HIGH RESOLUTION SEISMIC AND SONAR CHARACTERISTICS OF THE EASTERN BLACK SEA TURKISH CONTINENTAL SLOPE

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Abstract

The Black Sea is one of the largest inland seas in the world. Off the shelf, the water depth quickly plunges to an average depth of 2 km making it unusually deep for what would normally be termed a marginal sea. The slope failures and sediment instability are serious problems that can lead to the failure of offshore installations. Some marine geophysical surveys have been carried out in the Eastern Black Sea basin and continental slope areas using state-of-art technology to produce sonar and high-resolution maps.

Key Words: The Black Sea, Continental Slope, Sediment Transport.

Introduction

The Black Sea, one of the largest inland seas in the world lying at the junction between Europe and Asia, is both oceanographically and geologically unique because of its to anoxic layer below 100-150 m. Although there is excessive supply of terrigenous sediment input in the Black Sea, pelagic sedimentation plays the major role in the deep (1).

Since 1991 the group formed around the UNESCO/TREDMAR Training-Through-Research (TTR) program has investigated the Black Sea with the works of other groups. During these surveys, SIMRAD EM 12S low frequency multibeam and SEABAT echosounders were used to obtain bathymetric charts and reflectivity maps of the sea floor. In addition, MAK-1 deep-tow side scan sonar and subbottom profiler system was used to get acoustic images of the seafloor and the shallow sediments. SIMRAD EM 12S multibeam echosounder operates at 13 kHz frequency and has an angular coverage of 1200 m. The MAK-1 combined side scan sonar and subbottom profiler system has a swath range of up to 500 m per side in long-range mode (30 kHz) and up to 200 m per side in high-resolution mode (100 kHz). The high-resolution subbottom profiler sections and the side scan sonar records shown in this study were compiled from several TTR researches.

Turkish continental slope

Turkish Continental Slope of the Eastern Black Sea Basin, which has a relatively smooth slope and deepens from 305 m to 1945 m. depth, comprises of rectilinear gullies and V-like channels (2). In contrast with the concave Russian continental slope, the Turkish continental slope has a convex morphology. The slope gradient becomes progressively steeper as it is traced downwards from the top, which is the result of either mass movement or structural control. Maximum slope angle detected is 12.6° (3). The slope is cut by only a small number of canyons and valleys, which are generally on a smaller scale than those found on the Russian Continental Slope. The lower section of the slope comprises relict slump structures overlain by a semi-continuous surficial unit of parallel-bedded sediments. The middle section of the slope exhibits a steeper gradient, and slump structures are observed at the seabed here. The upper slope shows a zone of syn-sedimentary thrust faults (the upslope side is down- thrown). The basin and the canyons are a continuation of the Yesilir-mak River across the shelf to the continental slope. The basin and the canyons deepen towards the northwest.

The sediments on the continental slope show slump and creep structures (Fig. 1). The seabed slumping and creep occurs mainly in areas with slope gradients over 2°. During slumping, a mass of superficial sediment becomes detached from a seabed slope along a slip plane and moves downslope. Creep is the imperceptible but continuous movement of sediment down a slope in response to gravity. It is a viscous type of flow in which there is internal and permanent deformation. The steep slope exhibits minor and major northward dipping listric faults as a result of slump and creep features. The depth of the shallow gas remains constant at 20 meters (4, 5).

This has been clearly identified by the slide faults on the sonar and especially the landslides on the subbottom profiler records. The channels can be identified clearly on the sonar mosaics, bathymetric charts and subbottom profiler records, the channels are the best visible on the cross-lines of subbottom profiles (Fig.2). The velocity and direction of the sliding and flowing down of the material is not constant along the slope, but also in time duration. The sediment transportation direction is controlled by the general direction of the slope and channel direction. These rivers have marked associated submarine canyon systems. Turbidity current activity is responsible for much of the movement of sediment into the canyons. Slumping or turbidity flows of sediment from steep side walls of canyons is also thought to be a possible cause of damming the main channel and delaying sediment transport.

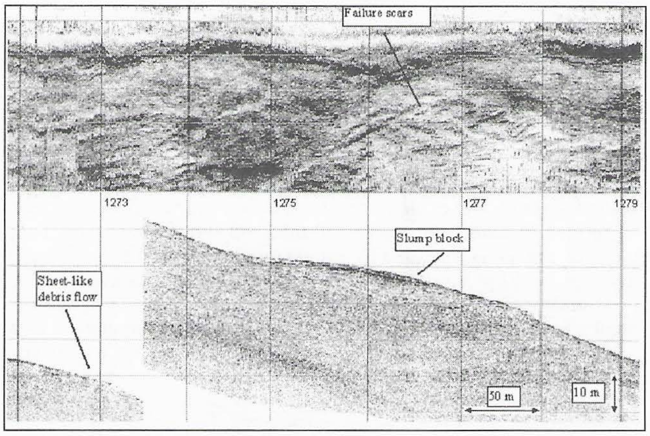

Fig. 1. Detailed Chirp Side Scan Sonar and Subbottom Profiler record example of a canyon wall. The subbottom record shows two slump blocks and a sheet-like debris flow. Failure scars are visible as high reflectivity lineations on the side scan sonar record.

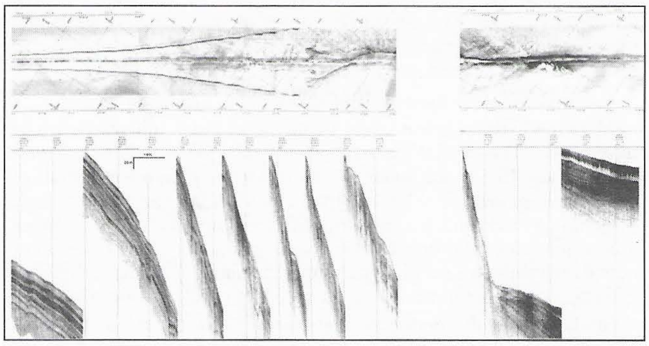

Fig. 2. Side scan sonar (top) and subbottom profiler (bottom) records from Turkish Continental Slope.

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