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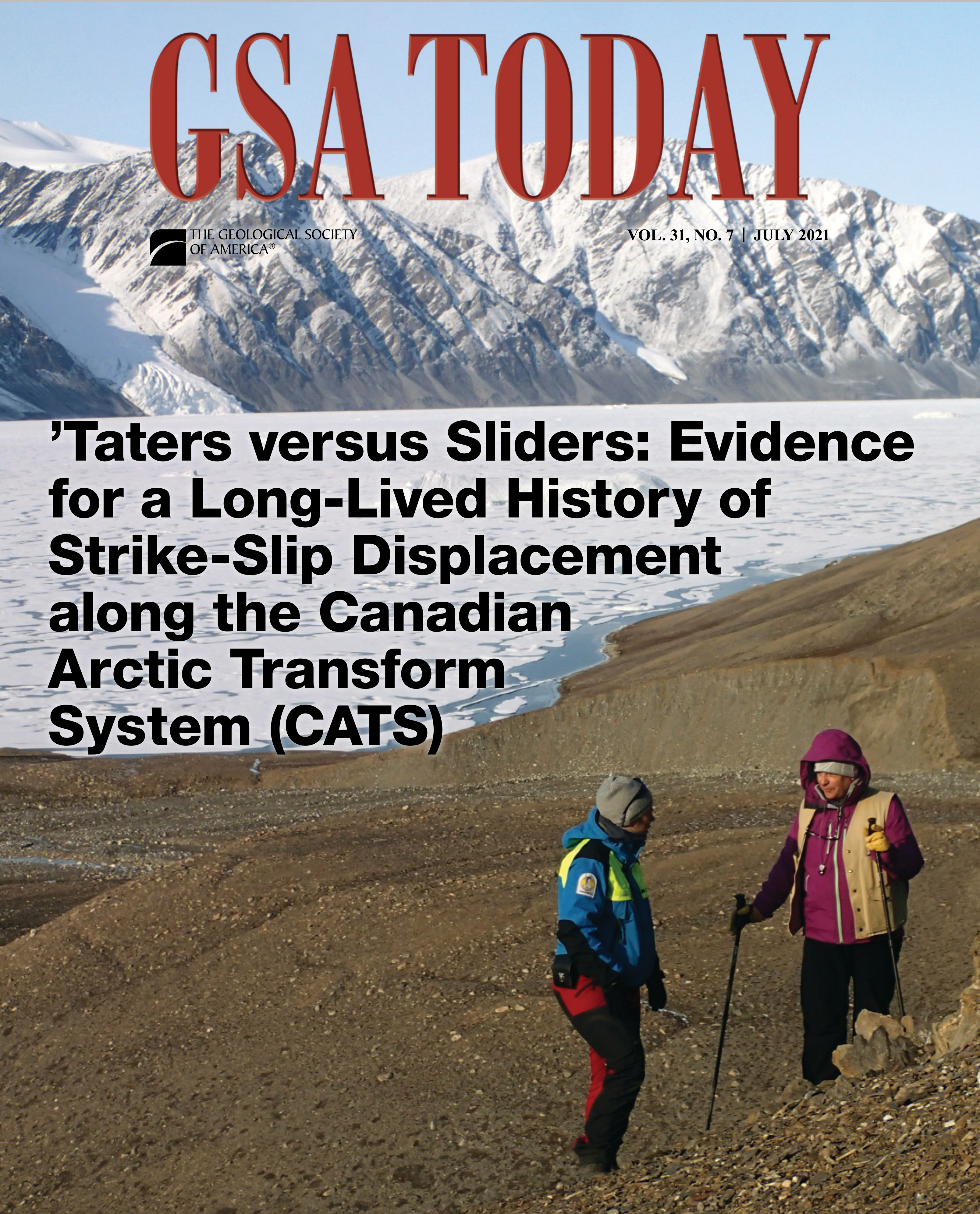

’Taters versus Sliders: Evidence for a Long-Lived History of Strike-Slip Displacement along the Canadian Arctic Transform System (CATS)

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ABSTRACT

Recent field-based studies indicate that the northern margin of North America is best interpreted as a tectonic boundary that experienced a long, complex history of strike-slip displacement. Structures juxtaposing the Pearya and Arctic Alaska terranes with North America are linked and define the Canadian Arctic transform system (CATS) that accommodated Paleozoic terrane translation, truncation of the Caledonian orogen, and shortening within the transpressional Ellesmerian orogen. The structure was reactivated during Mesozoic translational opening of the Canada Basin. Land-based evidence supporting translation along the Canadian Arctic margin is consistent with transform structures defined by marine geophysical data, thereby providing a robust alternative to the current consensus model for rotational opening of the Canada Basin.

