The bathymetry of the Aliwal Shoal, Scottburgh, South Africa

C. Bosman\textsuperscript{a}, R. Uken\textsuperscript{b} and A.M. Smith\textsuperscript{b}

This paper presents the first accurate geo-referenced bathymetric map of the Aliwal Shoal and illustrates its value as an essential tool for a wide range of applications useful to the broader scientific community. The dense coverage of echo-sounding data in the survey area permitted the construction of a detailed bathymetric contour map and 3-D model. It showed that the Aliwal Shoal forms part of a much larger offshore reef complex than was previously realized. Morphologically, the Aliwal Shoal is dominated by three distinct features, namely, the Crown, Spur and Ridge. The high-resolution bathymetric map presented here enabled the accurate positioning of the boundaries of the Restricted Zones of the newly proclaimed Aliwal Shoal Marine Protected Area. This geo-referenced GIS-compatible map will form the base map for future studies, ranging from the mapping of biological seafloor habitats to ocean current modelling, thereby also performing the function of an environmental planning and management tool.

Introduction

The Aliwal Shoal (Fig. 1) is one of the best-preserved examples of the many submerged reefs, parallel to the coast, documented on the southeastern continental shelf.\textsuperscript{13} These reefs consist primarily of aeolianite with subordinate beachrock and are primarily of aeolianite with subordinate beachrock and are

\begin{itemize}
\end{itemize}
System (dGPS) capable of single-second update rate and sub-metre accuracy. Using an average survey speed of 2.5 knots, this translated into a bathymetric data point every 1.29 m along each trackline.

In total, 101 433 data points were used to create the bathymetric model. All depth values were tidally corrected to the mean sea-level (MSL) datum (local tidal range is 2 m). Data were gridded in Surfer version 7 software using point kriging to produce seafloor contours as used in earlier reef surveys on the southeastern continental shelf. Grid sizes and search patterns were optimized to represent the reef most accurately using a 20 m × 20 m grid with an octant search pattern and a search radius of 180 m. Digital terrain models were generated using ER Mapper 6.4 and Surfer 8 software to provide three-dimensional (3-D) models of the continental shelf in addition to a 2-D contour plot (Fig. 4a), providing visualization of the reef morphology from any orientation.

Aliwal Shoal morphology
The Aliwal Shoal forms part of a much larger offshore reef complex than was previously realized. The seaward expression of the reef is a narrow ridge with a curvilinear sinusoidal northeast–southwest (coast-parallel) trend (Fig. 4) that has an abrupt northern edge called the Crown. The landward expression has a linear margin from which a narrow ridge, just over 1 km long (the Spur), projects shoreward. The shallowest part (6 m below MSL) is located in the northern extremity of the Crown, with a gradual increase in depth with distance southwards. The steepest gradient recorded, on the northern edge of the Crown, is 18°. Other gradients vary from 6.4° on the seaward side to 8° on the landward side.

The Aliwal Shoal averages 380 m in width in the north, narrows slightly in the central region but widens to more than 2 km in the south, where it bends shorewards (Fig. 2). This southern plateau region is called the Ridge.8 Northwest of the shoal, between the Sandridge and the Ridge, is a sand-filled depression, roughly divided into two basins by the Spur. The depression slopes towards the Sandridge (Fig. 4). The Spur consists in part of a northwards-migrating, 2–3-m-high subaqueous dune.

The average depth of the Crown is 12.5 m and it contains almost all of the SCUBA-diving locations used by recreational divers, the best known being the Main Pinnacle Ridge and North-Eastern Pinnacles (Fig. 4). The southern Ridge is deeper with an average depth of 19.5 m. This portion and the southern continuation of the Crown ridge are characterized by several other isolated pinnacles. The total area covered by the Aliwal Shoal is in excess of 5.56 km² and extends westwards to the coast beyond the Ridge.

