

Detrital Zircon Geochronology and Provenance Analysis Applied to the Franklinian Basin, Canadian Arctic Islands

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Abstract

The provenance of the Neoproterozoic to Devonian Franklinian Basin of the Canadian Arctic Islands has been clarified with approximately 2000 new uranium-lead (U-Pb) ages from individual detrital zircons derived from 20 sandstone samples collected from 9 formations within the basin. These data provide new insight into the major sediment source areas, pathways, and depocenters in the region, and enable improved reconstructions of basin paleogeography over this time interval. The broad geographic (latitudinal range 82° N to 75° N; longitudinal range- 69° W to 120° W) and stratigraphic (9 formations) scope of this endeavor far exceeds all previous geochronologic provenance studies in the Franklinian Basin. In total, the data set presented here is nearly 50 times that of all previously published results from the Franklinian Basin. The extensive sample set was possible due to the generous donation of samples from the Geological Survey of Canada's archives in Calgary, which have been collected over the past 40 years of arctic expeditions.

Detrital zircon provenance studies entail the determination of U-Pb ages of 100 to 120 individual grains from each sample, and the correlation of these grain populations to specific sediment source areas. Formations included in the study are as follows: (1) Neoproterozoic Kennedy Channel Formation; (2) Cambrian Archer Fjord Formation; (3) Silurian Danish River Formation; (4) Devonian Bird Fjord Formation; (5) Devonian Strathcona Formation; (6) Devonian Hecla Bay Formation; (7) Devonian Fram Formation; (8) Devonian Beverly Inlet Formation; and (9) Devonian Parry Islands Formation.

The detrital zircon U-Pb ages demonstrate the Franklinian Basin succession is composed of strata with three distinctly different provenance signatures. Samples collected from the Neoproterozoic Kennedy Channel and Cambrian Archer Fjord formations include prominent populations of Paleoproterozoic and Neoproterozoic detrital zircons, and lack grains younger than the Paleoproterozoic. By the time the Silurian Danish River Formation was

deposited and until the late-Devonian Beverly Inlet Formation was deposited the primary populations of detrital zircon ages encompass the Devonian and Mesoproterozoic, yet the samples also contain large populations of Paleoproterozoic ages. A dominant population of Late Devonian to Cambrian detrital zircon with secondary populations of Neoproterozoic to Mesoarchean detrital zircon in the Upper Devonian Parry Islands Formation suggests a potential shift in sediment source relative to the underlying sedimentary units. Additionally, detrital zircon U-Pb ages from the Parry Islands Formation help constrain the depositional age of this formation.

The detrital zircon U-Pb ages of Franklinian strata shed light on the history of these sediments, from sedimentary source area to depocentre. In addition, because detrital zircons are often recycled from older strata into younger deposits, these data provide the basis for understanding the sedimentary provenance of overlying units, including those in the Sverdrup basin.

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