INTRODUCTION

Recent ocean- and land-based studies of the circum-Arctic region bring significant advances in high-quality data to formulate new models for the tectonic evolution of the Arctic margin (e.g., Pease and Coakley, 2018; Piskarev et al., 2019; Piepjohn et al., 2019). Nevertheless, evolution of the Canada Basin remains one of the most enigmatic and contentious topics of the Arctic. Two end-member models for the Mesozoic opening of the Canada Basin invoke Arctic Alaska (1) rifting and rotating (*’taters*) from or (2) translating (*sliders*) along the Canadian Arctic margin (Fig. 1 inset). Late Paleozoic and Mesozoic stratigraphic correlations between the northwestern Alaskan and Canadian Arctic margins provide the clearest rationale for the rotation model (Embry, 1990), which is by far the most commonly expressed mechanism (e.g., Hutchinson et al., 2017; Miller et al., 2018). In contrast, we explore the implications of a growing set of onshore observations that indicate that the northern Laurentian margin has experienced a protracted history of translation. This view is bolstered by a variety of data that support models of Paleozoic large-magnitude terrane translation through the Arctic region (Colpron and Nelson, 2009). Despite early calls for large-magnitude sinistral offsets (e.g., Boreal fault of Bally in Kerr et al., 1982; Canadian transcurrent fault of Hubbard et al., 1987; Porcupine fault of Oldow et al., 1989), the Canadian Arctic margin generally has not been viewed as a viable candidate for transform boundaries to accommodate evolution of the Arctic region (e.g., Doré et al., 2016). Results of our recent field studies on the northern margin of Laurentia challenge this conclusion and support translation.

CURRENT SETTING

The Canadian Arctic Islands expose a south to north transition from shallow marine deposits of the Paleozoic Arctic platform into deep-water rocks of the late Proterozoic to early Paleozoic Franklinian basin that were deformed in the Devonian and overlain by late Paleozoic and early Mesozoic rocks of the Sverdrup basin. Rocks of the Franklinian basin were deposited after the Neoproterozoic breakup of Rodinia and rifting along the northern Laurentian margin, which closely followed mafic magmatism associated with the Franklin Large Igneous Province at 720 Ma (Macdonald et al., 2010; Cox et al., 2015). The basin is flanked to the north by Ordovician to Silurian clastic and subduction-related mafic and ultramafic rocks and allochthonous units of the Pearya terrane (Fig. 1; Trettin, 1998). The Pearya terrane is dominated by two assemblages juxtaposed in the Ordovician: a displaced peri-Laurentian crustal fragment that records early Neoproterozoic (Tonian) and Ordovician convergent margin magmatism (Malone et al., 2017, 2019) and a latest Neoproterozoic (Ediacaran) to Ordovician mafic arc complex built on Tonian basement (Majka et al., 2021). Steeply dipping faults juxtaposed Pearya with the Laurentian passive margin by the Devonian (Trettin, 1998; Malone et al., 2019). Subsequently, units of both the Pearya terrane and Franklinian basin were deformed within the Devonian–Carboniferous Ellesmerian fold belt and overlain by Carboniferous and younger deposits of the Sverdrup basin. Structures of the Ellesmerian fold belt extend westward to Prince Patrick Island where they, and Carboniferous to Mesozoic structures of the Sverdrup basin, are truncated at a high angle by the present-day Arctic margin (Fig. 1; Harrison and Brent, 2005).

Autochthonous strata of the Laurentian margin in northern Yukon are juxtaposed with peri-Laurentian platform and basinal strata of the North Slope subterrane of Arctic Alaska (Macdonald et al., 2009; Strauss et al., 2019a, 2019b; Colpron et al., 2019) on a near-vertical fault zone broadly referred to as the Porcupine shear zone (Fig. 1; von Gosen et al.,

