Sm-Nd and Detrital Zircon Provenance of Cambrian to Devonian Strata, Mackenzie Mountains, South Great Bear Lake, and Victoria Island, NT

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Summary

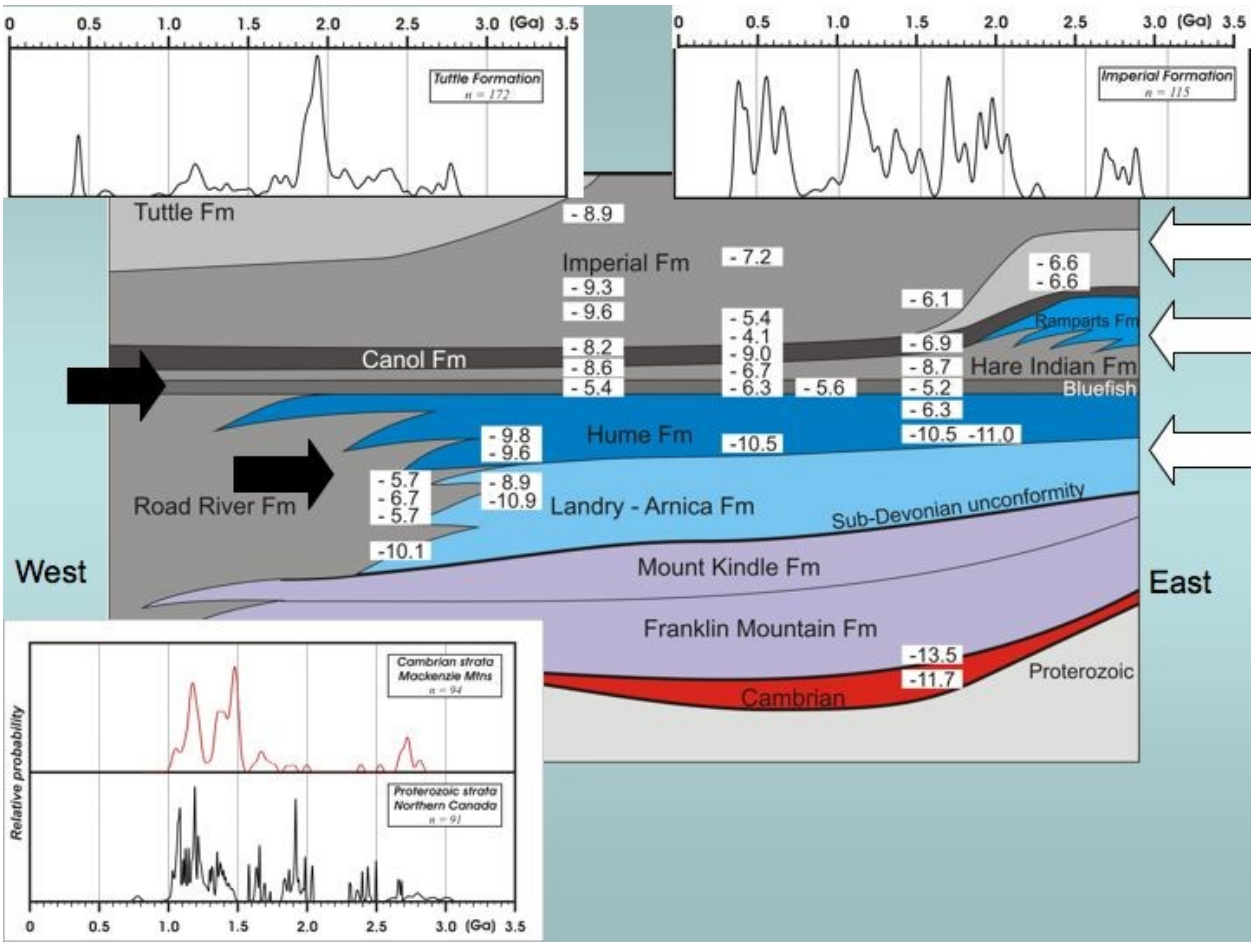
We present results from two complementary datasets that identify a change in provenance between Cambrian and Devonian strata of northern Northwest Territories.

Cambrian strata from Mackenzie Mountains, south Great Bear Lake, and Victoria Island were sampled for detrital zircon U-Pb analysis to establish a passive margin “baseline” for northern Canada. From Mackenzie Mountains, “Grenvillian” detrital zircon ages compare favourably with detrital zircon ages from the Proterozoic Mackenzie Mountains Supergroup (see figure below). Provenance of Cambrian samples from south of Great Bear Lake and Victoria Island are typical of Laurentian basement and consistent with Paleoproterozoic and Archean rocks of Wopmay Orogen and the Slave Craton.

It has been proposed that siliciclastic Devonian strata of Imperial Formation from Mackenzie Mountains were deposited in a foreland basin related in some way to the Ellesmerian Orogen (Embry and Klovan, 1976; Lane, 2007). Imperial Formation has been interpreted to have been deposited by a southwest prograding submarine fan and slope system in westward deepening basin (Hadlari et al., 2009). U-Pb detrital zircons from Imperial Formation characterize four sediment sources: one containing “Grenvillian” aged zircon; Archean and Paleoproterozoic ages typical of Laurentian basement; lower Paleozoic ages, ca. 360-500 Ma, attributed to arc magmatism; and ca. 500-700 Ma zircons that are exotic to Laurentia but typical of Baltican and Siberian sources. These data support the proposition of Arctic provenance for Imperial Formation.

Sm-Nd isotopes of shales from the southern Canadian Cordillera (Boghossian et al., 1996), northern Canadian Cordillera (Garzionne et al., 1997), and Arctic Canada (Patchett et al., 1999) have identified a shift from an evolved cratonic source to a more juvenile source prior to, or coincident with, the Lower Devonian. We analyzed Cambrian to upper Devonian shales from Mackenzie Mountains for Sm-Nd isotopes (figure below). Cambrian shales have epilson-Nd values less than -10 that we interpret to reflect a cratonic source characterizing the lower Paleozoic. Within Lower Devonian carbonate strata across Mackenzie Platform we identify an eastern cratonic source (approximate epsilon-Nd of -9), but also a western source of clay resulting in shales with epsilon-Nd values as high as -5.7. After drowning of the Mackenzie Platform that more juvenile source is recorded in shales of the Bluefish member and Canol Formations by epsilon-Nd values between -4.1 and -7. Accompanied by influx of siliciclastic sediment from the northeast, interpreted from detrital zircon ages as Arctic sources including Laurentian basement, Paleozoic arcs, and exotic crust, the more juvenile epsilon-Nd values of Canol Formation give way to more negative, or evolved, epsilon-Nd values of Imperial Formation.

Recent studies from the “pericratonic terranes” of the North American Cordillera have indicated that Upper Devonian arcs were built upon Laurentian basement, and were therefore probably attached to, and represent the western convergent margin of, Laurentia (e.g., Colpron and Nelson, 2009). In that context, we propose that the western-derived, more juvenile source of clay that was deposited on the Mackenzie Platform in the Devonian records arc magmatism of the western Laurentian margin.



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