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The Origin of Laurentia
Rae Craton as the Backstop for Proto-Laurentian Amalgamation by Slab Suction

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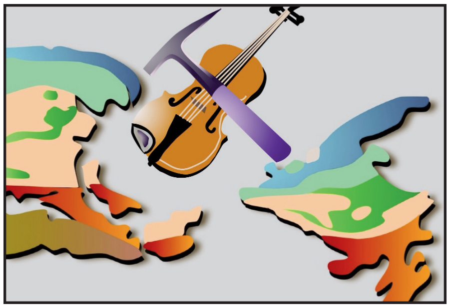
Résumé de l'article

La proto-Laurentie (c.-à-d. la Laurentie pré-grenvillienne) est un agrégat d'au moins six cratons archéens indépendants qui se sont amalgamés convulsivement durant les géons 19 et 18 (Orosirien), le long de zones de croûtes juvéniles paléoprotérozoïques réparties de manière hétérogène. Les polarités de subduction et les âges de collision entre les grands cratons (et d'autres moins grands) ont été provisoirement déduits, le plus récemment entre le craton de Rae et le craton de Hearne. Les plus anciennes collisions orosiriennes ont soudé le craton de Rae : 1,97 Ga (orogène de Taltson-Thelon) dans l'ouest, et 1,92 Ga (orogène de Snowbird) dans le sud-est. Tous les autres âges de collision en proto-Laurentie sont inférieurs à 1,88 Ga. Le craton de Rae constituait la plaque supérieure durant la convergence de plaque (asynchrone) à sa marge ouest, et peut-être aussi à ses marges sud-est. La convergence de plaque subséquente dans les orogènes de Wopmay et Trans-Hudson a été complexe, le craton de Rae étant encastré dans la plaque inférieure avant les premiers événements d'accrétion (orogènes caldérienne, de Reindeer et de Fox), puis dans la plaque supérieure durant la grande convergence subséquente et les collisions terminales, ce qui a créé les arcs magmatiques de Great Bear et de Cumberland respectivement. La théorie de « l'orthoversion » de la succession des supercontinents présuppose que les supercontinents s'amalgament au-dessus de creux géoïdaux en deçà d'une gaine méridienne de convections mantéliques descendantes, à angle droit d'un super-renflement persistant au site d'un ancien supercontinent. Si le noeud de convection descendante s'établit par rétroaction positive de la descente de plaques océaniques froides, la traction visqueuse devrait contribuer à entraîner les cratons ensembles au-dessus du noeud de convection descendante. Vu de cette façon, le craton de Rae a été le premier à s'établir au-dessus du noeud de convection descendante, ce qui en a fait la butée des autres cratons entraînés par la subduction. Littéralement, telle a été l'origine de la Laurentie. Quant à savoir si c'est le craton de Rae qui a été à l'origine de Nuna, cet hypothétique surpercontinent cogénétique, cela dépend des âges et des polarités de subduction des sutures orosiriennes au-delà de la proto-Laurentie.

HAROLD WILLIAMS SERIES



The Origin of Laurentia: Rae Craton as the Backstop for Proto-Laurentian Amalgamation by Slab Suction

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SUMMARY

Proto-Laurentia (i.e. pre-Grenvillian Laurentia) is an aggregate of six or more formerly independent Archean cratons that amalgamated convulsively in geons 19 and 18 (Orosirian Period), along with non-uniformly distributed areas of juvenile Paleoproterozoic crust. Subduction polarities and collision ages have been provisionally inferred between the major cratons (and some minor ones), most recently between the Rae and Hearne cratons. The oldest Orosirian collisions bound the Rae craton: 1.97 Ga (Taltson-Thelon orogen) in the west, and 1.92 Ga (Snowbird orogen) in the southeast. All other Orosirian collision ages in proto-Laurentia are < 1.88 Ga.

