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Baltican and Caledonian origins for Neoproterozoic successions in exotic terranes of the North American Cordillera

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Exotic terranes of inferred Arctic affinity form an outer belt within the North American Cordillera, extending from Alaska to northern California. These include Arctic Alaska-Chukotka and Farewell terranes in Alaska, the Alexander terrane of SE Alaska and coastal British Columbia, and the Eastern Klamath and Northern Sierra terranes of northern California. The geological history, fossil and detrital zircon data for these terranes show strong correlations and linkages among them, and many features in common with the northern Caledonides, the Timanide orogen, and the Urals.

In particular, the Neoproterozoic successions from a number of these terranes include: 1) early Neoproterozoic (ca. 980-920 Ma and ca. 870-850 Ma) magmatism; and 2) late Neoproterozoic arc magmatism (ca. 700-540 Ma). These contrast with the western Laurentian margin at that time, which was characterized by epeirogenic basinal sedimentation and rifting (with minor ca. 700-540 Ma alkalic magmatism) related to breakup of Rodinia, but are similar to magmatism in the North Atlantic region (Valhalla orogen) and in the Timanides of NE Baltica. In the Alexander terrane, the late Neoproterozoic arc succession is overlain by an Ordovician-Silurian sequence of arc volcanics and related plutons, and Silurian-Devonian conglomerate and sandstone that have been compared with the Old Red Sandstone. In northern California, Ordovician-Early Devonian mélanges contain blocks of both Neoproterozoic and early Paleozoic arc magmatic rocks and Ordovician blueschist. They are associated with late Neoproterozoic and Silurian ophiolites. These features have more in common with the Caledonian-Appalachian orogens than with the early Paleozoic passive margin of western Laurentia.

Early Paleozoic faunas from most of these Arctic terranes have strong affinities to Siberia and/or Baltica; parts of Arctic Alaska are transitional between Siberian and Laurentian faunal provinces. Detrital zircon populations from early Paleozoic sandstones in these terranes commonly show a nearly continuous spread of ages between 2.0-1.0 Ga, including significant populations in the 1.61-1.49 Ga “North American magmatic gap”, a pattern characteristic of Baltica. Some samples contain large populations of late Neoproterozoic (ca. 700-550 Ma) and/or Ordovician-Silurian (ca. 450-420 Ma) zircons; patterns ascribed to Timanian and Caledonian sources, respectively.

Together, these features suggest that Cordilleran terranes of inferred Arctic affinity probably occupied an intermediate position between Baltica, Laurentia and Siberia, in proximity to the northern Caledonides in Neoproterozoic-early Paleozoic time. Westward dispersion of these terranes is interpreted to result from development of a Scotia-style subduction system between Laurentia-Baltica and Siberia in mid-Paleozoic time – the Northwest Passage – following closure of the Iapetus ocean. Diachronous orogenic activity from Late Silurian in Arctic Canada to Early Devonian in north Yukon and Alaska records passage of some of these terranes. Westward propagation of a narrow subduction zone coupled with a global change in plate motion, linked to closure of the Rheic ocean, are proposed to have led to initiation of subduction along the western margin of Laurentia. This is recorded by the Late Devonian initiation of arc magmatism along western Laurentia, and the Late Devonian-Early Mississippian Antler orogeny in the western U.S. and Ellesmerian orogeny in the Canadian Arctic.