



The SANCOR marine sedimentology programme January 1984 – December 1988

Programme developed under the aegis of the South African
National Committee for Oceanographic Research

SOUTH AFRICAN NATIONAL SCIENTIFIC PROGRAMMES REPORT NO

82

MARCH 1984

Issued by
Cooperative Scientific Programmes
Council for Scientific and Industrial Research
P O Box 395
PRETORIA 0001
from whom copies of reports in this series are available on request

Printed in 1984 in the Republic of South Africa
by the Graphic Arts Division of the CSIR

ISBN 0 7988 3022 0

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PREFACE

The South African National Committee for Oceanographic Research (SANCOR) programme is one of a number of cooperative research programmes developed by the scientific community in South Africa and managed on their behalf by the Cooperative Scientific Programmes (CSP) of the Council for Scientific and Industrial Research (CSIR). These programmes depend upon cooperation between disciplines for the solution of many and diverse questions. They have also contributed to the increasing awareness by the scientific community of the value of such cooperation.

The objective of the SANCOR programme is to gain knowledge of the basic structures, processes and relationships in the marine environment around southern Africa in order to provide a fundamental scientific understanding and to facilitate:

- the efficient exploration, exploitation and conservation of living and non-living marine resources;
- the judicious management of the coastal zone;
- the fuller understanding of climate;
- improved utilization of environmental information in maritime activities.

The terms of reference of SANCOR are to provide policy and scientific guidance for oceanographic research in South Africa, by designating priorities. Specifically it:

- takes cognizance of actions and developments affecting marine science and technology in southern Africa and promotes communication within the oceanographic community;
- reviews the objectives, priorities and progress of its constituent programmes;
- guides effort by deciding on the funding of its constituent programmes, keeping in mind also the need for balance both geographical and disciplinary;
- ensures that its research findings reach decision makers;
- keeps informed on international developments in marine science, inter alia by acting as the South African National Committee for SCOR and related international bodies.

Within the SANCOR programme the following constituent programmes currently exist:

- Benguela Ecology Programme
- Programme on Coastal Processes
- Marine Linefish Programme
- Marine Pollution Programme

- Estuaries Programme
- Marine Sedimentology Programme

This publication contains a summary of what the Marine Sedimentology Programme stands for, the motivation for the programme, the definition and objectives of the programme, an overview of the research covered by the programme, and sets out those items which are considered specific priority areas for research during the five year period January 1984 to December 1988. However, any research organization is free to submit to SANCOR proposals for any research which it considers relevant to the Marine Sedimentology Programme.

The definitive status of this booklet is commensurate with best available current knowledge, but it should not be construed to be static or represent the last word on the subject. It is expected that as further research results become available the emphasis and direction of this programme may change.

The progress in the research programme is reviewed annually by the Marine Sedimentology Programme Committee. The structure and terms of reference of this committee are given in Appendix I, whereas Appendix II gives guidelines for the submission of project proposals and for the reporting on completed research. Titles of other publications in the series are given in the back of this booklet.

ABSTRACT

The Marine Sedimentology Programme is the latest phase of a research activity which was initiated in 1966 by the late Professor E S W Simpson. Related research is currently carried out by NRIO, UCT and the Geological Survey.

The main objectives of the Marine Sedimentology Programme are:

- the establishment of models for marine sedimentary environments,
- the recognition of the evolution of the eastern and western South African continental margins and ocean basins,
- the development of process models related to marine sedimentation,
- the synthesis of palaeo-oceanographic and palaeo-geographic models applicable to the geological record, and
- the prediction of expected variations in sedimentological and other trends in the South African marine environment.

Research done under the auspices of the Marine Sedimentology Programme is at present confined mainly to three fields:

- Pelagic sediments,
- sediments of the continental margins and nearby basins,
- studies on authigenic minerals and related geochemical aspects.

