VAN BEEK (1971). Clearly the only way to make the berm volume larger in terms of variance source is to consider the beach profile in terms of deviation from some mean/median/characteristic profile. In a sense this is what the eigen value/vector method of profile analysis attempts, with the added bonus that distinctive development of upper and lower beach berms would probably show up as differing components of profile variation. I would accept with this technique that variable beach profile widths may need to be numerically standardized prior to eigen value/vector analysis. The integral and Q_s methods apportion the affect of volume change by berm accretion across the whole beach profile. Thus berm presence is desensitized by integral and Q_s analysis, despite the clear diagnostic indication of macro-beach process that berm position contains.

I would not contest the point that Caldwell and Williams make concerning the elegance of either the step/bar/composite profile model, or the integral model. However to say that the former model has 'non-inclusion of processes' in incorrect. The step/bar/composite profile model has implicit process assumptions concerning the balance of beachface fluid force asymmetry as a function of breaker type and storm severity, a point which CALDWELL and WILLIAMS (1985, p.135) themselves recognize.

Clearly a number of problems and moot points concerning the optimum way to characterize gravel beach profiles remain. However as CALDWELL and WILLIAMS (1986) note, new approaches to analysis are always needed. If they work they open up log-jams, if they don't work they at least have an heuristic benefit. Either way our understanding of gravel beach dynamics and sedimentation are in sore need.

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REPORTS OF MEETINGS

INTERNATIONAL GEOLOGICAL CORRELATION PROGRAMME (IGCP)

Project No. 200: Sea-Level Correlations and Applications

1985 Annual Report on Scientific Progress

Late Quaternary Sea-Level Changes: Measurement, Correlation & Future Applications

The 1985 annual meeting of IGCP-200 was held during the 5th International Coral Reef Congress (Tahiti, 27 May — 1 June 1985). This sea-level meeting was co-sponsored by the INQUA Commission on Shorelines, Neotectonics, and the Holocene, the Inter-Union Commission on the Lithosphere, and the IGU Commission on the Coastal Environment, and consisted of a Symposium, a Seminar, business meetings and field excursions.

With 29 papers presented, the Symposium "Late Quaternary and Present Sea-Level Changes: Magnitude, Causes, Future Applications" (Chairmen: D. Hopley and P.A. Pirazzoli), was the most attended of the nine symposia of the Congress. It displayed a fine balance between research on sea level, coral reef response and the use of data on land/sea interaction applied especially to tectonic interpretation.

Five papers dealt with processes of global and regional sea-level change. Nakada and Lambeck used sea-level data from various localities in the South Pacific in an attempt to constrain rheological models for the mantle and to evaluate melting models for ice sheets. A value of 10^{23} poise has been suggested as most likely for effective Newtonian mantle viscosity.

In French Polynesia, late Quaternary shorelines give evidence of an active flexuring of the lithosphere in relatin to the volcanic load of the most recent islands (Pirazzoli and Montaggioni). Elastic models are however insufficient to explain all the sea-level data: thermal variations in the lithosphere near the hot spot of the Society Islands and visco-elastic phenomena are probably also involved. In any case, the occurrence of elevated reefs dating from the last Interglacial in the islands of Makatea, Anaa and Niau, which are situated on a rim concentric on Tahiti, can no longer be considered as evidence of an eustatically higher sea level at that time, because similar elevated reefs are not found in most Tuamotu atolls.

In Brazil, differences between Holocene sea-level curves obtained in several coastal sectors have been ascribed by Martin *et al.* to recent changes in the geoid shape. Indeed, in the State of Bahia, where the coastline is parallel to the isobases of present geoidal height, no shift can be observed between the curves, whereas in the Sao Paulo and Parana States, where isobases are intercepted by the shore, a vertical shift of up to 2 m appears.

An Antarctic ice "surge" during the last Interglacial is suggested by Hollin to explain the present elevation of shorelines in various parts of the world, under the assumption, however, that these areas have remained vertically stable.

A review presented by Bird and Koike stressed the increasing impact of man's activities as a process of sea-level change and discussed the possibility of a worldwide rise in sea level as the result of a carbon dioxide effect.

Some papers dealt with reef evolution in relation to sea-level rise. A well-documented overview of the Great Barrier Reef area, based on 297 dated samples from 85 drill holes, was presented by Davies *et al.* It was shown how different parts of the same reef may have responded differently to sea-level change. Indeed, terms such as "keep-up reefs," "catch-up reefs" and "give-up reefs," proposed by Davies *et al.* in the Great Barrier Reef and Neumann and MacIntyre in the Caribbean, will probably be in current use in coral reef literature.

The conditions of reef initiation over an older substrate were discussed by Davies *et al.* for the Holocene in the Great Barrier Reef, and by Gachon and Buigues for the Mio-Pliocene in the atoll of Mururoa. In the latter area, drill holes 1000 m deep have revealed six carbonate layers intercalated with volcanic material, giving evidence not only of subsidence movements, but also of periods of sea-level drop.

