SESSION NO. 207, 8:00 AM

Wednesday, November 10, 2004

T85. Whence the Mountains? New Developments in the Tectonic Evolution of Orogenic Belts: Celebrating the Dynamic Career of Raymond A. Price at the 50-Year Mark IV (*GSA Structural Geology and Tectonics Division, Geological Association of Canada*)

Colorado Convention Center, 702/704/706

207-1 8:15 AM Tohver, Eric

TERRANE TRANSFER DURING THE GRENVILLIAN ASSEMBLY OF RODINIA: TRACING THE AMAZONIAN ANCESTRY OF SOUTHERN APPALACHIAN BASEMENT THROUGH PB AND ND ISOTOPES

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Whole rock Pb isotope data can be used to determine the provenance of different blocks within the Rodinia supercontinent, providing a test for paleogeographic reconstructions. Using U-Pb zircon data as an anchor point, we calculate values for the initial Pb present at the time of rock crystallization (mu2) using published whole rock and feldspar data from the Grenville Province of Canada. The calculated values of mu2 values are remarkably coherent for the entire Grenville Province, including the Adirondacks of the northern U.S.A. and Grenvillian rocks of Texas and adjacent New Mexico ca.3000 km away, suggestive of a homogeneous mantle source for this entire region. A distinctly different source region characterizes "Grenvillian" basement rocks of the southern Appalachians (Blue Ridge/Mars Hill), suggesting that these rocks are not of Laurentian origin.

In order to test for a Rodinian connection between Laurentia and Amazonia, the Pb fingerprint of 54 whole rocks samples from the "Grenvillian" basement rocks of the SW Amazon craton (Rondônia, Brazil), are compared to those from the Grenville belt of North America and Grenvillian basement inliers in the southern Appalachians. Both the SW Amazon basement and the allochthonous Blue Ridge/Mars Hill terrane are defined by highly radiogenic mu2 values of ~10, well above the crustal average. In contrast, the greater Grenville Province of Laurentia is characterized by lower mu2 values of ~9.5. Published U-Pb zircon ages and Sm-Nd for the Blue Ridge/Mars Hill terrane also suggest an ancient provenance very different from the rest of the adjacent Grenville belt, which is dominated by juvenile, 1.3-1.5 Ga rocks. The presence of mature continental material in rocks older than 1.15 Ga in the Blue Ridge/Mars Hill terrane (Epsilon Nd > 0) is consistent with the signature of Amazon basement rocks. We propose that this portion of the S. Appalachian basement is derived from Amazonia and was transferred to Laurentia during Grenvillian orogenesis at ~1.15 Ga. The presence of these Amazonian rocks in southeastern Laurentia records the northward passage of the Amazon craton along the Laurentian margin, following the original collision with southernmost Laurentia at ca. 1.2 Ga.

207-2 8:30 AM Hurich, Charles A.

REFLECTION SEISMIC EVIDENCE FOR EXTENSIVE SYN- TO LATE-OROGENIC MELTS IN GRENVILLE OROGEN OF EASTERN CANADA: READING BETWEEN THE LINES IN SEISMIC DATA

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The Grenville Orogen of Eastern Canada represents the mid- to lower-crustal remnants of a Himalayan-scale, hot, collisional orogen. New statistical approaches to interpretation of seismic reflection data from the Grenville orogen provide images that contain strong evidence of extensive syn- to late orogenic migmatization and/or melt emplacement in the middle to lower crust. The interpretation technique is based on classification of the geometric and scaling properties of the reflection wave field which are arguably related to meso-scale petrofabrics. Zones in the seismic images in which fabrics associated with terrane accretion and continent-continent collision are disrupted or destroyed are interpreted as resulting from either re-scaling of the fabric due to migmatization or wholesale destruction of the fabric by intrusion. On the basis of this interpretation, the seismic data map intrusive bodies or migmatite terranes ranging in lateral scale from 10 to 60 km with relatively complex geometries and evidence for the incorporation of large blocks of the country rock. The timing of the interpreted melting event is not well constrained by surface dates but, cross-cutting relations in the seismic data suggest either the latest stage (Rigolet, 1000-980 Ma) of Grenville continent-continent collision or alternatively an association with a post-collision extension evident in the seismic data.

Although the seismic data are sparse with respect to the area of the Grenville Orogen, the new images suggest that the process that produced melt operated for at least 500 km along the strike of the orogen and must have exerted a major influence on mechanics and architecture of the late stages of Grenville orogenic development. The lack of surface dates consistent with the timing inferred from the seismic data enforces the notion that some parts of the continental crust young downward and significant episodes in the evolutionary history of an orogenic belt may be under-represented at the surface.

207-3 8:45 AM van Staal, C.R.

A NEW LOOK AT THE TECTONIC PROCESSES INVOLVED IN THE ORDOVICIAN TACONIC OROGENY IN THE NEWFOUNDLAND APPALACHIANS: EVIDENCE FOR MULTIPLE ACCRETION OF (INFANT) ARC TERRANES