New research is planned on:

- palaeoclimatology and palaeo-oceanography,
- the transportation and alteration of suspended sedimentary particles, and
- processes related to sediment accumulation and compaction.

This programme document outlines the types of research needed in the next five years, and provides guidelines for project proposals and reporting.

OPSOMMING

Die Mariene Sedimentologieprogram is die nuutste fase van 'n navorsingsaktiwiteit wat in 1966 deur wyle Professor E S W Simpson begin is. Verwante navorsing word tans ook deur NNO, UK en die Geologiese Opname uitgevoer.

Die hoofdoelstellings van die Mariene Sedimentologieprogram is:

- die daarstelling van modelle vir mariene sedimentologiese omgewings,
- die herkenning van die ontwikkeling van die oostelike en westelike Suid-Afrikaanse vastelandsbank en oseaan-komme,
- die ontwikkeling van proses-modelle ten opsigte van mariene sedimentasie,
- die samestelling van paleo-oseanografiese en -geografiese modelle wat op die geologiese rekord van toepassing is, en
- die voorspelling van verwagte wisselinge in sedimentologiese en ander aspekte in die Suid-Afrikaanse mariene omgewing.

Huidige navorsing verrig as deel van die Mariene Sedimentologieprogram behels drie studiegebiede:

- pelagiese sedimente,
- sedimente van die vastelandsbank en nabygeleë komme, en
- outigene minerale en verwante geochemiese prosesse.

Nuwe navorsing word beplan in:

- paleo-klimatologie en -oseanografie,
- vervoer en verandering van gesuspendeerde sedimentêre partikels, en
- prosesse verwant aan die versameling en kompaksie van mariene sedimente.

Hierdie programdokument gee 'n uiteensetting van die tipe navorsing wat gedurende die volgende vyf jaar benodig word en voorsien riglyne vir projekvoorstelle en verslaggewing.

LIST OF ACRONYMS

CSIR	Council for Scientific and Industrial Research
CSP	Cooperative Scientific Programmes
GS	Geological Survey
NRIO	National Research Institute for Oceanology
SANCOR	South African National Committee for Oceanographic Research
SOEKOR	Southern Oil Exploration Cooperation
SCOR	Scientific Committee on Oceanic Research
UCT	University of Cape Town

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INTRODUCTION

This document outlines a cooperative scientific programme in marine sedimentology; it consists of five parts: programme objectives, programme rationale, historical background, topics for study, and technical problems.

PROGRAMME OBJECTIVES

This programme seeks to advance our understanding of marine sedimentary processes and products in the South African marine sedimentary environment.

In the broadest sense the programme's main objectives are:

- The establishment of geological models for marine sedimentary environments, in particular with respect to those typical of the South African marine environment.
- The recognition of the evolution and development of the South African continental margin and adjacent ocean basins, including the identification of those sedimentological, geological, physical, chemical and biological features which characterise and contrast the eastern and western continental margins and basins.
- The development of models relating to the physical, chemical and biological processes affecting the transportation, deposition, erosion and diagenesis of marine sediments.
- The production of palaeo-oceanographic and palaeo-geographic models which would be applied to the historic sedimentological and stratigraphic record.
- The prediction of expected changes in sedimentological, climatological and related trends in the marine environment around southern Africa.

Although mainly sedimentological in emphasis, the programme encompasses other scientific disciplines as well. Furthermore, some of the problems addressed will require interaction with other CSP programmes. When this happens, it may be appropriate to carry out some of the work under the auspices of those programmes.

PROGRAMME RATIONALE

The following are some of the important reasons why this research needs to be done, and suggest the applicability of the expected research results:

- The programme will encourage those concerned with studies in the marine environment to coordinate their efforts and integrate their

results, thereby greatly advancing our understanding and knowledge of marine sedimentological and stratigraphic aspects.