In the Caribbean two models have been used for interpreting the evolution of a coastal area in Jamaica (Hendry and Head), and for predicting the changes in biota that would result in a semi-intertidal reef flat of Panama from a slight rise in sea level (Cubit).

Lastly, some effects of Holocene sea-level fluctuations on the morphology of the Brazilian coral reefs (Leao *et al.*) were presented by L. Martin.

A number of papers interpreted sea-level changes from reefal and coastal features. In three cases different areas were compared. Bourrouilh-le-Jan attempted to estimate, with assumptions, the age of lines of elevated notches carved in limestone cliffs in Mare (Loyalty Islands) and in Makatea (Tuamotu Islands); Strasser and Davaud recognized beach sequences corresponding to ancient sea levels in the sedimentary structures of Quaternary limestone cliffs in the Bahamas and the Maldive Islands; Woodroffe compared late Quaternary tectonics and sea-level changes in the Cayman and Tonga Islands.

Nine papers were devoted to coasts of the Pacific. In the Great Barrier Reef, where the reef facies was established no earlier than the Pleistocene (Symond and Davies), significant differences in reef development, facies and age can be found even at small distances in the same reef (Hopley and Barnes) and live Tridacnid shells show systematic spatial variability of $^{18}O/^{16}O$ ratios corresponding closely to the physiographic zonation and to different temperature regimes (Flood). In Efate Island (New Hebrides), where four series of marine terraces developed up to 130 m in elevation, Th/U dating enabled Lecolle and Bernat to establish an uplift rate of 1 mm/yr during the late Quaternary. In the Tuamotus the late Holocene MSL reached a maximum elevation at approximately +0.9 m and remained above the present MSL from 6000-5500 BP, until at least 1200 BP (Pirazzoli *et al.*). Human settlements on the atolls were extremely unlikely and probably impossible throughout this period. Indications of emergence since 1250 BP was also reported from Suwarrow atoll in the Cook Islands (Scoffin *et al.*). Mangaia Island, on the other hand, has experienced uplift movements which brought reefs of the last Interglacial up to 20 m above the present ones (Stoddart *et al.*). Finally, in the Ryukyu Islands, crustal movements associated with earthquakes of great magnitude were discussed by Kawana, whereas Tahahashi *et al.* presented in a poster a quantitative description of coral communities, giving a pattern of coral reef zonation. Emerged coral reef formations were also reported from Indonesia for the Holocene (Jouannic *et al.*) and from the Red Sea for the late Quaternary (Gvirtzman).

Lastly, four papers were devoted to non reefal areas: Hearty and Dai Pra used aminoacid geochronology to date late Pleistocene shorelines in Italy; Devoy discussed indicators of coastline and sea-level changes in Ireland; Kraft used stratigraphic sequences to interpret Holocene paleogeographies in coastal Delaware, with potential projections on future coastal morphologies; finally Van de Plassche discussed late Atlantic environmental changes in the central Rhine-Meuse delta (Netherlands).

For the first time at a Coral Reef Congress, and in one single symposium, it was possible to combine global modelling of sea-level change with actual field results obtained from reefal and non reefal areas.

The seminar "Reef Growth and Sea-Level Changes: the Environment Signature" (Chairmen: P.J. Davies and L.F. Montaggioni; discussion leader: I. McIntyre) had three major aims: (1) to assess whether coral reefs possess signatures directly related to the past or present positions of sea level; (2) to define criteria of geological significance in modern reefs which are indicative, directional or both, with respect to sea level; and (3) to identify directions for future research which will help relate the sea-level records in the reefs to the sea-level records in the rock.

Two passive margin situations (Great Barrier Reef and the Belize region of the Caribbean) and a mid-ocean hot spot environment (French Polynesia) were chosen as key areas for discussion. Greatest contrast occurs between the sea-level signatures of the Caribbean (continuous Holocene rise) and the southern Pacific (almost at a standstill for some 6000 years). In both regions, however, there may be responses in terms of reef growth and ultimately reef structure, independent of the direction and rate of sea-level change, with reefs responding to the Holocene transgression by keeping-up, while other reefs catch-up or give-up.

In conclusion, while points 1 and 2 received quite positive answers, the use of sea-level marks in the interpretation of ancient reefs varies with and depends on the preservation of the most typical figure prints.

On 30 May the Business Meeting of the International Working Group of IGCP-200 was attended by 20 people, including eight members of the Executive Board and representatives of ten national Working Groups (Australia, Brazil, Canada, France, Ireland, Israel, Jamaica, Japan, Netherlands, USA) and of IAG, ICL, IGCP, IGU-CCE, INQUA, and CCCO (IOC-SCOR). Progress reports and information on the activities of the various working groups were given (for further details see the 1985 Administrative Report).