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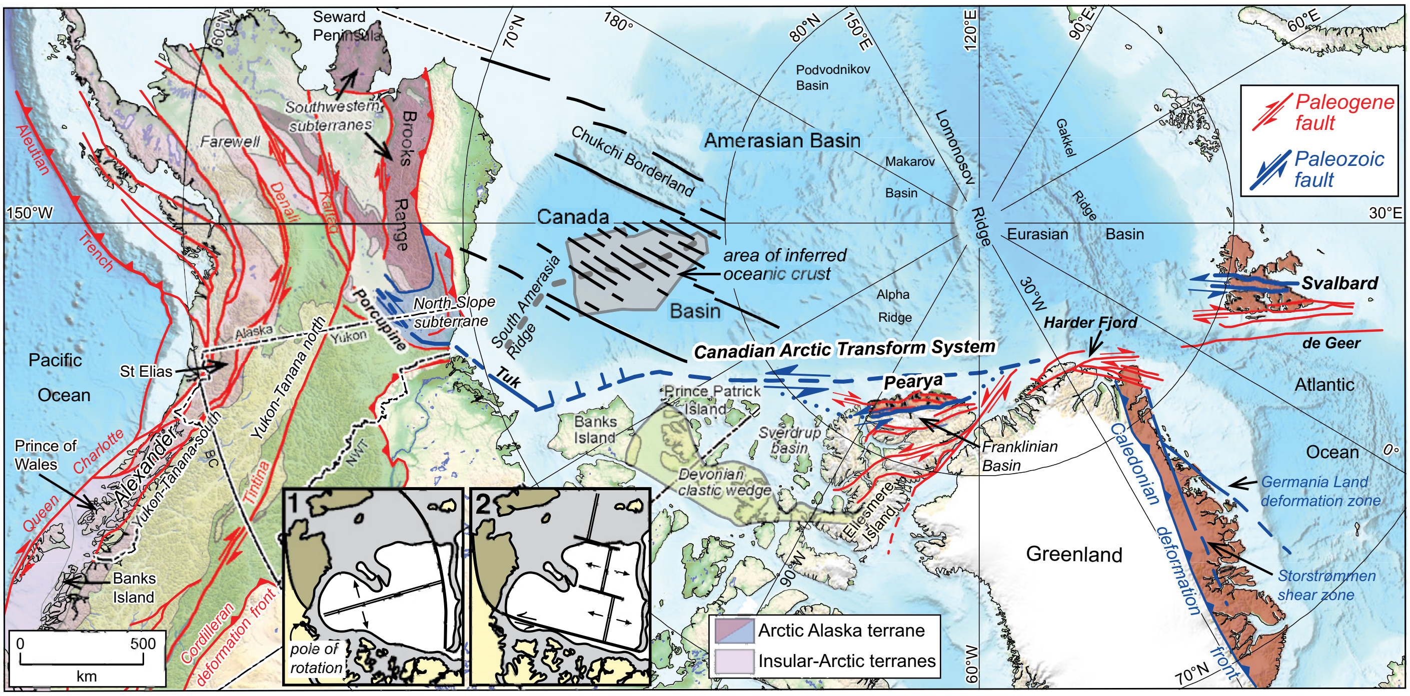

Figure 1. Generalized terrane map showing the location of the Canadian Arctic transform system, geophysically defined features in the Canada Basin, and terrane distribution on the Arctic and Cordilleran margins of Laurentia (modified after Colpron et al., 2019). Insets show simplified (1) rotation and (2) translation models (from Patrick and McClelland, 1995).

2019). The North Slope subterrane was incorporated into the greater Arctic Alaska terrane and juxtaposed with the Laurentian margin by the Carboniferous (Strauss et al., 2013). South-directed Late Devonian–Carboniferous structures on the north side of this boundary mark the probable offset western continuation of the Ellesmerian orogen (Oldow et al., 1987).

PALEOZOIC TERRANE ACCRETION AND TRANSLATION ON THE PEARYA AND PORCUPINE SHEAR ZONES

Models that invoke terrane translation from the Arctic domain to the Cordilleran margin (e.g., Northwest Passage model; Colpron and Nelson, 2009) require a transcurrent boundary along the Paleozoic Arctic margin. Evidence for such a boundary on Ellesmere Island was outlined by Trettin (1998) in his assessment of the history of Pearya. Recent fieldwork has confirmed that Pearya is separated from the Laurentian margin by vertical strike-slip structures that record a complex history of reactivation, overprinting, and reversals in displacement direction (Piepjohn et al., 2015). Current timing estimates for Paleozoic sinistral displacement suggest a long-lived Ordovician to Devonian metamorphic and deformation history associated with juxtaposition and translation of Pearya along the Laurentian margin (McClelland et al., 2012; Kośmińska et al., 2019).

Structures that accommodated translation of Pearya project eastward to faults with similar timing and kinematics in Svalbard (Fig. 1; Mazur et al., 2009). Although commonly linked with strike-slip faults in the Caledonides (e.g., Storstrømmen shear zone; Fig. 1), we suggest that faults in Svalbard truncate the Caledonian structures and continue eastward to Scandinavia as the de Geer transform (Fig. 1; Lundin and Doré, 2019). The Harder Fjord fault zone, a long-lived steep structure that juxtaposes Ediacaran arc rocks with the Franklinian margin on North Greenland (Rosa et al., 2016), is similar to faults in Pearya and Svalbard (Fig. 1).