- The national inventory of natural resources is dependent on sedimentological and geological data for a systematic and reliable assessment of economically significant sedimentary deposits in the marine environment. The types of deposits include hydrocarbons, beach placers, aggregates, phosphates (with uranium), glauconite, polymetallic nodules, etc. This information is of critical importance in the appraisal of an Exclusive Economic Zone.
- Offshore operations such as engineering projects, fisheries, and other research will benefit from data generated by this programme on such aspects as bathymetry, sediment types and their distribution, sediment distribution in the water column, substrate thickness and geotechnical properties, sedimentary processes, etc.
- The models developed will help us to understand ancient marine sedimentary rocks now exposed on land, many of which contain economic resources.
- The models will aid in the prediction of long-term changes in climate and ocean productivity.

HISTORICAL BACKGROUND

Marine geological and geophysical studies on the sediments of continental margins around southern Africa were firmly established in 1966 at the University of Cape Town (UCT) by the late Professor E S W Simpson with SANCOR and Geological Survey (GS) finance and personnel. Since that date there have been several administrative reorganizations, so that present research in these fields is carried out by the National Research Institute for Oceanology (NRIO), the joint UCT/GS Marine Geoscience Unit, and University of Cape Town staff funded by SANCOR and UCT. Various mining companies, Southern Oil Exploration Cooperation (SOEKOR) and other state and semi-state mineral corporations undertake offshore exploration programmes which often have a direct bearing upon the academic research activities. The results from several boreholes from the Deep Sea Drilling Project have made a significant contribution to our overall understanding of the sedimentary history of the adjacent oceans.

The first phase of the activity 1966 to about 1975 was sponsored mainly by SANCOR and GS. Early work consisted primarily of detailed bathymetric surveying, surface sediment and rock sampling on the continental shelves between the Kunene River and Ponto do Ouro, and seismic reflection traverses across the continental slope and rise into the Cape Basin and Natal Valley. The sediment and rock collection of over 3 000 samples is stored at UCT. Maps showing regional sediment lithofacies, surface geology, and authigenic minerals appear in several MSc and PhD theses, journal publications and GS publications.

A second phase of activity (1975 to present) includes:

- the establishment of a viable NRIO research unit, which has studied sediment dynamics on the high energy east coast continental shelf and the Agulhas Bank,
- the extension of the UCT/SANCOR activity to deep water areas off the South East African margin.
- GS studies on the inner shelf around southern Africa, in particular off Namaqualand,
- the compilation of a series of regional charts by GS for publication in colour.

This pioneering work produced numerous "discoveries" but arguably the main achievements are:

- a preliminary bathymetric map of the continental margin around southern Africa;
- a preliminary Pre-Quaternary geological map of the continental margin around southern Africa;
- a set of sediment distribution maps of the continental margin around southern Africa;
- delimitation of deposits of potentially economic authigenic minerals off the south and west coasts (phosphate-, glauconite-, trace metal rich-sediments) and proposal of models for their formation;
- recognition, mapping and modelling of sedimentary bedforms in the high energy Agulhas Current regime off the east coast;
- recognition and preliminary mapping of large slump structures on the continental slopes around southern Africa;
- establishment of preliminary acoustic stratigraphy for the continental margin and adjacent ocean basins around southern Africa (in conjunction with the results of SOEKOR, overseas oceanographic institutes and deep sea drilling projects);
- formulation of preliminary palaeo-geographic reconstructions for Mesozoic to Cenozoic sedimentation around southern Africa;
- initial studies on deep water benthic sedimentary processes.

TOPICS FOR STUDY

Whilst much of the early work was of a survey nature (which must continue), the background knowledge will now permit investigations of a more fundamental nature. The following areas of research hold the potential for achieving many of the objectives listed above.

Ongoing research

- Distribution and genesis of modern and ancient sediments
- Bedforms, internal structures and other aspects of sediment dynamics
- Acoustic "events" in seismic profiles: their correlation with the sedimentary, climatic, and oceanographic record
- Tectono-sedimentary structures; their identification and formation.

