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Canadian Tectonics Group

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The fifth annual meeting of the Canadian Tectonics Group was held in Halifax, Nova Scotia, on 8-10 November 1985. Drawing participants from Canada and the United States, a total of 34 members attended the meeting despite a late change in location from Newfoundland. The group consists of university faculty, students, members of government surveys and private industry. To become a member, all one has to do is attend a meeting, the objective of which is to present and discuss in an open forum setting a wide range of topics related to structural geology. The format of the meetings consists of an evening open for poster displays, a day filled with oral presentations and a full-day field trip. Such a format was followed at this meeting, and was run in impeccable fashion by the meeting's three chairmen: Chris Mawer, now a professor at the University of New Mexico; Paul Williams, professor of structural geology at the University of New Brunswick (UNB); and Jack Henderson of the Geological Survey of Canada (GSC).

The meeting was officially opened with a presentation on the geology of Nova Scotia by J. Duncan Keppie from the Nova Scotia Department of Mines and Energy. A part of the Appalachian Mountains, Nova Scotia is dominantly a fold-and-thrust belt of Paleozoic shelf facies metasediments. The province is cut roughly in half by the east-west trending Minas Geofracture, a long-lived dextral transcurrent fault zone which has experienced a total movement of 600-700 km since its initiation during the Devonian Acadian orogeny. The northern half of the province is composed of a wide variety of rock types ranging from Proterozoic basement to Carboniferous granitoids. South of the Minas Geofracture, three major litho-tectonic sequences can be recognized in Nova Scotia: (1) complex Proterozoic gneisses deformed during Cadomian transpression which comprise the basement; (2) sediments of the Meguma Group, the Kentville Formation and other sediments deposited from Late Cambrian to Early Devonian and deformed in the Acadian orogeny; (3) Horton and Windsor Groups deposited and deformed during Hercynian transpression which spanned Late Devonian to Permian time. The Early Ordovician Taconian orogeny, which had a major effect on the geology of the northeastern United States, played only a minor role in Nova Scotia.

During the Sunday field trip, many aspects of the deformational history of the southern half of Nova Scotia were seen. At Durell Island, Duncan Keppie showed a Devono-Carboniferous granite deformed along the Chedabucto Fault, an expression of the Minas Geofracture. Early ductile deformation is reflected in the augen gneiss as a homoclastic protomylonite fabric (as coined by Simon Hanmer in the presentation section) and was followed by cross-cutting pseudotachylyte veins.

The effects of the Acadian orogeny were seen in two outcrops on the field trip: (1) at Halfway Cove, polyphase deformation of pelitic and coticule beds of the Halifax Formation resulted in tightly refolded folds and in particular, beautiful refolded sheath folds with three-dimensionally exposed hinges; (2) at Redman Head, where Goldenville Formation metagreywackes and slates are deformed in the Liscombe syncline. In this outcrop, Jack Henderson pointed out that en echelon quartz veins in slate beds displayed opposing senses of shear on opposite limbs of the syncline. The veins were folded, unfolded and then stretched beyond their original lengths along metagreywacke-slate interfaces which remained coherent during the deformation.

The last stop of the field trip was at the Harrigan Cove gold mine where bedding-parallel, auriferous quartz veins display beautiful crack-seal textures in Goldenville Formation slates.

Posters

On Friday evening, the walls of the conference room were used for poster displays which covered a wide range of topics from microstructure to major tectonic processes. M.-L. Tremblay (grad. student, UNB) showed plagioclase feldspar microstructure in the major shear zones of the Parry Sound, Ontario region, Grenville Province, while A. Leger (grad. student, UNB) displayed S-C mylonite textures from southern New Brunswick. He discussed how the model by Berthe *et al.* (1979) could help to solve problems in structural interpretation. B. La France (student, UNB) displayed some complex inter-relationships between cleavage and fold development in rocks from the Bay of Exploits, Newfoundland.

Jack Henderson (GSC) displayed some of the kinematic indictors found in the Wager Bay Shear Zone, NWT and G. Ruixiang (UNB) showed evidence for displacement along the Hollow Fault, Nova Scotia. H. Poulsen's (GSC) poster on shear zone fabrics related gold to the shearing event for the Star Lake granitoid pluton, northern Saskatchewan. W. Fyson (U. of Ottawa) had an interesting display of quartz veins and their relationship to multiple deformation events in Archean metaturbidites, Yellowknife Domain, Slave Province. C. Moreton, A. McAlistar and P. Williams (UNB) showed the structural features at the Heath Steele Mines, Newcastle, New Brunswick.

