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The same type of relationship has been observed in fragments produced by nuclear explosions, and by Sammis in fault gouge (or breccia). Turcotte cited evidence in his lectures that it can be extended to metre-size fractures, and indeed to entire systems of faults and fault blocks, such as those displayed by the crust of the state of California. A physical model that displays much the same fractal dimension as observed in these examples can be developed using the reasonable premise that blocks fragment only when two blocks of nearly equal size come into contact with each other in a zone of compression or shear.

My personal reaction to these two days at AGU was first that these are exciting and controversial times during which the practical application of the main concepts and techniques of nonlinear dynamics are being extensively tested for the first time on a wide range of geological phenomena, and second that I must immediately learn a lot more about fractals — there is a great deal more there than pretty pictures! A short bibliography of references not in my recent review article on nonlinear dynamics follows. The emphasis is on practical applications rather than on mathematical theory.

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Reminder: GAC is sponsoring a two-day Short Course on Nonlinear Dynamics, Chaos and Fractals (with Applications to Geological Systems) at the 1991 Annual Meeting in Toronto, 27-29 May 1991.

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CANQUA

Rapid Change in the Quaternary AMQUA/CANQUA 1990

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On 4-6 June 1990, more than 250 participants from across Canada and the US attended the first joint meeting of AMQUA (American Quaternary Association) and CANQUA (Canadian Quaternary Association) at the University of Waterloo. Although this was the second CANQUA meeting in as many years, it did not seem to affect attendance by Canadians, underlining the need for an annual regular scientific CANQUA meeting. This conference was extremely well organized, with a wealth of excellent presentations on a variety of Quaternary interests. Each province and territory was represented by participants, in addition to most US states. Participants were split among industry, government, and university research personnel.

Before the conference, three field trips showed participants the numerous Quaternary features in the region of Southern Ontario and northern New York state. I personally found the Waterloo regional glacial geomorphology trip to be excellent. In addition to seeing five different local moraines, we examined Wittlesea shorelines, visited a major drumlin field, a series of kames *sensu stricto*, a kettle lake, and karst features that may have been carved during melting of the local ice. Also evident on the trip were several examples of poor regional planning that did not consider local Quaternary geology:

1. Continued unrestrained urban expansion has so taxed the local water supply that a major project to draw water from the Grand River and pump it through the local aquifer has become necessary.
2. A housing development had to be abandonned because methane leaching from a land fill could not dissipate through the clay-rich till.
3. More than 25 years of corn-based agriculture have so reduced the quality of the soil, that wind erosion has deflated the *entire* A and B horizons in many fields, leaving exposed C horizons. In the 60 km+ winds, on the day of our trip, we watched incredible amounts of soil blow away.

Other participants on the Eastern Lake Erie basin and Lake Ontario north shore trips reported that they had seen some fascinating glacial and archeological sites as well.

The conference kicked off with a mixer on Sunday night at which many old friends had an opportunity to catch up on recent events. Early Monday morning, the scientific sessions started with welcomes from conference Chairman Alan Morgan, Barry Warner, and Dr. D.V. Wright, President, University of Waterloo.

The theme for the conference was rapid change in the Quaternary. In the keynote address, Bill Fyfe repeatedly asked the question "What will the world be like in 2050?" With vivid pictures and eloquent phrases, he then described to us what it will be like if we do not start to clean up our act as a race. He cited a variety of evidence to convince us that global change is upon us whether we like it or not:

1. Canadians use more energy per capita than any other nation, with the US only slightly behind us.
2. If world population continues adding 90,000,000 per year, then by 2050, there will be 10 billion. Population will increase to 14 billion before leveling off.
3. 40,000 children a day die of starvation and/or disease.
4. If the efficiency of the earth's thermal blanket increases by 1%, the ice caps will melt in 60 years!
5. Iowa has lost *one-half* of its top soil.
6. As much as 30 cm of top soil can be lost from land cleared of jungle in Thailand in *one* rain.
7. Several towns in Poland have had *no live* births in decades due to pollution.
8. In the Amazon basin, the major dam project will silt up in less than 10 years, but is only producing 5% of its capacity. Plus, it has covered millions of hectares of jungle in a lake averaging 1 m deep, the ideal breeding ground for malaria.
9. One edition of the Sunday New York Times requires 77,000 Canadian trees.
10. More than half the elephants alive in 1981 are now dead due to poaching.
11. Primary productivity in the Mediterranean has almost ceased now due to pollution.

