Northeastern Section - 44th Annual Meeting (22–24 March 2009)

Paper No. 1-10

Presentation Time: 11:20 AM-11:40 AM

ACADIAN SLAB DETACHMENT RECORDED IN THE SILURO-DEVONIAN GEOLOGY OF NORTHERN MAINE

SCHOONMAKER, Adam, Geosciences, Utica College, 175 Gordon Hall, 1600 Burrstone Road, Utica, NY 13502, adschoonmaker@utica.edu and KIDD, William, Dept of Earth and Atmospheric Sciences, University at Albany, 1400 Washington Ave, Albany, NY 12222-0100

A compilation of new and existing data shows that the stratigraphy and magmatic rocks exposed in the Siluro-Devonian section of northern Maine record a series of events that include: 1) proximal, shallow water deposition and sub-aerial exposure, followed by 2) rapid foundering, normal faulting, and within-plate volcanism, and 3) subsequent flysch deposition, Acadian deformation and bimodal magmatism. The first two events are recorded by the Ripogenus Fm, West Branch Group, and Frost Pond Shale in the Chesuncook Dome, by The Forks, Carrabassett, and Capens formations in the Lobster Mountain Anticlinorium, by unnamed Silurian pebble conglomerates and limestones, and Siluro-Devonian siltstones overlain by intermediate-to-mafic volcanics on the northwest flank of the Weeksboro-Lunksoos Anticlinorium, and by the East Branch Group and Spider Lake Volcanics in the Munsungun Anticlinorium. These isolated inliers were all subsequently overlain by the Seboomook Flysch and experienced bimodal magmatism of the mafic Moxie Pluton and felsic Katahdin-Traveler Suite that occurred during the initial onset of Acadian deformation in northern Maine.

Our geochemical study of the West Branch Volcanics shows enrichment in LREE and thorium, and a negative Ta-Nb anomaly. These findings are consistent with earlier geochemical studies here and in Quebec, and indicate derivation from a previously subduction-modified upper mantle source contaminated by thorium-rich continental crust, emplaced in a continental within-plate setting.

We interpret this to be the result of slab detachment during the Acadian Orogeny, where the southeast-dipping margin of Taconic-modified Laurentia failed during the early stages of its subduction. Early, shallow-water sedimentation and sub-aerial exposure occurred along the margin during its approach to, and passage through the peripheral bulge. Rapid deepening occurred as the margin entered the outer trench slope. Concurrent failure of the margin resulted in decompression melting of the sub-continental lithosphere and extrusion of the within-plate volcanics and subsequent magmatism of the Moxie-Katahdin-Traveler suite and related igneous rocks as the Acadian deformation front crossed the region.

Northeastern Section - 44th Annual Meeting (22–24 March 2009)
General Information for this Meeting

Session No. 1
Orogenesis and Arc Collisions: From Models to Observations of Modern and Ancient Orogens
Holiday Inn By the Bay: New Hampshire Room
7:50 AM-12:00 PM, Sunday, 22 March 2009

Geological Society of America *Abstracts with Programs*, Vol. 41, No. 3, p. 4

ments show that the Paleozoic tectonic processes recorded in the Southern Urals can be favorably compared with those in currently active settings such as the west Pacific.

1-5 9:20 AM Growdon, Martha L.

PUNCTUATED MONAZITE GROWTH: A KEY TO METAMORPHIC EVOLUTION AND OROGENIC RATES DURING THE 1.8 GA TRANS-HUDSON OROGENY, MANITOBA

GROWDON, Martha L., Department of Geological Sciences, Indiana University, 1001 East 10th Street, Bloomington, IN 47405, mgrowdon@indiana.edu, JERCINOVIC, Mike, Department of Geosciences, University of Massachusetts, 611 North Pleasant Street, Amherst, MA 01003, RAYNER, Nicole, Geol Survey of Canada, 601 Booth Street, Ottawa, ON K1A 0E8, Canada, PERCIVAL, John, Geological Survey of Canada, 601 Rue Booth Street, Ottawa, ON K1A 0E8, Canada, and WINTSCH, Robert, Geology, Indiana University Bloomington, 1001 East 10th Street, Bloomington, IN 47405

