

order to compare the raw data to factors such as the presence or absence of a clay effect, an improperly calculated shear zone or the effects of large sand grains within a clay-rich matrix. Till sampled from the ring shear device as well as protolith were also tested for Anisotropic Magnetic Susceptibility (AMS) and plotted on a Flinn diagram and a stereonet. Results from the thin sections indicate a weak to moderately strong fabric in both the sheared and unsheared zones. AMS data correlate well with the results of the thin sections, demonstrating a weak compaction fabric within the sheared and unsheared zones and the protolith. This indicates that compaction prior to shearing as well as minimal clast rotation may cause a fabric to form before shearing occurs.

## SESSION 86, 08:00 AM

Tuesday, October 26, 1999

### T57. Granite Systems and Proterozoic Lithospheric Processes (Posters) (International Geological Correlation Program, Project #426 [IGCP-426])

CCC Poster Hall

#### BTH 106 Rosen, O. M.

EARLY PROTEROZOIC COLLISIONAL GRANITES AND SHEAR ZONES AS MARKERS OF THE SIBERIAN CRATON RECONSTRUCTION

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Paleoproterozoic granites, monzogranites and syenites are localized along shear zones and formed by partial melting of tectonites (blasto-mylonites, biotite-hornblende gneisses) in those zones. This granite system is important for understanding the Laurentia-Siberia connection. Sm-Nd isotopic studies and U-Pb zircon dating, including SHRIMP, were used for basement rocks cropping out in the Anabar Shield and the Olenek Uplift. Investigations of drill cores and crustal xenoliths in kimberlites, together with interpretation of potential field data, were also used where sedimentary basins cover basement. The NE Siberian craton formed in the Late Paleoproterozoic (2.0-1.8 Ga) by amalgamation of Archean microcontinents along collisional shear zones. Juvenile crust of the Magan and Daldyn granulite terranes in the Anabar shield separated from depleted mantle at 3.0 Ga (TDM); that of the Birekte and Markha granite-greenstone terranes at 2.5-2.4 Ga (TDM). Volcanic-sedimentary sequences formed at 2.4 Ga upon the Magan terrane (U-Pb zircon) and 2.1 Ga upon the Birekte terrane (U-Pb zircon and TDM). The Kotuykan and Bilyaykh collisional shear zones of the Anabar shield evolved through at least two stages, like Phanerozoic systems (Himalaya, Caucasus, etc.); the first stage at 1.9 Ga and the second at 1.8 Ga. Granite melting and metamorphism inside shear zones (U-Pb zircon) was accompanied by coeval granulite metamorphism (Sm-Nd mineral isochrons) in nearby terranes. A homogeneous field of high temperatures and pressures was evidently widespread inside thickened crust that was under the terranes. As a whole, such an association of granite melting, shear zones, and ancient terranes is indicative of the deep roots of a continental-collision orogen. Invasion of juvenile material into the crust during Late Paleoproterozoic collision is absent except in rare cases (TDM data). Supported by BRFF Grants 97-05-64463 and 99-05-68642.

#### BTH 107 Bell, Stephanie

ORIGIN OF ARC-RELATED GRANITOIDS FROM THE SW AMAZON CRATON: JUVENILE CRUSTAL ADDITIONS AT 1550-1450 MA

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The 1475-1425 Ma Santa Helena batholith (SHB) and ~1550 Ma granitoids of the Jauru terrane in the Mato Grosso area of SW Brazil are largely juvenile crustal additions (ENd(t) = +2.4 to +3.7) added to the Amazon craton along an extensive Mesoproterozoic continental-margin arc system. The granitoids are emplaced into older basement (1800-1550 Ma), also with arc affinities. Granitoids range in composition from tonalite to granite, with the latter dominating. Jauru rocks are typically peraluminous I-types, whereas SHB rocks are mixed I- and A-types lying near the peraluminous/metaluminous boundary. Jauru granitoids have arc geochemical affinities (on such diagrams as Rb-(Nb+Y) and Rb-Ta-Hf), and SHB granitoids have mixed arc and within-plate affinities. On multielement diagrams, all rocks show significant negative Nb-Ta, P, and Ti anomalies and positive Pb anomalies, typical of subduction zones.

