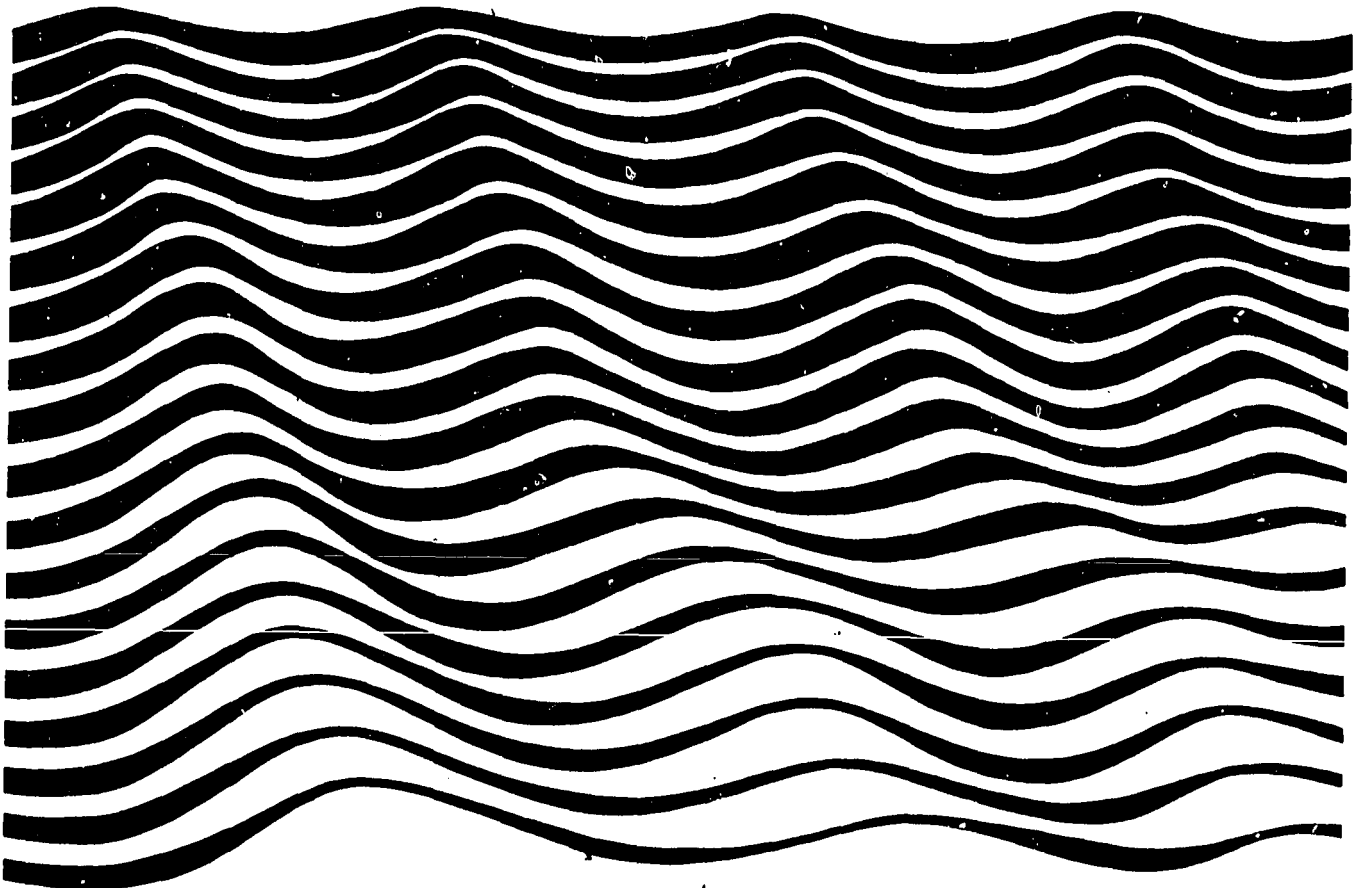


Benthic ecology and sedimentation of the south Atlantic continental platform

Report of the seminar
organized by Unesco in Montevideo,
Uruguay, 9-12 May 1978



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PREFACE

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1. INTRODUCTION

1.1 General presentation of the problem

The continental platform of the South American Atlantic Ocean is one of the most important continental margins in the world, due to its great extension and the particular conditions of its sedimentation. Only in recent times - not more than the past twenty years - has it attracted the attention of scientists of the region (Argentina, Brasil and Uruguay), and of other parts of the world, with the discovery of important renewable and non-renewable natural resources. The studies undertaken have shown that this coastal system represents an economic potential for Latin America whose value should be estimated through international assistance and with the continued support of the countries of the region.

There is thus strong justification for the use of all living and mineral resources of the coastal areas under study by means of projects for their exploitation. But the scientific community agrees that such projects could produce serious damage to an environment which must be carefully preserved, as the biological productivity of superficial waters depends largely on the benthic processes, which are themselves related to the substrata and their organisms. Therefore, the only activities compatible with such exploitation will be those designed to safeguard these zones by maintaining their ecological balance, bearing in mind their sensitivity and frequent pollution.

Unesco, through its Division of Marine Sciences and with local support from the Regional Office for Science and Technology for Latin America and the Caribbean (ROSTLAC), organized the present Seminar on Benthic Ecology and Sedimentation Geology, 9-12 May 1978 in Montevideo. Its implementation was made possible with the prompt cooperation of the Government of Uruguay, whose Ministry of Education and Culture provided the physical facilities and institutional support required and declared the Seminar to be of national interest.

The Seminar's main objectives were:

- a) To review the research undertaken by scientists inside and outside the region, on the subject of the continental shelf of the South American Atlantic coast.
- b) To identify the existing gaps of information and to stress the need to close them in the near future.
- c) To discuss the convenience and possibility of promoting coordinated research at sub-regional and international levels.