New research

- Palaeoclimatology and palaeo-oceanography
- Transport and alteration of particulates in the water column
- Geochemical and biological processes of sediment accumulation and compaction.

What follows is a pragmatic list of projects in which the scientific community can expect to undertake meaningful research given the current manpower and technical and financial resources. For convenience these projects can be listed under three headings, but the multidisciplinary nature of the work should be stressed, both within and outside geoscientific fields: Pelagic sediments, Margin to basin sediments, Authigenic mineral and geochemical studies.

Pelagic sediments

- Investigation of the late Quaternary as seen in undisturbed cores of pelagic sediments. This will result in a "standard" stratigraphy for modelling changes in biological productivity and climate.

Techniques: box coring, ^{14}C dating, stable isotope studies, tectural analyses, geochemistry.

- Microplankton studies on shelf-to-basin sediment sample profiles. Work will be partly taxonomic, to establish distribution patterns for living and sub-Recent taxa. The patterns will provide data for core correlation, core stratigraphy and palaeoclimate and -oceanographic studies.

Techniques: piston and box coring, optical and SEM microscopy, culturing, stable isotope studies.

Margin to basin sediments

- Investigation of shelf sediment lithofacies and relating them to physical, chemical and biological processes in the water column and at the sea bed. Particular attention should be given to establishing models for east, south and west coast situations and

to understanding their responses to major environmental changes (eg sea level changes). It will be important to recognize provenance areas and to identify exit routes for material into deep sea basins.

Techniques: box and vibracoring, textural and structural analyses, shallow penetration seismics and side scan sonar, in- and epifaunal studies, photography, water column and boundary layer instrument packages.

- Investigation of slope, rise and ocean basin lithofacies and relating them to physical processes and pelagic productivity. Particular attention to be paid to recognizing the various lithofacies and bedforms, core correlation, and identifying the role in dispersion of sea floor currents of various sorts. In addition, establish the provenance of terrigenous material (to link in with projects on the adjacent continental shelves). It will be necessary to assess the role played by canyons in channelling material across the slope. Eventually the aim will be to compare and contrast the sedimentary regimes in the Natal Valley and Cape Basin (ie under eastern and western boundary current regimes and contrasting tectono-sedimentary settings).

Techniques: piston coring, textural and geochemical analyses, seismic profiling, monitoring benthic sedimentary process (current metering, suspensate collection, nephelometry), photography.

- Investigating the distribution of ancient and modern large-scale translational and erosion features on the continental slope and rise, with particular attention to their role in moving sediments across the margin into the deep basins, and the construction and modification of the outer continental margin. This will involve routine mapping and identification as well as specific projects to investigate the age of translation (in the case of allochthonous bodies), the age of formation and active role (or otherwise) of canyon-like features.

Techniques: piston and box coring, outcrop sampling, ¹⁴C dating, stable isotope analyses, photography, seismic profiling.

- Ongoing programmes of refining and correlating acoustic stratigraphy across the continental margin into the deep ocean basins, and refining bio- and lithostratigraphic correlation of Mesozoic and Cenozoic sediments on the continental margins (onshore and offshore). Much of the data required will be collated from published literature, whereas others will be collated in the course of other projects. This data base will ultimately form the historical component in palaeo-sedimentary environmental modelling.

Techniques: age determination of rock and sediment samples, seismic reflection profiling.

Authigenic mineral and other geochemical studies

- Geochemical analyses of phosphorite rocks from west, south and east coasts to refine models for their formation (modern and ancient).

Techniques: microprobe analyses.

- Investigating the relationship of water column productivity to trace metal and authigenic mineral production in the Walvis Bay area. Results of this work may help to establish the importance of the upwelling process to west coast sedimentation (ancient and modern).

Techniques: box and vibracoring, ^{14}C dating, micropalaeontology, major, minor and trace element determinations.

- Pore water and interparticle geochemistry of modern sediments in margin to ocean basin traverses, primarily to investigate such aspects as sediment/water chemical flux, the fate of various land-derived components, the chemistry of sediment compaction and lithification.