Four distinct monazite U-Pb SHRIMP age populations are identified regionally in meta-arenitic to meta-argillaceous migmatites in the Kisseynew Domain in the eastern Trans-Hudson Orogen (THO) in northern Manitoba, Canada. These ages are interpreted to represent multiple pulses of fabric development during metamorphism that initiated in the northwestern Kisseynew Domain around 1.83 Ga and lasted until 1.78 Ga in the southeast. Chemical mapping of monazite in both grain mount and thin section reveals zoning patterns that record a complex and punctuated growth history characterized by embayed cores mantled by multiple rims. Quantitative analysis reveals higher Y-content in the older cores and the youngest outer-most rims than in the intervening mantles. This may indicate that monazite grew prior to and then contemporaneously with the growth of garnet during prograde metamorphism and then continued to grow during the dissolution of garnet during retrograde metamorphism. Peak metamorphism recorded by reconstructed equilibrium mineral assemblages was recovered through high-temperature thermobarometry and reached 850°C and 8 kbar in the north.

Metamorphic monazite ages combined with detrital monazite and zircon U-Pb SHRIMP ages (Percival et al., 2005 Manitoba Report of Activities) and $^{40}Ar/^{39}Ar$ hornblende and biotite cooling ages (Schneider et al, 2007, Precambrian Research) constrain the timing of the 850°C and 8 kbar peak metamorphism resolved from isochemical equilibrium models and high-temperature thermobarometry. One-dimensional thermal models incorporate these data and yield rapid average heating and loading rates of 30°C/m.y. and 1.5 mm/year respectively between 1.83 and 1.80 Ga.

1-6 10:00 AM van Staal, Cees R.

TACONIC ARC-CONTINENT COLLISION CONFIRMED IN THE NEWFOUNDLAND APPALACHIANS

VAN STAAL, Cees R.[1], CASTONGUAY, Sébastien[2], MCNICOLL, Vicki[3], BREM, Arjan[4], HIBBARD, James[5], SKULSKI, Tom[3], and JOYCE, Nancy[3], (1) Geological Survey of Canada, 625 Robson Street, Vancouver, BC V6B 5J3, Canada, cvanstaa@NRCan.gc.ca, (2) Geological Survey of Canada, 490 rue de la Couronne, Québec, QC G1K 9A9, Canada, (3) Geological Survey of Canada, 601 Booth Street, Ottawa, ON K1A 0E8, Canada, (4) Shell International Exploration and Production B.V, Kessler Park 1, Rijswijk, 2288 GS, Netherlands, (5) Marine, Earth, and Atmospheric Sciences, North Carolina State University, Box 8208, Raleigh, NC 27695

The Taconic orogeny is generally considered to represent a collision between the Laurentian margin and outboard arc(s). Although evidence for penetrative Taconic tectonism is generally strong in deformed Notre Dame arc rocks, the scarcity of Taconic radiometric ages in the Humber margin rocks (down-going plate) of the Canadian Appalachians has been problematic, calling into question the intensity and nature of Taconic orogenesis by many workers and even shedding doubt on whether the Taconic orogeny was due to an arc-continent collision. The large number of available radiometric ages indicate that the predominant amphibolite facies metamorphism of the Fleur de Lys Supergroup was Salinic, not Taconic, suggesting to some that Taconic suturing was incomplete.