1.2 Status of studies on benthic ecology

An important problem resides in the definition of parameters which describe how the biological and abiotic environments affect populations of species. It is widely recognized that coastal marine productivity in

the surface waters is closely linked with the water-sediment-organism processes at the benthic boundary. In other words, a major problem is how to relate individuals, populations and communities to sediments. Organic material, particulate and in solution, from surface and mid-water food webs, reaches the bottom and provides an energy input for the organisms associated with the sediments. Breakdown products return from the benthic layer to the sea and are eventually used by autotrophs in the euphotic zone. There is always an organic component that contributes to the structure of the benthic layer and modifies, sometimes initiating the physical and chemical processes that take place at the boundary. The physical structure of the sediment is modified by micro-, meio- and macro-organisms. They also change the chemistry and notably alter the redox potential discontinuity of the sediment. On the other hand, the dynamic mosaic of sediments which forms the sea bed exerts a powerful influence on the distribution of animals, according to their preferences, both in the larval and adult stages.

The total interaction between organisms, and of organisms with the inorganic fraction of the sediment, is poorly understood by reasons of its complexity although some of the broad processes are known to geologists, biologists and geochemists.

It is felt relevant to consider that two types of ecological approaches are necessary to a comprehensive understanding of organism-sediment relationships. The first approach relates to community structure. This topic is held to mean the variations in quantitative terms of individuals and species in space and time. The second approach relates to community function and benthic productivity including biomass, production and energy transfers. Such knowledge is quite fundamental to better understanding of the Southern Atlantic continental shelf.

1.3 Brief history of the development of marine sedimentation research in Brazil, Uruguay and Argentina

The development of research in marine geology, specifically marine sedimentation, is related to two well-defined stages.

The first one, clearly of an academic nature, was based on university research, i.e. in Brazil (Federal Universities of Pernambuco and Rio Grande do Sul), Argentina (Faculty of Sciences and 'Bernardino Rivadavia' Museum of Natural Sciences) and Uruguay (Department of Geography of the Faculty of Sciences). These initiatives, however, confronted similar problems in the three countries: lack of funds for larger projects, inadequate laboratories, and insufficient qualified personnel to enable the development of larger programmes of some scientific impact.

The second stage, of an applied nature, has developed over the past ten years and stems from a new political mentality focusing on the sea. Through this, the South American nations of the South Atlantic launched various programmes to discover the mineral resource potential of their continental platforms.

More recently, as a result of the problems caused by the oil crisis, the three countries, notably Brazil, have increased their research of the sea floor. The object of these was not only to obtain clear scientific knowledge, but at the same time to train qualified specialists both abroad

and in their own countries. These programmes were supported by concrete resources so that their goals could be fully attained.

In Brazil, two programmes of this nature were established in 1970. One was undertaken by the Ministry of the Navy through its Dirección de Hidrografía y Navegación (DHN) and the National Council of Scientific and Technological Development (CNPq). The object of this activity, called Marine Geology and Geophysics Programme (PGGM), was to elaborate the geological maps of the Brazilian continental margin from a morphologic, structural and sedimentary point of view, taking into account the training of personnel at graduate and post-graduate level.

The second study programme, called Reconnaissance Project of the Continental Margin (REMAC), developed in the area by the Ministry of Mining and Energy, was undertaken by PETROBRAS, Companhia de Pesquisa de Recursos Minerais (CPRM) and the National Department of Mineral Production (DNPM). Its basic objectives were mainly related to an evaluation of the existing mineral resources of the continental margin. The project, which ended in June 1978, should continue through the PGGM, which at present is supported by a national data centre functioning at the Dirección de Hidrografía y Navegación; a sampling centre at the Laboratory of Marine Geology of the Instituto de Geociencias of the Federal University of Rio de Janeiro; and a personnel training centre at the Research Centre for Coastal Geology and Oceanographic Studies (CECO) of the Federal University of Rio Grande do Sul (Porto Alegre).

Since 1970 these programmes have resulted in more than 300 scientific papers, communications and active participation in congresses and symposia, at both the national and international level. From an original figure of only five marine geologists, at present there are more than 50 professionals working in Brazil in this field.

In Argentina, two centres are working in research and personnel training: the Servicio de Hidrografía Naval, which is undertaking systematic studies of the Río de la Plata, the continental platform and the region of the large gulfs; and the Instituto Argentino de Oceanografía of the Universidad del Sur in Bahía Blanca, which conducts similar studies and training of personnel required for the development of their programmes.

Before these institutional activities began, during the 1932 campaign of the 'Discovery II', the first sedimentation studies were carried out in the Argentinian seas. Consequently the Servicio de Hidrografía Naval, in conjunction with the hydrographic surveys, began to elaborate the first 'atlas of the sea floor' which would constitute the basis for future sedimentation charts. In this way, studies on sedimentation and marine geology were developed in Argentina by the Servicio de Hidrografía Naval and in collaboration with other national institutions, especially the Museums of Natural Sciences 'Bernardino Rivadavia' and of La Plata. They were responsible for sedimentological studies in the Argentinian seas and the Atlantic littoral.

In 1957 the Servicio de Hidrografía Naval collaborated with the Lamont Doherty Geological Observatory in a geophysical and sedimentological reconnaissance programme of the South-west Atlantic Ocean. This project

concentrated on the continental platform and enabled the determination of various sedimentary basins. These would later on be explored by private enterprises looking for hydrocarbons. In 1962 the Servicio de Hidrografía Naval set up the first laboratory of marine sedimentology where the first specialists in the field of marine geology were trained. At the same time several important projects such as the survey of the Río de la Plata and sedimentary and bathimetric studies of the continental shelf were undertaken with the participation of other national and provincial institutions. Later, during the fisheries campaign sponsored by FAO, the first sedimentation chart of the Argentine epicontinental sea was elaborated. In agreement with the Instituto de Geología y Minas, the Servicio de Hidrografía Naval is presently studying the economic resources of the large gulfs.