The Rae craton was the upper plate during (asynchronous) plate convergence at its western and, tentatively, southeastern margins. Subsequent plate convergence in the Wopmay and Trans-Hudson orogens was complex, with the Rae craton embedded in the lower plate prior to the first accretion events (Calderian, Reindeer and Foxe orogenies), but in the upper plate during major subsequent convergence and terminal collisions, giving rise to the Great Bear and Cumberland magmatic arcs, respectively.

The 'orthoversion' theory of supercontinental succession postulates that supercontinents amalgamate over geoidal lows within a meridional girdle of mantle downwellings, orthogonal to the lingering superswell at the site of the former supercontinent. If the downwelling nodes develop through positive feedback from the descent of cold oceanic slabs, then viscous traction should contribute to drawing the cratons together over the downwelling node. Viewed in this way, the Rae craton was the first to settle over the downwelling node and became the backstop for the other cratons that were drawn towards it by subduction. It was, literally, the origin of Laurentia.

Whether the Rae craton was also the origin of Nuna, the hypothetical cogenetic supercontinent, depends on ages and subduction polarities of Orosirian sutures beyond proto-Laurentia.

SOMMAIRE

La proto-Laurentie (c.-à-d. la Laurentie pré-grenvillienne) est un agrégat d'au moins six cratons archéens indépendants qui se sont amalgamés convulsivement durant les géons 19 et 18 (Orosirien), le long de zones de croûtes juvéniles paléoprotérozoïques réparties de manière hétérogène. Les polarités de subduction et les âges de collision entre les grands cratons (et d'autres moins grands) ont été provisoirement déduits, le plus récemment entre le craton de Rae et le craton de Hearne. Les plus anciennes collisions orosiriennes ont soudé le craton de Rae : 1,97 Ga (orogène de Taltson-Thelon) dans l'ouest, et 1,92 Ga (orogène de Snowbird) dans le sud-est. Tous les autres âges de collision en proto-Laurentie sont inférieurs à 1,88 Ga.

Le craton de Rae constituait la plaque supérieure durant la convergence de plaque (asynchrone) à sa marge ouest, et peut-être aussi à ses marges sud-est. La convergence de plaque subséquente dans les orogènes de Wopmay et Trans-Hudson a été complexe, le craton de Rae étant encastré dans la plaque inférieure avant les premiers événements d'accrétion (orogènes caldérienne, de Reindeer et de Fox), puis dans la plaque supérieure durant la grande convergence subséquente et les collisions terminales, ce qui a créé les arcs magmatiques de Great Bear et de Cumberland respectivement.

La théorie de « l'orthoversion » de la succession des supercontinents présuppose que les supercontinents s'amalgament au-dessus de creux géoïdaux en deça d'une gaine méridienne de convections mantéliques descendantes, à angle droit d'un super-renflement persistant au site d'un ancien supercontinent. Si le nœud de convec-

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Table 1. Estimated collision ages and subduction polarities for Orosirian sutures in proto-Laurentia

Orogen	Collision	Upper plate	Lower plate	References
Thelon - Taltson	1.97 Ga	Rae	Slave	van Breemen et al. (1987); Bostock et al. (1987); James et al. (1988); van Breemen and Henderson (1988); Grotzinger and Royden (1990); Tirrul and Grotzinger (1990); Bowring and Grotzinger (1992); Thériault (1992); McDonough et al. (2000)
Snowbird	1.92 Ga	Rae	Hearne	Berman et al. (2007); Martel et al. (2008)
Wopmay	1.88 Ga	Hottah	Slave	Hildebrand et al. (2010); Hoffman et al. (2011)
Foxe - Rinkian	1.88 Ga	Rae	Meta Incognita-Disco	Connelly et al. (2006); St-Onge et al. (2007)
Great Falls	1.87 Ga	Medicine Hat	Wyoming	Mueller et al. (2002)
Torngat - Nagssugtoqidian	1.86 Ga	North Atlantic	SE Churchill-Disco	Scott (1998); van Gool et al. (2002); Kolb (2014)
Penokean	1.85 Ga	Marshfield	Superior	Schulz and Cannon (2007)
Vulcan	1.84 Ga	Medicine Hat	Hearne	Eaton et al. (1999)
Wopmay	1.84(?) Ga	Hottah	Nahanni	Cook (2011)
Trans-Hudson (southern)	1.83 Ga	Hearne	Superior	Corrigan et al. (2009); Maxeiner and Rayner (2011)
New Quebec	1.82 Ga	SE Churchill	Superior	Wardle et al. (2002)
Trans-Hudson (northern)	1.82 Ga	Rae	Superior	Machado et al. (1993); St-Onge et al. (2006, 2007); Berman et al. (2013)

