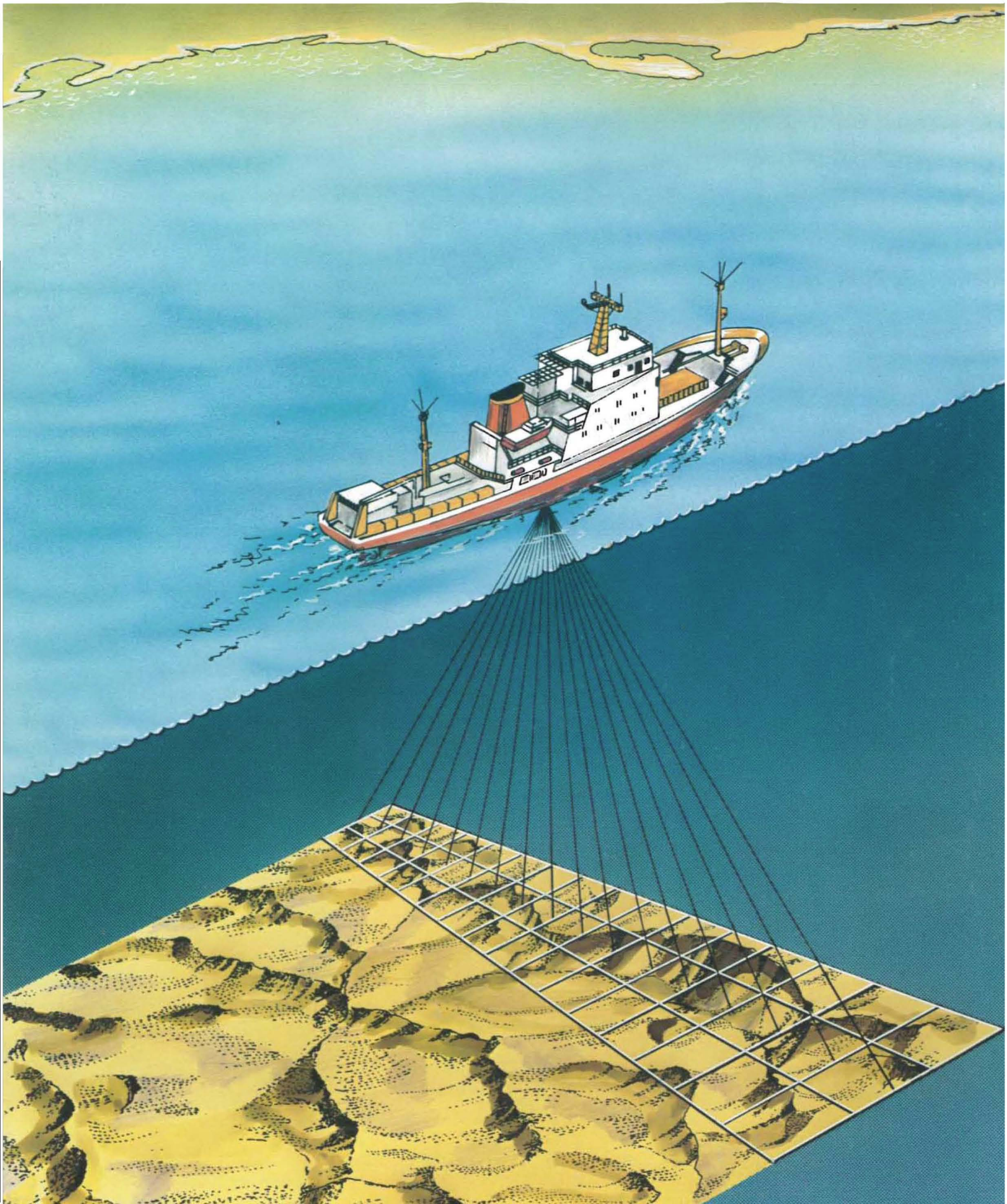
PRAKLA-SEISMOS INFORMATION No. 44

Sea Beam Postprocessing



Sea Beam Postprocessing

To apply PRAKLA-SEISMOS' experience in geophysical data processing to SEA BEAM data postprocessing, an existing software package was modified for a qualified upgrading of bathymetric data.