In another field, the Instituto Nacional de Biología Pesquera is preparing the bathymitologic chart of the Argentine epicontinental sea. Finally, the Lamont Doherty Observatory, under an agreement with Argentina, continues geophysical research in the continental terrace and Malvinas plateau with the object of obtaining additional information on its structure and evolution.

Regarding education, in 1962 the Instituto Tecnológico de Buenos Aires established the first degree programme in oceanography with the Argentine Navy's sponsorship. Marine geology is included among the subjects of this specialization. Recently, the Universidad Nacional del Sur created a degree in oceanography in which a specialization in marine geology is contemplated in the near future.

In Uruguay, the Instituto Geológico made a long and detailed study on heavy-mineral concentrations along its oceanic beaches, while the Servicio de Hidrografía y Meteorología of the Navy, in cooperation with Unesco, undertook a programme called 'Beach conservation and improvement'. This included geological and geomorphological research of the coastal zone and continental shelf of the Río de la Plata and Atlantic Ocean uninterruptedly from Montevideo to the outfall of the Chuy stream in the department of Rocha. The purpose of this study was to determine the geology and geomorphology of the littoral zone, and to define the main morphologic characteristics of the beaches, in order to contribute to the understanding of their dynamic behaviour and origin.

1.4 Background of the Seminar

The Latin American Seminar on Benthic Ecology and Sedimentation Geology of the South Atlantic Continental Platform was organized by the Unesco Regional Office for Science and Technology for Latin America and the Caribbean (ROSTLAC), in accordance with Resolution 2.181 approved by the 19th Session of the Unesco General Conference (Nairobi, 1976). This authorized the Director General to continue to implement the programme aimed at promoting the advancement of the marine sciences, with special attention being given to problems of the coastal areas.

The Ministry of Education and Culture of Uruguay agreed to sponsor the Seminar and Unesco covered travel expenses of invited lecturers of countries of the region and of some participants from other countries. Two of the participants, Dr. Luiz R. Martins of the Centro de Estudos

de Geologia Costeira e Oceanica of the Federal University of Rio Grande do Sul (Brazil) and Dr. Pierre Lasserre, of the Institute of Marine Biology of the University of Bordeaux, acted as Seminar coordinators. Dr. Martins coordinated the topics in geology, geochemistry and mineral resources, and Dr. Lasserre in benthic ecology.

The Uruguayan National Commission for Oceanography and the authorities of the Taranco Palace in Montevideo were responsible for local arrangements, which included meeting rooms at the Taranco Palace, secretarial support, cultural activities and reception of participants.

ROSTLAC called the meeting and collaborated with local scientists and authorities in coordinating scientific activities to be carried out during the Seminar. A permanent contact with the Seminar coordinators permitted the selection of participants.

The Governments of Argentina and Brazil provided travel funds for some of their scientists.

The meeting was divided into three main topics:

- 1) Geology and sedimentation
- 2) Benthic ecology and living resources
- 3) Geochemistry and mineral resources

The participants were asked to give lectures on various phases of research, with special attention being devoted to the South Atlantic continental platform. In addition to the presentation of communications, the Seminar was intended as a forum for open discussion between participants to:

- define scientific problems of multidisciplinary cooperation,
- outline the corresponding solutions, and
- consider the need of establishing a scientific basis for the rational use and management of the marine environment and its resources in the South-west Atlantic area.

2. DEVELOPMENT OF THE SEMINAR

2.1. Participants

The large number of scientists who attended the Seminar in addition to the invited participants shows the interest of developed and developing countries in this area of research, due mostly to the applicability of these studies to the management of living and mineral resources and to their protection.

Fifty-six participants from the following countries were represented: Argentina (8), Brazil (18), Chile (4), France (3), Federal Republic of Germany (1), Norway (1), Uruguay (19), Venezuela (2). A great number of graduate students participated in the Seminar as observers. The complete list of participants appears in Annex II.

2.2 Programme

The Seminar opened at the Taranco Palace with a preparatory meeting and the election of the chairmen. Dr. Hebert Ni6n (Uruguay) was elected President. Drs. Jos6 M. Gallardo (Argentina) and Walter Narchi (Brazil) were elected Vice-presidents. The following rapporteurs were elected following proposals by the coordinators, Dr. Martins (topics 1 and 3) and Dr. Lasserre (topic 2):

- Topic 1 Geology and sedimentation:
 Dr. P. Coutinho (Brazil)
 Dr. J.A. Villwock (Brazil)
- Topic 2 Benthic ecology and living resources:
 Dr. E. Boschi (Argentina)
 Dr. M. Kempf (France)
 Dr. U. Lie (Norway)
 Dr. P. Penchaszadeh (Venezuela)
- Topic 3 Geochemistry and mineral resources:
 Dr. F. Mouzo (Argentina)
 Dr. C. M. Urien (Argentina)
 Dr. C.I. Santana (Brazil)

The opening ceremony was presided over by the Minister of Education and Culture of Uruguay, in the presence of the National Commission for Oceanography, national authorities, members of the diplomatic corps, as well as the ROSTLAC Director and the Programme Specialist in Marine Sciences, and the two Seminar coordinators.

2.3 Summary of topics presented

2.3.1 Geology and sedimentation

The presented papers clearly indicated the present level of knowledge (or state of the art) in these two fields of oceanography at present in full development. All surface distribution of sediments occurring in the continental platform from Cape Orange to Tierra del Fuego is very well known. The provenance areas, distribution mechanisms, paleo-environments and age of sediments were appropriately discussed in conferences and short contributions. The geology of marginal basins was also discussed.