Strike-slip faults project westward from Pearya to the boundary between the Laurentian margin and North Slope subterrane in Yukon (Fig. 1). This boundary is marked by the Porcupine shear zone, a broad fault zone (>17 km wide) of older sinistral and recent (late Cenozoic) dextral brittle deformation (von Gosen et al., 2019). The lithology and structural history of the North Slope subterrane contrast sharply with the adjacent Laurentian margin rocks and are more akin to units in northeastern Laurentia (Macdonald et al., 2009; Strauss et al., 2013; Gibson et al., 2021). Although originally interpreted to crosscut the shear zone (Lane, 1992), Devonian granitoids common to the North Slope subterrane were emplaced within the Porcupine shear zone while it was an active lithosphere-scale transform (Ward et al., 2019). Strike-slip basin sedimentation may be recorded by the newly recognized Devonian–Carboniferous Darcy Creek formation within the Porcupine shear zone (Faehnrich et al., 2021).

Linking strike-slip structures across Svalbard and northern Ellesmere Island to Yukon and Alaska on the basis of orientation, timing, and kinematics defines a throughgoing Paleozoic fault system on the northern Laurentian margin (Fig. 1), referred to here as the Canadian Arctic margin transform system (CATS). Recognition of CATS carries significant implications for Paleozoic paleogeographic reconstructions of the northern Laurentian margin. Displacement and terrane juxtaposition along the margin culminated with south-directed shortening of the Late Devonian–Early Carboniferous Ellesmerian orogeny and development of a thick clastic wedge derived from a continental sediment source to the north. The nature of this northern source remains tentative but is most probably derived from the Arctic Alaska–Chukotka terrane (Beranek et al., 2010; Anfinson et al., 2012). The CATS model that accommodates large-magnitude translational motion of terranes suggests the source may have varied through time.

GRAINS AND TERRANES: WHERE DID THEY COME FROM?

Evidence for terrane displacement along the Arctic margin can be evaluated by comparing detrital zircon data from the Paleozoic passive margin to terranes thought to have moved along it. Critical components include (1) variation in detrital zircon signatures across northern Laurentia; (2) the ca. 970 Ma signature of the convergent margin external to Rodinia; (3) Neoproterozoic magmatic ages; and (4) Ordovician, Silurian, and Devonian arc magmatism common to many of the displaced terranes. Tracking detrital zircons in combination with their Hf isotopic signatures demonstrates significant differences in provenance history between Arctic terranes and the Laurentian margin. For example, Proterozoic to Devonian units of Svalbard remain similar throughout their evolution, whereas Proterozoic to Silurian components of the Alexander terrane are highly variable but coalesce to a common signature in the Devonian (Fig. 2A).

The terranes of Svalbard, Pearya, and North Slope show clear evidence of Mesoproterozoic and older material consistent with derivation from Laurentia but distinct from passive margin units in the Franklinian basin. The Precambrian signature of the North Slope subterrane is most compatible with northeastern Laurentia (Greenland), making a strong case for large-scale translation of a peri-Laurentian fragment along the Arctic margin (Gibson et al., 2021). The Tonian (ca. 970 Ma) signature of the Pearya, Svalbard, Arctic Alaska, and Farewell terranes clearly distinguishes these crustal fragments from the Franklinian margin (Fig. 2). The Tonian signature is subtle to absent in the Alexander and Yukon-Tanana terranes, making it a useful discriminant as well. Evidence for Neoproterozoic–early Paleozoic (710–520 Ma) magmatism coeval with activity in the Timanide orogen of eastern Baltica (Fig. 3) appears in the Pearya, Arctic Alaska, Farewell, and Alexander terranes, but is notably missing from the Laurentian signature of the North Slope subterrane and Franklinian basin. Terranes with this signature are assigned origins adjacent to Baltica or Siberia (e.g., Beranek et al., 2013; White et al., 2016), consistent with faunal (Soja and Antoshkina, 1997) and paleomagnetic (Bazard et al., 1995) data.

Ordovician to Silurian arc magmatism observed in the Arctic terranes indicates that they largely represent displaced arc fragments. The age of individual peaks varies by terrane, and Hf isotopes range from juvenile (>+5 $\varepsilon \mathrm{Hf}_t$) to evolved (<–5 $\varepsilon \mathrm{Hf}_t$) settings (Fig. 2B), tracking differences in arc basement and proximity to active convergent boundaries. For example, Ordovician signatures are dominant in the Pearya, Alexander, Farewell, and Arctic Alaska terranes, but lacking in Svalbard and portions of the Yukon-Tanana terrane. Silurian magmatic rocks are absent from Pearya and the North Slope subterrane although both regions record influx of Silurian detrital components. The $\varepsilon \mathrm{Hf}_t$ signatures for Ordovician and

