Bathymetric Survey

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Outline

- - Introduction: Definition & Importance
- - The history of bathymetry (ocean depths) and ocean floor
- topography.
- - Echo sounding
- - satellites bathymetry.
- - Optical
- - RADAR

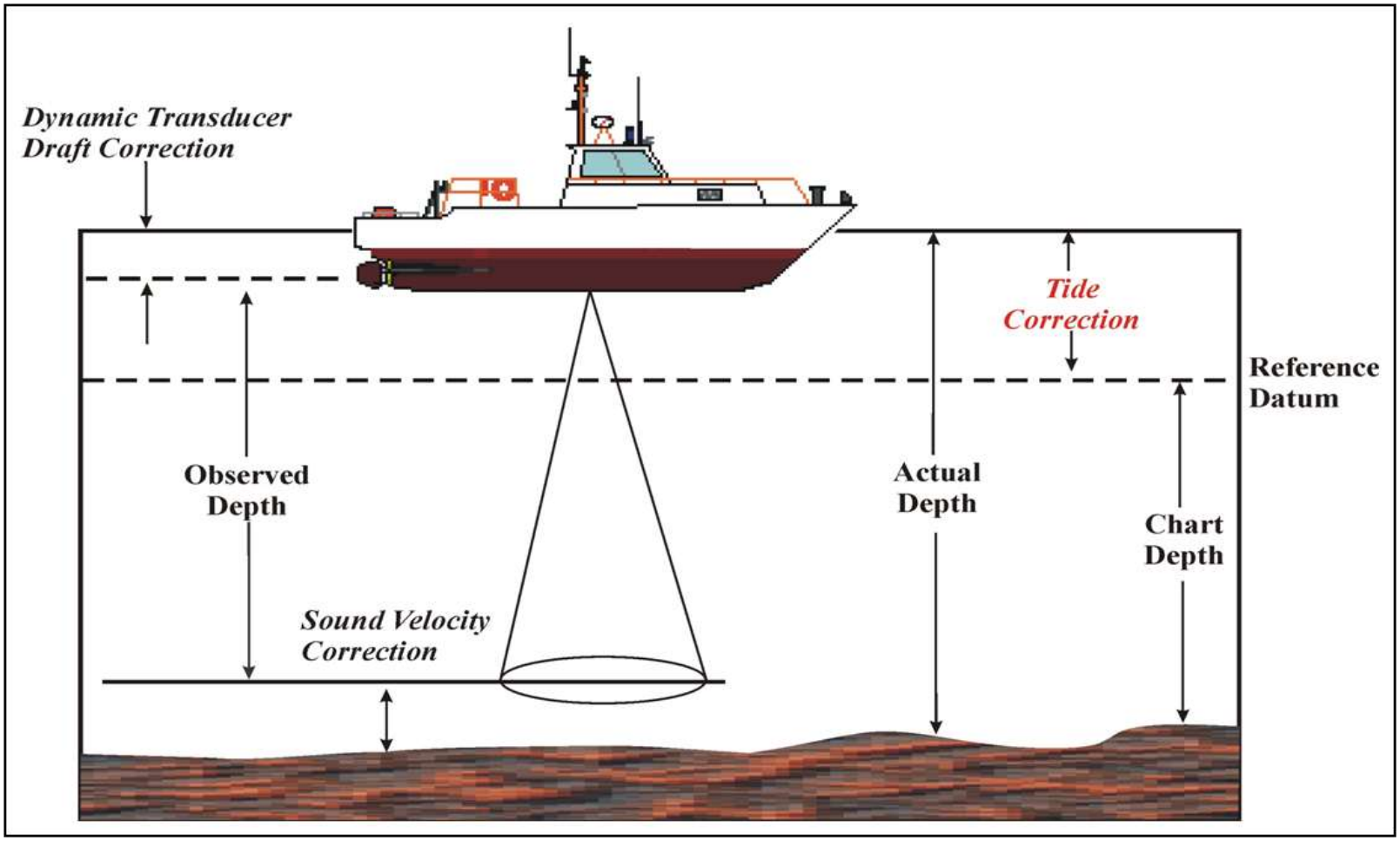
Introduction

- ***Definition***
- **Bathymetry** is the measurement of water depth: height from water bed to water surface. (Sounding)

