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200m thick Plains Sill, one of many contemporaneous diabase sills with U-Pb zircon ages of ~1469 Ma. Petrologic evidence suggests that the sill had a metasomatic, but not a large thermal effect on its host sediments. Thermobarometric and petrologic analyses of the country rocks suggest that their metamorphism resulted from burial beneath most or all of the Belt Supergroup. P-T conditions calculated from garnet-biotite-plagioclase-muscovite equilibria indicate that peak metamorphism was at 600°C and 530 MPa. $^{40}Ar/^{39}Ar$ data from hornblende in the sill and mica in the lower Prichard metasediments indicate that these rocks have been above 300°C as recently as the late Proterozoic. This data is consistent with a metamorphism with peak temperature between 600 and 500°C prior to about 830 Ma.

This evidence supports a model of burial metamorphism for the lower Belt basin. Peak pressures and temperatures, taken in conjunction with recent dating by Aleinkoff et al. (1996) and Sears and Chamberlain (submitted, 1997), suggest that peak metamorphism must have occurred after 1443 Ma, at least 25 Ma after the emplacement of the Plains Sill. Thus the metamorphism of the lower Belt Supergroup was caused by burial and not by emplacement of the diabase sills.

BTH 76 Johnson, Eric L.

RE-EVALUATION OF NODAL ISOGRAD PATTERNS IN NORTHERN MICHIGAN: A THERMAL CROSS-SECTION OF THE PEAVY NODE

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Many regional metamorphic terrains preserve nodal isograd patterns These isograd patterns are often attributed to the rise of core complexes or large scale thermal aureoles. These models assume that the nodal isograd pattern provides a snapshot of the thermal structure of the crust at the time of metamorphism and has not been altered by later faulting or folding. Rocks involved in the 1.82 bya Penokean Orogeny (Northern Michigan, Wisconsin) provide a classic example of nodal isograd patterns as well as the problems in their interpretation. We determined through the reevaluation of spatial, and temperature relationships within the Peavy metamorphic node that the presently accepted nodal isograd pattern is an artifact of juxtaposition of metamorphic rocks of varying grade by later faulting/folding complicated by multiple thermal events. Metamorphic temperatures across the node were calculated using garnet-biotite geothermometry (Ferry & Spear, 1978) for schists and amphibole-plagioclase geothermometry (Holland & Blundy, 1994) for metabasic rocks. The results of this work show that the rocks within the Peavy metamorphic node have undergone three metamorphic episodes with a well-preserved contact aureole surrounding the Peavy Pond Igneous Complex. Mn-AFM projections of bulk compositions for pelitic schist samples show that disequilibrium assemblages are common across the node. Metamorphic temperatures increase across the node (ranging from 485oC to 595oC for pelitic samples and 534oC- to 694oC for metabasic samples) but several temperature reversals are present. Based on these data, we conclude that the nodal isograd pattern in this region is clearly an oversimplification of a more complex thermal/structural history.

BTH 77 Stevenson, R.

ISOTOPIC EVOLUTION OF THE WESTERN SUPERIOR PROVINCE, CANADA

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The Superior Province is one of the world's largest and best preserved late Archean cratons. We present Sm-Nd and Pb-Pb isotopic data for the western portion of the Superior Province (WSP) which is characterized by sub-parallel, elongated subprovinces, believed to have been accreted together by subduction-related processes at about 2.7 Ga. This study encompasses a wide range of lithologies from ultramafic to felsic volcanic, sedimentary and pre- to post-tectonic plutonic rocks in order to fully characterize the isotopic evolution of each subprovince. The results are consistent with the evolution of the WSP from a collage of small 3.0-3.2 Ga immature island arcs. There is also evedence for 3.4 Ga old material which may be derived from recycled sediments.

A number of greenstone belts in the WSP have multi-volcano-sedimentary cycle histories, the evolution of which can be traced for periods up to 300 My. In each case, the belt evolves from an immature arc through succeeding volcanic cycles which incorporate (recycle) material from previous cycles. As the volcano-sedimentary pile thickens it undergoes intra-crustal melting leading to granite formation. These processes document the evolution from simple arc systems to micro-continental nuclei. The accretion of the micro-continental nuclei led to the collapse, metamorphism and melting of sedimentary basins to produce S-type granites with variable isotopic signatures due to contribution of sedimentary material from early and juvenile volcanic cycles.

Diorite-monzodiorite-granodiorite (sanukitoid) suites were intruded during and following accretion. A comparison of the trace element contents of the different suites suggest that they can be described as representing variable degrees of fractionation of a dioritic parental magma. Epsilon Nd values decrease with increasing differentiation which suggests that magma differentiation was accompanied by extensive fractionation and that the spectrum of rock types that comprise the suite results from assimilation-fractional crystallization processes.

BTH 78 Woodard, Henry H.

CANOEING A PRECAMBRIAN SUTURE: THE QUETICO-WAWA SUBPROVINCE JUNCTION

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ABSTRACT WITHDRAWN

BTH 79 Fetter, Allen H.