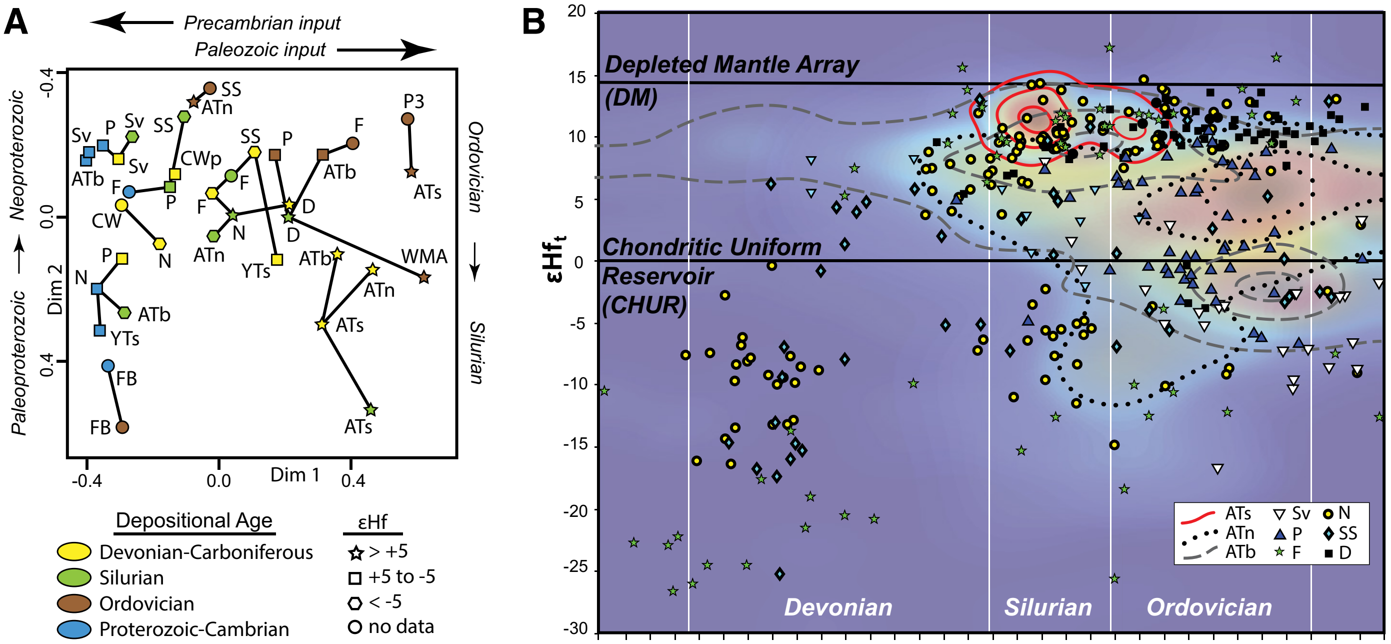

Figure 2. (A) Two-dimensional multidimensional scaling (MDS) plot (Saylor et al., 2017; Kolmogorov-Smirnov comparison of probability density plots, metric squared test = 0.137) and (B) age-$\varepsilon \mathrm{Hf}_t$ plot of detrital zircon data from units involved in translation along the Canadian Arctic transform system. Annotations on (A) show general detrital age trends reflected in the MDS plot. Alexander terrane data in (B) is plotted as contoured density maps of bivariate kernel density estimates with contours of 68% (1σ) and 95% (2σ) of peak density and cool to hot color gradient reflecting increasing peak density (Sundell et al., 2019). Data from Svalbard (Sv); Franklinian basin (FB); Pearya terrane (P; P3—Succession 3); Canadian Arctic Islands clastic wedge (CW; CWp—Parry Islands Formation); Arctic Alaska terrane (N—North Slope subterrane; SS—southwestern subterranes; D—Doonerak; WMA—Whale Mountain Allochthon); Farewell terrane (F); Alexander terrane (AT: ATn—northern, St. Elias; ATs—southern, Prince of Wales Island; ATb—Banks Island assemblage); the Yukon-Tanana terrane (YTs) in southeastern Alaska is presented in additional plots and references in the supplemental material[1].

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[1] Supplemental Material. Probability plots, Shepard plot, and sources of U/Pb data in Figure 2A. Go to https://doi.org/10.1130/GSAT.S.14442635 to access the supplemental material; contact editing@geosociety.org with any questions.