Measures the vertical distance from the ocean surface to mountains, valleys, plains, and other sea floor features

70.8% of Earth is covered by oceans

Introduction



Importance of Bathymetry

- **Importance:**
- Navigation Safety: Nautical charts
- Water volume computation
- Pollution control
- Mineral & Fish industries
- Under water engineering construction
- Harbor & Docks construction & maintenance
- Determine the bottom depth and contour these depths for bottom analysis
- Determine topographic features by looking from the top down and bottom

History of Sounding

- SOUNDING: WATER DEPTH MEASUREMENT

Poseidonus did the first sounding in 85 B.C.

Line with heavy weight was used, called sounding line

Sounding lines were used for 2000 years

- UNIT OF MEASURE I S A FATHOM

1 fathom =1.8 meters (6 feet)

1- Sounding Pole

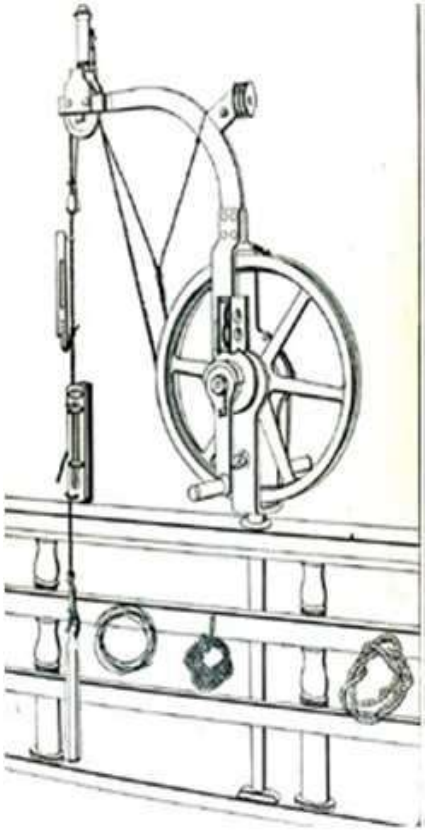
2- Sounding Line

Historical Sounding

Sounding Pole

sounding Lead

History of sounding



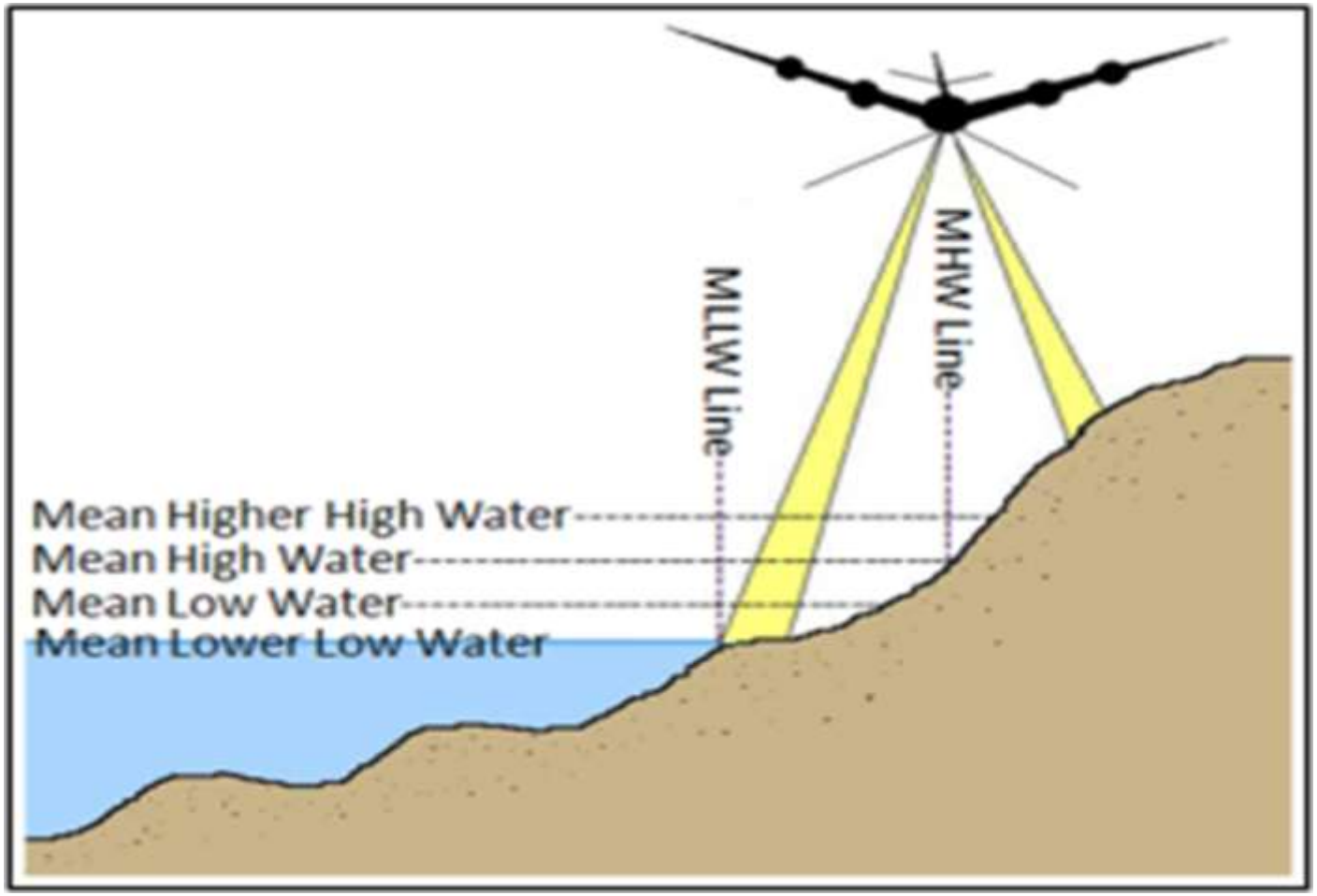
Charles Wilkes (NOAA)

Lord Kelvin

Shoreline Survey

- Shoreline
  - Syn. to Coastline
  - Line of contact between the land and the body of water
  - USC&GS uses the high water line
- It consist of:
  - Determination or delineation of shorelines
  - Location of shore details and prominent features to which soundings may be connected
  - Determination of low and high water lines