tion descendante s’établit par rétroaction positive de la descente de plaques océaniques froides, la traction visqueuse devrait contribuer à entraîner les cratons ensembles au-dessus du nœud de convection descendante. Vu de cette façon, le craton de Rae a été le premier à s’établir au-dessus du nœud de convection descendante, ce qui en a fait la butée des autres cratons entraînés par la subduction. Littéralement, telle a été l’origine de la Laurentie.

Quant à savoir si c’est le craton de Rae qui a été à l’origine de Nuna, cet hypothétique supercontinent cogénétique, cela dépend des âges et des polarités de subduction des sutures orosiriennes au-delà de la proto-Laurentie.

INTRODUCTION

In his postcards showing the tectonic elements of the North American continent, Hank Williams divided the Churchill Province roughly in half along a hypothetical suture, the Snowbird tectonic zone, separating what he called the North and South Keewatin cratons (Williams et al. 1991). With the disappearance of the District of Keewatin as a political entity, Hank’s cratons reverted to their synonyms, the Rae and Hearne cratons respectively (Hoffman 1988; Eglington et al. 2013). The collision zone between the two cratons, originally inferred from reconnaissance geology, gravity gradient maps, aeromagnetic discontinuities, and seismic soundings (Taylor 1963; Sharpton et al. 1987; Hoffman 1990; Ross et al. 1995), has been confirmed in the last decade by inter-cratonic comparative geology, igneous petrology, metamorphic thermobarometry, and U–Pb geochronology (Mahan et al. 2006; Berman et al. 2007; Martel et al. 2008). Although no well-defined magmatic arc is recognized, a subduction zone dipping northwest under the Rae craton is tentatively inferred from magmatic and metamorphic asymmetry across the suture zone (Berman et al. 2007). The best estimate of the age of collision between the Rae and Hearne cratons is 1.92 Ga (Berman et al. 2007; Martel et al. 2008).

Outside of largely ice-covered Greenland, the Snowbird tectonic zone was the last of the major Orosirian (2.05 – 1.80 Ga, Gradstein et al. 2012) geosutures in proto-Laurentia to be dated. The age sequence and inferred subduction polarity of sutures can now be tabulated (Table 1 and Fig. 1). Subduction polarity refers to the time of large ocean closure leading to craton-craton collision, not to earlier arc- and continental ribbon-accretion events that typically involve subduction flips (e.g. Suppe 1984), nor to post-collisional convergence when structural vergence may flip as a result of *retrocharriage* (Roeder 1973). The suture sequence and polarity patterns shed light on the dynamics of cratonic convergence and amalgamation (Faccenna et al. 2013; see also Hager and O’Connell 1978; Hager et al. 1983). If plate convergence was driven primarily by ‘slab rollback’ (Fig. 2A), we should expect that suture ages would decrease with distance from the Superior craton, which was the lower plate with respect