It can be stated that the present state-of-the-art can serve as the basis for more sophisticated studies.

The two conferences (L.R. Martins and C.M. Urien) presented a realistic and comprehensive overview of the morphology structure and sedimentation of the continental platform and marginal basins.

The short communications (L.R. Martins, L.J. Tomazelli and I.C. Correa) showed aspects of some regions with contributions which can serve as the basis for studies of provenance deposition mechanisms and paleogeographic evolution.

2.3.2 Geochemistry and mineral resources

During the session devoted to the second geological topic, the participants showed particular interest in the new information presented by the lecturers on the potential of the South Atlantic continental shelf, little-known until recently. The papers and communications emphasized the interest of the countries of the region in research of this nature. The only paper on geochemistry presented on this occasion clearly showed the non-existence of specific studies of this nature and the scarce knowledge on this subject in the whole South American continental margin.

The main problems in geochemistry were summed up by M.L. Formoso while mineral resources were analyzed by E. Blissenbach and C.I. Santana. The dark-mineral accumulations and problems related to the exploitation of calcareous were discussed by J.A. Villwock and P.N. Coutinho.

Two films from Preussag (Federal Republic of Germany) on metallic oozes and polymetallic nodules were shown during this session.

2.3.3 Benthic ecology

The sessions devoted to benthic ecology occupied two whole days (10-11 May). The seven conferences covered the structure of benthic communities of the Brazilian and Argentinian continental margins (M. Kempf and P. Penchaszadeh respectively). Benthic macroalgae were described by O. Kuhnemann. Benthic fishes of the Río de la Plata (Uruguay/Argentina) were covered by H. Nión, in collaboration with A. Abella, G. Arena and C. Ríos. U. Lie's conference focused on syn-ecology quantitative methods used in a general framework for the study of macrobenthic communities. Lie stressed that good instruments for sampling benthic infauna are available and described some of these sampling gears. He made a critical review of the numerous methods employed nowadays for quantitative analysis in benthic syn-ecology. The important role of meiofauna in the benthic marine ecosystems was assessed by P. Lasserre. There is urgent need for information on the interactions of microbenthos and meiobenthos with lower and higher elements in the food chain of the shelf of the South-western Atlantic coast.

The short communications, no less informative, reviewed various aspects of the benthic ecology of the communities of the continental platform, littoral and coastal lagoons of the Atlantic coast of South America. They described the problems of the benthic syn-ecology of diverse groups, generally macrobenthic (molluscs, demersal fishes, crustaceans). These papers were of an essentially descriptive nature. However, they constitute an excellent basis for future research on the functioning of these ecosystems, including the papers on microbenthos (bacteria, microflora) and meiofauna.

2.3.4 Discussions

The discussions in the plenary sessions on the different topics referred mostly to clarifications requested by participants regarding the research which had been carried out. During these discussions it became evident that there is a great lack of information among researchers as to what each one, in particular, or each team is doing in their respective countries.

For this reason, discussions were less technical than would have been expected in a seminar of this nature, but nevertheless it served the purpose of disseminating scientific papers of a sound level.

2.4 Conclusions and recommendations

Three committees were established during the Seminar: two for marine geology and one for biology. Specifically, one referred to the topic covered on the first day, geology and sedimentation, another one to the second and third days, benthic ecology, and the last one to the fourth day, geochemistry and mineral resources. The three working groups summarized their main conclusions and recommendations which were submitted to the plenary session and duly approved.

Bearing in mind the need to establish a scientific basis for the rational use and management of the marine environment and its resources in the South-west Atlantic area, the working groups on marine geology and sedimentation, geochemistry and mineral resources and benthic ecology make the following recommendations.

Considering that:

- 1) the present seminar provides the basis for a fruitful exchange of ideas in the fields of (1) marine geology and geophysics and the use of mineral resources, and (2) benthic ecology and living resources;
- 2) there is a need for a closer relationship between institutions working on these subjects as regards technical cooperation, exchange of basic information, publications of interregional character and organization of meetings;
- 3) there is a need to collect and transfer scientific information on activities related to marine geology and geophysics and biology to the countries of the region in a systematic and methodical way;
- 4) international organizations which possess human, technical and financial resources should assist in the execution of concrete plans in the field of marine geology and geophysics and in the evaluation of renewable and non-renewable natural resources.

The committees on geology and sedimentation, and geochemistry and mineral resources RECOMMEND that:

- 1) ROSTLAC, in cooperation with national oceanographic committees, undertake the centralization and dissemination of scientific information on relevant research activities being conducted in the south-west Atlantic by countries of the region in order to promote and facilitate such research;
- 2) closer cooperation be fostered among the countries of the region through the transfer of technology and training of personnel at different levels;

- 3) the organization of meetings similar to the present seminar be encouraged to increase the mutual exchange of opinions, experiences and results obtained by specialists in this field;
- 4) the countries of the region should strive to attain a rational and planned management of their marine resources for their social well-being and economic development and, in doing so, should stress the need for multidisciplinary technical participation in the planned exploitation of marine mineral resources so that all aspects of potential ecological changes can be analyzed;
- 5) the attention of government leaders should be drawn to the national interests which are served by supporting and financing appropriate evaluation and exploitation of their countries' natural resources;
- 6) support be given to the project of publishing a Regional Review in Marine Science, under the sponsorship of Unesco;
- 7) the application of standard statistical methods, used in the quantitative study of benthic communities as well as in marine sedimentation, be used in future joint studies and for the exchange of information;
- 8) taking into account the small number of papers presented to the seminar in the fields of marine geochemistry and geophysics, geological research and training be given particular attention;

The committee on biology RECOMMENDS that,

- 1) ROSTLAC centralize and update information on regional research in the fields of benthic ecology and related subjects, including lists of research workers and institutions providing training and research facilities;
- 2) a Regional Review in Marine Science be created to ensure better dissemination of information on research in benthic ecology and related subjects;
- 3) increased support be given to the study of the dynamics of benthic systems. Existing knowledge on the distribution of flora and fauna should serve as a basis for obtaining data on benthic productivity through research on population dynamics, energy transfer and organism-sediment relationships. These studies should be planned in collaboration with participating institutions and countries through their relevant organizations to avoid duplication of effort and to ensure the best use of human and economic resources.