Shoreline Survey



Methods of Locating Sounding

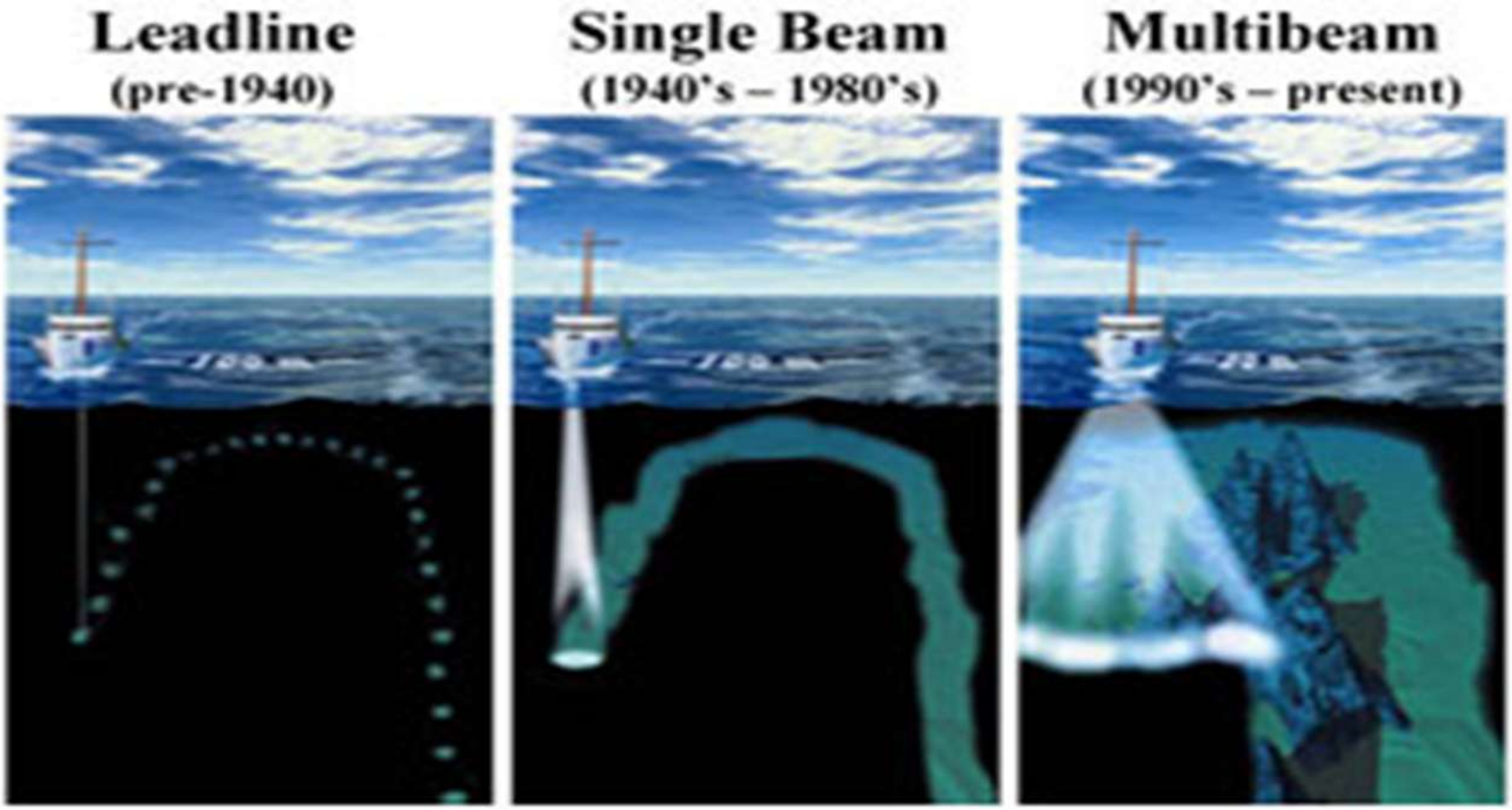
- **From the shore**
  - Location by Cross-Rope
  - Location by two angles from the shore
  - Location by Range and One angle from the shore
- **From the boat**
  - Location by two angle from the boat
  - Location by Range and One angle from the boat
- **From both the shore and the boat**
  - Location by One angle from the shore and from the boat
  - Location by Range and Time Intervals of the boat
  - Location by Intersecting Ranges
  - Location by Tacheometric Observations

Sounding Lines

- Systems of Sounding Lines
  - Parallel straight lines –> open coasts
  - Radiating lines –> small bays and islets
  - Circular curves or arcs –> isolated shoal
- Spacing of Sounding Lines
  - Factors: the **scale** of the survey, **depth** of water, **proximity** to shore, **character** of submarine relief, **importance** of the region

Scale	Ordinary Spacing	Closest Spacing
1:10,000	50-60	25-30
1:20,000	100-125	50-60
1:40,000	200-250	100-125
1:80,000	400-500	200-250
1:120,000	600-750	300-375