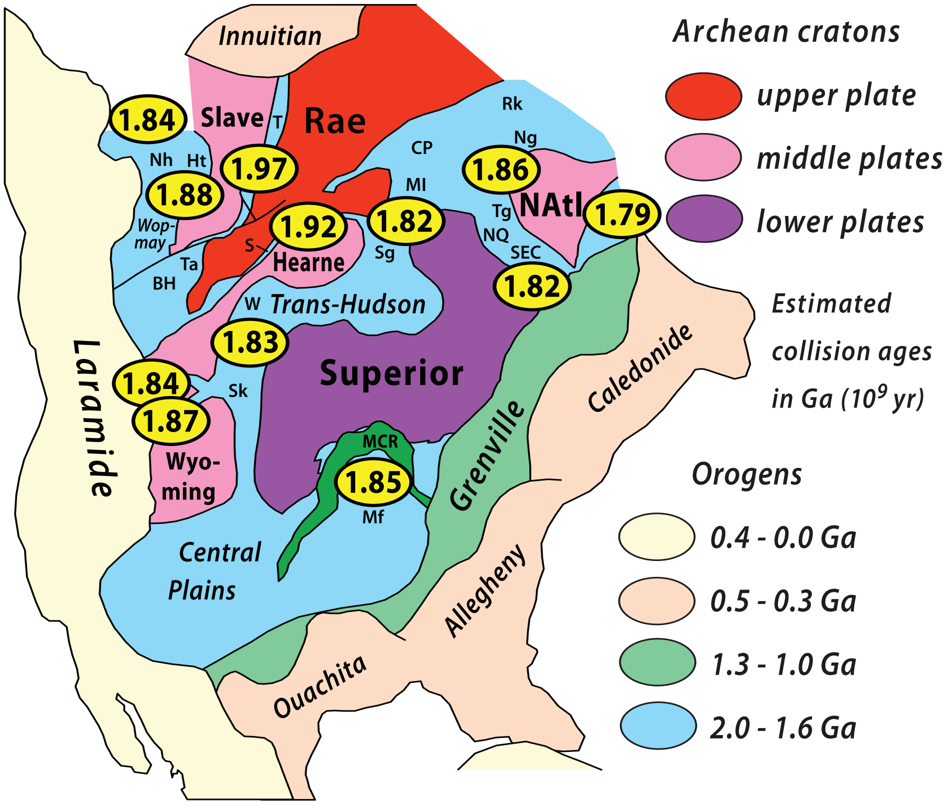

Figure 1. Tectonic sketch map of Laurentia showing Orosirian orogens (blue) and Archean cratons, differentiated according to the subduction polarities of their collisional boundaries. 'Middle plates' were the upper plate on one side and the lower plate on the other. 'Upper' and 'lower' plates had the same polarities on all sides. Estimated collision ages in 10^9 years before present (Ga). Names mentioned in the text or Table: BH, Buffalo Head terrane; CP, Cumberland-Prøven arc; Ht, Hottah terrane; MI, Meta Incognita terrane; MCR, Mid-Continent Rift (1.1 Ga); Mf, Marshfield terrane; NAtl, North Atlantic craton; Ng, Nagssugtoqidian orogen; Nh, Nahanni terrane; NQ, New Quebec orogen; Rk, Rinkian orogen; SEC, Southeast Churchill (Core Zone) hinterland; S, Snowbird orogen; Sg, Sugluk terrane; Sk, Sask terrane; T, Thelon orogen; Ta, Taltson arc; Tg, Torngat orogen; W, Wathaman arc.

to the adjacent cratons. Alternatively, if the cratons were drawn together by 'slab suction' (Fig. 2B), suture ages should decrease with distance from the Rae craton, which was the upper plate with respect to its neighbours. All other cratons are known to have mixed polarities with respect to adjacent cratons (Fig. 1).