Our new $^{40}Ar/^{39}Ar$ ages of amphibole and micas from the Birchy Complex combined with in-situ U-Pb zircon ages of eclogite in the Fleur de Lys rocks, confirm Taconic metamorphism (477-460 Ma) in the footwall of the obducted ophiolites of the Baie Verte oceanic tract. The c. 558 Ma Birchy Complex is interpreted to have been part of the leading edge of the Humber margin. It comprises a base of Latest Neoproterozoic rift-related gabbro and basalt overlain or structurally interlayered with Palaeozoic coticule rocks and dark shales and siltstones. The latter locally contain actinolite-fuchsite clasts and single fuchsite grains, which are thought to represent the alteration products of ultramafic knockers and chromite minerals respectively that were incorporated in an Early Ordovician foredeep sequence, partially transformed into mélange during ophiolite overthrusting. In Newfoundland, the stark contrast between the intensity of the Taconic in the Notre Dame arc with respect to most of the Humber margin is probably due to a combination of several factors: 1) renewed post-Taconic tectonism, which caused emplacement of the arc and ophiolites further over the weakly metamorphosed Taconic foreland, burying most of the Taconic Humber margin rocks beneath the overriding allochthons, 2) locally strong Salinic overprint possibly guided by thermal weakening and 3) large strike-slip translations, juxtaposing weakly metamorphosed segments of the Humber margin with segments of the Notre Dame arc characterised by high grade metamorphism.

1-7 10:20 AM De Souza, Stéphane

THE RIVIERE-DES-PLANTE OPHIOLITIC MELANGE, SOUTHERN QUEBEC : ORIGIN AND IMPLICATIONS FOR THE CHAIN LAKES MASSIF

DE SOUZA, Stéphane, Sciences de la Terre et de l'Atmosphère, Université du Québec à Montréal, C.P. 8888, Succursale Centre-Ville, Montréal, QC H3C 3P8, de_souza.stephane@courrier.uqam.ca and TREMBLAY, Alain, Sciences de la Terre et de l'Atmosphère, Université du Québec à Montréal, Montreal, QC G7H 2B1, Canada

The Rivière-des-Plante Ophiolitic Mélange (RPOM) is located along the Baie-Verte – Brompton line in southern Québec, 40 km NE of the Thetford-Mines ophiolite. It consists of harzburgite, serpentinite, ophicalcite and of a fragmental granofelsic rock and mylonitic gneiss that have been interpreted as belonging to the Chain Lakes Massif (CLM) of northern Maine. It is limited to the northwest by a SE-verging thrust fault. To the southeast, the contact with the overlying Saint-Daniel Mélange is a major erosional unconformity marked by debris flows and conglomerates containing fragments of the underlying peridotites and CLM-type rocks. In the Thetford-Mines area, the Bécancour antiform exposes greenschist-facies metasedimentary rocks formed during the Taconic orogeny (ca. 462 Ma), these rocks occur structurally below the Thetford-Mines ophiolite and show lithological facies similar to, but of lower metamorphic grade than those of the CLM. The granofels and gneisses of both the RPOM and CLM were previously interpreted as sediments mostly derived from the Laurentian margin, and metamorphosed during the Taconic orogeny. Our mapping and petrographic observations on the RPOM rather suggest that both the granofels and mylonitic gneisses were derived from a xenolith-rich granitoid crosscutting the mantle peridotites. This granitoid formed in response to crustal thickening and partial melting of Laurentian sedimentary rocks during ophiolite obduction. We believe that the RPOM therefore represents a deeply-eroded fragment of mantle peridotites belonging to the Thetford-Mines ophiolite, in which similar peridotite-hosted granitoids are also found. Existing monazite U/Pb data for the CLM suggest a 469 ± 4 Ma age for peak metamorphism and migmatization. We think that this event was synchronous with ophiolite obduction and formation of anatectic granitoids found in the Thetford-Mines ophiolite (ca. 470 Ma) and in the RPOM; partial melting and metamorphism during ophiolite obduction being related to the formation of granitic melts crosscutting the mantle peridotites.

1-8 10:40 AM Hatcher, Robert D.