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Detailed investigations in Newfoundland suggest that the Taconic Orogeny involves a circa 50 Ma long history of Early Palaeozoic, oblique accretion of oceanic and continental arc terranes. The oldest event is the 495-490 Ma obduction of the suprasubduction zone (ssz) 510-500 Ma Lushs Bight oceanic tract onto the peri-Laurentian Dashwoods microcontinent, followed by subduction stepping back into the Humber seaway, which generated the 489-485 Ma ssz Baie Verte oceanic tract (BVOT) and the 1st phase of the Notre Dame arc (488-480 Ma). The BVOT in part occupied a forearc position to the Notre Dame arc built on Dashwoods, but also became the foundation to a coeval (Snooks Arm) oceanic arc along strike. Syn-convergence dextral motion juxtaposed the oceanic and continental arc segments. Arenig loading of the Humber margin coincides with a magmatic gap (479 to 469 Ma) that separates the 1st and 2nd phases of the Notre Dame arc, probably as a result of arc-continent collision. The ~ 462 Ma tonalitic flare-up of the 2nd phase of the Notre Dame arc is related to break-off of the oceanic slab attached to the subducting Humber margin. Arenig to Llanvirn ssz ophiolites and island arc volcanic rocks were generated immediately east of the Dashwoods in the AAT during Notre Dame arc and Humber margin collision. Structural relationships, the presence of boninites and isotope data indicate that the AAT comprises a ~ 480 Ma infant arc generated during west-directed subduction, initiated east of Dashwoods and several thin thrust slices of younger arc volcanic rocks (473 to 460 Ma), separated by incomplete ophiolitic suites that become progressively younger towards the east. Sinistral oblique accretion of the AAT to the Dashwoods started ~ 470 Ma and resulted in strike-slip duplexing of arc segments. All the AAT was accreted to Laurentia by at least 455 Ma when the peri-Gondwanan Popelogan – Victoria Arc started to collide with Laurentia during the final phase of the Taconic Orogeny.

207-4 9:00 AM Hibbard, James

LINKS BETWEEN CRUSTAL BLOCKS IN THE APPALACHIAN PERI-GONDWANAN REALM

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Four extensive Neoproterozoic-early Paleozoic crustal blocks that originated in a peri-Gondwanan magmatic arc setting form the eastern flank of the Appalachian orogen. They include Carolina in the southern Appalachians and Ganderia, Avalonia, and Meguma in the northern portion of the orogen. Interrelationships between these crustal blocks are important for understanding both the accretionary history of the orogen and the evolution of the Iapetus and Rheic oceans, first-order features of the Paleozoic globe.

Traditionally, Carolina and Avalonia were considered to represent a single microcontinent that accreted to Laurentia in the middle to late Paleozoic. Although they appear to share a similar lithotectonic history between c. 680-590, their latest Neoproterozoic-Paleozoic tectonic evolution is different. In particular, the Avalonian arc system ended in the late Neoproterozoic and was succeeded by a robust Cambrian-Silurian platform sequence, possibly representing a strike-slip margin. Distinct from Avalonia, the Carolina arc system terminated during late Neoproterozoic arc-arc collision; only a thin Middle Cambrian clastic sequence is preserved atop the Carolina arc sequences. Furthermore, the Avalonian platform was not deformed until the Early Devonian whereas Carolina experienced widespread Ordovician-Silurian deformation.

In contrast to the orthodox Carolina-Avalon correlation, we note more striking similarities between Ganderia and Carolina. Specifically, late Neoproterozoic magmatism and tectonism extended into the Cambrian in both Ganderia and Carolina, and both were accreted to Laurentia during the Late Ordovician-Silurian, involving a major component of sinistral transpression. In addition, a Middle Cambrian to Early Ordovician clastic sequence caps Gander arc rocks, similar to relations in Carolina. Consequently, Carolina may be more closely affiliated with Ganderia than with Avalonia. Collectively, Carolina-Ganderia may represent an extensive Neoproterozoic arc system that originated in Amazonia.

Meguma displays significant Paleozoic differences with the other blocks; a common tectonic evolution between Meguma and Avalonia cannot be inferred until the late Early Devonian, suggesting a complex and long lasting accretionary history of peri-Gondwanan terranes.

207-5 9:15 AM Karabinos, Paul

TRANSPRESSION, OROGEN-PARALLEL EXTRUSION, AND THE FORMATION OF MANTLED GNEISS DOMES

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There are two north-south trending sets of gneiss domes in the New England Appalachians. The western belt contains thirteen domes that expose either Laurentian basement rocks or 475 Ma rocks of the Shelburne Falls arc (SFA). The eastern belt contains twenty-one gneiss domes cored by either Avalonian (?) crust or 450 Ma rocks of the Bronson Hill arc (BHA). The dome belts are flanked by Silurian to Early Devonian basins that formed just before the Acadian orogeny: the Connecticut Valley trough (CVT) and the Central Maine terrane (CMT). During the Acadian, km-scale nappes from the CVT and CMT were transported westward over the regions now occupied by the gneiss domes. The domes are elongated north-south and surrounded by high-strain zones (HSZ) that separate the core gneisses from the mantling units. The nappes were refolded during doming and units were dramatically thinned or omitted in the HSZ. In the Chester dome in Vermont, sense of shear indicators suggest that rocks above the high-strain zone were displaced southwest relative to rocks below it. P-T paths of rocks from below the HSZ in the Chester dome indicate decompression of several kbars during metamorphism, whereas rocks above the HSZ record nearly isobaric conditions. This pattern is consistent with normal-sense displacement between the core of the dome and its mantling sequence during Acadian metamorphism.

The domes occur in a region where the Acadian orogen is atypically narrow. Mechanical decoupling along the HSZ occurred between the quartz-feldspar-rich core gneisses of the domes and the overlying nappes of mica-rich metasediments. Pressure estimates of approximately 10 kbar indicate significant tectonic loading in the core of the Chester dome, presumably during the westward transport of nappes from the CVT. East-west shortening and vertical thickening of the quartz-feldspar-rich gneisses below the nappes would have required enormous work against gravity. It was energetically more favorable for the gneisses to be extruded

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