Two phases are recognized in the SHB: a northern phase with high Sr contents, low (La/Sr) ratios, and relatively steep REE patterns ((La/Yb)<sub>n</sub> = 20) in which tonalite and monodiorite dominate, and a southern phase with low Sr, high Rb/Sr ratios, and relatively flat REE patterns ((La/Yb)<sub>n</sub> = 3.5) with large negative Eu anomalies in which granites dominate. On multielement diagrams, the southern phase also shows negative Sr and Ba anomalies. Jauru granitoids have geochemical characteristics similar to northern-phase SHB rocks. The spread of compositions within each phase of the SHB (and among the Jauru granitoids) can be related by shallow fractional crystallization in which quartz, feldspars, and biotite are the dominant cumulus phases. REE distributions, however, preclude the two SHB phases being related to each other by fractional crystallization. Parent magmas for SHB and Jauru granitoids appear to have been derived from partial melting of amphibolite sources no older than 1800 Ma. Garnet was left in the residue of the northern phase SHB magmas only.

#### BTH 108 Bettencourt, J. S.

MESOPROTEROZOIC RAPAKIVI GRANITES OF RONDÔNIA TIN PROVINCE, SW AMAZON CRATON, BRAZIL: Nd, Sr, O, Pb ISOTOPES AND METALLOGENIC IMPLICATIONS

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Mesoproterozoic bimodal anorogenic magmatism in the Rondônia Tin Province, SW Amazon craton, emplaced seven rapakivi granite suites episodically between ca. 1600 Ma and 970 Ma into older Proterozoic crust. The rapakivi intrusive suites are: Serra da Providência (SPIS; 1606-1532 Ma); Santo Antônio (SAIS; 1406 Ma); Teotônio (TIS; 1387 Ma); Alto Candeias (ACIS; 1346-1338 Ma); São Lourenço-Caripunas (SLCIS; 1314-1309 Ma); Santa Clara (SCIS; 1082-1074 Ma); and Younger Granites of Rondônia (YGR; 998-974 Ma).

Whole-rock Nd, Sr, O and Pb isotopes allow the rapakivi suites to be divided into two groups. One group (>1300 Ma; SPIS, SAIS, TIS, ACIS, and SLCIS) is characterized by eNd(T) of 0 to +2.74, depleted mantle model ages (TDM) between 1.52 and 1.87 Ga, ISr of 0.702-0.710 (except Serra da Providência batholith, ISr > 0.713), d18O between +5.77 and +8.23 per mil, and elevated 206Pb/204Pb (18.0-30.1) with limited 208Pb/204Pb (40-45) indicating high U/Pb but time-averaged Th/U < 4 (except for TIS). The younger group (<1100 Ma; SCIS and YGR) has eNd(T) values of +0.33 to -3.25, TDM between 1.66 to 1.73 Ga, ISr of 0.707 to 0.709, d18O of +8.1 to +9.5 per mil, and low 206Pb/204Pb (17.7-20.6) but elevated 208Pb/204Pb (37.3-43.2) indicating time-averaged Th/U > 4. Older crustal rocks are clearly involved in granite genesis. Intersuite differences in Nd and U-Th-Pb systematics reflect not only magmatic processes but also granite sources. A lower than average crustal Th/U source contributed to most of the older group. In contrast, a source characterized by average crustal to elevated Th/U contributed to the younger group. Oxygen isotopes of the older suites suggest that partial melts of lower crust mixed with mantle-derived magmas, consistent with evidence of magma mixing and mingling. For younger suites, oxygen isotopes indicate a calc-alkaline magma component, or assimilation of high-level crustal material. Massifs characterized by average crustal U/Pb values but time-average Th/U = 4 and high d18O are most favorable for Sn deposits.

#### BTH 109 Barker, Daniel S.

PROTEROZOIC GRANITES OF THE LLANO UPLIFT, TEXAS: A-TYPE? SOME, POSSIBLY ANOROGENIC? NO.

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Metaluminous to weakly peraluminous granites form nearly half the 9000 km<sup>2</sup> outcrop area of Precambrian rocks in the Llano uplift, central Texas. Ten plutons are approximately circular in plan and average 15 km in diameter. These are younger than syndeformational irregular and sheet-like granite bodies that occupy about half as much outcrop area. The circular plutons, compared to the irregular and sheet-like bodies, tend to have higher SiO<sub>2</sub>, Pb, Nb, and Ga/Al, and lower K/Rb and TiO<sub>2</sub>, but most trace element abundances and ratios do not distinguish between these two styles of granite occurrence. Some fashionable tectonic discrimination diagrams based on trace elements classify these granites as A-type, but other diagrams classify the same samples as syn-collisional or volcanic arc granites.

