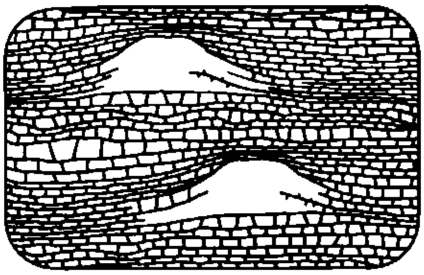

Recent Advances in Carbonate Sedimentology in Canada

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There was something for every geologist interested in carbonates at the CSPG Symposium held in honour of Dr. A. D. Baillie in Calgary, September 20-21, 1979. Virtually every aspect of carbonate sedimentology and related sediments and diagenesis was touched on regarding occurences both in Canada and further afield. The "Recent Advances" portion of the symposium titled: "Recent Advances in Carbonate Sedimentology in Canada" required further qualification in that a few papers were actually reviews of progress over the last couple of decades. While the 26 papers presented were divided into five sub-groups, a recurrent theme throughout all sections was the prevalent effect of diagenesis on carbonate rocks of all ages.

This is clearly reflected in the present emphasis of applied research in carbonate sedimentology to diagenesis as pointed out by the lead-off speaker, G. R. Davies in a paper entitled "Carbonate Reservoirs in Canada: The Economics of Diagenesis". Descriptions of present day models of carbonate sedimentation have evolved in a natural way into studies of Quaternary Carbonate diagenesis, and efforts are presently focused on applications of these inter-related studies to ancient carbonates. It should be pointed out that all three avenues of investigation are still being actively pursued; that is, we are still learning new things about the model and recent diagenesis even as we are applying this knowledge to the ancient carbonates.

An excellent synthesis of characteristics common to fossil bioherms and modern reefs was presented by N. P. James in his paper "The Comparative Anatomy of Fossil Reefs". Despite the great diversity of calcium carbonate secreting organisms throughout geologic time, many of the groups, in response to the same paleoecologic environmental factors, produced bioherms which bear a striking morphologic similarity to one another.

Two papers, by R. S. Harrison and D. Morrow, described carbonate sedimentation on shallow marine carbonate platforms in the Florida Bay - Bahamas regions, with many excellent illustrations. To complete the profile of modern carbonate sedimentation, a fourth paper by I. A. McIlreath described some aspects of "Deep Water" carbonate sedimentation; a regime which is just opening up to geological investigation.

The two remaining papers in the section on "Carbonate Depositional Facies" dealt with older rock sequences: one by A. C. Kendall on some physico-chemical attributes of epeiric carbonate deposition; the other was a very interesting paper by W. R. Danner on limestone occurence in the Western Cordillera eugeocline. The limestones ranging in age from Devonian to Triassic are described as chemically pure calcium carbonate, rich in fossils. Most of the limestone sequences are interpreted to have originated in paleotropical environments in the South Pacific and equatorial regions and later became accreted to Western North America by sea floor spreading. As Dr. Danner pointed out, this raises the possibility that Victoria was indeed made in Japan.

Two papers dealt with the associations of lead-zinc sulphide deposits in carbonates. R. A. Olson described the diagenetic origin of some lead-zinc deposits in Proterozoic karstic dolomite on Baffin Island. The second paper, by R. W. Macqueen left the audience with a feeling of eager anticipation that here at last was some research that was putting it all together: ie. by attempting to solve the problem of the origin of lead-zinc sulphides, (particularly in the Devonian carbonates at Pine Point) with the idea that they are a result of the normal evolution of a sedimentary basin, Macqueen may arrive at some exciting results regarding the relationships of sulphide ore emplacement to hydrocarbon generation, as progressive phases of the same subsurface diagenetic processes.