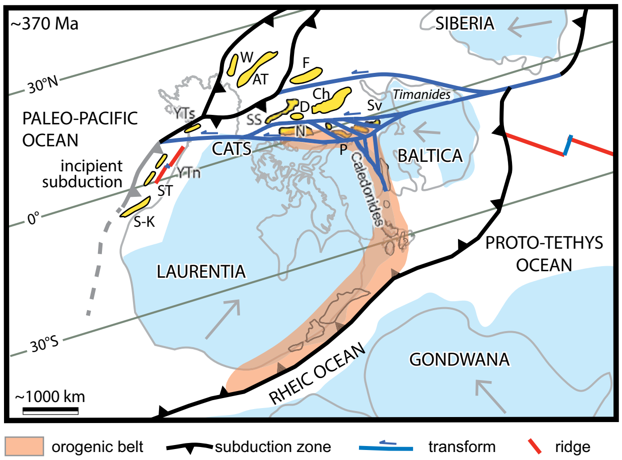

Figure 3. Schematic Devonian paleogeographic reconstruction showing terrane translation on the Canadian Arctic transform system (CATS). Modified after Torsvik and Cocks (2017). AT—Alexander terrane; Ch—Chukotka; D—Doonerak arc; F—Farewell; N—North Slope subterrane; P—Pearya terrane; S-K—Sierra-Klamath terranes; SS—southwestern Arctic Alaska subterranes; ST—Stikinia; Sv—Svalbard; W—Wrangellia; YTn—Yukon-Tanana terrane in Yukon; YTs—Yukon-Tanana terrane in southeastern Alaska.

Silurian zircon in most terranes, ranging from +5 to –15, record evolution in settings with variable input from older continental sources, either from the arc basement or influx of continentally derived sedimentary material. In stark contrast, the southern Alexander terrane on Prince of Wales Island, along with the Doonerak arc and Whale Mountain allochthon of Arctic Alaska, consistently have a juvenile signature that indicates evolution in an intraoceanic setting isolated from any continental input throughout their pre-Devonian history (Fig. 2).

Devonian–Carboniferous detrital zircon signatures define amalgamation of terranes and juxtaposition with the Arctic margin. The Devonian clastic wedge in the Canadian Arctic Islands records deposition on Laurentia from a more juvenile source emplaced along the Franklinian margin (Patchett et al., 1999). Late Devonian units (e.g., Parry Islands Formation) at the top of the wedge are dominated by Neoproterozoic to Devonian grains with juvenile $\varepsilon\mathrm{Hf}_t$ (Anfinson et al., 2012). This shift in signature is consistent with recycling of Silurian units from the Pearya, Farewell, northern Alexander, and Arctic Alaska terranes (Fig. 2). The $\varepsilon\mathrm{Hf}_t$ values for Ordovician to Early Devonian grains in many terranes are markedly juvenile but show a sharp pull down in the Late Devonian (Fig. 2), which reflects increased crustal involvement due to contraction and perhaps collision. The Banks Island and northern (St. Elias) units of the Alexander terrane (Fig. 1) show a transition from strongly evolved in Ordovician–Silurian grains to dominantly juvenile values—a signature that is more consistent with the southern Alexander terrane (Fig. 2). This transition, combined with the similarity in detrital zircon patterns, suggests Devonian amalgamation of the disparate Alexander fragments.

PALEOZOIC EVOLUTION OF THE NORTHERN LAURENTIAN MARGIN

The variations in zircon age and $\varepsilon\mathrm{Hf}_t$ signatures in circum-Arctic and Cordilleran terranes record changes in Paleozoic arc magmatism that broadly represent a northern continuation of the arc system associated with closure of Iapetus and the subsequent Silurian collision of Baltica with Laurentia (Fig. 3; Strauss et al., 2017). These arc complexes are best viewed as age equivalent to subduction-related rocks preserved in the thrust sheets of the Caledonides. Svalbard represents a Caledonian signature; however, the other circum-Arctic terranes are arc complexes that extended beyond the Caledonides and are characterized by a mixture of juvenile intraoceanic fragments (e.g., southern Alexander terrane, Doonerak) and arc fragments with continental substrates (e.g., Pearya, northern Alexander terrane).

Translation associated with the CATS initiated as Ordovician and Silurian subduction migrated along the northern Laurentian margin. Subduction-related rocks inboard of Pearya are inferred to record transpressional collapse of the Ordovician arc against the Franklinian margin, with Silurian arc activity continuing offshore as subduction migrated westward. The location of Siberia and its role in the transfer of circum-Arctic terranes to the Cordilleran margin is poorly understood, but relative motion between Baltica, Siberia, and the Arctic terranes likely increased after the Silurian Baltica–Laurentia collision. Silurian translation placed several crustal fragments and arc terranes along the Arctic margin. Silurian to Early Devonian arc activity continued in outboard terranes destined to approach the Cordilleran realm.