OROSIRIAN COLLISION AGES AND SUBDUCTION POLARITIES

Collision ages can be constrained by the chronology of the lower plate, the upper plate, or preferably the consilience of both. On the lower plate, the onset of foredeep subsidence marks the arrival of a passive margin at a subduction zone (Bradley 2008). For typical foredeep widths (trench axis to forebulge crest) of 100–200 km and plate convergence rates of 2–10 cm yr^{-1}, foredeep subsidence at any point begins 1–10 Myr before its passage beneath the leading edge of the upper plate (the trench axis). The onset of foredeep subsidence is sedimentologically most apparent when the outer shelf of a passive margin enters the trench, by which time the continental rise will have already passed beneath the trench axis in most cases. Passive-margin shelf-to-foredeep transitions of Orosirian age have been recognized throughout proto-Laurentia (Hoffman 1987; Partin et al. 2014) and some are tightly constrained chronometrically from U–Pb dating of tuffs (Bowring and Grotzinger 1992). Metamorphic dates from passive-margin protoliths provide minimum constraints on collision age. On the upper plate, collision is marked by the change from steady-state arc magmatism to short-lived slab-breakoff magmatism (Davies and von Blanckenburg 1995), followed by post-collisional crustal anatexis, often accompanied by rapid tectonic exhumation through gravitational collapse and lateral extrusion of tectonically thickened crust.

Taltson-Thelon Orogen

The oldest Orosirian sutures bound the Rae craton (Table 1 and Fig. 1). To the west, it was impacted by the Slave craton along the Thelon-Taltson orogen. To the southeast, it collided with the Hearne craton along the Snowbird tectonic zone. The age of the Rae/Slave collision is constrained by a U–Pb (ID–TIMS) zircon date of 1968.7 ± 1.1 Ma from a tuff in the basal part of the Bear Creek foredeep on the Slave margin (Bowring and Grotzinger 1992; Grotzinger and Royden 1990). This is a tight minimum age constraint on collision as the onset of foredeep subsidence marked the arrival of the passive-margin shelf (Kimerot platform) at the trench (Tirrul and Grotzinger 1990). The marine-to-nonmarine transition in the Bear Creek foredeep occurred around 1.93 Ga (Bowring and Grotzinger 1992). On the upper plate, subduction-related (including slab-breakoff?) magmatism (2.03 – 1.96 Ga) and associated high-temperature granulite-grade metamorphism switched around 1.96 Ga to anatectic magmatism (1.96 – 1.91 Ga) and exhumation (Bostock et al. 1987; van Breemen et al. 1987; James et al. 1988; van Breemen and Henderson 1988; Thériault 1992; McDonough et al. 2000). The Rae/Slave collision age estimate of 1.97 Ga, determined over 20 years ago, remains an excellent example of apparent consilience between lower and upper plate chronologies.

Snowbird Tectonic Zone

As described in the Introduction, the Rae craton is bounded on the southeast by the Snowbird suture zone, with an estimated collision age with the Hearne craton of 1.92 Ga based on dates of high-pressure metamorphism followed by high-temperature exhumation (orogenic collapse) around 1.90 Ga (Mahan et al. 2006; Berman et al.