The first day ended with three presentations in the "Exemplary Studies in Carbonate" section on ancient carbonate sedimentation from different parts of Canada: Ordovician bioherms in Newfoundland, by B. R. Pratt, a Silurian reef in Southwestern Ontario by E. Pearson, and an update of his previous publication on the Mesozoic carbonate shelf, offshore Nova Scotia, by L. S. Eliuk

Seven excellent papers were presented in the section on Carbonate Diagenesis. N. P. James led off with an informative account of lithification and dissolution of carbonate sediments on the sea floor. Of particular interest was the observation that when there is continuous deposition on the sea floor, carbonate sediments appear to be unaltered. However, if deposition is arrested periodically, magnesian calcite and argonite sediments exposed at the sea floor alter to calcite by dissolution-reprecipitation in exactly the same manner as those exposed to meteoric waters on land. The striking similarities of submarine and subaerial discontinity surfaces were further emphasized by C. F. Klappa in his presentation on biologically induced diagenesis. With a series of convincing illustrations, Klappa showed how any of four biological processes - excavation, biochemical precipitation, biophysical brecciation and sediment production, operating in either a submarine, or a subaerial environment, may produce look-alike carbonate rock fabrics. Detailed examination of subaerially exposed carbonates in Florida led R. S. Harrison to the conclusion that significant diastems, representing several thousands of years, may be overlooked in core because of the absence of good evidence locally; so that in addition to potential confusion in distinguishing subaerial from submarine discontinuities, subaerial diastems may be present but go entirely undetected! Subsurface diagenesis, involving mechanical compaction and chemical solution and reprecipitation, while being a key factor in porosity enhancement or destruction in carbonates is presently the least understood mode of carbonate diagenesis, according to V. Schmidt. The behaviour of multiphase fluids in carbonates with a variety of pore geometries is something that will be better understood when the rather unique lab investigations of N. C. Wardlaw are complete. Greater attention to the vital fluid-filled five percent or so of pore space present in carbonate reservoirs may well provide a few clues to solving subsurface diagenetic problems, not to mention the more direct applications to secondary and tertiary hydrocarbon recoveries. No session on carbonates worthy of its salt could leave out a discussion of evaporites. A. C. Kendall pointed out that the diagenetic addition of sulphates or halite reduces carbonate porosity, while the removal of these materials enhances porosity.

The final session, on Devonian carbonates of western Canada, would not have been complete without some consideration of regional marine transgressions and regressions. Four papers, by E. W. Mountjoy, J. C. Wendte, and F. Stoakes, dealt with various aspects of regional Devonian sedimentation in Western Canada. Finishing up in a blaze of diagenesis were the three final papers; the first by R. A. Walls presented examples of the three major types of diagenesis (submarine, subaerial and subsurface) modifying the original depositional fabrics found in various Devonian carbonates in Western Canada. B. Osborne gave a useful account of the Devonian Slave Point sedimentation and diagenesis in the Meikle River area of northern Alberta. An extremely well illustrated presentation of diagenesis in the Swan Hills Formation in the Kaybob reef, Alberta was given by P. K. Wong. Three generations of cementation were identified; the first syndepositional, common in the reef interior facies; the second derived from mechanical-chemical compaction, found in the reef slope and adjacent reef rim as dolomite cement, or as calcite cement in the reef slope and reef interior; third generation cement was found throughout.

The Symposium, chaired by I. A. McIlreath, had something of value for all the five hundred or so geologists who attended.

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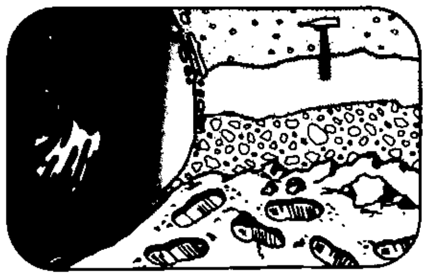

Hudson Bay Field Meeting

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A 10 day field conference was held from June 15 - June 25, 1979 to present the results of recent research into the "Holocene Stratigraphy and Sea-Level Changes in southeastern Hudson Bay". Twenty-five participants attended from seven nations representing IGCP Project 61 (Sea Level Changes) and the Holocene, Shoreline and Neotectonic Commissions of the International Association for Quaternary Research. The trip was organized and run by Claude Hillaire-Marcel (Université du Québec a Montréal) and Jean-Serge Vincent (GSC) who were ably assisted by Bernard de Boutray (UQUAM), Pierre Guimont (La Société de Dévelopment de la Baie James) and several support staff.