SIGNIFICANCE OF SOUTHERN APPALACHIAN BLUE RIDGE AND WESTERN INNER PIEDMONT ORDOVICIAN PLUTONIC AND VOLCANIC ASSEMBLAGES

HATCHER, Robert D. Jr, Earth and Planetary Sciences and Science Alliance Center of Excellence, University of Tennessee-Knoxville, 306 EPS Building, Knoxville, TN 37996-1410, bobmap@utk.edu and BREAM, Brendan R., Earth and Environmental Sciences, Vanderbilt University, 2301 Vanderbilt Place, Station B 35-1805, Nashville, TN 37235-1805

Ordovician (Ord) metaplutonic and metavolcanic rocks are widely distributed throughout the southern Appalachian Blue Ridge (BR) and Inner Piedmont (IP) in the Cowrock and Cartoogechaye terranes, Dahlonega gold belt (DGB), and western and eastern Tugaloo (Tt) terranes in the Carolinas and NE GA, and their equivalents to the SW and NE. Enclosing rocks consist of deep-water clastics (Ashe-Tallulah Falls Fm., and similar units) with a Laurentian source. All have been subjected to amphibolite facies metamorphism and polyphase ductile deformation, which makes their lineage more difficult to ascertain. Today metavolcanic units occur as mafic and mafic-ultramafic complexes, and as interlayers and boudins in medium to high-grade rocks. Ord granitoids are more abundant in the eastern Tt than to the W, and metavolcanic rocks also become more abundant in the eastern Tt. Numerous studies of major and trace element geochemistry of the mafic rocks have revealed that almost all of these bodies have a non-continental origin, and most frequently plot in the arc to MORB fields of tectonic discrimination diagrams. Although the DGB was recently characterized as an arc terrane, metasedimentary rocks make up >85% of the northern two thirds of the belt, and it contains several isolated arc complexes (Lake Burton, Sally Free), with other BR terranes containing a similar distribution. The eastern Tt, however, contains voluminous arc-to-MORB volcanic rocks, many of which belong to the Mid-Late Ord (452 Ma SHRIMP) Poor Mountain Fm. Four prominent Ord BR-IP granitoids (Persimmon Creek, 468 Ma; Whiteside, 466 Ma; Henderson, 470 Ma, and Elkahatchee, 490 Ma) were likely derived from mafic sources. Eastern BR granitoids from NC to AL may have formed over a W-dipping subduction zone, whereas the younger Ord volcanic and plutonic rocks of the eastern Tt may have formed in arcs generated over an E-dipping subduction zone. Ironically, the Middle Ord clastic wedge contains no volcanic detritus.

1-9 11:00 AM Jones, Laura K.Z.

A PETROLOGICAL AND GEOCHEMICAL INVESTIGATION OF THE AMPHIBOLITES AND GREENSTONES IN THE CONNECTICUT VALLEY SYNCLINORIUM

JONES, Laura K.Z.[1], WINTSCH, Robert P.[1], and GROWDON, Martha L.[2], (1) Geological Sciences, Indiana University - Bloomington, 1001 E 10th St, Bloomington, IN 47405, lkj@indiana.edu, (2) Geological Sciences, Indiana University, 1001 East 10th Street, Bloomington, IN 47405

Diverse lithologic and tectonic settings inferred through petrographic and geochemical analysis suggest that two bands of the Ordovician Oronoque member of the Derby Hill Schist should be considered individual lithologic units. In the west the Oronoque member is associated with the Derby Hill Schist and the Wepawaug Schist and may have been a product of shearing along the East Derby Shear Zone. In the east the unit is intercalated between the Maltby Lakes Metavolcanics and may be a low-grade metamorphosed volcanogenic sediment.

Geochemical XRF analyses of amphibolites associated with these two bands of the Oronoque member show a higher degree of affinity with the local country rocks then with each other. This suggests that these rocks may not correlate across a regional syncline as previously suggested (Fritts, USGS, 1965) but may have been sediments on opposite sides of a closing basin with a passive margin in the west and a volcanic arc in the east. The sediments were juxtaposed and folded against a rigid backstop during the Acadian orogeny and reworked during the Alleganian to form their current exposure pattern.