3. OUTLINE FOR THE PREPARATION OF A COORDINATED RESEARCH PROGRAMME IN THE REGION

3.1 General considerations

The general aim of coordinated research programmes on the continental shelf of the south-western Atlantic should be to arrive at comprehensive outlines which take into account as much information as possible on (1) the physics and the geology of the shelf, (2) the chemical and geochemical properties of recent sediments (in hydrodynamic balance) and relict sediments (in hydrodynamic imbalance), and (3) the demographic and adaptive features of the organisms including the mechanisms of production.

This call for the development of pluridisciplinary cooperation should lead to the elaboration of methods specifically adapted to the following purposes:

- 1) Studying the mechanisms of the mixing and dispersal of sediments and waters at the boundary.
- 2) Determining the mineral resources.
- 3) Studying the mineralization of organic matter.
- 4) Assessing the biological productivity of the benthic flora and fauna.
- 5) Studying the possibilities for compatible exploitation and protection of living resources.
- 6) Determining the current pollution level.

A cooperative programme should lead to the elaboration of pilot projects on a regional basis. In this way an attempt could be made to establish correlations between the specific biological composition of the plant and animal populations: the biocenotic associations and the resultant energy structure on the one hand, and the sedimentary and geochemical features of the shelf on the other. These programmes seem highly desirable and feasible given the scientific and logistic support generally available in the countries concerned.

3.2 Phase I. Analytical approach (structural parameters)

It would be desirable to arrive at an agreed definition of a reference state for the continental shelf in question. It would seem possible to carry out an exhaustive structural study on selected sites suffering from little or no pollution which would serve as reference points. The general situation at these sites would have to be such as to allow extrapolation to all other cases.

Projected programme

Physical chemistry

- measurements of thermal variations
- determination of salinity, pH and redox potential gradients

- nutrients, mineral elements
- oxygenation

Hydrology

- study of surface currents
- studies of the mixing and replenishment of waters as a result of climatic variations

Sedimentation

- mapping of the principal sediment faeces
- measurement of grain size, calcium, carbonate, organic matter
- identification of material in suspension
- mapping of the surface mineral resources

Biology

- systematic inventories of plant and animal species
- distribution and specific diversity
- life cycles of dominant species
- inventory of pollutants in water, in sediments and in organisms.

3.3 Phase II. Systemic approach (dynamic study)

On completion of the study suggested for Phase I, it would be desirable to adopt a systemic approach which takes account of information on an over-all scale. This is already possible in the case of a few systems which have been the object of analytical studies. Using an approach of this kind, the dynamic features of the shelf could be envisaged. In this way, living structures and their habitats can be put in functional groupings and the quality and quantity of the exchange of matter and energy in the ecosystems under consideration can be described. Such an approach must be given priority if we are to gain an adequate knowledge of the mechanisms governing the production of these coastal systems.

Projected programme

Sedimentology and chemistry

- study of sediment particles and their relation with the soluble phase
- distribution and role of the inorganic and organic elements in the interstitial water
- study of coastal lagoons and coastal geomorphology
- applied studies on coastal management

Geochemistry and metabolism at the benthic boundary

- the mineralization of organic substances of plant origin
- use of the particulate organic matter and dissolved organic matter

- respiration, in situ, and laboratory experiments
- anaerobic activities
- energy relationships between bacteria-microalgae-meiofauna and macrofauna
- sedimentary oxidative activities

Biology

- population dynamics and demographic structures
- microbiology, bacterial ecology
- energetics and environmental adaptation
- energy budgets (assimilation, respiration, excretion) on species populations

Effects of pollution

The effects of pollution on the continental shelf should be intensively studied. The inventory of pollutants made during Phase I should serve three purposes:

- determination of the current level of chemical elements present in the environment
- identification of pollutants (toxic metals and organic elements: phenols, hydrocarbons, cyanides, pesticides)
- study of the tendencies of change along the coastal zones, constantly being modified by the presence of man.

ABSTRACTS OF PRESENTED PAPERSThe Brazilian continental margin, L.R. Martins, P.N. Countinho and C.M. Urien

The work presents the main features of the morphology, structure and sedimentology of the Brazilian continental margin. Six physiographical provinces are recognized and discussed. Surface sediments show five distinct faeces-types: littoral quartz sand, mud, transition sand-mud, coralline algae and biotrititic. Economically important resources are sand and gravels, carbonate deposits, besides oil evaporites and coal in subsurface. Other possible sources could be phosphate, heavy minerals, mud for ceramics and polymetallic nodules from the deep sea.

Bedding: a regional structure on the Rio Grande do Sul inner shelf, L.R. Martins, L. Martins and C.M. Urien

Driscoll piston cores collected along Rio Grande do Sul (Brazil) inner shelf revealed the presence of graded bedding. These sedimentary sequences are mainly controlled by the action of storm waves and bottom current along the shoreline and shallow shelf area.

