesozoic-Cenozoic structures. (1) The trajectory is derived from paleomagnetic evidence which shows how the latitude of the craton has changed since 220 Ma, and from longitude changes based on the contention that Africa has been the least mobile continent geographically for ~300 million years. As the central Atlantic Ocean floor spread, starting ~190 Ma, the North American continent gradually moved away from Africa. (2) For much of Mesozoic-Cenozoic time the approximately north-south oriented western margin of North America has been the site of arc magmatism, mostly generated by subduction dipping beneath it. Warm, weak arc/back-arc lithosphere, sandwiched between strong ocean floor and craton lithospheres focused strain that was recorded by structures whose styles and ages mirror different craton trajectory vectors. At times, from ~180 to 160 Ma (latest Early Jurassic and Middle Jurassic) and from ~120 to 60 Ma (Early Cretaceous to earliest Cenozoic), it appears that the craton moved due westward. Dominant structures formed then record orogen-normal compression and were accompanied by crustal thickening, uplift and erosion (i.e. orogeny). Structures mainly in eastern and interior parts of the Cordillera formed during the earlier episode at about the time as all major terranes were accreted. Structures formed during the later episode span the entire Cordillera,

which became a structural and physiographic entity in Late Cretaceous-earliest Cenozoic time. Before and between these times, the craton migrated mainly northwestward; geological and paleomagnetic considerations show the terranes moved southward relative to the craton. After 60 Ma, southwestward craton movement coincided with northward relative displacement along dextral strike-slip faults that disrupt the previously established ancestral Canadian Cordillera. Correlation between structures formed by orogen-normal compression at times when the craton moved due westward, and orogen-parallel displacements when the craton had either a northward or southward component of motion suggest the craton, acting as a "continental bulldozer", was the primary driver of deformation and orogenesis.