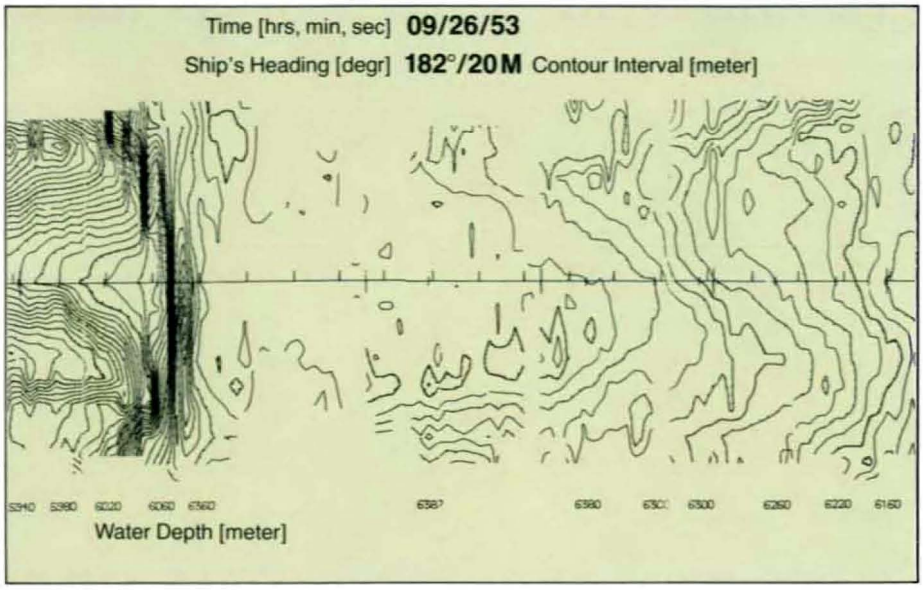


Fig. 1:
Realtime Contour Strip Chart of the Sea Bottom (Swath 1)

What is Sea Beam?

Sea Beam, manufactured by General Instrument Corporation, is a deep ocean multibeam bathymetric swath survey system for measuring water depths of up to 11 000 meters. The system is fully operational aboard various research vessels.

The main components of the Sea Beam system are the **narrow beam echo sounder** and the **echo processor.** The transmitting array of 20 projectors emits sonar signals to be reflected at the sea bottom. From the signals, received by a 40 hydrophone array, 16 micro processor controlled beams are formed, which represent 16 reflection elements of the crosstrack profile directly beneath the ship (see frontcover). The swath width is approximately 0.8 times the water depth.

The primary output of the echo processor is a **real time contour strip chart** of the sea bottom (see fig. 1). Additionally, data are logged on magnetic tape, which enables postprocessing for production of **bathymetric maps** and of various other presentations.

Aim of Sea Beam Postprocessing

Postprocessing of the Sea Beam data improves the reliability of the recorded data. By making use of the positional data it is possible to combine and adjust various Sea Beam swaths for producing **bathymetric maps in any geodetic grid.**

An advanced and flexible processing package (see flow diagram) is used to meet the requirements.

Positional Processing

The quality of the final results depends on the accuracy of the determination of the ship's track from the recorded navigation data. Hence, the positional processing must be as accurate as possible.

PRAKLA-SEISMOS' involvement in international geophysical surveys is naturally associated with a great deal of navigation processing experience. Consequently, a positioning software package can be offered, which is capable of processing data from satellite positioning and all shore-based navigation systems to increase the accuracy of ship locations significantly.