This gloomy litany of symptoms indicates a sick planet. Dr. Fyfe emphasized that the solution must include education for all, especially women, everywhere, but an education that ensures people are literate, "numerate", and "sciencate" (scientifically literate). Our governments must stop considering scientists to be plumbers who get called in only when there's a leak. Technological innovation must include a readily available cheap power supply, such as GaAs and GaSb power cells, in which one hour of solar energy stored will provide for a fridge, TV, fan, and

lights for a house. He emphasized that, as Quaternary scientists, we provide the background data against which more recent global changes must be measured.

Art Dyke used the incidence of bowhead whale skeletons and driftwood logs to show that the pack ice in the Arctic must have been at maximum extent between 4 and 7 ka. Citing climatic monitoring data from the Arctic, Alan Morgan sketched the effects on permafrost and arctic climate from the expected temperature rises due to greenhouse gases. By using frequency histograms of ^{14}C dates obtained from marine molluscs, Brunneau *et al.* attempted to show how marine conditions had varied since deglaciation. I.P. Martini (with R. Morrison) discussed deglaciation, the development of wetlands, and biota on Prince Charles Island, NWT.

In a very erudite talk, Jim Teller *et al.* explained how drainage from the proto-Swan River caused catastrophic drainage of Lake Assiniboine into Lake Agassiz. Patrick Julig described how points from gravel lags in several sites around the upper Great Lakes showed evidence of having been rounded during floods which deposited the gravels. Using transfer functions on pollen species abundances during the Younger Dryas, Linda Shane determined that cold temperatures then prevailed in the Lake Michigan region. By comparing pollen zones in Ontario, Quebec, and the Maritimes, Pierre Richard determined that pollen production rates were lowest from 10 to 7 ka, and charcoal production peaked at 10-9 ka. Differential abundances of trace fossils on the bedding planes enabled Dana Naldrett to define Champlain Sea sediment seasonality. In many sites in eastern North America, Bob Mott (with R. Stea) correlates increased mineral concentrations and decreased organic sedimentation, particularly pollen, at 11.5 ka with the European Younger Dryas.

At the AMQUA Annual General Meeting, discussion centred on how the society should spend some of its surplus funds. Several proposals were considered including lobbying congress, lobbying NSF coordinators, education, and PR. In the evening, many participants visited the local pubs to continue the day's discussions.

Starting Tuesday's sessions, S. Lehman explained to us how meltwater pulses entering the Atlantic cooled the ocean surface by adding a pulse of cold freshwater to ocean, which allowed the sea ice limits to move significantly further south and caused readvances of the ice sheets, particularly the Laurentide sheet. These pulses can be seen in $\delta^{18}O$ records of Atlantic cores from the tropics to Arctic. The pulse at 15-14 ka occurred from collapse of the ice blocking the Norwegian channel. Two meltwater pulses came down the Mississippi at 13.5 and 12 ka due to the melting Laurentide sheet. The final pulse at 10 ka, the Younger Dryas, is not as well documented in the cores, and may be due to the draining of Lake Agassiz through the St. Lawrence, as recently suggested by several Canadian Quaternarists.

Michel Parent (with J.M.M. Dubois) feels that the glaciation on les Iles de Madelaine may have occurred in Stage 3 or 4, but not in the late Wisconsinan. Stephen Hicock (with A. Dreimanis) discussed the rheology of deformation till, and cited some examples. Robert Gilbert detailed the sedimentological history of deglaciation in the Kingston basin (now part of Lake Ontario). J.T Grey (with N. Hetu) described the sand spit stratigraphies along the lower St. Lawrence. Alan Kehew explained how the Grand Valley spillway was cut by floods from Lake Saginaw into Lake Chicago. Using the pollen records from beaver ponds and oxbow lakes in Iowa, Richard Baker (with C. Chumbley) determined that the warmest, driest period during the Holocene occurred at 5.5 ka.

By using diatom preferences, Jan Smol *et al.* determined that pH has decreased in most lakes in the Adirondacks since 1850. Furthermore, R.B. Davis *et al.* showed that the acidification was *not* a response to recovery from logging, and was well beyond the normal changes seen in the Pleistocene. K. Johnson explained the problems that many rural communities in the Adirondacks are having with their water supplies. Buddy Schweig, with L. Leffler, described examples of the damage done by the New Madrid earthquakes in 1810. The quote-of-the-conference award must go to Michel Bouchard for his description of cars as the "trace (fossil) erratics" in the next glaciation's till, and our ability to determine the depth of erosion by the amount removed from the CN Tower. Michel Bouchard *et al.* used the erosion of the rims of the Nouveau Québec crater to determine that each glaciation removes about 1-5 m of rock from the shield.

At the CANQUA Annual General Meeting, it was determined that the 1993 meeting would be held in Winnipeg, but that the decision regarding the 1995 meeting would wait until Fredericton for a final approval. The problems of professional registration were also raised again, given the exclusion of geologists from the Free Trade agreement. It was also announced that all future Johnston Medal awards would be handled by the committee headed by the past president. The problems of increasing conference size were also addressed. Most people would prefer not to have concurrent sessions.

