Geology of the Aley Creek Area, Northeastern BC Rocky Mountains: A record of Mississippian orogenesis in the Cordilleran Foreland Belt?

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Abstract

Detailed, 1:10,000 scale field mapping of the Aley Creek area (NTS sheet 094B-042) reveals a record of pre-Laramide age orogenesis previously unrecognized in the foreland belt of the Canadian Cordillera. Specifically, the area is host to a Mississippian-age deformation event that is manifest by a penetrative, bedding-parallel cleavage (S1) and a younger crenulation cleavage (S2) that locally transposes bedding and is axial planar to large-scale Laramide folds. Polystage deformation is regionally expressed in fold interference patterns where symmetric, small-scale isoclinal folds (F1) are folded about asymmetric, large-amplitude chevron folds (F2) of the Laramide orogeny.

Lithologically, the Aley Creek area is characterized by: (1) fine-bedded, silt-rich ramp carbonates, phyllitic siltstone, and altered volcanic tuff of the Kechika Formation; (2) thick-bedded to massive platform carbonates with interlayered alkali volcanic tuff and pillow basalt of the Skoki Formation; and (3) basinal shale, calcareous mudstone, and minor sandstone of the Road River Group. A sill of fersmite-bearing dolomite-apatite-carbonatite and pyrochlore-bearing calcite-apatite-carbonatite intrudes the base of the Kechika Formation. The amphibolitic margin of the carbonatite sill, previously interpreted as being an early magmatic phase of the carbonatite, is now recognized as a separate volcanic unit at the base of the Kechika Formation based on its overall stratiform structure and the identification of well-developed pillow textures and brecciaed conglomeratic quartzite clasts in the unit.

Our mapping shows the entire Kechika-Road River-Carbonatite stratigraphic sequence to be part of the lower, overturned limb of a major south-verging nappe emplaced synchronously with the D1 deformation event. This interpretation provides an effective explanation for the development of bedding-parallel cleavage (S1), south-verging isoclinal folds (F1), and uniformly overturned nature of Paleozoic strata.

Although largely concordant with S1, carbonatite dykes locally cross-cut phase-one structures in low-angle thrust faults, thereby providing a unique constraint on the age of D1. Two K-Ar dates on phlogopite from the carbonatite sill by Cominco Ltd. (1986, unpublished) yielded ages of 339 +/- 12 Ma and 349 +/- 12 Ma, suggesting a Mississippian age for the syn-magmatic D1 event. Zircons from the carbonatite were sampled during the field mapping component of this study; U-Pb dating efforts are underway at UBC in order to better constrain the carbonatite emplacement age.
The implications of a Mississippian deformation event in the Cordilleran foreland belt are manifold. First, western Laurentia is believed to be host to a well-established passive margin by the Carboniferous, as no Middle Paleozoic age deformation event is known in the southern Foreland Belt. If the Kechika/Skoki/Road River succession of strata mapped in the Aley creek

area is indeed correlatable with a similar succession of strata in the southern Canadian Rockies (Survey Peak/Outram/Skoki/Owen Creek/Mount Wilson Formations), as widely reported, the southern Foreland Belt must also be host to a Mississippian deformation event previously unrecognized. Alternatively, a genuine difference in the tectonic record of the respective Paleozoic strata may exist, indicating that the two successions are not correlatable. This study views the latter explanation as more likely given: (a) the Paleozoic strata of the southern Foreland Belt have been extensively studied with no Mississippian-aged deformation event being found; and (b) major differences in lithology exist between the southern and northern Paleozoic foreland successions – most notably, northern strata, as observed at Aley Creek, contain an extensive record of Paleozoic volcanism unseen in the south.

Lastly, the major carbonatite-cored nappe structure mapped at Aley Creek is the first of its kind to be identified in Cordilleran Foreland Belt and suggests that Mississippian deformation in the NE BC Cordillera was a significant orogenic event. This observation calls into question the traditional belief that carbonatites in the Cordilleran Foreland Belt were emplaced anorogenically into a well-established passive margin on the western edge of Laurentia.

In conclusion, the tectonic history and lithological record of Paleozoic strata in the Aley Creek area are inconsistent with that of Paleozoic foreland strata in the southern Canadian Cordillera. These along-strike variations in tectonic history and lithology are most effectively explained through considering large parts of the northern foreland exotic with respect to the North American craton. As this finding is not supported by the majority of Cordilleran orogenic models, which implicitly assume that all Cordilleran foreland sedimentary sequences are autochthonous, a reevaluation of our understanding of Cordilleran tectonic evolution is in order.