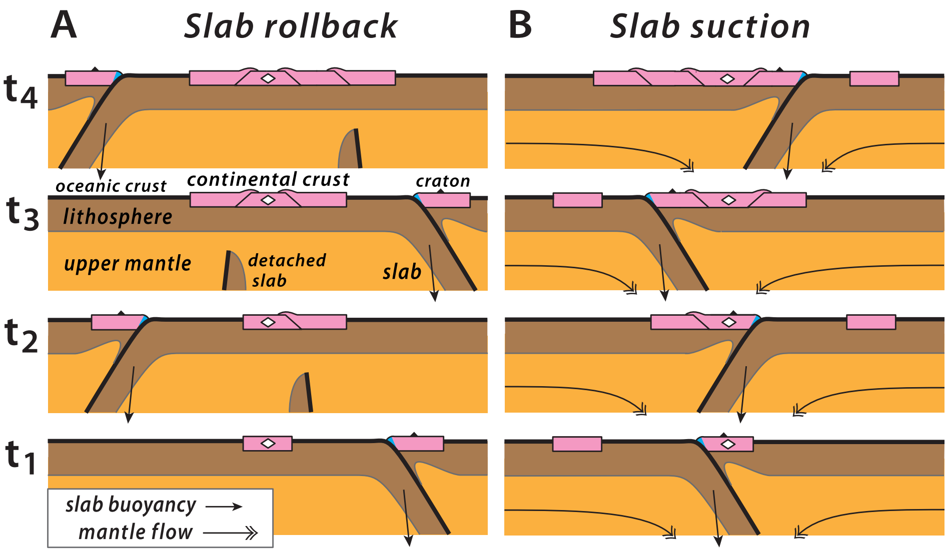

Figure 2. Four time steps (t_1 to t_4) in multicratonic assembly by slab rollback (**A**), in which slabs sink gravitationally into a passive medium, and slab suction (**B**), in which convergent mantle flow (downwelling) has traction with the plates. In each case, the founding craton of the assembly is tracked by the open diamonds. In A, the founding craton remains on the lower plate and subduction zones dip away from it. In B, the founding craton remains on the upper plate and subduction zones dip toward it. The amalgamation of proto-Laurentia is better described by (B).

2007; Martel et al. 2008).

Trans-Hudson Orogen

Beyond the northeastern limit of the Hearne craton, the Rae craton is bounded by the Trans-Hudson orogen of Southampton and southern Baffin islands, and central West Greenland. This segment of the orogen includes three episodes of collision (Wardle et al. 2002; van Gool et al. 2002; St-Onge et al. 2006, 2007; Berman et al. 2013; Corrigan et al. 2009; Corrigan 2013; Eglington et al. 2013; Pehrsson et al. 2013a; Partin et al. 2014). The first, ~1.88–1.86 Ga, involved the accretion of Archean microcontinents (Sugluk, Meta Incognita, Southeast Churchill Core Zone, Disco and North Atlantic) to the Rae craton. Second, ~1.845 Ga, was the addition of a juvenile arc-forearc terrane (Narsajuaq arc). Last was the arrival of the Superior craton, ~1.82 Ga. Accretion progressed outwards from the Rae craton and, although subduction dipped southeastward prior to the first arrivals (e.g. Meta Incognita terrane), northwestward-directed subduction, manifested by the Cumberland-Prøven arc batholith, accommodated subsequent convergence and accretion.

South of Hudson Bay, the Trans-Hudson orogen borders the Hearne craton (St-Onge et al. 2006; Corrigan et al. 2009; Maxeiner and Rayner 2011; Corrigan 2013). The first accretion event, the Reindeer orogeny ~1.88 Ga, was an arc-continent collision involving the juvenile La Ronge – Lynn Lake island arc. The Rae craton, conjoined with the Hearne craton, was in the lower plate with respect to this arc-continent collision. Following arc-accretion, subduction flipped to northwestward-dipping beneath the Hearne-Rae cratons, accommodating convergence and collision of a second juvenile terrane, the Flin Flon – Glennie complex, ~1.85 Ga. The arrival of the western Superior craton ~1.83 Ga was preceded by the accretion of an Archean microcontinent, Sask craton, to the southeast-facing forearc of the Flin Flon – Glennie complex ~1.84 Ga.

Wopmay Orogen

In the Wopmay orogen, west dipping subduction led to collisional accretion of the Hottah terrane on the present western margin of the Slave craton at 1.88 Ga (Hildebrand et al. 2010), based on a U–Pb (ID–TIMS) zircon date of 1882.50 ± 0.95 Ma from a tuff in the basal part of the Recluse foredeep on the Slave margin (Bowring and Grotzinger 1992; Hoffman et al. 2011). Hottah accretion was immediately followed by eastward subduction, producing the epi-orogenic Great Bear magmatic arc, active between 1.88 and 1.84 Ga (Hildebrand et al. 2010; Cook 2011, 2013; Hayward and Oneschuk 2011). Terminal collision in Wopmay orogen involved accretion of the buried Nahanni – Fort Simpson terrane ~1.84 Ga, also as a consequence of east-dipping subduction as inferred from seismic profiling (Cook 2011, 2013).