Tuesday wrapped up with a barbeque where plenty of good food and beer lubricated the discussions. A local group treated us to unusual musical renditions, that included the CANQUA/AMQUA "theme song" from the Flintstones, and everything from Irish folk music to recent rock. The local organizing committee also favoured us with a lively song and dance (somewhat reluctantly).

Wednesday morning began with the presentation of the W.A. Johnston Medal to Jan Terasmae for his career contributions to Quaternary sedimentology. Alan Morgan also detailed plans for the 1991 International Quaternary Association (INQUA) meeting in China.

In Louisiana soils, Scott Burns *et al.* found the highest natural radioactivity generally occurred in the B_t horizon. June Mirecki *et al.* described several problem sections for amino acid stratigraphy from the Virginian coastal plain. By ^{36}Cl dating of Searles Lake cores, Fred Phillips *et al.* determined that pluvial/interpluvial changes are very abrupt and that glaciations correlate with pluvials. D.J. Sauchyn (with S. Porter) reported on a 9 m core from the Cypress Hills, Alberta.

Using ^{36}Cl dating, M. Zreda *et al.* found several Sierra Nevada glaciations to be contemporaneous with the major glacial events. Vic Levson described how ice advancing down the main valleys in the Cordillera first ponds glacial lakes in the side valleys before the main alpine sheet covers the area. On the basis of till filling prairie dog burrows in the Hand Hills, Alberta, R. Young *et al.* determined that significant erosion occurred in Alberta during the last glaciation, hinting at complete blockage of the ice-free corridor. Dorn, presenting for Moody *et al.*, described gravels from 17 distinct flood events in the channeled scablands from 18 to 11.8 ka.

By dating bottom sediments from lakes ponded behind moraines, Tom Davis (with G. Zielinski) has re-evaluated the supposedly Neoglacial moraines in the Cordillera as Younger Dryas, or earlier. Allen Gottesfeld (with Lynn Johnson-Gottesfeld) described the abandonment of little Ice Age terraces in the Cordillera.

Posters presented included discussions of late glacial and post-glacial stratigraphy, sedimentology, palynology, and/or paleoenvironmental interpretations from all over Canada and the world, including Newfoundland (Liverman and Taylor; Catto; Macpherson; Bolduc *et al.*; Batterson and Liverman; Miller *et al.*; Irwin and Davis), the Maritimes (Seaman; Walker; Miller; Pronk *et al.*; Anderson; Stenson; Finck and Stea; Stea and Mott), Quebec (Lauriol *et al.*; Pienitz and Lortie; Richard and Bouchard; Gajewski and Garralla), Ontario (Miller and DiLabio; Suffling *et al.*), the Great Lakes region (Feenstra *et al.*; Brown *et al.*; Karrow *et al.*; Vanderveer; Hann; Morris; Motz and Morgan; Marsters and Warner; Heath *et al.*), the Prairies (Vreeken; Kuhry; Osborn *et al.*; McGinn; Wayne), the Cordillera (Hebda; Matthews; Petersen), Arctic (Douglas and Smol; Morgan *et al.*; Bell; Keenan and Cwynar), Virginia (Kneller and Peteet), Florida (Karrow *et al.*), Ohio (Snyder *et al.*; Lowell *et al.*; Szabo *et al.*), Minnesota (Zeeb and Smol; Huber and Gilbertson; Card), Texas (Haywood), the Gulf of Mexico (Johnson and Wehmiller), Mexico (Elias), South America (Seltzer; Kuhry), and Africa (Wilson). The geochronological dating methods discussed included dendrochronology (Luckman *et al.*), ESR (Blackwell *et al.*;

Porat *et al.*), U series (Ford and Lundberg), and ^{14}C (Shoshani; Stuckenrath; Aravena *et al.*; Mayle and Cwynar). Several other interesting topics were presented, including drumlin formation (Patterson), p-forms (Stenson and Tinkler), neotectonics (Thomas *et al.*; Bobrowsky and Clague), placers (Milner), collapsing ice sheets (Johnson), aboriginal adaptations to change (Webb), marl $\delta^{18}O$ (Edwards and Dyrkton), ecological density models (Shoshani), isotope dendroclimatology (Buhay *et al.*), a paleoecological data base (Jette), bog formation (McAndrews and Ovenden), geophysical prospecting for archeological sites (Hunter and Nobes) and resource mapping (Schneider and Greenhouse). All the posters were high-calibre presentations scientifically. Furthermore, only two posters looked like they had been done on the plane to the conference. Poster presenters must be congratulated for the efforts they put into their presentation.

