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The Plate Tectonic Odyssey of the Tethyan Cache Creek terrane of the Canadian Cordillera

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The Cache Creek terrane of western Canada presents us with a major plate tectonic dilemma – how to accommodate translation of this Tethyan oceanic assemblage east across the Panthalassian / Proto-Pacific basin into the Cordilleran accretionary orogen of western North America? We report on the results of recent mapping and sampling along a transect across the northern Canadian Cordillera, as well as presenting a compilation of available stratigraphic, geochemical and faunal data, that constrain the nature and origin of the Cache Creek terrane. We then use an established plate tectonic model (Stampfli & Borel, 2002, EPSL 196, 17-33) for the Tethyan region as a starting point for developing a rigorous whole earth plate tectonic model spanning the period of deposition and terrane translation. Our goal is to use the presence of Tethyan units in the Canadian Cordillera to further constrain paleogeographic and tectonic models of earth evolution for the period of time pre-dating the oldest preserved portions of earth's oceanic crust (i.e. pre-Jurassic), and, for the first time, to place limits on the plate tectonic configuration of Panthalassia, an oceanic expanse which covered 60% of the surface of the earth. Expected outcomes include defining the displacement path followed by the Cache Creek terrane, and constraining the geometry of plate tectonic boundaries that facilitated terrane translation.

Key observations constraining the origins and evolution of the Cache Creek terrane include (1) massive and brecciated shallow water carbonate sequences overlie and are locally intercalated with minor amounts of alkali basalts of Ocean Island (OIB) geochemical affinity, (2) at least two distinct massive carbonate sequences are present

– an older Bashkirian to Asselian group (318 – 295 Ma), and a younger Rodian to Wuchiapingian (271 – 254 Ma) group, (3) karst in-fill and breccia formation indicate exposure and reworking with marine pelagic infill of Carnian (228 – 217 Ma) and possibly earlier age, (4) fauna remain distinctively Tethyan as late as the Middle Triassic, and (5) the Late Triassic – Early Jurassic rocks, the youngest in the terrane, consist entirely of chert and greywacke.

We interpret the Cache Creek terrane as an accretionary prism that incorporates carbonates of at least two different sets of oceanic plateau or seamounts. The present structural juxtaposition of these disparate seamount sequences suggests that they originated within and overlay different parts of the same oceanic basement. The seafloor on which the seamounts were built had to, therefore, be at least in part pre-Pennsylvanian. Drowning of the seamounts and subsequent infill of karst records thermal subsidence and deepening of the underpinning oceanic lithosphere in the Late Permian and Early Triassic. Decapitation of the seamounts during subduction explains the limited volume of preserved OIB. Intercalation of Middle to Late Triassic strata with arc-derived clastics indicates proximity, and probable accretion to an arc that lay either within or proximal to the Tethyan domain. Subsequent translation into the Canadian Cordillera probably involved displacement of the arc and its acquired accretionary complex.