In summary, Orosirian collisions become younger with distance from the center of the Rae craton (Fig. 3B). No such age relation exists with respect to the Superior craton (Fig. 3A). Except for the first accretion events in the Trans-Hudson and Wopmay orogens, the Rae craton was predominantly on the upper plate during convergence of the Slave, Hearne, North Atlantic, Nahanni and Superior cratons. These patterns suggest that slab suction (Faccenna et al. 2013), rather than slab rollback, drove the amalgamation of proto-Laurentia (Fig. 2).

DISCUSSION

The Rae craton was the founding craton, the 'origin' around which the other cratons amalgamated (Fig. 3). There are, of course, older pre-Orosirian (mostly Neoarchean) sutures within the constituent cratons, inherited from older episodes of amalgamation (e.g. Pehrsson et al. 2013b), but they are not relevant to the Orosirian assembly of proto-Laurentia.

Contrasting modes of supercontinental reassembly have been described. Introversion and extraversion are kinematic end-members (Murphy and Nance 2004). *Intraversion* predicts that the present Atlantic and Indian oceans will close and the ghost of Pangea will reappear, with modification. *Extraversion* predicts a future Atlantic-Indian Panthalassa at the expense of the remaining half of the Pacific. Like plate tectonics, these are kinematic theories only. They do not address dynamics, nor are they explicitly tied to the geoidal coordinates of first-order mantle convection.

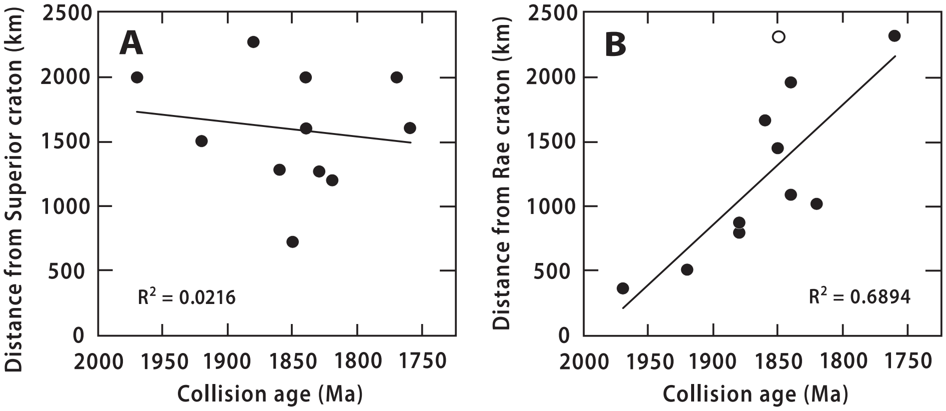

Figure 3. Orosirian collision ages (black dots) in proto-Laurentia as a function of distance (where the age was determined) from (**A**) the center of the Superior craton (James Bay, 52°00’N, 80°00’E) and (**B**) the center of the Rae craton (Aberdeen Lake, 64°30’N, 100°00’E). Open circle in B is the Penokean orogen, which docked with the southern margin of the Superior craton at an unknown distance from Rae craton. It was therefore excluded from the calculated correlation line. Collision ages do not diminish with distance from the center of the Superior craton, as predicted by slab rollback (Fig. 2A), but they do become systematically younger with distance from the Rae craton, consistent with slab suction (Fig. 2B).

Orthoversion (Mitchell et al. 2012; Evans 2003; Li and Zhong 2009) by contrast is a dynamical theory of supercontinental reassembly coupled with large-scale mantle convection. As a dynamical theory, it can and has been tested with numerical simulations (e.g. Zhong et al. 2007), as well as by paleomagnetic data (Mitchell et al. 2012). Paleomagnetic testing requires additional constraints on paleolongitude, which can be obtained from Cenozoic–Mesozoic plume trails and Paleozoic–Proterozoic true-polar-wander rotation axes (Steinberger and Torsvik 2008; Mitchell et al. 2012). Orthoversion postulates that long-lived supercontinents bring about their own destruction through the mantle superswells engendered by continental insulation and absence of slab injections. This was basically Arthur Holmes’ (Holmes 1928, 1931, 1944) dynamical explication of the breakup of Wegener’s Pangea, ruled inadmissable by the many who claimed no mechanism existed for continental drift. According to orthoversion, in order-1 convection the supercontinental fragments go with the flow and reassemble above the mantle downwelling located approximately 180° distant. In order-2 convection, like the present, the fragments reassemble somewhere along the meridional girdle of mantle downwelling, today the circum-Pacific ring, approximately 90° from the center of the former supercontinent and its lingering superswell. If the reassembly occurs away from the paleoequator, then superswell development will incite true polar wander to restore inertial stability. If the reassembly is equatorial, true polar wander is unnecessary.