1-10 11:20 AM Schoonmaker, Adam

ACADIAN SLAB DETACHMENT RECORDED IN THE SILURO-DEVONIAN GEOLOGY OF NORTHERN MAINE

SCHOONMAKER, Adam, Geosciences, Utica College, 175 Gordon Hall, 1600 Burrstone Road, Utica, NY 13502, adschoonmaker@utica.edu and KIDD, William, Dept of Earth and Atmospheric Sciences, University at Albany, 1400 Washington Ave, Albany, NY 12222-0100

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Abstracts

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22–24 March 2009

NOTE INDEXING SYSTEM
Numbers (2-4, 15-4) indicate session and order of presentation within that session.
Further information concerning the presented papers on which these abstracts are based should be obtained by contacting the authors of the abstracts.

(CC) indicates session related to Climate Change theme.

SESSION NO. 1, 7:50 AM

Sunday, 22 March 2009

S2. Orogenesis and Arc Collisions: From Models to Observations of Modern and Ancient Orogens

Holiday Inn By the Bay, New Hampshire Room

1-1 **8:00 AM** Byrne, Timothy

FOOTWALL GEOMETRY AND TOPOGRAPHY IN THE TAIWAN ARC-CONTINENT COLLISION

BYRNE, Timothy, Center for Integrative Geosciences, Univ of Connecticut, 354 Mansfield Road U-2045, Storrs, CT 06269-2045, tim.byrne@uconn.edu, DANIELS, Melinda, Geography, Kansas State University, Manhattan, KS 66506, and MILLER, Jason, Geography, University of Connecticut, Storrs, Storrs, CT 06269

Previous interpretations of the arc-continent collision in Taiwan have treated the colliding passive margin as relatively homogeneous and used the approximately constant width of the orogen along strike to argue for a steady state in the regional-scale topography. More detailed analyses, however, suggest significant anomalies in both the topography and the geometry of the colliding continental margin. We present a new analysis of the topography and focus on a region in central Taiwan where the orogen is anomalously narrow and steep, and displays a relatively low ridge crest height; the cross-sectional area of the orogen in this area is therefore less than it is to the north and south. Using a 40-DEM, 61 basins and sub-basins were recognized and extracted for detailed study. The results show higher hypsometric integrals, higher first order stream gradients and higher stream length-gradient indices on both flanks of the Central Range with the highest values in the center of the range where it is anomalously low and narrow. This area also correlates with the location of an inferred continental prong or indenter in the underthrusting continental margin. We propose that the rigidity of the continental indenter and colliding arc constrain the orogen to be relatively narrow in this area, which limits the height of the orogen. The orogenic systems north and south of the indenter appear to have advanced and widened westward, thus allowing for topographically higher orogenic wedges in these areas. This is also consistent with a slight westward deflection in the ridge crest in the northern and southern regions. The area between the indenter and the arc may have also experienced more internal shortening, steepening the backstop and leading to eastward migration of the ridge crest. The higher geomorphic indices in this area may reflect the steeper flanks of the orogen in this area, higher uplift rates, or both. In either case, the presence of an irregular continental footwall appears to have resulted in an irregular orogenic system rather than a uniform orogen with a steady size and shape.

1-2 **8:20 AM** Zeitler, Peter

CLIMATE AND RHEOLOGICAL CONTROL IN CONVERGENT MARGINS FROM A GEOCHRONOLOGICAL PERSPECTIVE

ZEITLER, Peter, Earth & Environmental Sciences, Lehigh University, 31 Williams Drive, Bethlehem, PA 18015, peter.zeitler@lehigh.edu and KOONS, Peter, Department of Earth Sciences, University of Maine, 5790 Bryand Global Sciences, Orono, ME 04469

Cooperation among surface, rheological, and tectonic processes associated with convergent margins influences particle trajectories in a manner that characteristically leads to flow bifurcation and massive strength heterogeneities. In the early stages of convergence, influence on trajectories is dominantly exerted by atmospheric advective perturbations via the concentration of surface processes. With time, on a scale controlled by thermal Peclet number, rheological effects dominate particle trajectories, leading to the non-linear positive feedbacks that characterize tectonic aneurysm behavior.

This transition from flow paths dominated by surface processes to rheologically dominated trajectories can be identified in modern and ancient orogens from the geochronological patterns generated from a broad spectrum of thermochronological methods. Through examination and comparison of the geochronological patterns of three modern plate corners where non-linear aneurysm behavior can be demonstrated, Nanga Parbat (western Pakistan), Namche Barwa (eastern Tibet), and St Elias (southern Alaska) we have identified the transition from climate to rheological control that persists in the geological record of ancient orogens.