Data application
This dataset provides the first detailed and useful information on the nature of the seafloor in the Aliwal Shoal area and enabled the accurate positioning of the newly proclaimed Restricted
Zone of the Alivwal Shoal Marine Protected Area (MPA). Basic biological inventory studies to determine the status of the reef are required for conservation and management planning of the MPA. This relies on reliable knowledge of the location and distribution of reef habitats. The bathymetry map of the Alivwal Shoal serves as a spatially accurate base map that is easily imported into a GIS database, where it can be used as a multi-surface attribute model for spatially referenced data. The dataset forms a base map for biological surveys to chart changes to habitats and biological zones and provides a means to model effluent discharge and environmental impacts from marine outfall pipelines situated north of the study area.

The new bathymetric map also indicates the presence of other shallow, isolated pinnacles that can be used as alternative dive sites, alleviating pressure on the more popular dive sites situated on the Crown. Recreational divers will benefit from the high accuracy of the map by planning the exact location of their dives and minimizing user conflict within the MPA. Furthermore, it is envisaged that these data will form part of an MPA website providing tourists and divers with geological, biological, and oceanographic information and 3-D ‘fly-through’ visualization.

The bathymetric dataset not only serves as the first accurate and detailed map of the Alivwal Shoal but also serves as a useful ‘environmental tool’ which will form the baseline for future studies ranging from the mapping of biological seafloor habitats to ocean current modelling. Integration of all the data types will facilitate the development of a comprehensive multidisciplinary environmental management plan, which is vital for the future development, management and conservation of the Alivwal Shoal.

This paper is published with permission of the director of the Council for Geoscience, and benefited from the comments of two anonymous reviewers.

Received 12 September 2004; Accepted 14 May 2005.

The Southern African Research and Innovation Management Association offers two courses for members and stakeholders

Overview of the South African research and innovation system

To be held at the Stellenbosch Lodge, Cape Town, 3–5 October 2005

The presenters are Prof. Johann Mouton, Director of CREST, University of Stellenbosch, Prof. Anastosissis Pouri, Institute of Technological Innovation, University of Pretoria, Prof. David Kaplan, Graduate School of Business, University of Cape Town, and Dr Eric Wood, Graduate School of Business, University of Cape Town. The course is targeted towards mid- and senior level managers of research, innovation and technology transfer offices in the academic, government, research agency and industry sectors.

The themes to be covered include: A short history of South African science, key policy documents in science and technology; The national system of innovation: Key facts and figures, An overview of the main institutions in the science system; The Department of Science and Technology, National Advisory Council on Innovation, The Science Councils, The higher education sector, The national research facilities, The funding agencies, The Academies of Science, The CHoE and HESA; The demographies of the R&D workforce; Key initiatives in science and technology; Key debates in science and technology; Challenges facing the SA science and technology system.

The registration cost of R1900 for the three-day course includes a workshop folder, reading pack and all meals. SARIMA members who have paid their subscriptions for 2005 are eligible for a 15% rebate (R1015). Accommodation costs are not included in the registration fee.

The registration form may be downloaded from the SARIMA website (www.sarima.co.za) and the completed form should be e-mailed to sarima@sarima.co.za. On receipt of the registration form, an invoice will be sent for payment, prior to or at the event. The closing date for registration is 29 September.

Research administration and management in South African higher education institutions

To be held at the Protea Hotel, Stellenbosch, 6–8 October 2005

The objectives of the course are to develop the participants’ understanding of: The transformational challenges facing research in higher education; The human resource requirements for research; The financial resources for research; The elements of effective administrative infrastructure for research; The elements of development plans for research.

The course is aimed at professionals who work in research administration and management offices in higher education institutions in South Africa and in organizations that deal with managers and administrators in these offices. Participants will typically not have received any formal training in research management or related fields. It is an introductory course but deals comprehensively with all aspects of research administration.

The registration cost of R1000 for the three-day course includes a workshop folder, reading pack and all meals. SARIMA members who have paid their subscriptions for 2005 are eligible for a 15% rebate (R1015). The registration form and programme may be downloaded from the SARIMA website (www.sarima.co.za) and the completed form should be e-mailed to sarima@sarima.co.za. On receipt of the registration form, an invoice will be sent for payment, prior to or at the event. The closing date for registration is 29 September. The events co-ordinator, Margaret Wood, can be contacted about both workshops on 084 583 6769 between 2.54 pm.

References