Out of the seven post-Congress field trips, two were devoted especially to sea-level problems. The visit of four Leeward Islands (19 places, all taken; guide: P.A. Pirazzoli) illustrated the sequence from high volcanic island to almost-atoll and atoll, in the same island chain where 150 years ago Charles Darwin conceived his classic model of mid-oceanic atoll formation. It was shown that while subsidence increases towards the oldest islands in the long term, the lithosphere is flexured in the opposite direction at short term, due to the load of the most recent volcanic islands. This means that late Holocene emergence decreases from the Leeward Islands towards Tahiti. Evidence of this recent emergence (former reef flats, exposed coral conglomerates, *in situ* microatolls of *Porites* and abandoned algal ridges) were examined on the reefs, together with the effects of recent and ancient hurricanes. Some stops were also made at archaeological sites of early Polynesian settlements and to places of volcanic or geodynamic interest, including the NASA Satellite Laser Ranging Station at Huahine.

Makatea Island, a raised atoll in the Tuamotus, was visited under the guidance of L.F. Montaggioni (32 places, all taken). Here limestone cliffs are cut by three lines of notches, at 1.0-1.5 m, 5-8 m, and 20-25 m in elevation, which are related to three late Quaternary reef terraces, whereas the top of the carbonate rock reaches about 110 m. As indicated by mathematical models, at least part of this emergence occurred in relation to isostatic effects caused by the load of the volcanic masses of Tahiti and Moorea Islands.

In conclusion, this annual meeting, which was the first organized by IGCP-200 in a coral reef area, was especially successful in bringing together some one hundred scientists from a wide range of disciplines (geologists, geographers, marine biologists, geophysicists, geodesists, oceanographers, archaeologists, anthropologists, . . .) from more than twenty countries, and enabling them to compare their sea-level approach, in order to obtain a better mutual understanding of the respective methods and results.

Many contributions indicated future directions of research, but not one of them appears to offer more prospects than the two-way interactions between those producing global models based on melting histories of the major ice sheets or of volcanic loading and mantle rheology, and those working in the field. The former have suggested that variations in sensitivity to deglacial history and to mantle viscosity exist, which may point to special or important locations for future sea-level research. The latter are producing finer details on relative sea-level history and hopefully will increase our knowledge of upper earth rheology and result in the production of more sophisticated models.

From 16 to 23 June 1985 a regional meeting of IGCP-200 was held in Norway, co-sponsored by the INQUA Shorelines Commission. According to information which reached the project leader in time for this report, it included a symposium (six papers given) and a well-organized excursion on the west Norwegian coast.

ACTIVITY PLANNED IN 1986

The thematic Working Group "Shelf Studies" is planning to carry out an expedition in January and February to the NW part of the Indian Ocean, between the Seychelles, Madagascar and the African continent (Tanzania, Kenya) on board the oceanographic research vessel "Professor Stokman" of the Academy of Sciences of the USSR. The investigations will deal mainly with submarine morphology, late Quaternary palaeoenvironments and the identification of deposits corresponding to submerged shorelines and to placers. Scientists from the developing countries concerned have been invited to join the expedition.

In March 1986 a Conference on the hydrodynamic and sedimentary consequences of sea level changes will be held in Cork (Ireland). The Conference will include a workshop for participants in IGCP-200, themes 13 and 14 (Sea-level change applications and coastal process/management problems).

In April 1986 a regional meeting will be held in Dakar (Senegal) at the Symposium "Global Change in Africa During the Quaternary: Past-Present-Future." Other regional meetings are scheduled in July in Sao Paulo (Brazil) at the "International Symposium on Sea-Level Changes and Quaternary Shorelines," in August in Canberra (Australia) during the 12th International Sedimentological Congress, and in September in Haifa (Israel) during the 1st International Symposium on Harbours, Port Cities and Coastal Topography: "Cities on the Sea: Past and Present."

Lastly, the 1986 annual meeting of IGCP-200 will be held in October in Qingdao (China). D. Hopley, of the Executive Board, went to Qingdao in 1985 and is busy preparing this meeting in conjunction with Y. Qin and other Chinese Organizers, and they are writing a field guide for the excursion.

The final annual meeting of IGCP-200 is planned for 1987, in Halifax and Ottawa (Canada), during the 12th INQUA Congress.

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8th INTERNATIONAL CONFERENCE ON PORT AND OCEAN ENGINEERING UNDER ARCTIC CONDITIONS

The 8th Conference was held at Narsarsuaq in Greenland September 7-12 with excursion to Jacobshavn until September 18th. The meeting was attended by 180 arctic engineers and scientists from 14 different countries.