GEOLOGIC HISTORY AND FRAMEWORK OF CEARÁ STATE: NW BORBOREMA PROVINCE, NE BRAZIL

FETTER, Allen H. and VAN SCHMUS, William R. (Dept. Geol., U. Kansas, Lawrence, KS, 66045); SARIVA DOS SANTOS, Ticiano (Inst. Geociências e Ciências Exatas, UNESP, Rio Claro, SP, Brasil); ARTHAUD, Michel and NOGUEIRA NETO, Jose (Dept. Geologia, UFC, Fortaleza, CE, Brasil)

Precambrian basement and supracrustal rocks in the State of Ceará, northeast Brazil, are part of a Gondwana orogenic belt known as the Borborema Province. The region was tectonized by the convergence of the Amazonian, West African-São Luis, and São Francisco-Congo cratons during the Pan African-Brasiliano orogeny ca. 600 Ma. Recent U-Pb zircon and Sm-Nd whole-rock data from Ceará State provide constraints on its pre-assembly geologic history and help delineate the different crustal blocks that comprise the region.

The basement rocks that comprise Ceará consist primarily of ca. 2.1 Ga reworked gneisses and migmatites which are considered to have formed during the Transamazonian-Eburnian orogeny. These rocks are found exclusively southeast of the Sobral shear zone (SSZ) in what is commonly referred to as the central Ceará domain. Also found within this block are smaller enclaves or nuclei of ca. 2.78 Ga Archean rocks. Northwest of the SSZ, in the Medió-Coreau domain, rocks of Transamazonian age are absent. Instead, older pre-Transamazonian gneisses, migmatites and granulites yield U-Pb zircon ages that cluster around 2.35 Ga. In addition, these rocks have Nd T(DM) model ages that closely correspond to their crystallization ages, indicating that the crust of this block is juvenile.

Between the cratonization of these basement rocks and the ca. 600 Ma Brasiliano orogeny a series of rifting episodes affected the region, resulting in the deposition of a series of volcanic-sedimentary sequences at ca. 1.79 Ga and ca. 800 Ma. Data from the corresponding part of Africa suggests that the ca. 800 Ma rifting episode may have resulted in the opening of a small ocean basin just northwest of Ceará State. Evidence for subsequent ocean basin closure comes from a granitoid complex in the NW part of central Ceará which has Nd signatures indicating a mixture between older basement and younger mantle material, a feature common to continental arc rocks.

U-Pb zircon and monazite ages from variably deformed Brasiliano plutons and leucosomes from paragneisses from NW Ceará indicate that Brasiliano magmatism in this part of the Borborema Province extended from about 622 Ma until ca. 580 Ma.

BTH 80 Kozuch, M.

2.1 GA TRANSAMAZONIAN CRUST AS A SOURCE FOR MORE RECENT MELT EVENTS IN NORTHEAST BRAZIL: 1 GA AND 0.75 GA

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The Borborema Province of NE Brazil, an 0.6 Ga continental collision belt, contains an E-W trending crustal block called the Zona Transversal (ZT). Relationships among crystalline (gneissic, granitoid) and volcanic rocks are being defined through the application of U-Pb geochronology and Nd geochemistry.

NE-trending gneisses are divided by the NE-trending Afogados da Ingazeira shear zone (AISZ) in central ZT. Gneisses immediately to the SE of the AISZ have 2.12-2.06 Ga U-Pb ages and were activated during the Brasiliano orogeny ~0.6 Ga. To date, 1.00-0.93 Ga gneisses (U-Pb, Rb-Sr ages) have been found along, and to the NW of, the AISZ; the gneisses are coeval with bimodal volcanosedimentary sequences that are mainly found NW of the AISZ. A younger, 0.81-0.72 Ga episode of bimodal volcanism is also recorded on both flanks of the AISZ. Nd isotope data as well as U-Pb ages confirm that many Brasiliano plutons in the central ZT were derived from 2.1 Ga Transamazonian crust, although some in other parts of the ZT are mixtures involving younger crustal sources. This shows vertical variations in crustal age that may represent tectonic imbrication. The 0.75 Ga volcanics share Nd signatures with those of the 1.0 Ga volcanics and 1.0 Ga gneisses, i.e. epsilon values (0.6 Ga) are near 0, while depleted-mantle model ages range from 1.8 to 1.2 Ga. The newly recognized 0.75 Ga magmatism may represent an extensional event in the ZT, that melted 1 Ga continental (arc?) crust.

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BTH 81 Malcuit, Robert J.

ARE LUNAR ORIGIN MODELS COMPATIBLE WITH A PRIMITIVE (PRE-3.9 GA) TERRESTRIAL CRUST?

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Of the four major models of lunar origin (fission, co-formation, capture, giant-impact), only the giant-impact and tidal-capture models have some promise of being physically possible. There is also a growing body of geochemical and mineralogical evidence for a crust-mantle

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