

New Perspectives in the Appalachian-Caledonian Orogen: A Conference in Honour of Dr. Harold Williams

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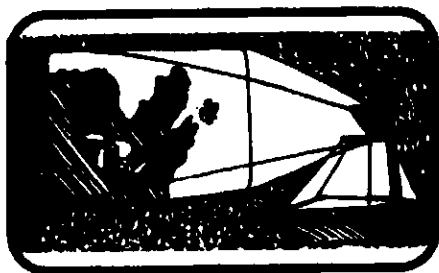
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Conference Reports



New Perspectives in the Appalachian-Caledonian Orogen: A Conference in Honour of Dr. Harold Williams

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A Geological Association of Canada NUNA conference took place in Grand Falls, Newfoundland 12-16 August 1994. It was convened by Jim Hibbard, Cees van Staal, Peter Cawood and Steve Colman-Sadd in order to honour the enormous, and continuing, contribution of Harold (Hank) Williams to the understanding of the geology of the Appalachian-Caledonian orogenic belt. The conference consisted of two days of invited papers, followed by three days of field excursions, two of which were led by Hank Williams himself.

At the start of the first day, Ward Neale began the conference with an illustrated biographical sketch of Hank. From babe-in-arms, childhood on St. John's southside, student at Memorial and the University of Toronto, then as the scourge of middle management at

the Geological Survey of Canada, and once more back to Memorial University as a faculty member, Hank's view of rocks has constantly progressed, but his hairline has remained unchanged.

The order of the scientific papers reflected the three-fold division of the orogen outlined by Hank in his classic 1964 paper on "a two-sided symmetrical system" in Newfoundland. The first three papers described the constructive phase of the Laurentian passive margin. Bill Thomas and Brian Whiting extended the concept of promontories and embayments with 3D mechanical and thermal modelling that predicts structural and depositional histories along segments of the rifted margin; their work was illustrated by quantitative comparisons with the Alabama promontory. Moving northward, Louise Quinn described provenance studies on the early Paleozoic foredeep sedimentary rocks of western Newfoundland, continuing work begun as a doctoral student at Memorial University. Most of the detritus in these rocks matches rock types in the Taconian allochthons, but some exotic clasts suggest a more complex geology for the source area. The history of the Laurentian margin from the paleontological perspective was reviewed by Svend Stouge and Doug Boyce. An evaluation of the interchange of conodont and trilobite faunas between platform and slope in the Ordovician has led them to the conclusions that faunal migrations are governed by sea-level changes and tectonics, and that faunal provinces do not strictly reflect paleogeography.

Four papers addressed the destruction of the Laurentian margin in North America. Mark Adams and others described an eclogite-bearing suture zone dividing the Blue Ridge of North Carolina. They attributed the zone to subduction that culminated in the Taconian Orogeny with the collision of Laurentia

and South America, followed by Acadian dextral transpression. The suture zone is correlated with the Baie Verte-Brompton Line (BBL) of the northern Appalachians and the sequence of faulting along the Quebec segment of the BBL, as determined by Michel Malo and Donna Kirkwood. The zone shows the same transition from dip-slip movement during the Ordovician and Silurian to dextral transpression in the Acadian Orogeny. In Newfoundland, Cawood and others reported that new Ar/Ar and U/Pb dating indicates major regional deformation, metamorphism and cooling of rocks adjacent to the BBL during the Early Silurian. The effect of orogeny on the platformal part of Newfoundland's Humber Zone was addressed by John Waldron and Glen Stockmal, who estimated transport distances using new industry seismic data and calculations of lithospheric flexure in response to tectonic loading.

The Laurentian margin in the British Isles was the topic of two papers. John Dewey and Paul Ryan correlated North America's BBL with the Clew Bay Fault Zone of western Ireland, and provided the familiar interpretation of a mid-Ordovician suture zone between the Laurentian margin and a north-facing Ordovician arc; much of the Ordovician structure was then overprinted during Late Silurian sinistral transpression. Tony Harris described the apparent decrease in the disparity of deformation ages across the Great Glen Fault of Scotland from the Precambrian to the Devonian. If real, the contrasts may imply that two far-travelled terranes were brought together by the early Devonian.

The oceanic tract of the orogen is represented by the Dunnage Zone. Geochemical and geochronologic work by Paul Karabinos and others in New England has distinguished two arcs in these rocks; the older of these may have collided with Laurentia on an east-

dipping subduction zone to cause the Taconian Orogeny, while the younger is attributed to post-Taconian west-dipping subduction. Scott Swinden and others reviewed epsilon-Nd results from the western part of the Dunnage Zone in Newfoundland and concluded that present models are inadequate because they do not account for contamination of magmas by continental material from the earliest Ordovician onward, or for the close spatial relationship of mantle-derived ophiolites and continentally contaminated calc-alkalic rocks. Dec and others described detailed stratigraphic, geochemical and geochronologic work in a part of this region, which was subsequently visited during the field excursions. Results show marked continental contamination of Early Ordovician arc rocks.