Devonian displacement on the CATS emplaced Pearya and the North Slope subterrane along the Laurentian continental margin, with the rest of Arctic Alaska and Alexander located farther outboard. Final contraction in the northern Caledonides, represented by ultrahigh-pressure metamorphism at 360 Ma in North-East Greenland, was accompanied by sinistral and dextral translation that accommodated margin-parallel escape from the orogen (Gilotti and McClelland, 2007). This intra-Caledonian strike-slip system was truncated by the CATS, effectively transferring Caledonian rocks of Svalbard to the Arctic margin (Fig. 3). The eastern continuation of CATS projects toward the truncated margin of northern Scandinavia marked by the Trollfjord-Komagelva fault system, requiring an Ordovician–Devonian strike-slip history on this or an outboard structure along the Timanide-Baltica suture.

The amalgamated terranes translated along the Arctic margin shed detritus with characteristic juvenile isotopic signatures (e.g., Anfinson et al., 2012) southward into the Canadian Arctic Island clastic wedge (Fig. 1). Middle Devonian arc magmatism developed in Arctic Alaska simultaneously with clastic wedge deposition. This activity was contemporaneous with Uralian arc magmatism on the Baltican margin, but the two systems were separated by the CATS. The Late Devonian marks a transition to subduction initiation along the western margin of Laurentia with granitic magmatism present in the North Slope subterrane to the north and Yukon-Tanana, Stikinia, Quesnellia, Kootenay, and Sierra-Klamath terranes to the south (Fig. 3). The CATS effectively accommodated migration of Paleozoic arcs active outboard of the Laurentian margin into the paleo-Pacific realm. Latest stages of Ellesmerian shortening and translation on the northern margin coincide with the start of Yukon-Tanana magmatism in the northern Cordillera (Colpron and Nelson, 2009).

MESOZOIC TRANSLATION AND OPENING OF THE CANADA BASIN

Despite lithologic, sedimentologic, and structural arguments for translation of Arctic Alaska along the northern Laurentian margin (Patrick and McClelland, 1995; Oldow et al., 1987, 1989; Dickinson, 2009), Early Cretaceous counterclockwise rotation of Alaska is the generally accepted model for opening of the Canada Basin (Grantz et al., 2011). The rotation model persists in large part due to a perceived lack of evidence for Mesozoic displacement on the Canadian

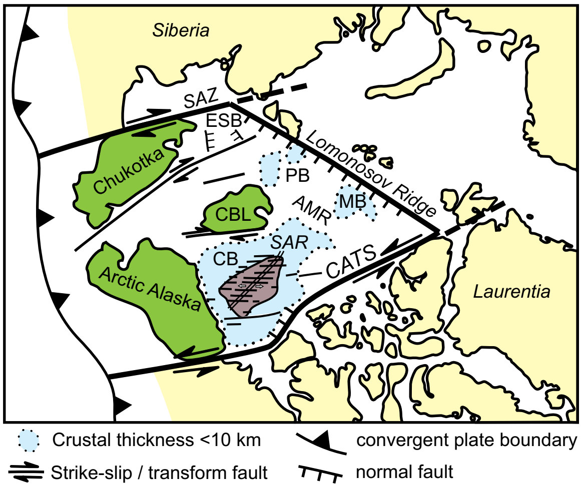

Figure 4. Schematic Mesozoic paleogeographic reconstruction showing the role of the Canadian Arctic transform system (CATS) in opening of the Canada Basin and large magnitude extension in the Amerasian Basin. Modified after Patrick and McClelland (1995), Dickinson (2009), Miller et al. (2018), and Døssing et al. (2020). AMR—Alpha-Mendelev Ridge; CB—Canada Basin; CBL—Chukchi Borderland; ESB—East Siberian basins (see Nikishin et al., 2021); MB—Makarov basin; PB—Podvodnikov basin; SAR—south Amerasia ridge; SAZ—South Anyui suture zone. Extent of thin crust (<10 km) is from Lebedeva-Ivanova et al. (2019).

Arctic margin. Strike-slip faults are clearly exposed on Ellesmere Island and record a complex history of post-Carboniferous to Eocene sinistral and dextral displacement (Piepjohn et al., 2013). These structures record reactivation of the Paleozoic transform margin. West of Ellesmere Island to the Yukon-Alaska mainland, the structural history of the Canadian margin is in question.

Although conventionally interpreted as representative of Mesozoic extension, published seismic reflection profiles across the northern boundary of the Sverdrup basin (Embry and Dixon, 1990) show the boundary to be disrupted by near-vertical faults more reasonably interpreted as strike-slip faults. The faults separate blocks with substantial differences in thickness of Late Jurassic and Early Cretaceous sedimentary rocks. The faults cut and are locally sealed by Late Cretaceous clastic rocks that indicate displacement into the late Mesozoic. Along Prince Patrick Island, the faults truncate Paleozoic and Mesozoic stratigraphic and structural trends at a high angle to the margin (Harrison and Brent, 2005). Local evidence of extensional deformation is described along Banks Island (Fig. 1; Helwig et al., 2011) in a segment of the boundary characterized by a slight deflection in strike consistent with an extensional step in a sinistral transcurrent fault system (Fig. 4). Seismic sections west of Banks Island document near-vertical structures that truncate the continental margin along the Tuk transform (Helwig et al., 2011).