After flying from Montreal, the group set out from Matagami for a four-day 650 km trip to La Grande Riviere to study the late glacial and postglacial history of the eastern James Bay Region. Near Matagami a large north-south trending glaciofluvial complex, previously mapped as an esker, was studied. This is now referred to as the Harricana Interlobate Moraine which formed when the retreating Labrador Sector of the Laurentide Ice Sheet divided into two residual ice masses, one retreating northeasterly (New-Quebec ice) the other northwesterly (Hudson ice). Retreat was accompanied by Glacial Lake Ojibway and the deposition of non-calcareous varved clay.

Retreat of the Hudson ice was accompanied by as many as three glacial readvances toward the southeast about 8,200-8,000 radiocarbon years B. P. (Cochrane I, Rupert, and Cochrane II: Hardy, 1977; Prest, 1970) Calcareous clay till was deposited (Cochrane till) and Lake Ojibway sediments changed from non-calcareous to calcareous, the limestone component being derived from the western James Bay Lowland. Calcareous Ojibway clays extend northerly to at least Great Whale River. Though these readvances are interpreted as surges into Lake Ojibway, the exposed rock at higher altitudes is strongly striated, the drift is fluted or drumlinized, and the Cochrane till is largely basal in origin showing little evidence of subaqueous deposition. The surging mechanism proposed by trip leaders was that residual Hudson ice had rapidly retreating ice margins due to calving on the south (Lake Ojibway) and the north (sea) causing a positive anomaly towards the ice centre and an overall instability. Resultant surging caused rapid thinning which allowed for the very rapid subsequent disintergration of the ice.

Travelling northward, the Tyrrell Sea sediments and the Sakami Moraine were studied. The contact between the Tyrrell Sea and Lake Ojibway sediments is marked by a bed of coarse sand containing limestone pebbles, derived from the Cochrane readvance, and clay pebbles eroded from the Lake Ojibway clays. This is present as far north as Great Whale River. This conglomeratic unit was interpreted as marking the drainage of Lake Ojibway into the Tyrrell Sea in northeastern Hudson Bay as the Lake level fell several hundred feet to sea level. This contrasts with Skinner's (1973) interpretation of similar sediments in the Moose River Basin (Ontario) which he attributed to density underflows of marine waters into the fresh waters of Lake Barlow-Ojibway.

The Sakami Moraine is a narrow, arcuate ridge trending north-westerly toward Great Whale River. Its remarkable shape is interpreted as indicative of an equilibrum profile of the New Quebec ice, formed when the ice-margin was afloat and calving into Lake Ojibway. Drainage of the Lake into the Tyrrell Sea caused a water lowering of up to 150 metres with subsequent grounding of the ice front. The Sakami Moraine apparently marks this grounding position and has been described by the field trip leaders as a "re-equilibrium moraine". In many ways this moraine is similar to very long, narrow, arcuate moraines in northwestern Ontario which were fronted by Glacial Lake Aggassiz and associated lakes; the mode of formation is probably similar.

At Great Whale River the stratigraphy of the Tyrrell Sea sediments, the basal conglomeratic unit and the Lake Ojibway clays were studied further. These imply an embayment of Lake Ojibway in southeastern Hudson Bay between the Hudson and New Quebec ice masses and that the Tyrrell sea first entered Hudson Bay from the Hudson Strait area along the east side of the Bay. Terrace deposits related to lowering sea level (rising land) were also examined.