Three other Llano granite types differ markedly from both the circular plutons and the irregular and sheet-like granites. One of these forms small intrusive bodies that cut the circular plutons; it is weakly peraluminous, lacks rapakivi texture, perthitic intergrowths, amphibole, and fluorite, shows the highest Ce<sub>n</sub>/Yb<sub>n</sub>, the lowest Ga/Al, Y, and Yb, and is the most depleted in Nb + Ta. The remaining two types form small plutons and have the highest SiO<sub>2</sub>, U, Pb, Rb, and Ga/Al, the lowest Ce<sub>n</sub>/Yb<sub>n</sub> (less than 1), TiO<sub>2</sub>, and Ba, and show Nb + Ta enrichment rather than depletion. One differs from the other in having higher Ni, Yb, Y, and Rb/Sr, and the most negative Eu anomaly of all five types.

Granites that plot in the "A-type" field on some diagrams are intruded by others that plot outside that field. All these granites were emplaced within 50 m.y., after collision of the southern margin of Laurentia with a volcanic arc and then with another continental mass. The older granites were contemporaneous with the last stages of continent-continent collision. The granites cannot all have formed from one parental magma, and did not rise from a single source. All compositional groups are geographically interspersed and shared the same tectonic setting but a diversity of magma sources. Some Llano granites may be "A-type" (according to composition) but are not "anorogenic" (according to chronology and structure).

#### BTH 110 Moeglin, Thomas D.

SHEAR-SENSE INDICATORS SUPPORTING SOUTHEAST-SIDE-UP MOVEMENT FOR THE SKIN GULCH SHEAR ZONE, NORTHERN MUMMY RANGE, NORTH-CENTRAL COLORADO

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The northeast-trending Skin gulch shear zone (SGSZ) cuts Proterozoic granitoid and metamorphic rocks of the northern Mummy Range, Larimer County, north-central Colorado. The SGSZ extends for more than 40 km, from the Poudre Park quadrangle on the east, across the entire width of the Big Narrows, Pingree Park, and Comanche Peak quadrangles; the western termination has not yet been located precisely. Protomylonite, mylonite, and cataclases represent the major lithologic components of the shear zone; lenses of ultramylonite are interspersed locally. Although the lithology and geochemistry of the rocks exposed within the SGSZ have been studied (Abbott, 1972, GSA Bull., 83:487-494 and Nesse, 1984, GSA Bull., 95:1158-1167), movement direction remains problematical.

Oriented samples collected from the Comanche Peak quadrangle yield shear-sense structures indicating southeast-side-up movement along the SGSZ. Early Proterozoic (X) biotite schists contain well developed S-C fabric and both  $\sigma$  and  $\delta$  type winged porphyroclasts. Early Proterozoic (X) granitoids contain  $\phi$  and possibly  $\sigma$  type winged porphyroclasts. The  $\phi$  structures do not yield absolute movement direction, but they are consistent with a dip-slip interpretation. Middle Proterozoic (Y) granitoids have a strong S-C fabric,  $\sigma$  type winged porphyroclasts, antithetic microfaults, and oblique microscopic foliation. Folds in mylonitic layering in the biotite schist have a vergence consistent with the southeast-side-up interpretation. Thin sections of the strike-oriented motion plane, cut perpendicular to the dip motion plane, do not indicate any coupled sinistral or dextral motion along the shear zone.

#### BTH 111 Edwards, Benjamin R.

THE SHERMAN BATHOLITH, SOUTHEASTERN WYOMING: IMPLICATIONS FOR THE EVOLUTION OF THE MESOPROTEROZOIC LITHOSPHERE

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The 1.43 Ga Sherman batholith, in southeastern Wyoming and northeastern Colorado, comprises the most diverse suite of rock types of any 1.4 Ga granitic batholith in the western U.S. We use a new compilation of data from the Sherman batholith to examine: (1) geochemical differences between the three main phases of the batholith; (2) geochemical similarities between rocks of the batholith and two groups of cotemporal intrusions; and (3) processes associated with the geochemical evolution of Mesoproterozoic lithosphere.

The Sherman batholith comprises seven units (in order of decreasing mapped extent): coarse-grained, metaluminous granite (Sherman); porphyritic, metaluminous granite and