One hundred papers were presented on a variety of subjects all referring to arctic conditions including basic ice, movements and drift of ice, ice ridging, rafting, piling, overriding, bottom scouring, forces by ice on structures, navigation and transportation in arctic waters, environmental data and surveys, structures in ice, ice breaking exploration, exploitation, materials under arctic conditions and environmental problems. Theme papers were presented on the Greenland icecap, environmental problems in the Arctic, arctic oceanography and meteorology, and behavior of materials and structures in the Arctic.

Arctic navigation included papers from the USA, the USSR and Canada. During the conference excursions were made to the glacier, the old nordic colonies and by the icebreaker vessel DISKO which also functioned as hotel vessel to bolster the capacity of the "Arctic Hotel."

The post-conference at Jacobshavn was attended by 40 people who during 3 days visit concentrated on Greenland technical problems hosted by the Greenland technical organization. Excursion was made to the world's largest "ice-factory," the Jacobshavn Icefiord glacier producing 10^{10} tons of icebergs per year in blocks up to about 0.5 cubic kilometers!

Proceedings are available from the POAC-85 Secretariat, the Danish Hydraulic Institute, Agern Alle 5, DK 2970 Horsholm, Denmark at 600 Danish Crowns for 2 Volumes (1100 pages) plus mailing cost. The Secretariat also distributes an Index of 100 papers presented at the 8th POAC conference. The price is 85 DK per copy plus mailing cost.

Per Bruun
Secretary General, POAC International

ICELAND COASTAL & RIVER SYMPOSIUM

2-4 September 1985, Reykjavik, Iceland

Thirty-nine papers were presented at the first Iceland Coastal and River Symposium. Topics ranged widely from practical and theoretical considerations of erosion, artificial beach renourishment, and evolution of sandy shores to presentations dealing with bypassing at tidal inlets, sediment balance and bar morphodynamics, effects of ice on beach sedimentation, coastal cave development, shoreline hazards and mitigation, and the geomorphology of tidal flats. Although the various presentations provided a truely international flavor to the symposium, most of the foreign participants found the papers dealing with Icelandic conditions to be remarkably facinating and informative.

Most impressive of all observations relating to local shorelines is the complicated interaction of volcanic and glacial and coastal processes. The combined actions of these major natural forces produce distinctive coastal environments. Shorelines in this region may result directly from volcanic activity as, for example, when submarine volcanoes rise up from the Mid-Atlantic Ridge from below the sea surface to form new islands or when lavas flow to the sea from volcanoes on the main island. Subglacial volcanic eruptions often lead to a phenomena referred to as a "glacial burst" when huge volumes of igneous detritus are delivered to the coast in catastrophic floods. Some fjords on the south coast have, for example, been infilled to depths of 300 meters or more, the surfaces of these infilled glacial valleys now being occupied by sandurs graded to sea level. These and other interesting observations were highlighted in talks dealing with local environments.

Per Bruun, who originally conceived the idea for a symposium dealing with the interactions of coasts and rivers, is to be commended along with local sponsors for the selection of Iceland as the host country. The geographic locale provided a perfect setting for such a meeting because examples of the various phenomena that were discussed are found close by in the field. Participants of the symposium also appreciated Per's ability to present talks for some the registrants that could not, at the last minute, attend the meetings.

Two workshops were presented on different afternoons. The first session dealt with discussions of potential impacts of sea-level rise and the stratigies that might be applied to various coastal sectors, viz. developed versus undeveloped coastlines. The discussion made it quite clear that politicians, coastal managers, and engineers are reluctant to make plans for coastal defense works when it can not yet be ascertained, by the U.S. Environmental Protection Agency or others, whether the observed trends in rising sea level are secular or just short-term fluctuations. Although more precise information is clearly desired by all concerned, absolute or definitively accurate predicitons of rates and directions of sea level fluctuation seem to be elusive. The problem for coastal managers and engineers lies in the fact that by the time scientists are sure that present rates of sea-level rise will continue at least through the foreseeable future, there may be too little time to react effectively. Perhaps more disturbing is the realization that the developing countries of the world may be most affected with huge populations living on low-lying coastal flood plains or deltas. These countries, lacking large financial reserves, are unfortunately also the least able to quickly adjust to an increasingly higher mean sea level.

There was some discussion of the various mechanisms and interactions that induce a rise in sea level but the main concern was clearly oriented towards potential impacts. In the developed nations there will also be some difficult, if not seemingly impossible, questions to answer. If sea level rise continues at the present rate, it is clear that at some stage in future policies favoring coastal protection and abandonment will be selectively deployed. Such decisions will probably be based, in part, on assessments of resource allocation, the value of coastal developments, and political bias. In sum, this first workshop laid to bare the uncertainties involved in predicting the course of future fluctuations in sea level and probed into some of the ramifications of a postulated rise in MSL. This is food for thought not only to coastal researchers but to all those that live, work, or play in the coastal zone.