In orthoversion, superswells are long-lived (100s Myrs) but impermanent. This contrasts with the neofixist view that the antipodal superswells of today have persisted since the Moon-forming impact (Burke et al. 2012). Whether order-1 or order-2, prone to true polar wander or not, orthoversion predicts that supercontinents assembled over first-order mantle downwellings. Such downwellings must develop in areas of long-lived subduction through positive feedback between cold slabs and thermal convection.

Orthoversion assumes that mantle flow plays an active role in plate motions. It predicts the style of multicratonic amalgamation described as ‘slab suction’ (Faccenna et al. 2013), where the cratonic backstop is an upper plate and subduction plunged inward beneath the founding craton (Fig. 2B). Conversely, dominance of slab rollback, where slabs collapse gravitationally into a passive medium, predicts a lower plate as the cratonic backstop and outward dipping subduction (Fig. 2A). In proto-Laurentia, suture chronology (Fig. 3) and subduction polarities (Fig. 1) support slab suction as the dominant assembly mechanism.

In one sense, it is an unfair comparison: negative buoyancy of old oceanic slabs operates in both regimes (Fig. 2A and B). Slab suction is simply slab rollback with the addition of mantle flow and significant plate-mantle traction. Viewed this way, proto-Laurentian amalgamation history implies long-lived convergent (downwelling) mantle flow and significant plate traction. A lingering manifestation of this mantle supersucker was dynamic subsidence, accommodating widespread post-orogenic sheet sandstones in proto-Laurentia (e.g. Thelon, Athabasca, Hornby Bay and Baraboo sandstones) and beyond.

Proto-Laurentia is a megacontinent, arguably cogenetic with the supercontinent Nuna (Zhang et al. 2012). Whether the Rae craton was also the founding craton of Nuna depends on the Orosirian subduction polarities and collision ages throughout Nuna as a whole (Zhang et al. 2012).

CONCLUSIONS

The collision age and subduction polarity of each of the major Orosirian geosutures in proto-Laurentia have been estimated. The oldest sutures bound the Rae craton and sutures become progressively younger with distance from its center. Subduction in both the bounding orogens dipped (asynchronously) beneath the Rae craton, which remained on the upper plate essentially for the duration of proto-Laurentia’s Orosirian amalgamation. From the patterns of suturing and subduction polarity I infer that the Rae craton was captured above a long-lived, subduction-induced, downwelling in the mantle, after which it served as the backstop for other cratons swept in by continued subduction beneath it. An active role for mantle convection in cratonic drift is implied: slab suction prevailed over slab rollback. Whether the Rae craton and slab suction played the same roles in the assembly of supercontintent Nuna remains unanswered. An active role for mantle convection and plate traction is also consistent with orthoversion dynamics of supercontinental reassembly. However, it remains uncertain if Nuna assembled under order-1 or order-2 convection, or if it was ever preceded by a continental assembly large enough to grow a superswell. It appears possible that these questions may be answerable.

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This paper originated with an invitation from Christian Böhm as Technical Program co-chair to attend the 2013 GAC-MAC Joint Annual Meeting in Winnipeg. Cees van Staal encouraged me to write it up as a tribute to Hank Williams, who I first knew as a noon-hour table-tennis hustler with GSC in Ottawa, and later as a fiddler whose playing grew more assured with each Trans-Newfoundland field trip. Sally Pehrsson and Bruce Eglington made constructive comments on the draft manuscript.

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