On a more regional scale, A. Okulitch (GSC, Calgary) displayed a compilation of new and previously collected data for the Boothia Uplift. He suggested that this major tectonic feature — which has long been regarded as a classical horst — can be interpreted as a major, west-directed imbricate mass. Vertical uplift as shown through stratigraphic studies, reached a maximum of 5 km and estimates of horizontal movement, predicted on assumed fault dips, could be as much as 30 km. Dwight Bradley (Johns Hopkins U.) displayed a poster which covered Eurekan structure and tectonics of the Vesle Fjord area, Ellesmere Island, Canadian Arctic Archipelago. J.T. van Berkel (GSC) showed a reconnaissance map of the southern Long Range Mountains, southwest Newfoundland. The product of his first summer's mapping is the delineation of this complex area into four distinctive terrains separated by major faults. The area contains a wide range of rock types from anorthosite to ophiolite complexes, from granitoid gneisses to marbles, and has a variety of structural deformation states.

Oral Presentations

On Saturday, a series of 20-minute oral presentations covered topics ranging from the statistical treatment of the effect of sample size on paleostrain measurement (Pierre Robin, U. of Toronto) to a description of the tectonic activity along the northern part of the Thelon Tectonic Zone, District of Mackenzie (Nick Culshaw, PDF, GSC).

An interesting discussion on cleavage development was instigated by Frank Feuten's (grad. student, U. of Toronto) presentation on the role of chemical differentiation during spaced cleavage formation in the Meguma Group metagreywackes, Nova Scotia and by Debbie Spratt's (U. of Calgary) description of cleavage development in the Foothills and Eastern Front Ranges of Alberta. Chris Mawer (UNB) described a hypothetical model on the rate of formation of quartz veins which turned out to be a much argued topic at the last field trip stop. The model predicts extremely rapid rates of dilation; e.g. a quartz vein which dimensions 100 m × 100 m × 1.75 m thick could form in 0.55-1.0 year.

Fried Schwerdtner (U. of Toronto) described the deformation of bedded anhydrite in three listric thrust faults, Eureka fold-and-thrust belt, Canadian Arctic Archipelago. Simon Hanmer (GSC) presented preliminary mapping results from the Great Slave Lake Shear Zone, NWT. This great shear zone is up to 25 km in width and separates the Slave and Churchill Provinces of the Canadian Shield. In order to effectively map such a large mylonite belt, Simon introduced a new mylonite terminology based on grain size distribution within the porphyroclast population. The terms homoclastic and heteroclastic describe the dominance of one clast size over the others and the dominance of several clast sizes (or none), respectively.

A. Caron (grad. student, Memorial U.) re-evaluated movement along the Dover Fault, Newfoundland, while C. Elliott (grad. student, UNB) described the confusing tectonic history of the many regional thrusts in central Newfoundland.

Other large-scale investigations included Phil Simony's (U. of Calgary) correlation of the field characteristics of allochthonous plutons in southeastern BC with thin-skinned tectonics of the Cordillera. Charlotte Hy (PDF, UNB) discussed changes in metamorphic grade related to two periods of schistosity development in the mica schists of the Monte Mucrone area, Sesia Lanzio Zone, western Italian Alps. Closer to home, Paul Clifford (McMaster U.) described the little deformed rocks of the Killarney Triangle Zone, Killarney, Ontario as possibly related to the anorogenic igneous terrane of the US. This zone is apparently unrelated to the Grenville Province (located to the southeast) or to the Southern Province (located to the north).

Don Rousell (Laurentian U.) and Paul Clifford have offered to host the next Canadian Tectonics Group Meeting at Sudbury, Ontario during the weekend of 18-19 October 1986 with a field trip across the Grenville Front. To be included in the first circular mailing list, contact: Dr. Paul Clifford, Dept. of Geology, McMaster University, Hamilton, Ontario, Canada L8S 4M1, or telephone (416) 525-9140.