The final workshop pretty much showed the primary focus of the Iceland Coastal and River Symposium. There were three days of technical sessions, with papers devoted to river and coastal problems from around the world, perhaps roughly a third of them dealing with Iceland. Another workshop, concentrated on the US government (Environmental Protection Agency) approach to what some people see as a near-future castastrophic sea-level rise, but the real center of attention was the river and coastal sediment transport workshop, which requires an extended discussion.

Iceland is 100% volcanic. Much of the shore is cliffed and irregular, providing good harbors, but the south coast is different. The largest glacial cap on the island, almost 200 km wide, extends to within 20-40 km of the south coast. The highest point within this glacial complex is over 2,000 m high. This and other smaller glaciers have supplied a system of meltwater streams which flow largely toward the south. Either now, or at some time in the last few thousand years, these streams have been carrying tremendous quantities of glacial debris to the south coast, which is marked by straight or gently curving map outlines, and more-or-less continuous beaches of sand- and gravel-sized volcanic material. There are no good harbors along this high-energy wave-dominated coast marked by sea cliffs and narrow-to-wide beaches in front of the cliffs.

The problem at hand is as follows: are the conditions on the south coast such that one or more suitable harbors might be constructed? So little work has been done on the Iceland coast that no one knows. Engineers attending the workshop apparently thought that this is not an overly difficult problem: the scientists present generally seemed to think otherwise.

The basic information is more-or-less simple. The coast faces a relatively steep continental shelf, and hence wave energy delivery to the beach may be a rather high percentage of the offshore wave energy. At present the beach is protected by the fact that the through-put of sediment, from glacial streams to the offshore area is or recently has been high. However, there is the clear possibility that the apparent large supply of sand and gravel is the temporary result of one or more glacial surges, that such surges will not be repeated on the same scale in the near future, and that the south coast may pass relatively quickly from a rather neatly-balanced equilibrium to an economy of scarcity of sediment. Unfortunately, data are not in hand to permit definitive statements to be made, and, in fact, there is at present no body of knowledge directly applicable to the coast in question that would permit an easy assessment of the problem outlined at the symposium. With these uncertainties, one does not know whether harbor building would be a wise decision at this time or not.

It is pertinent to stress that the few available coastal energy-vs-sediment budgets have been obtained from areas where the transverse slope is rather gentle, the loss of offshore wave energy is relatively great in the inshore zone, and the deep-water waves may not be very large in the first place. It is not known whether such data can be transferred to the Icelandic south coast. In the short period of time covered by offshore ice and wave recorders, heights of 20 m have been observed; there is no particular reason to think that these are the 10-year waves, or the 20-year waves, or the 50-year waves, which might be even higher.

In the workshop, remarks from the engineers were generally of the nature that what we need to do is to get on with it. From the scientists, however, there was a great deal of uncertainty as to how one proceeds, in view of the fact that the sediment transport system on the south coast (rivers, beach, shallow shelf, deep water) cannot be treated as a closed system (and therefore measurable) until it is known where that sediment comes to rest. There was even some doubt expressed as to whether the meltwater streams are now moving any significant quantity of what might be called bedload. It seems to be clear, however, that there is no long-term depositional area for this debris, short of truly deep water.

Dr. Jonas Eliasson, of the University of Iceland, was named chairman of an interim committee to function for the remainder of 1985 and at least into the early part of 1986. Part of the work of the committee will be to see if a continuing program of research, on Icelandic river and coastal sedimentation and engineering, can be established.

For all interested parties, the need for additional research — in an environment of a type where very little has been done in the past — is evident. The question then becomes how does one proceed with such research? The methodology is not obvious. Dr. Jonas Eliasson is now charged with the responsibility of drawing together suggestions and perhaps plans for the next steps. Whether or not there will be a second symposium, in some future year, remains to be seen.

The papers submitted for the September meeting have been compiled into a proceedings volume and are available from the National Energy Authority, Grensavegur 9, Reykjavik 109, Iceland. The cost is approximately $45.00 per copy plus shiping.

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ICELAND COASTAL AND RIVER SYMPOSIUM

Report of Field Trip, 5-7 September 1985

Following the main symposium in Reykjavik, interested participants joined a bus tour of the south coast returning to the capitol via mountainous inland routes. The excursion included many stops at key coastal sites where important or unusual processes, materials, or landforms could be photographed and investigated. Tour guides provided excellent summaries of local geology and geomorphology as well as providing opportunity for expressing interpretive or alternative views at each scheduled stop.