Preprocessing

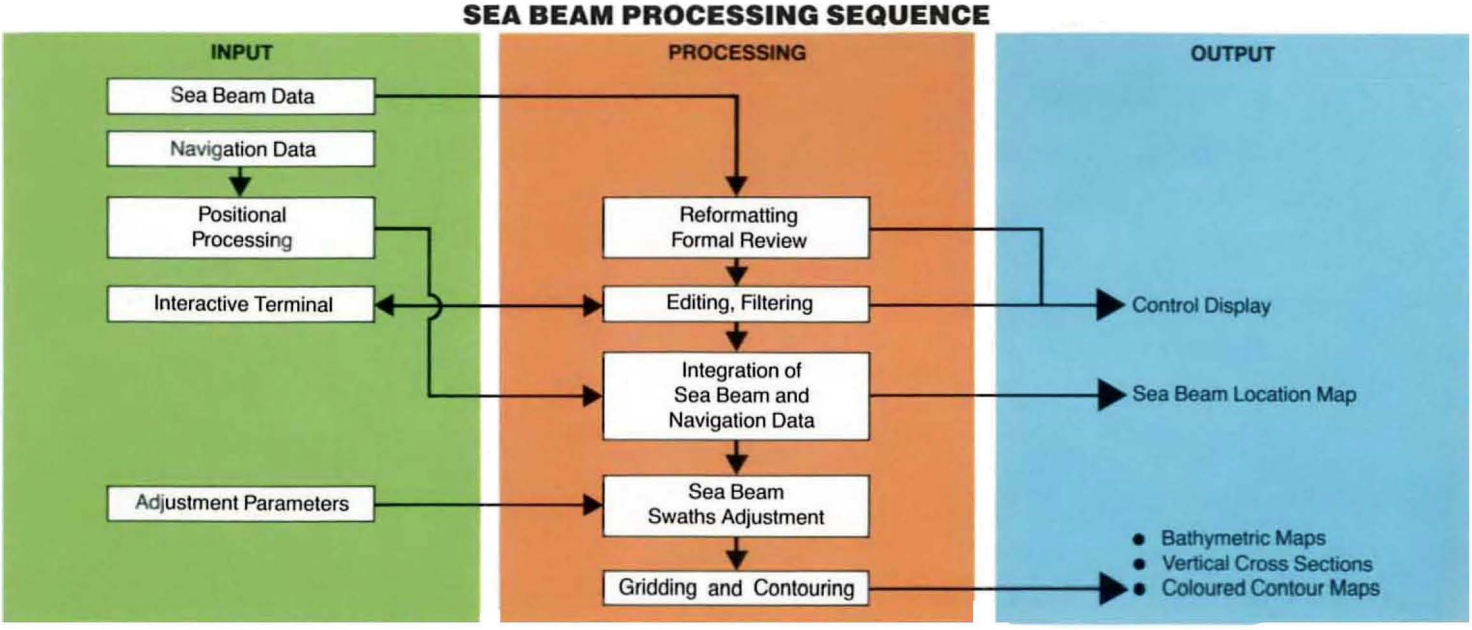
The recorded water depth data are noisy and contain spikes and gaps resulting from system component malfunctions. A graphic display of the Sea Beam data monitors quantity and magnitude of the noise, spikes and gaps and assists in editing and filtering.

Main Processing

The relative positions of the 16 sea floor reflection elements are recorded as crosstrack distances in the Sea Beam records. Using the recorded time these records and the positional records are synchronized, and merged.

Central positions of the reflection elements are derived from final ship positions and the appropriate headings and distances. A **Sea Beam location map** of the sea bottom reflec-