Two different approaches are being used to unravel the complex paleogeography of the Iapetus Ocean. Ben van der Pluijm and Rob van der Voo described paleomagnetic results that imply subduction at both margins of Iapetus as well as within the oceanic tract; their results require that a major component of this subduction be northerly directed beneath the Laurentian margin. Studies of faunal provincialism, reviewed by Henry Williams and others, lead to broadly similar conclusions. They depict a pattern of changing faunal affinities through time that can be matched between North America and Europe and can be used to make tectonostratigraphic correlations. John Winchester and Cees van Staal have studied Dunnage Zone rocks in both the northeast Appalachians and the British and Irish Caledonides and were able to produce a single plate tectonic model that is compatible with their data from both areas. Their model suggests subduction at both margins of Iapetus, followed by subduction beneath the Laurentian margin.

The second day of the conference opened with a series of papers on the eastern, peri-Gondwanan margin of Iapetus. Sean O'Brien and others outlined the composite nature of the Avalon Zone in southern Newfoundland, as revealed by U/Pb dating and detailed field studies. The episodic history has been traced from ca. 680 Ma to ca. 550 Ma, the latter age being derived from rocks beneath the global stratotype for the Proterozoic-Paleozoic boundary. Comparable events in the South Carolina

Piedmont are indicated by U/Pb dating reported by Allen Dennis and others; deformation of the Carolina Terrane preceded deposition of rocks containing an Acado-Baltic fauna and therefore predated accretion to Laurentia. The nature of the Avalonian basement was discussed by Scott Samson, with and without slides. Epsilon-Nd values are generally high, and zircon inheritance absent in both the Carolinas and Newfoundland, suggesting little or no old crust in these areas, but in New Brunswick, zircon geochronology has provided evidence of an Archean basement. Epsilon-Nd work in Nova Scotia by Murphy and others has produced mainly positive values for Late Proterozoic to Early Silurian volcanic rocks, but strongly negative values for certain Early Silurian sedimentary rocks. These data were interpreted to indicate a sediment source in Laurentia and therefore accretion of Avalonia before or during the Early Silurian. Taking the larger view, Nick Rast and Jim Skehan examined models for the Late Proterozoic development of Gondwana and concluded that the Avalon Zone can be traced from North America through parts of South America, and that it is premature to abandon the correlation with parts of West Africa.

The sessions on the three main components of the orogen were followed by six papers, collectively entitled "East Meets West," that described what happened when the Iapetus Ocean closed and Laurentia and peri-Gondwana collided. Benoit Dubé and others described this process as seen in southwest Newfoundland, where the Iapetus suture is thought to be the Cape Ray Fault. From the Late Silurian into the Devonian, the sequence of events on this fault includes reverse-sinistral and reverse-dextral thrusting, transcurrent sinistral shearing and extensional faulting. The rocks immediately east of the Cape Ray Fault, around Port aux Basques, were discussed at length by Cees van Staal and others and compared to rocks of equivalent age and derivation in New Brunswick. Deformation in Port aux Basques rocks extended from the mid-Ordovician through the Silurian. The exceptionally high P-T conditions of the accompanying metamorphism are attributed to the collision, in this region, of two promontories, one Laurentian and one Gondwanan. Ken Currie described the geology

along strike in northeast Newfoundland, where a deformation history starting in the Arenig can be traced through to the Late Silurian. The Silurian sequences show a marked contrast along the Dog Bay Line, subsequently visited on the field excursions, and he suggested that final closure took place along this feature in the Late Silurian, prior to the onset of regional metamorphism and granitoid plutonism. The various boundaries of the Gander Zone were described by Mark Piasecki as other lines of major Silurian activity. The boundaries were the sites of north-over-south, orogen-parallel shearing, which may have been most rapid in the partially melted rocks along the Gander-Avalon boundary, resulting in the curvature of the Hermitage Flexure. A detailed picture of this shearing was presented by Bob Holdsworth and Richard D'Lemos from a study in the Gander area; shearing was progressively focussed into narrow high-strain belts that coincided, either by cause or effect, with elevated metamorphic grade and syntectonic igneous intrusion. New U/Pb geochronology was presented by Chris Hepburn and others to show that the Silurian age of the major metamorphic and deformational event in Newfoundland's Gander Zone has a parallel in the Nashoba Terrane of southeast New England. The new dating also shows that rocks in the Nashoba terrane previously thought to be Precambrian basement are, in fact, no older than latest Cambrian.