Per Bruun (Figure 1), one of the symposium conveners, emphasized on several occasions during the symposium that Icelandic conditions provide excellent opportunities to view natural processes in scaled-up modes. It was obvious from the surprised and inquisitive facial expressions of the foreign field trippers that few fully appreciated Per Bruun's remarks. Observations of such scaled-up processes in the Icelandic coastal zone provide useful analogs to related but diminished processes that occur elsewhere in different environments and which, by the subtle nature, are less obvious. Natural coastal processes here are emphasized and seem to operate with gusto. Relationships between coastal processes, geological materials, and landsurface forms are perhaps more clearly evident in this tiny island-nation than in many other regions. For this reason,

Figure 1. Dr. Per Bruun (left) and other symposium participants (Dr. Claude Jean Bodéré, Dr. and Mrs. John Hoffman, Dr. Stephen P. Leatherman) aboard the flagship of the Icelandic navy, enjoyed a tour of fjords near Reykjavik.

Iceland seems to be an ideal location for the study and elucidation of many natural coastal systems.

One of the first stops on the south coast at Borlákshöfn emphasized the megadynamics of this region. This basaltic coastal stretch is characterized by skerries and a contemporary marine abrasion platform (Figure 2). The 4-m tidal range here provides for an interesting and diverse rocky intertidal zone around the margin of the marine bench. The high energy conditions along this rocky coast are, however, apparent from the coarse materials that are thrown up onto the marine platform during storms. Many of the larger basaltic rocks that are heaped up into huge shore-parallel boulder mounds by 15-meter waves are at least 3 to 4 meters in diameter (Figure 3). Even though the boulder lines, which are more or less regular in plan and about 5 to 8 meters in overall height, provide some natural protection from the monstrous waves that affect this coast, storm surges still filter through the coarse boulder mounds flooding the coastal plain up to a kilometer or so inland. These same natural basaltic boulders, with a density of about 2.8, are put to good use in the artificial breakwater for the harbor itself at Borlákshöfn.

In stark contrast to the rocky headlands near Borlákshöfn are the fine-grained clastic shorelines. These soft sandy shores are supplied with enormous amounts of sediment brought down from the interior highlands to the coast by numerous glacier-fed streams such as the Ölfusa, Bjórsá, and Hólsá rivers. In spite of the high energy conditions that

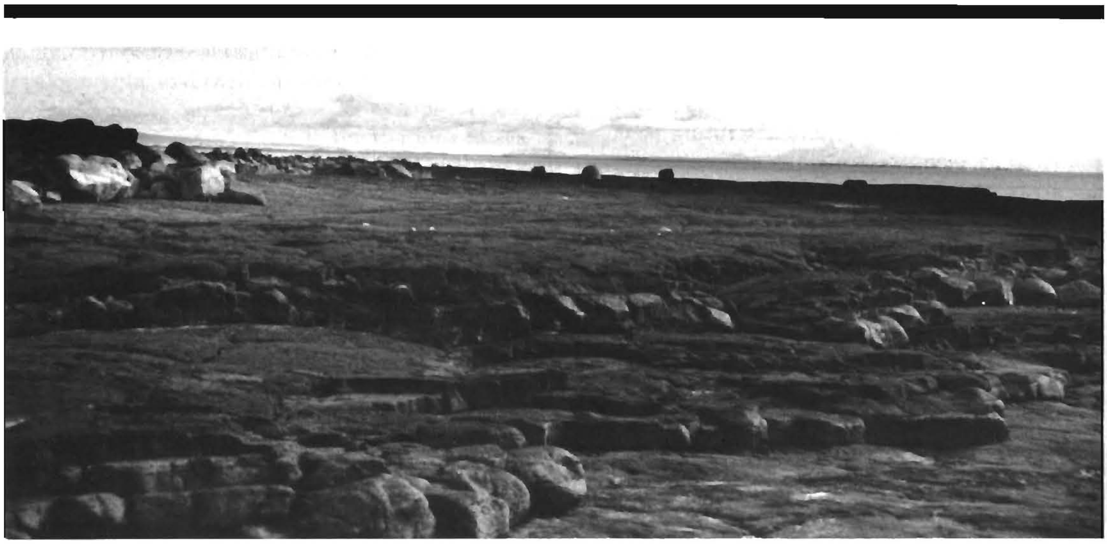

Figure 2. Marine platform cut into basaltic lava flows on the south coast of Iceland near Borlákshöfn. Large boulders are broken from the seaward margin of the platform and moved about the surface of the platform where they are eventually subrounded and piled by wave action into large shore-parallel mounds.