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CESAR and Future Arctic Studies: A Workshop

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The Alpha Ridge, the submarine ridge that stretches toward the North Pole from the continental shelf off Ellesmere Island, is tectonically enigmatic. It has in the past been thought to be either an extinct spreading ridge or a submerged strip of continent. In 1983, the Canadian Expedition to Study the Alpha Ridge (CESAR) occupied the Arctic ice 400 km from the North Pole and over a period of 8 weeks, conducted a series of geophysical, geological, oceanographic and other scientific investigations over the Alpha Ridge. The geophysical interpretation of these investigations is just now reaching synthesis. To act as a focus for this process and to take stock before planning new directions in the Arctic Basin, the Earth Physics Branch (EPB) of the Department of Energy, Mines and Resources invited 40-50 Canadian and US scientists to Ottawa, 12-13 November 1985.

In his introduction, EPB Director-General, Jim Tanner noted that co-operation was a key feature of Arctic studies, both co-operation between Canada and the US and between differing agencies and organizations. In particular, he praised the "workhorse" of Canadian Arctic science, the Polar Continental Shelf Project (PCSP) under George Hobson. Chairman Mike Dence (EPB) then briefly reviewed the main features of the Arctic Basin and the geophysical data in the region. In some ways, this is more notable for its gaps than its coverage. Serious gaps in bathymetry, gravity, and heat flow pose a number of problems. Aeromagnetic coverage, while better, still leaves the identification of ocean-floor lineations unresolved in some critical areas. The difficulties of access — physical, political and financial — mean that much of the Arctic Basin remains totally unexplored and unknown. Small patches, such as the CESAR area, are known in more detail but in comparison with the sea floor off western Canada, very poorly. As a consequence, views on the evolution of the Arctic Basin are very varied.

Hans Weber (EPB) then presented a review of the principal CESAR geophysical results and the compiled bathymetric and gravity maps of the area. The Alpha Ridge is rugged with long ridges and valleys parallel to the main axis. Thin sediments overlie a basement that is laterally uniform in both density and magnetization. There is no evidence for magnetic reversals. From gravity interpretations, the crest of the part of the Ridge observed has a crustal thickness of 36-40 km as compared with the Makarov Basin (15 km to Moho, probably oceanic) and the Lomonosov Ridge (27 km to Moho, continental) to the north-east.

Alan Green (EPB) showed the results of seismic refraction data from CESAR. Again a strong uniformity was observed in the upper (less than 14 km depth) crustal layers. Seismic velocities over 8 km s^{-1}, indicative of the base of the crust, were reached at depths of 25 km beneath the west flank of the Ridge, at around 40 km beneath its crest and then shallowed to 20-25 km beneath the flank adjoining the Makarov Basin. Comparing the Alpha Ridge with other oceanic structures he suggested that it was much simpler than Vancouver Island but had similarities with oceanic plateaus such as Ontong-Java. Seismic reflection data was described by Ruth Jackson (Atlantic Geoscience Centre (AGC)) as showing up to 500 m of sediment in grabens on the Ridge. Some faulting and possible extension is evident but the age of well-preserved foraminifera in the sediments suggests that there has been no major tectonism since the late Cretaceous.

Alan Judge (EPB) reviewed the heat flow and thermal conductivity measurements made during CESAR, noting that the conductivities are not similar to normal ocean sediments. Calculated heat-flow values vary from 39-67 mW m^{-2}, averaging about 50. This is similar to other values in the Arctic Ocean basin and if used to determine age, could indicate an age of 50-120 Ma. Satellite magnetic anomalies (nominal altitude 370 km) presented by Richard Coles (EPB) reveal a dramatic 30nT high over the Alpha Ridge. Similar highs occur over northern Greenland and Iceland. Modelling confirms that the rocks of the Mendeleyev Ridge (a possible continuation of the Alpha Ridge towards the USSR margin) are not as magnetic as those of the Alpha Ridge. Calculations of the magnetizations necessary to model the anomaly suggest that comparisons with Iceland may be valid.

Magnetotelluric investigations were reported by Ron Niblett (EPB) who outlined how high frequency data essentially followed the bathymetry. However, "low-pass" (low frequency) data sampled much greater depths within the earth and indicated a major drop in resistivity near 85 km depth. Interpreted as the base of the lithosphere, this compares with results from the same technique of 120-150 km under Lomonosov Ridge,