Provenance and dispersal patterns of the Rio Grande do Sul continental shelf superficial sediments, L.J. Tomazelli

Heavy mineral studies established the principal lines of provenance and dispersal patterns of the terrigenous superficial sediments throughout the Rio Grande do Sul continental shelf. Four heavy mineral provinces were recognized: (1) Inner Rio-Grandense Province; (2) Outer Rio-Grandense Province; (3) Patos Province and (4) Platina Province. Each of these provinces forms a unit with respect to geographic distribution, age and provenance.

Marine sedimentation in Eastern South America, C.M. Urien and L.R. Martins

The present study describes the evolution of the continental shelf since the origin of the Atlantic Ocean, which caused the first marine sedimentation. The historical evolution and paleogeography of sedimentary basins and their faeces must be envisaged as a whole to be able to understand the processes which occurred in this marine environment from its first stages up to the present state. This enables one to understand the genesis of forms and sediments observed nowadays in the region.

Bioclastic carbonate deposits between Albardao and Mostardas along the Rio Grande do Sul inner continental shelf, I.C. Correa and V.R. Ponzi

The present work describes detailed geological studies along Rio Grande do Sul (Brazil) inner continental shelf, near the Albardao and Mostardas area, using side scan sonar profiles and 'Driscoll' sedimentary cores which were carried out with the purpose of mapping the presence of shoals with bioclastic carbonate material. These elongated banks, aligned approximately parallel to the present coastline, are mainly limited between the 10-50 metre depths. Using data from more prominent ridges it was possible to evaluate the potential of bioclastic carbonate in relation to its economic feasibility.

Megafitobenthos of the Argentine littoral, O. Kuhnemann

This large ecological system has been studied from different angles, beginning with the knowledge of its living components, the species, followed by its relation to the medium, and studying the influence of ecological factors upon the major communities, the conquest of substratum, interspecific competition and

climax. As a result of these interactions and taking into account the geographical areas of the main macrophytas, as well as the presence of endemics of different rank, we have proposed the following dominions and oceanic provinces:

Atlantic Region: Subtropical Dominion, with a Uruguay-Buenos Aires Province.
American Austral Atlantic Dominion, with two Oceanic Provinces: Patagonic Province and Fuegian Province.

Antarctic Region: Antarctic Dominion, with an Antarctic Province.

We enclose some data about industrial use as an appendix.

Research on benthic biology and sedimentology undertaken by the "Bernardino Rivadavia" Argentine Museum of Natural History, J.M. Gallardo

For more than 60 years the Museo Argentino de Ciencias Naturales has been studying the Argentine sea. The Museum has a staff of 24 scientists specializing in various branches of marine biology and marine geology; there is a Planktology Department, a Marine Invertebrates Department and an Ichthyology Department as well as laboratories and specialists in marine bacteriology, fisheries biology, algology, marine mammals, marine geology and sedimentology, seabirds, marine reptiles. The Museum has maintained a Marine Biology Station in Puerto Quequén since 1928.

Some peculiarities of Southern Ocean benthos and their bearing on exploitation of its resources, P.M. Arnaud

Following a review of benthic resources of the Southern Ocean resulting from the 1976 International conference at Woods Hole, some comments are presented about geographical, ecological and biological peculiarities of this benthos. Those peculiarities are evaluated and classified as favourable and unfavourable, and as a result, several new recommendations are proposed.

Studies on the microfauna along 7.408 km. of the Brazilian coast, I.D. Pinto

Ostracods, Foraminifera and molluscs found in 586 samples from the continental shelf along 7.408 km. of the Brazilian coast (from Lat. 33°45'S to 4°25'N) were studied and the results were presented as an internal report. In this paper the main results achieved by these studies, especially those on ostrados, are reported; it describes the different geographical range of the genera of ostrados along the coast, the possible influences of temperature, salinity and bathymetry of their distribution.

Community structure and its determining processes in *Mytilus platensis* circalittoral banks, P. Penchaszadeh

The mussel *Mytilus platensis* d'Orbigny develops in banks deeper than other mitilids from the Northern hemisphere. This fact makes that community characteristic of the continental shelf of the southern South American Atlantic. Studies were carried out on the population dynamics and the community structure of *M. platensis*. We discuss here the importance of some factors influencing the community structure: substrates used by the recruits, the recruitment pattern and the predatory pressure. A trophic interspecific interrelations diagram and a discussion of the relation between the trophic structure and the stability of the system are given. The colonization of *M. platensis* is frequently done in a massive way on filamentous or corded-like substrates, as Hidrozoans and colonial Tunicates. The recruitment on old banks is seriously affected by predation of a series of benthic animals, especially sea urchins, gastropods, chitons and starfish.

The rocky littoral communities of Uruguay: zonation, local distribution and biogeographic considerations, S. Maytía and V. Scarabino

This paper describes zonation in rocky substrata of the Uruguayan littoral. Distribution along the coast as well as specific diversity of indicator organisms are conditioned by the fluvio-marine regime of the Rio de la Plata. This river also acts as an ecological barrier for latitudinal distribution of communities, most of which found in Uruguay being of temperate-warm origin.

Bioecology of the crab community. I: Contribution to the biological knowledge of the estuarine crab *Chasmagnathus granulata* Dana (Crustacea, Decapoda, Grapsidae) at the mouth of the Rio Salado (Province of Buenos Aires, J.L. Botto and H.R. Irigoyen

Information is presented on zonation, feeding habits, density, structure of population by categories of individuals and sexes, fertility and reproduction seasons, and dispersal of species, based on 80 surveys made between 1972 and 1974 in the Rio Salado mouth zone, Province of Buenos Aires.