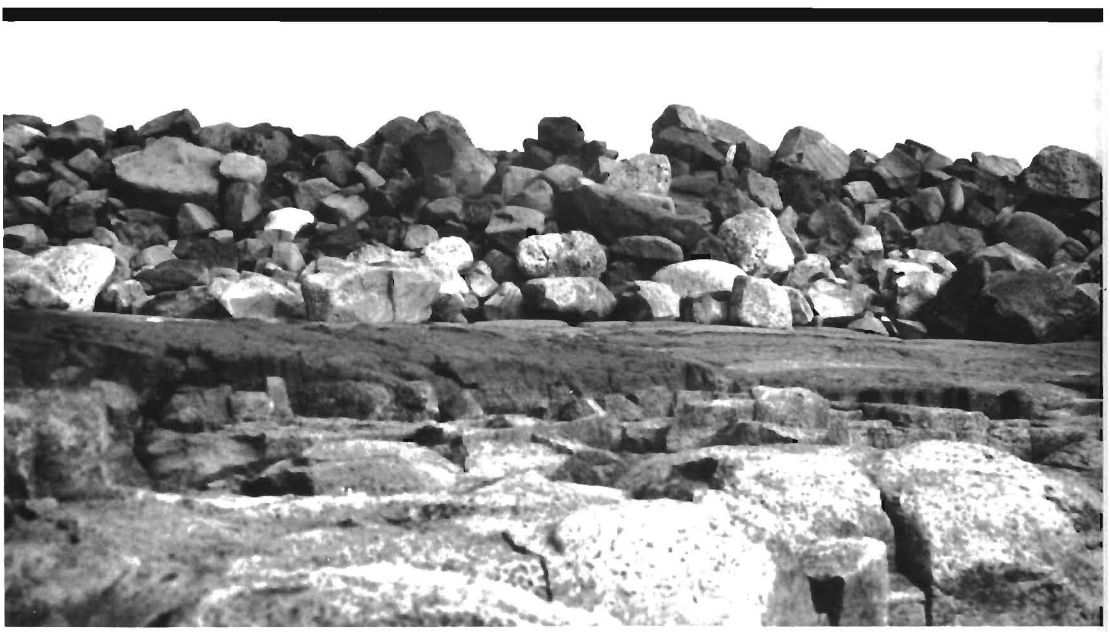

Figure 3. Basaltic boulder heaps deposited on the landward margin of a marine platform by storm waves and surges. These natural boulder piles often resemble construction mounds designed to protect harbors and other coastal engineering works. The enormous size of these boulders (3 to 4 meters maximum mean diameter) attests to the high energy conditions that affect the south coast of Iceland.

predominate along this coast, clastic shorelines that are perhaps more commonly recognized in association with lower energies, are apparently maintained by the abundant sediment supply to coastal systems. Longshore currents distribute the sediments along the coast where spits, bars, and other types of barriers often temporarily close inlets and bays as, for example, at Holstós, Dyrhólaey, Múlakvist, and Kúdafljót.

One type of accretionary sandy coast occurs just east of Borkákshöfn. This large log-spiral barrier blocks the Ölfusa delta and is backed by marsh. The spit is surmounted by dark-colored dunes that are largely composed of sand-sized particles of basaltic composition (Figure 4). Although the dunes are largely stabilized by *Elymus arenarius*, a northern dune grass, small blowouts occasionally cause indentations in the dune line and lower the dune crest.

Other types of sandy deposits comprise relatively large coastal plains, up to several kilometers in width, that front Pleistocene cliffs cut into basaltic lava flows. These coastal plains stretch, for example, from Stóridalur to Skógar along the Eyjafjoll coast. Wave cut notches are clearly visible in some of the cliff lines at Steinafjall and Raudafell but the lower cliff faces are now generally buried by talus cones.

In addition to the sandy barriers along this high energy coast are extensive sandur (outwash) plains. These glaciofluvial deposits become finer-grained downvalley, *i. e.* towards the coast, and tend to infill pre-existing fjords. One particularly spectacular example of fjord infilling is found on the sandur plain of the Markarfljót River which is fed by two small glaciers, the Tindfjallajökull and the Eyjafjallajökull, and the much larger Myrdalsjökull. Here the fjord is filled with at least 200 m of alluvium that was deposited at various times by glacial outbursts. These outbursts are caused by subglacial eruptions, viz. Godasteinn and Katla, that induce rapid localized melting of the glacier. Meltwaters associated with the partial collapse of the glacier surge down valleys into the fjords bringing vast amounts of sediments mixed with ice. These slurries poured into the fjords until, eventually, the surface of the deposits reached sea level. Successive subglacial eruptions and outbursts have thus not only filled in fjords along the south coast but have built large alluvial plains prograding the coastline. Surrounded by the braided streams of the sandur plains, islands of basic and intermediate hyaloclastites and tuffaceous sediments sometimes poke up thru the thick fjord infills (Figure 5). Outliers near Hvolsvöllur and at Stóri-Dimon stand in mute testimony of a former shoreline that now lies many kilometers inland.

Because sediments become finer textured on the distal (seaward) margins of the sandur plains, the finest grain sizes tend to accumulate in the shore zone where they are entrained in the dynamic processes associated with wave, current, and wind action. Remarkable features of these large sandur plains are the various types of eolian deposits that

'igure 4. Black-colored sand dunes near Borlákshöfn. These dunes are stabilized by *Elymus arenarius*, a northern beach grass.