The final five papers of the conference were devoted to syntheses of geological data along the length of the orogen. Jim Hibbard began in the southern Appalachians, describing a now-familiar three-fold division of the orogen as comprising Laurentia, the peri-Gondwanan Carolina terrane, and an intervening mobile belt, the Piedmont terrane. He outlined two significant accretionary events in the Carolina and Piedmont terranes that predated establishment of the Laurentian passive margin and thus must be exotic to the Laurentian-Iapetan realm. The general spatial and temporal pattern and the similarity with Newfoundland were also emphasized by Sandra Barr and others in their review of the geology of Cape Breton Island. They pointed out that the main problems now centre on the original relationships between terranes and the timing of accretion, both of which are

are largely obscured by post-accretionary movements. In few places are these problems more acute than in Cape Breton Island and southwest Newfoundland where, as related by Shoufa Lin and others, two opposing promontories collided, causing intense deformation, high-grade metamorphism, and an abrupt narrowing of the mobile belt. Moving across the Atlantic, the mosaic of terranes in the Scandinavian Caledonides was described by David Roberts and Brian Sturt, revealing both parallels and contrasts with the Appalachian part of the orogen. The final paper, by Kevin Pickering and Alan Smith, represented a bold and controversial attempt to model the evolution of the entire Appalachian-Caledonian jigsaw puzzle from the Late Proterozoic to the Middle Devonian. It seems that previous speakers had been unduly limiting themselves by using only one lapetus Ocean when two provide far more room in which to manoeuvre.

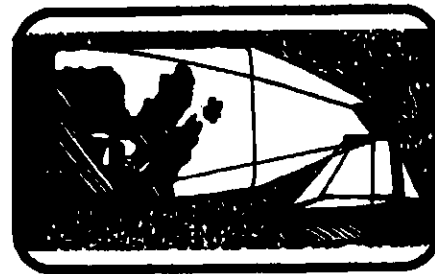
On 14 August, field trip participants set off, in excellent weather, for three days of exploring the remains of the lapetus Ocean (or oceans). The first day's excursion was led by Brian O'Brien, with input from Tomasz Dec and Scott Swinden. The route, from north to south down the Fortune Harbour Peninsula, crossed the marine volcano-sedimentary sequences of both the Notre Dame and Exploits subzones of the Dunnage Zone. Basalts were deftly distinguished by laminated extended REE diagrams and seemed to describe a recurring theme of island arcs succeeded by back-arc basins. Halfway through the day, participants were able to view the Red Indian Line, the major structural divide in the Dunnage Zone, and, according to several papers presented during the conference, the suture between the Laurentian and peri-Gondwanan terranes of lapetus.

The second and third days were led by Hank Williams and, fittingly, covered some of the earliest work he did for the Geological Survey of Canada in the 1960s as well as some of his most recent work. The first of these two excursions started in the ever-perplexing Dunnage Melange and proceeded onto New World Island to view exposures in both the Exploits, Notre Dame and Twillingate subzones. Southeast of Red Indian Line, stops displayed Early Ordovician brachiopods and basalts, Late Or-

dovician turbidites and Silurian melange. Northeast of the line, the Early Ordovician relationship between deformed Twillingate Granite and younger dykes and volcanic rocks was examined.

The final day of the field trip consisted of a transect across the Dog Bay Line, which separates subaerial and marine Silurian strata. The first stop, as on the previous day, was in melange, this time the Carmanville Melange. The field trip then proceeded to Horwood to see the marine Silurian rocks on the east side of the Dog Bay Line and then to the line itself for igneous blocks in black shale (more melange). On the west side of the line, rocks that are unrepresented to the east were viewed on both limbs of the Farewell Syncline. Late Ordovician to Early Silurian conglomerates are well flattened on the southeast limb near Dog Bay Line and much less deformed on the northwest limb. The last stop showed that the contact between these marine turbidite deposits and the overlying subaerial volcanic rocks of the Botwood Group is undeniably stratigraphic, although its relationship to deformational events leaves much room for discussion.

Papers from the conference are to be published as a Special Paper of the Geological Association of Canada. The commitment of the participants was reflected in the large number of manuscripts submitted at the conference. The convenors left Grand Falls with enough papers in hand for an outstanding publication. The co-operation of the authors has made it possible to proceed with peer review immediately and timely publication can be expected.



1994 Workshops in Archeometry

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The annual archeometry workshop at the State University of New York (SUNY) at Buffalo is eagerly anticipated by regular attendees. It allows presenters the opportunity to try out new ideas, to "iron out the kinks" in new presentations, and, most importantly, to talk with colleagues in a quiet atmosphere conducive to generating new ideas for archeometric research. This year was no exception. Approximately 40 scientists from Ontario and New York attended the fifth meeting, 26-27 February 1994. As always, the talks were informal with no prescribed length, except that set by the health of one's vocal cords. Questions occur at any time, and essentially no limit exists for the discussions following each paper.

Participants convened on Saturday morning, having braved another winter storm and having been fortified by the preconference breakfast goodies. Doug Perrelli, the conference organizer, welcomed everyone. Ezra Zubrow (SUNY, Buffalo) reported that, of some 10,000 archeologically oriented articles in the major international media, only 50 mentioned archeometry or archeometric methods, and interestingly, none of those was carried by the wire services. Major radio/TV networks reported no archeometry news, but did carry about 60 archeological items. Generally, one archeometric item is reported for every 200 to 2 000 archeology items. Discussion centred on the reasons for this lack of coverage. Several people noted that most archeological stories depended on archeometric data, but that it was often not reported. Several people not-