The Porcupine shear zone, separated from the Tuk transform to the east by a series of north-striking Cenozoic faults that record east-west contraction and disrupt the simple continuation of the CATS, is essential to translation models for opening of the Canada Basin. Preliminary structural studies supported Late Jurassic to Early Cretaceous sinistral transpression along the Porcupine shear zone (Oldow and Avé Lallemant, 1993). Recent studies have demonstrated that reactivation of the Porcupine shear zone involved Jurassic and Cretaceous rocks (von Gosen et al., 2019). Although the magnitude and timing of Mesozoic displacement on the Porcupine shear zone is not well documented at present, sinistral translation associated with opening of the Canada Basin is clear.

Marine geophysical data have long been interpreted in support of the rotation model, particularly satellite gravity data that was inferred to represent a spreading center (McAdoo et al., 2008). New data suggest a much more limited extent of oceanic crust (Chian et al., 2016), and interpretation of geophysical lineaments as transform structures has produced models invoking strike-slip faults within the Canada Basin (Hutchinson et al., 2017). These new models will be greatly improved by incorporating the CATS. In fact, the recent transform model of Døssing et al. (2020) explicitly requires sinistral translation on the Porcupine shear zone. Many uncertainties remain regarding the crustal composition and the timing and magnitude of extension within the Canada Basin and broader Amerasian Basin (Lebedeva-Ivanova et al., 2019), but tectonic models place the region in a back arc setting relative to the Mesozoic Cordilleran margin (Miller et al., 2018). Integrating our land-based observations of translation with the offshore geophysics provides a realistic geodynamic model for the Cretaceous opening of the Canada Basin in this setting (Fig. 4). The greater Amerasian Basin is best viewed as a domain of large-magnitude extension in response to slab rollback on the paleo-Pacific margin that is bound by strike-slip displacement on the Laurentian and Siberian margins (Miller et al., 2018). Transforms on the Siberian margin and within the Canada Basin are commonly accepted as components of the rotational model (Amato et al., 2015; Doré et al., 2016). Sinistral reactivation of the CATS on the Laurentian margin similarly bounds the extensional domain to the south. Block rotation of northern Alaska related to opening of the Canada Basin is permissible but no longer required.

Cenozoic reactivation of the CATS is recorded along its length. Displacement on the de Geer transform during opening of the Eurasian Basin records reactivation at the eastern end (Doré et al., 2016). Dextral displacement along the Arctic margin (Piepjohn et al, 2013) and the Porcupine shear zone marks reactivation of the central and western segments of the CATS, respectively. Activity on the western CATS was linked with continued evolution of the Cordilleran strike-slip orogen (Murphy, 2019).

CONCLUDING REMARKS

Available field evidence strongly supports the presence of a long-lived strike-slip fault extending from North Greenland westward to Alaska along the northern Laurentian margin. Onshore and offshore observations are consistent with Paleozoic translation of arc terranes and crustal fragments along the CATS, followed by Mesozoic reactivation to accommodate regional extension of continental and hybrid crust (Miller et al., 2018) during translational opening of the Canada Basin. Ongoing geochronologic and kinematic studies of fault rocks will provide additional insight on the magnitude, timing, and direction of displacement along the length of the boundary. Pre-Devonian terrane translation complicates restorations based on age or lithologic similarities since many correlations are non-unique. In addition, extension within the Canada Basin accommodated by transform boundaries on the Canadian and Chukchi Borderland margins does not preclude block rotation within the basin, leading to hybrid models (Miller et al., 2018).

The rotation model for opening of the Canada Basin has long rested on stratigraphic arguments (e.g., Embry, 1990). Early structural analysis recognized translation of units with different Paleozoic and Mesozoic deformation histories (Oldow et al., 1987, 1989), but the necessary kinematic and timing constraints were missing, thus allowing the rotation model to persist as the consensus model with little supporting structural evidence. For instance, no demonstrable increase in shortening along the length of the Brooks Range or obvious contraction south of the rotation axis in the Mackenzie delta exists to support rotation. The rotation model has in essence achieved the status of a Geomyth (Dickinson, 2003) since it is commonly assumed and rarely tested. Future models for Mesozoic opening of the Canada Basin will need to merge existing stratigraphic and geophysical observations with the substantial database that documents the Paleozoic evolution and Mesozoic–Cenozoic reactivation of the CATS in order to solve a tectonic problem that has dogged the community for decades.

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