Figure 5. Sandur (outwash) plain and the braided channels of the Markafljót River. These glaciofluvial deposits have filled in the fjord and prograded seaward to form extensive low-lying coastal plains. Outliers of basement rock (center and right, near main road) poke up through more than 200 meters of fill.

Figure 6. Icebergs in a small proglacial lake on the southern margin of Breidamerkurjökull. Some of the smaller bergs pass through the tidal inlet near Skipbrotsmannaskýli and enter the North Atlantic.

Figure 7. This beach near Skipbrotsmammaskýli, just east of Breidamerakursandur, is developed in coarse till. The ingress of dark-colored, fine-grained materials from offshore produces pseudo beach cusps that are clearly visible against the lighter-colored cobbles.

occur along the shore. Here on the margins of the Skógasandur, Mýrdalssandur, Medallandssandur, Skeidararsandur and the Breidamerkersandur, fine-grained black sands and silts are moved about the sandur surface by strong winds. Because ground water is very close to the surface of the sandur plain, these fine-grained particles are only selectively winnowed as the ground surface dries. When wet, the small clasts form cohesive mats that resist wind transport. Thus, during summer dry spells when tides are low and the ground water recedes several centimeters, rather remarkable dust storms may develop along the coast. Attempting to cross the intertidal flats of the Leiur on the eastern margin of the Skeidararsandur between Fagurhólsmýri and Ingólfshöfdi the tour was fortunate enough to experience first hand the effects of eolian activity on these flat coastal expanses. Although parts of the sandur were thixotropic in places, the most intractable ground was associated with small (15 to 20 cm in height) seif dunes and eolian flats. These wind-blown materials were loosely packed and provided little traction for the bus which had to retreat to more solid ground. Rainfall and incoming tides would again temporarily stabilize the seaward margin of the sandur plain.

The dynamic interactions between rivers and coasts, the theme of the Iceland symposium and field trip, was impressively demonstrated in the proglacial area of Breidamerkurjökull, the last stop in the south coast. The deep proglacial lake,

Figure 8. Series of storm beaches and berms developed in coarse-grained basaltic sediments near Dyrhólaey. The wide swash zones and pronounced beach ridges are indicative of the extremely high energy conditions that periodically affect the south coast of Iceland.

Jökulsärlón, here is fed by subglacial meltwater. The icebergs that are calved in this small tidal lake provide a scenic backdrop to this morainic coast (Figure 6). Although many small proglacial streams also drain the glacial front, they disappear behind frontal moraines never reaching the sea as surface flow. Along the shoreline coarse-grained glacial sediments are being continually infilled by fines that are transported into the area by longshore currents and then moved onto the cobble beach by wave action (Figure 7). Beaches developed in these coarse tills are thus "softened" by the introduction of fine-grained sediments. These and other coarse-grained beaches, for example those immediately west of Dyrhólaey (Figure 8), contrast strongly with the eolian drifts found along the sandur shorelines.

The return trip to Reykjavik followed river valleys into the volcanic interior of the island. Visits to medial rift valleys, water falls, crater lakes, snow fields, high deserts, and hydroelectric schemes rounded out the field trip and provided many interesting examples of fluvial geomorphology in this intriguing land of ice and fire. For many of us experiencing Icelandic conditions for the first time, the field trip was the highlight of the Coastal and River Symposium. It is hoped that this meeting and field trip was but a forerunner of others to come in the future.

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NEWS AND ANNOUNCEMENTS

INTERNATIONAL SOCIETY FOR REEF STUDIES

The International Society for Reef Studies was founded at a meeting in Churchill College, England on Tuesday 9th December 1980. Under the Constitution adopted since the Society's formation the aims are: To promote for the benefit of the public the production and dissemination of scientific knowledge and understanding concerning coral reefs, both living and fossil. In furtherance of the above object but not further the Society shall have the following powers:

(1) To hold meetings, symposia, conferences or other gatherings to disseminate this scientific knowledge and understanding of coral reefs, both living and fossil.

(2) To print, publish and sell, lend and distribute any papers, treatise or communication relating to coral reefs, living and fossil and any Reports of the Proceedings or the Accounts of the Society.

(3) To raise funds and invite and receive contributions from any persons whatsoever by way of subscription, donation or otherwise providing that the Society shall not undertake any permanent trading activities in raising funds for its primary objects.

The Society collaborates with Springer-Verlag in producing the quarterly journal *Coral Reefs*. This large-format journal is issued free of charge to all members of the Society, and concentrates on quantitative and theoretical reef studies, including experimental and laboratory work and modeling.

The annual subscription for membership of the International Society for Reef Studies is £30 sterling or $US40. Under the constitution subscriptions are due by 31st January each year. Student rates, which include receiving the news letter *Reef Encounters*, Abstracts of the Annual Meetings and the Great Barrier Reef current awareness bulletin *Reef*, is £6 sterling or $US8. We welcome your support in making these exciting advances in reef science a success.

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