Techniques: box and piston coring, various geochemical techniques including C/N analyses and Flameless Atomic Absorption Spectrometry.

TECHNICAL PROBLEMS

Certain technical problems need to be addressed in the short and medium term by the whole community:

- First and foremost is the replacement of the two small research vessels **Meiring Naudé** and **Thomas B Davie** with a larger vessel specifically equipped to undertake marine geological and geophysical work in the continental shelf and adjacent ocean basins.
- A serious stumbling block to research on Mesozoic and Cenozoic sediments is our inability to vertically sample Cretaceous and Tertiary sequences. A drill capable of continuously coring the upper 100 m of the sea floor is needed. Such a facility should be complemented by a drill capable of coring the upper few metres of the sea floor, eg for assessing authigenic mineral reserves and for rapid stratigraphic pilot studies.
- Another problem is the need for laboratory equipment: a device for X-raying cores aboard ship, instrumentation for on-board pore-water extraction and analysis, and a set-up for ^{14}C dating.
- Finally the programme needs nationally-maintained, high-quality systems for seismic profiling and sediment sampling, rather than the haphazard, institutionally-bound, *ad hoc* arrangements we have at present.

APPENDIX I

STRUCTURE AND TERMS OF REFERENCE OF SANCOR COMMITTEE FOR THE MARINE SEDIMENTOLOGY PROGRAMME

The Committee consists of scientists active and involved in the Programme, independent assessors and representatives of the principal authorities concerned. The Chairman serves on SANCOR and is appointed on the advice of the Committee for a three year period.

The primary responsibility of the Committee is to manage the SANCOR Marine Sedimentology Programme on behalf of SANCOR by:

- monitoring the balanced development of the programme in relation to its objectives;
- annually reviewing the relevance of the programme to changing needs;
- remaining informed on national and international developments relevant to the programme;
- stimulating interest in the programme and its results among scientists and decision makers in related fields;
- drawing attention to aspects of the programme not receiving adequate attention and initiating projects thus required;
- ensuring close collaboration with other SANCOR programmes;
- reviewing the progress of the work being done within the programme;
- evaluating project proposals for participation in the programme;
- recommending on funding priorities particularly if SANCOR funds are involved;
- annually providing a long-term (3 to 5 years) projection of financial requirements;
- dealing with specific matters relevant to the programme referred to it by any SANCOR Committee.

APPENDIX II

GUIDELINES ON PROJECT PROPOSALS AND REPORTING

Project Proposals

Within the guidelines contained in these pages prospective participants are invited to submit project proposals on special forms which are available for the purpose. These forms (NP10) are available from CSP/CSIR and also from University Registrars' offices.

Guidelines for completing project proposals are also available (CSP2, 1980). In summary, prospective participants are expected to be as specific as possible with their proposals by indicating clearly how they correspond with the objectives of and fit into the programme, providing a realistic list of key questions to be answered and preparing a well defined work plan according to which the project will be undertaken in a specified time (typically one, two or three years). Participants are expected to consider what they expect the final product of the project to be and to indicate this clearly.

In particular, first proposals should be accompanied by an appropriate summary of existing knowledge/literature survey. Where new or untried fields of activity are being proposed, proponents are advised to consider short (that is one year) feasibility studies to establish more definitive research programmes.

In completing the financial sections of applications, guidelines for salary scales are available from CSP, University Registrars and institute secretaries.

It is recognized that it may be necessary to import expert manpower for certain projects where the necessary expertise or capacity does not exist in the country. This is acceptable provided the normal CSIR/CSP policy regarding such matters is adhered to (for example, in the simplest case, this provides for part (maximum 20%) of the allocation for a specific salary to be spent on assistance for travel and the transport of personal effects).