Benthic bionomy of the coast of tropical Brazil, M. Kempf

This work is the result of several years of research by the Department of Oceanography of the Federal University of Pernambuco, Recife (Brazil), updated with the most recent literature. The zonation of intertidal populations is commented upon and the great types of shallow water populations are classified under reefs, phanerogam prairies, vermetidae formations and mangroves. The main biotopes of the continental shelf are defined as reefs, quartz sands, mud, calcareous algae and biodebitric sediments. Due to particular climatic and physiographic conditions, the most characteristic feature of the tropical Brazilian shelf, is the large geographical and bathymetric extension of organic sediments based on calcareous algae (Rhod. Corall. Melobesiade).

Studies on the benthic ecology and functional adaptations of some bivalves correlated with the substratum, W. Narchi

Along the coast of Sao Paulo (Brazil), a series of studies has been conducted by the author on sandy beaches ranging from well-protected to very exposed ones. *Donax hanleyanus* (Philippi, 1847), inhabits the wave-swept sandy beaches and their ability to overcome the stresses of the environment is based on rapid burrowing; these bivalves are adapted to life on exposed shores and they do not occur in protected beaches or in shallow bays. Living respectively in muddy and sandy beaches of the littoral of Sao Paulo, *Anomalocardia brasiliensis* (Gmelin, 1791) and *Tivela mactroides* (Bom, 1778), have specialized as shallow burrowers, being very successful animals found in soft substrates. Deeper burrowing requires the development of longer siphons. *Iphigenia brasiliensis* (Lamarck, 1818) and *Mesodesma mactroides* (Deshayes, 1854) are found in the intertidal region, burrowing 15 or 20 cm deep. Some aspects of the functional adaptations and ecology have been investigated in the present study.

Studies on benthic ecology in the estuarine region of the Lagoa dos Patos, RGS. (Brazil). I: Benthic communities, R. Capitoli, C. Bemvenuti and N. Gianuca

Studies of the estuarine area of the Lagoa dos Patos show interesting and peculiar features, among which must be mentioned a high physical and chemical instability. The composition of the benthic fauna is dominated by

estuarine and euryhaline marine organisms over those of freshwater origin. According to the zonation, four communities were determined:

Supralittoral level: Spartina sp. community

Mesolittoral level: Chasmagnathus granulata community

Infralittoral level: Laeonereis acuta community with Tagelus plebeius faeces

Mean and lower infralittoral level: Erodona mactroides-Kalliapseudes schubartii community

Ubiquitous species of wide distribution such as the gastropod Littoridina australis and the polychaete Heteromastus similis were found. In summer with low water the Ruppia sp. (phanerogam) appears, as well as Cumaceans, Mysidaceans, Amphipods, Isopods, Ostracods and Phoronideans, and other groups complete the fauna, presenting in many cases close relationships with the four basic types of sediment: sand, muddy-sand, mud and sandy-mud.

Methods in quantitative synecology, U. Lie

Efficient instruments for quantitative sampling of benthic infauna in a variety of substrates are available today but such instruments must be chosen with consideration of environmental conditions in the area of investigation. In order to improve the precision in the estimates of benthic parameters, a proper sampling design should be planned before embarking on large scale surveys. Quantitative methods of data analysis, which permit both classification and ordination of the benthic communities, are available. The choice of methods depends on the objectives of the investigation, and on the quality of the data.

Benthic Foraminifera of the continental shelf of north and north-eastern Brazil: a summary, I. Tinoco

The biogeographical sub-province of N-NE Brazil is situated between the latitudes 4°N and 23°S, including the oceanic islands of Fernando de Noronha and Trindade. Critical interpretative consideration of numerous papers on Foraminiferal composition of sediments permits conclusions about test morphology and species distribution in relation with sedimentary faeces. The preservation of carapace and ecological incoherence supports the idea that the shelf is covered with relict deposits.

Macrobenthic zonation in an oceanic littoral lagoon system, H. Nión

In the present paper a study is made of the macrobenthic fauna in the Laguna de Castillos-Arroyo Valizas system and its ecologic relationship, zonation and abundance in relation to fluctuations caused by environmental factors such as salinity and temperature. There are groups of organisms that make trophic and reproductive migrations to and from the system, and whose presence is related to the lagoon-river-sea relationship, and with seasonal changes in temperature. Finally, it confirms the presence of organisms living permanently in the system and which probably are indicators of the different areas. Among them we can mention especially Diplodon paraclelipipedon for the limnetic zone (meso and infralittoral), Erodona mactroides (infralittoral), Cyrtograpsus angulatus (meso and infralittoral) in the whole fluvio-marine zone, and Tagellus plebeius, Chasmagnathus granulatus and Metasesarma rubripes (mesolittoral), in the fluvio-marine zone (except the lagoon).

Molluscs of the continental shelf in the Rio San Francisco region (north-eastern Brazil): systematic study and ecology, H. Mathews and M. Kempf
318 species of molluscs are presented from a systematic point of view, and studied from an ecological standpoint, in relation to the vertical distribution and biotopes considered. A diversity study is also made as well as a mathematical study by inertia analysis. Characteristic molluscs, by biotope and by layer, are identified. A certain number of relict species in the top part of the continental shelf are witness of an ancient marine level.

Sandy beaches of the western South Atlantic between 28° and 42°S latitude: general and biocenologic considerations, A. Escofet, N. Gianuca, S. Maytía and V. Scarabino

This study presents bionomic considerations of the sandy substratum sectors of southern Brazil, Uruguay and Argentina down to the Golfo Nuevo (Province of Chubut), giving a functional scheme of the beach ecosystem. Consideration is also given to biogeographic characteristics of the area in which faunistic composition has a combination of warm-temperate and cold-temperate origin, the Rio de la Plata acting as an effective ecological barrier.

The bacteriobenthos of the continental shelf of the southwestern coast of South America: a recent discovery, V. Gallardo

This study gives information on the recent discovery of large microbiological associations in the continental shelf of Peru and Chile and some of the main features of the structure of benthic communities in this area. The importance of this finding in connection with benthic ecology concepts is briefly analyzed.