Two more field trips followed the meeting. The Waterloo regional geomorphology trip was repeated. A good group took a Lake Ontario cruise and visited the Canada Centre for Inland Waters research facility at Burlington, luckily on the only really nice day all week.

Also, three short courses were given following the meeting. David Nobes, John Greenhouse, and G. Schneider taught a course in geophysical applications in Quaternary sciences which included one day of field experience followed by a day of lectures and computing. Several experts taught the short course on biological techniques in paleoenvironmental interpretation. The short course on Quaternary dating techniques brought ten experts in TL, ESR, U series, ^{14}C, and amino acid racemization together to discuss the methodology, problems, and sampling. Extra copies of the notes for this course sold out almost immediately, requiring a second printing during the conference. Comments from course participants praised the content and organization. Course notes for all courses can be purchased by the public. The conference and short course organizers are to be congratulated for successfully delivering such an ambitious number of courses.

As with any conference there were minor technical and organizational problems, not to mention miserable weather complete with a small tornado. This year, microphones enabled us to hear the speakers better than in most conferences, although some were still hard to hear. It was also a delight that this year the talks only fell behind schedule on the last day, partially due to the presentation of the Johnson Medal. The session chairmen who stringently enforced the time limits, yet did not strangle the discussions, are to be congratulated, as are the organizers.

The idea of having a designated time for the poster sessions which did not conflict with any talks ensured that many people visited the posters, but unfortunately, the area with the posters became very crowded. Future conference organizers must solve this problem, without relegating the posters to one (or, worse yet, many) hidden rooms. With the number of submissions to meetings constantly increasing, it may become necessary to split the conference into concurrent sessions, to accommodate the number of people wanting to talk. A side issue to this problem is that not all presenters are equally good at oral presentations. Most of us have fallen asleep at one time or another during a boring talk in which the speaker droned on and on. One solution here might be to review not only the scientific content of the paper, but also the ability of the speaker to present his/her message. People who do not communicate as well orally would still be able to present in a poster session. This would ensure stimulating talks, but still allow everyone to present their data.

Given that probably the most frustrating thing about the meeting was having to choose from the great variety of interesting post-conference activities, I think the Waterloo AMQUA/CANQUA conference was a great success. Certainly, it was the biggest CANQUA meeting ever. As the first joint meeting, we all hope it is only the first of many. It's also the first time CANQUA has tried offering short courses, but I'm sure, not the last. The local organizing committee did a superb job. People wishing copies of either the conference abstracts, field trip guidebook, or any of the short course notes can obtain them from Barry Warner, Department of Earth Sciences, University of Waterloo, Waterloo, Ontario N2L 3G1. The next CANQUA meeting is scheduled for Fredericton, New Brunswick, in 1991.

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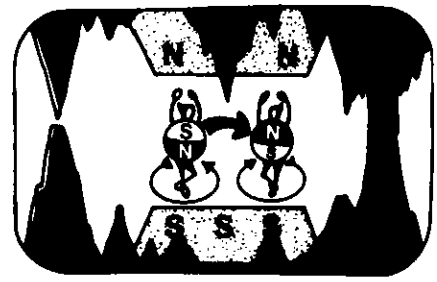

TL + ESR 6th International Specialist Seminar on Thermoluminescence and Electron Spin Resonance Dating

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On 2-6 July 1990, more than 150 participants from around the world, including six Canadian scientists, attended the sixth international symposium on thermoluminescence (TL) and electron spin resonance (ESR) dating at Clermont-Ferrand, France, hosted by l'Université Blaise-Pascal. This conference was extremely well organized, with a wealth of excellent presentations in the problems and applications of TL and ESR. Participants were split between government and university research personnel.

The conference kicked off with a dinner on Sunday night at which many old friends had an opportunity to catch up on recent events. Early Monday morning, the scientific sessions started with welcomes from Dr. Jean Fain, the conference chairman, Dr. M. Montret, head of the Laboratoire de Physique Corpusculaire, and Dr. Renal, the INQUA representative for France.

In the opening address, Steve McKeever developed his theory to explain why the "hard to bleach" TL component cannot be completely removed. Reuven Chen *et al.* reviewed the problem of the predose effect. In discussing the characteristics of the red TL curve from quartz, Jean Fain et al. detailed their theory based on local interaction effects. For the problems of fading, charge transfer, and bleaching, Bill Hornyak with A. Franklin suggested that isothermal decay does not demonstrate which of three mathematical model applies. Paul Levy, however, indicated that the nature of the glow curve would elucidate the trap kinetics. A lively discussion of the problem followed, but did not resolve the difference of opinion.

In an excellent paper about the problems of TL dating burnt flint, Hélène Valladas