Reporting

The following are guidelines on the format for annual progress reports and final project reports to SANCOR :

Annual Progress Reports

- (a) Identification : Title of project, names and addresses of project leaders and project researchers, date, period of report, maximum five keywords of contents for indexing purposes.
- (b) Objectives

- (c) Background : Concise history of project to allow (b) and (d) to be read in context.
- (d) Scientific progress : Scientific progress made since submission of last report, with emphasis on scientific findings and achievements during the year, as measured against the objectives and target dates provided in the project proposal.
- (e) Publications : Full references to publications emanating from the project and which have appeared since submission of last report (including published, accepted for publication and unrestricted internal reports).
- (f) Activities report : An activities report as an addendum to the main report, if it is felt that, for some reason, activities and not scientific progress have to be reported.

As a guideline, the length of the body of the report ((a) above) should be about three A4 pages (typed single spacing), although it has to be accepted that this varies from project to project.

Progress reports are required from all those supported in the programme by 30 June. Those not supported but who are engaged on projects which complement the work supported from the programme are encouraged to submit reports on their work in the same format.

These progress reports, in addition to serving as the basis for the evaluation of progress with a view to continued support, are also compiled into a single volume entitled, "Progress Reports to SANCOR 19 " and distributed to all participants in the SANCOR Programme and its committees in an inexpensively reproduced form.

Final Reports

Participants are encouraged to publish their findings as soon as possible in reputable scientific journals of their choice. However, no project will be regarded as complete until a final report has also been submitted to SANCOR and all the data collected in the project have been lodged in the South African Data Centre for Oceanography as applicable. The final report, submitted at the end of the last year of the project, should cover:

- (a) Background : Identification (as in annual reports), introduction, background and objectives of the project (refer to the relevant NP10 proposal).
- (b) Methods : Description of procedures, methods, study areas and other aspects of relevance to the project or summary with reference to published descriptions.
- (c) Findings : A synthesis of the findings of the project, with special reference to the realization of the objectives set.

- (d) Conclusions and recommendations : Conclusions and recommendations on the work as a whole, including comments on future work to be undertaken or avoided, and any practical decision-making implications.
- (e) Publications : List of scientific publications and other documents arising from the work including a list of any data available and stored in the institute concerned.
- (f) Project staff : List of participants and collaborators in the project.
- (g) Acknowledgements : Including sources of funds and assistance. Final reports are bound in with the volume "Progress Reports to SANCOR" of the year concerned, but also serve to inform decision makers of the findings of the research done within the programme, some of which they may have supported.

TITLES IN THIS SERIES

1. *A description of the Savanna Ecosystem Project, Nylsvley, South Africa. December 1975. 24 pp.
2. *Sensitivity analysis of a simple linear model of a savanna ecosystem at Nylsvley. W M Getz and A M Starfield. December 1975. 18 pp.
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4. Solid wastes research in South Africa. R G Noble. June 1976. 13 pp.
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11. *South African Red Data Book - Small mammals. J A J Meester. November 1976. 59 pp.
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22. *Cooperative National Oceanographic Programme. SANCOR. January 1978. 19 pp.
23. South African Red Data Book - Reptiles and amphibians. G R McLachlan. February 1978. 53 pp.
24. *Guidelines for the disposal of dangerous and toxic wastes so as to minimize or prevent environmental and water pollution. R T Rudd. January 1978. 12 pp.
25. Richards Bay mesometeorological data. Vertical profiles of air temperatures and wind velocity and surface wind statistics. M T Scholtz, E T Woodburn, C J Brouckaert and M Mulholland. March 1978. 104 pp.
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30. *Review of Coastal Currents in Southern African Waters. T F W Harris. August 1978. 106 pp.
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32. South African programme for the SCOPE mid-term project on the ecological effects of fire. September 1978. 36 pp.
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43. Terrestrial ecology in South Africa - project abstracts for 1978. February 1980. 92 pp.
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49. National Geoscience Programme. The Evolution of Earth Resource Systems. SACUGS. June 1981. 42 pp.
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