Ecology of marine meiobenthos, P. Lasserre

The recognition of benthic communities of ciliates and meiofauna with extremely high individual numbers is recent and is of steadily increasing interest. The need for more quantitative information was stressed in an important review published by McIntyre (1969). Recent efforts concentrating on the questions of population density, community dynamics and energetics have assessed the significant and important role of meiofauna in the benthic marine ecosystems.

Mytilus edulis platensis - Pinnotheres maculatus: a case of comensalism with incidence in canned fish technology, J. Amaro

This study notes the absence of this association in the coastal shoals of commonly-exploited mussels as well as its presence and incidence in the high-seas banks of recent exploitation. The packing industry is advised of the technology to be employed to avoid the appearance of strange crustaceans in the presentation of tinned mussels.

Decapod crustaceans in the benthic communities of the Argentine sea, E. Boschi

Decapod crustaceans are described as characterizing benthic communities of the region: they are classified depending on the type of substratum and according to their habitats. Three bathymetric profiles are given, listing species living in hard substrata and soft substrata (sediments), for three different latitudes.

Benthic fishes of the Rio de la Plata and of the common Argentinian-Uruguayan fishing zone, A. Abella, G. Arena, H. Ni6n and C. R6s

The present communication analyzes the distribution of benthic fishes in

the different environments and aims to determine the characteristic genera in the area under study. For this purpose, stratification was determined according to volume of dominant waters, depth and types of bottom. The composition of benthic ichthyofauna within these variables was analyzed with representative profiles. A general chart of the area is presented.

Distribution of the ichthyological fauna in the Caribbean Sea area and off the northeast coast of South America, F. Cervigon

The factors that determine spacial distribution of the species can be grouped as:

1. Biogeographic factors: Fundamentally due to the existence of natural barriers or to the diverse origin of the fauna which have remained isolated during long periods of time.
2. Ecological factors: Although these do not constitute impassable barriers to the dispersion of the species, they determine a discontinuous distribution or a mosaic one.
3. Specific factors: Those characteristics of certain species which influence their capacity for adaptation to or exploitation of diverse environments and which constitute peculiar cases within the general established framework.
4. Endemism: Species of local distribution which are related to certain restricted areas of particular characteristics or which, because of geological processes, have given rise to the presence of twin species as in the case of the Maracaibo system.

In the whole of the tropical province of the American Atlantic, it is possible to define the following areas or districts in relation to benthic fish:

1. The Gulf of Mexico
2. The Antillean-Caribbean insular region
3. The north and northeast coast of South America including Central America south of the Yucatan.

Halophilic Vibrios in benthic fishes in Uruguay, T. Ramos and V. Bertullo

The presence of Halophilic Vibrios in benthic fishes and in faeces of children with diarrhea is described for the first time in Uruguay. For the most part, such microorganisms have been ascribed as Vibrio parahemolyticus and V. alginolyticus.

Preliminary note on some ecological aspects of shrimp, F. Villegas

Observations were made on ecological aspects of Penaeus paulensis shrimp. Feeding habits were of interest in order to improve pond production. Other aspects were behaviour and mortality due to predation by the Chasmagnathus granulata crab. Observations were made also on salinity and temperatures related to postlarvae.

Some topics in marine geochemistry, H. Formoso

This study presents some problems related to the chemical composition of oceans and certain changes which occur during the marine diagenesis. It comments on the main reactions with clay minerals as well as the formation of glauconite, carbonates and metalliferous oozes.

Mineral resources of the sea, C.I. Santana

The mineral resources of a determined continental margin are basically associated with the type of margin that contains them. In the case of the

Brazilian continental margin and, by extension, the continental margin of eastern South America, mineral resources are associated with the continental margin of diverging or Atlantic type. In the particular case of the Brazilian continental margin, the existence of evaporites, sulphur, construction materials, heavy minerals, phosphates and polymetallic nodules is discussed.

Prospective sedimentary mineral potentials of the South American Atlantic margin, E. Blissenbach

Hydrocarbons represent the most prospective and valuable resource. Ore deposits originating as hydrothermal mud may occur below the sedimentary wedge. Phosphorites and metalliferous oozes are likely to be present on shelf and slope. The prospects for large placer deposits are good. The state of exploration and exploitation techniques, in particular research and mining vessels, is described. The training of research workers is emphasized.

Dark-mineral accumulations along the beaches of the Rio Grande do Sul coast (Brazil), J.A. Villwock, E.L. Loss, E.A. Denhardt, L.J. Tomazelli and T. Hofmeister

Accumulations of dark minerals were observed along 25% of the Rio Grande do Sul coast, between Rio Grande and Tramandai. Field work and laboratory studies showed that ilmenite, magnetite, rutile and zircon are the more important economic minerals present in these deposits. The accumulation of these black sands was caused by wave and wind actions that made a continuous reworking of the coastal sandy sediments of this area. Their primary source is on the igneous and metamorphic rocks of the Rio Grande do Sul shield and on the sedimentary and volcanic rocks which lie over them.

Some problems of exploitation of calcareous algae in the Brazilian continental shelf, P.N. Coutinho

Almost the whole Brazilian tropical continental shelf is covered by carbonate sediments, consisting predominantly of branching and encrusting coralline algae and green algae, associated with a smaller quantity of Foraminifera, molluscs and bryozoans. In contrast with other tropical shelves, corals are virtually absent from the sediments, as are ooids and other precipitated forms of carbonate. In the present work a programme is proposed to evaluate the exploration and exploitation possibilities of the calcareous algae deposits on the Brazilian northeast shelf and to obtain scientific information to guide the exploitation of these deposits. Intensive exploitation of these resources without a rational and methodic study could cause serious damage to the environment.

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