SEA BEAM PROCESSING SEQUENCE



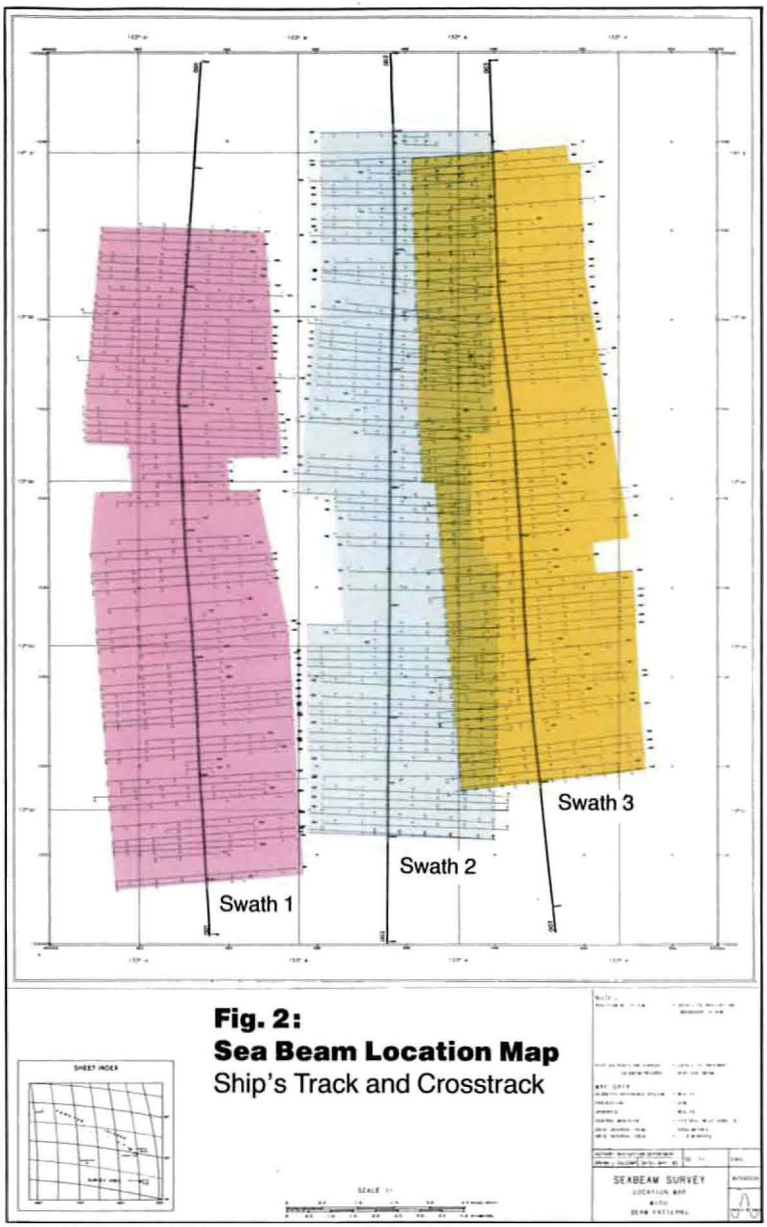


Fig. 2:
Sea Beam Location Map
Ship's Track and Crosstrack

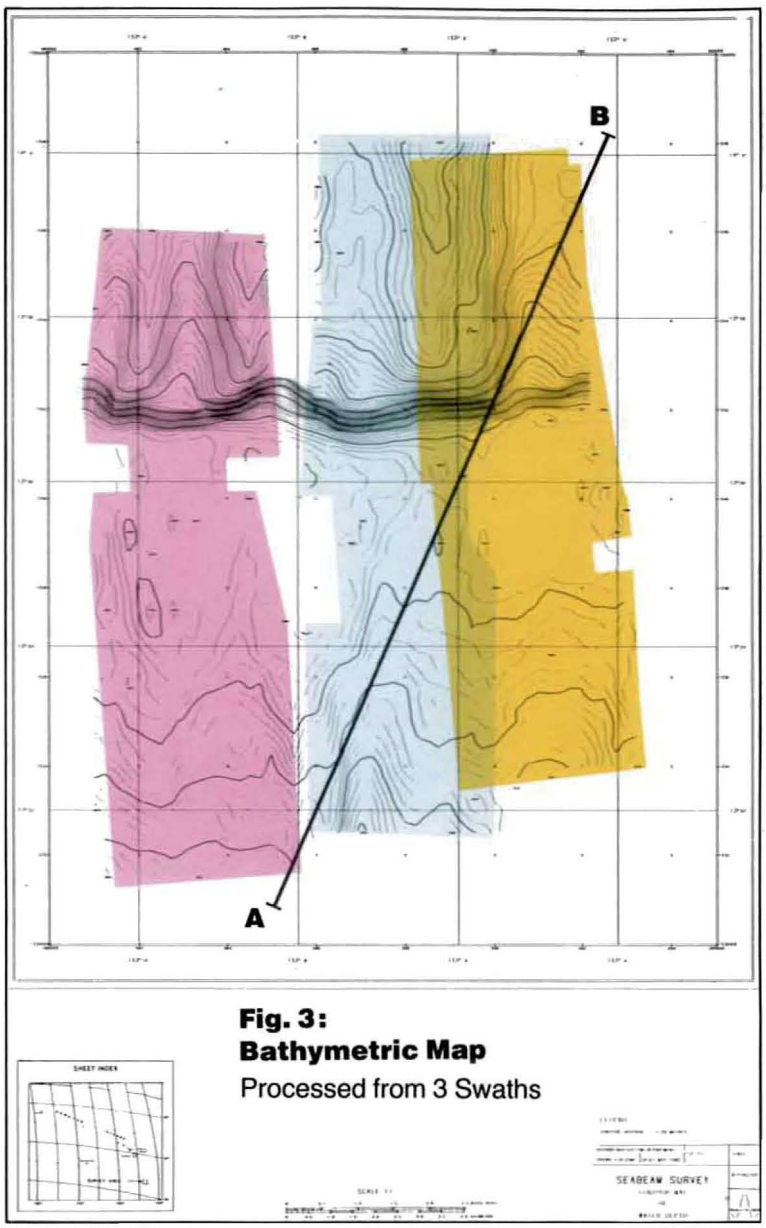


Fig. 3:
Bathymetric Map
Processed from 3 Swaths

tion elements can be produced to control the previous processing steps and to show overlaps and gaps in the Sea Beam swaths (see fig. 2). Therefore the location map is particularly suitable for determining optimal parameters for an areal adjustment.

In order to **establish an adjusted data field**, systematic and random errors are treated in two successive processing steps