1-3 **8:40 AM** Murphy, J. Brendan

SUPERCONTINENT RECONSTRUCTION FROM ACCRETIONARY HISTORY AT LEADING CONTINENTAL EDGES

MURPHY, J. Brendan, Department of Earth Sciences, St. Francis Xavier University, Antigonish, NS B2G 2W5, Canada, bmurphy@stfx.ca, NANCE, R. Damian, Department of Geological Sciences, Ohio University, Athens, OH 45701, GUTIERREZ-ALONSO, Gabriel, Departamento de Geologia, Universidad de Salamanca, Salamanca, 37008, and KEPPIE, J. Duncan, Departamento de Geología Regional, Instituto de Geología, Universidad Nacional Autónoma de México, México, DF 04510, Mexico

Repeated amalgamation and subsequent break-up of continental lithosphere have profoundly affected Earth's evolution since the Archean. Distinctive rift-related stratigraphy and magmatism followed by passive margin development along the trailing edges of dispersing continents have been used to identify such margins in the geologic past. Using the isotopic record of Mesozoic-Cenozoic igneous rocks of western North America as an analogue, we show that the leading edges of dispersing continents have Sm-Nd isotopic characteristics that may be used to identify these margins in the geologic past. The Sm-Nd isotopic signatures of Late Neoproterozoic and Early Paleozoic igneous rocks along the northern Gondwanan margin indicate derivation from 0.7 to 1.1 Ga mantle lithosphere. This lithosphere originated in the Mirovoi Ocean that surrounded Rodinia, accreted to the northern Gondwanan margin by ca. 650 Ma in response to Rodinia breakup, and provided a source for subsequent magmatism. The accretion and subsequent recycling of oceanic mantle lithosphere should be common along the leading edges of dispersing continents following supercontinent breakup. Identification of this phenomenon should therefore provide an additional aid in paleocontinental reconstructions.

1-4 **9:00 AM** Brown, Dennis

ARC-CONTINENT COLLISION IN THE SOUTHERN URALS

BROWN, Dennis, Strucutre of the Earths Lithosphere, Instituto de Ciencias de la Tierra "Jaume Almera", CSIC, c/Lluis Sole i Sabaris s/n, Barcelona 08028 Spain, dbrown@ija.csic.es

The Southern Urals of Russia contain what is arguably one of the best-preserved examples of an arc-continent collision in any Paleozoic orogen. The arc-continent collision history recorded in the rocks of the Southern Urals began in the Early Devonian with the onset of intra-oceanic subduction and the formation of the Magnitogorsk Arc and ended with its collision with the margin of Laurussia during the Late Devonian. The Laurussia margin consisted of a basement that was composed predominantly of rocks of Archean and Proterozoic age that, by the time of arc-continent collision, was overlain by Cambrian, Ordovician, Silurian, and Devonian sediments interpreted to have been deposited in rift-related grabens on the continental slope and rise, and on the shallow marine platform. The Magnitogorsk Arc consists of Early to Late Devonian island arc volcanic rocks and overlying volcaniclastic sediments. Arc-continent collision led to the development of an accretionary complex that includes shallowly and deeply subducted continental margin rocks, ophiolite fragments, and sediments that were deposited in a foreland-basin setting. High-pressure rocks derived from the leading edge of the continental margin indicate that it was subducted to a depth of between 70 km (eclogite assemblages) to 120 km (micro diamonds). It is estimated that the volume of continental crust that was subducted and lost to the mantle was approximately one third of the volume that was added to the Laurussia margin by the accretion of the Magnitogorsk arc. The geochemistry of the Magnitogorsk Arc volcanic rocks, the structure of the arc-continent collision accretionary complex and the forearc, the high-pressure rocks beneath and along the suture zone, the mafic and ultra-mafic ophiolitic material, and the syn-tectonic sedi-

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