- Systematic errors in adjacent Sea Beam swaths are reduced by a level adjustment
- Random errors are diminished by investigating an area of influence around a recorded value using a least mean squares adjustment.

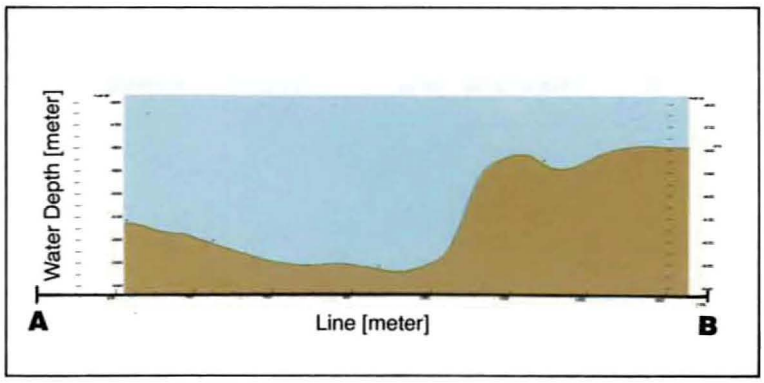


Fig 4:
Vertical Cross Section A–B (see fig. 3)

Interpolation and Contouring

To meet specific requirements for treating geophysical data, e.g. consideration of geological trends, an advanced interpolation process is used to produce a regular data grid. This data grid serves as the input for various graphic presentations, for example:

- **Bathymetric Maps**

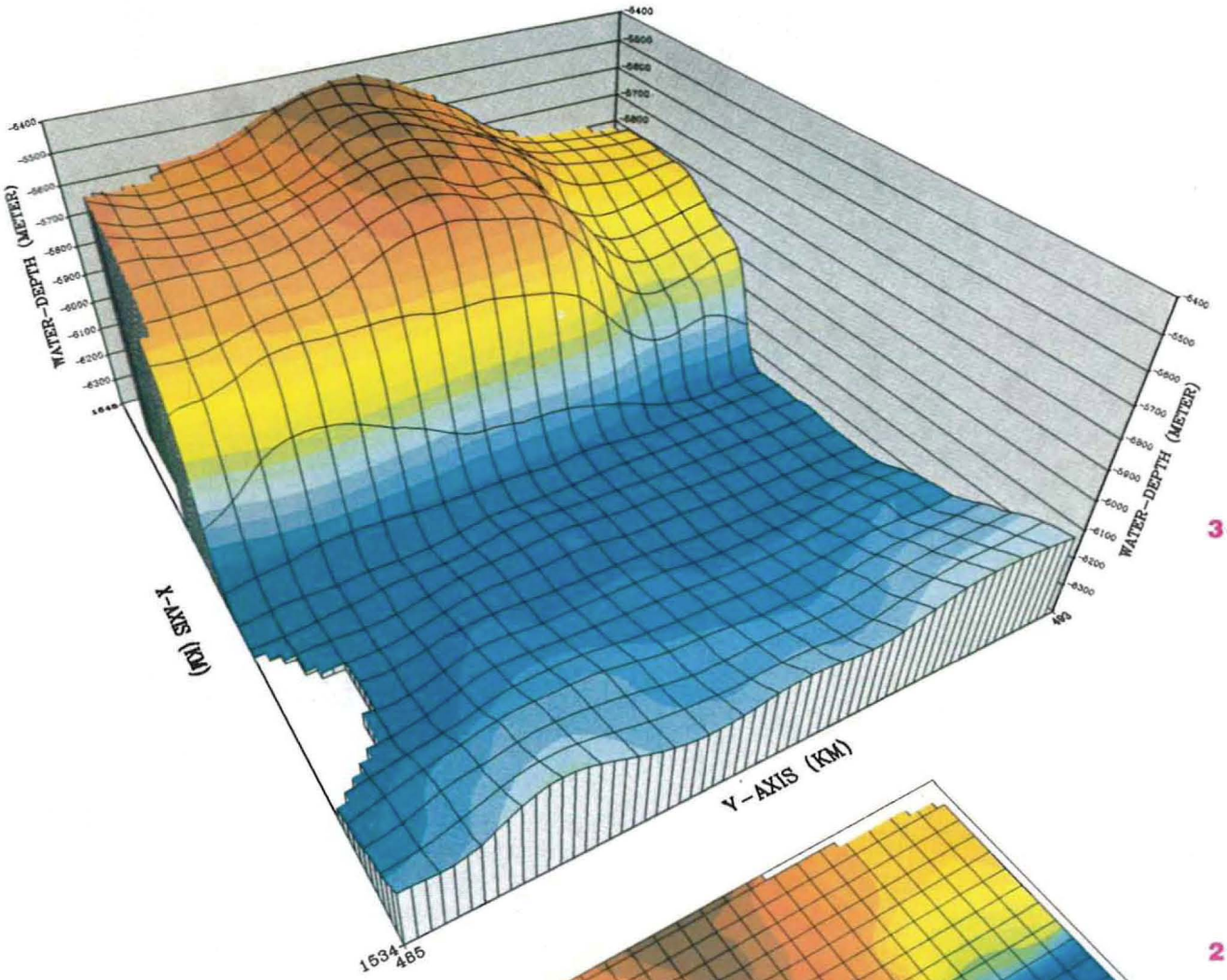
  The contouring program offers a great variety of options, such as specifying of up to eight different contour levels, marking of extreme values (high/low), gradient dependent contour suppression, etc. (see fig. 3).

- **Vertical Cross Sections**

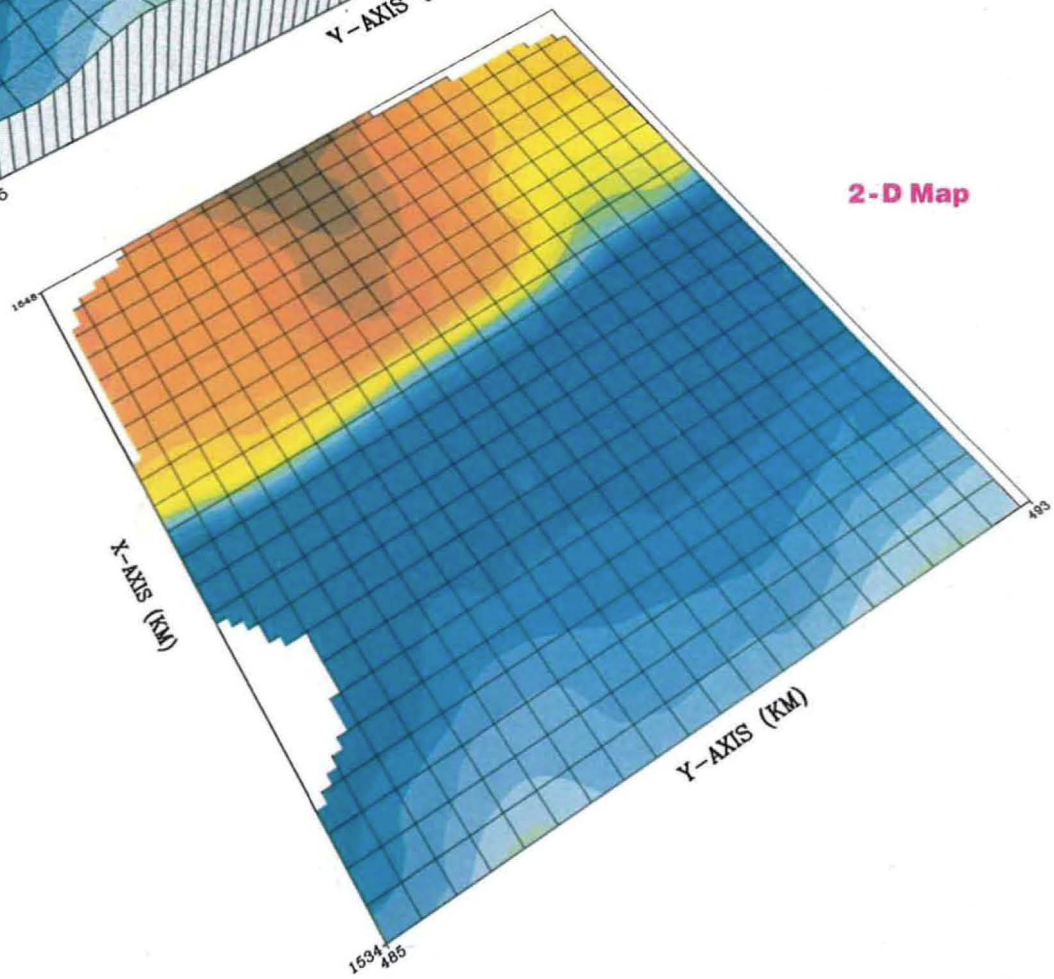
  Any arbitrary direction can be displayed at selected horizontal and vertical scales (see fig. 4).

- **Coloured Contour Presentations**

  A powerful graphic package is available to produce colour coded maps. Any arbitrary viewpoint and user specified colour scales can be chosen (see examples on backcover).



3-D Map



2-D Map

Water Depth [meter]

- above -5500
- -5550 – -5500
- -5600 – -5550
- -5650 – -5600
- -5700 – -5650
- -5750 – -5700
- -5800 – -5750
- -5850 – -5800
- -5900 – -5850
- -5950 – -5900
- -6000 – -5950
- -6050 – -6000
- -6100 – -6050
- -6150 – -6100
- -6200 – -6150
- -6250 – -6200
- -6300 – -6250
- below -6300

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