sounding

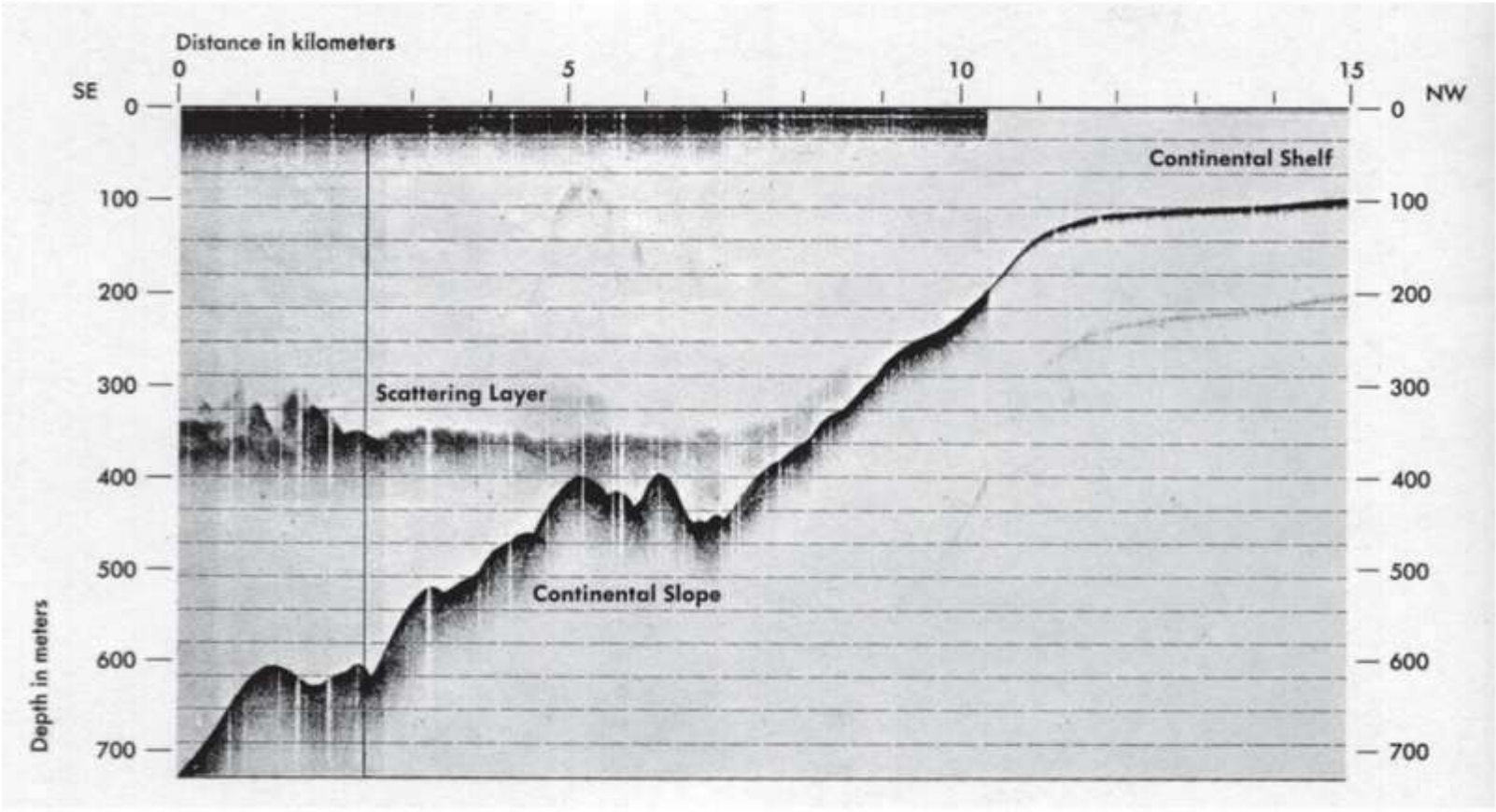

Leadline
(pre-1940)
Single Beam
(1940's – 1980's)
Multibeam
(1990's – present)

Echo Sounding

- Echo Sounding Instrumnt:
- Echo sounder or fathometer
- Reflection of sound signals
- German ship Meteor identified mid-Atlantic ridge in 1925
- using echo-sounder.
- **Disadvantages:**
- Point by point sounding has disadvantages:
- -Lacks detail
- -May provide inaccurate view of sea floor
- -Time and cost consuming for large sea or ocean coverage

Echo Sounding

- Recorded depth from echo-sounder



Echo Sounding

- Distance is measured by multiplying half the time(t) from the signal's outgoing pulse to its return by the speed of sound(S) in the water, which is approximately 1.5 kilometres per second.

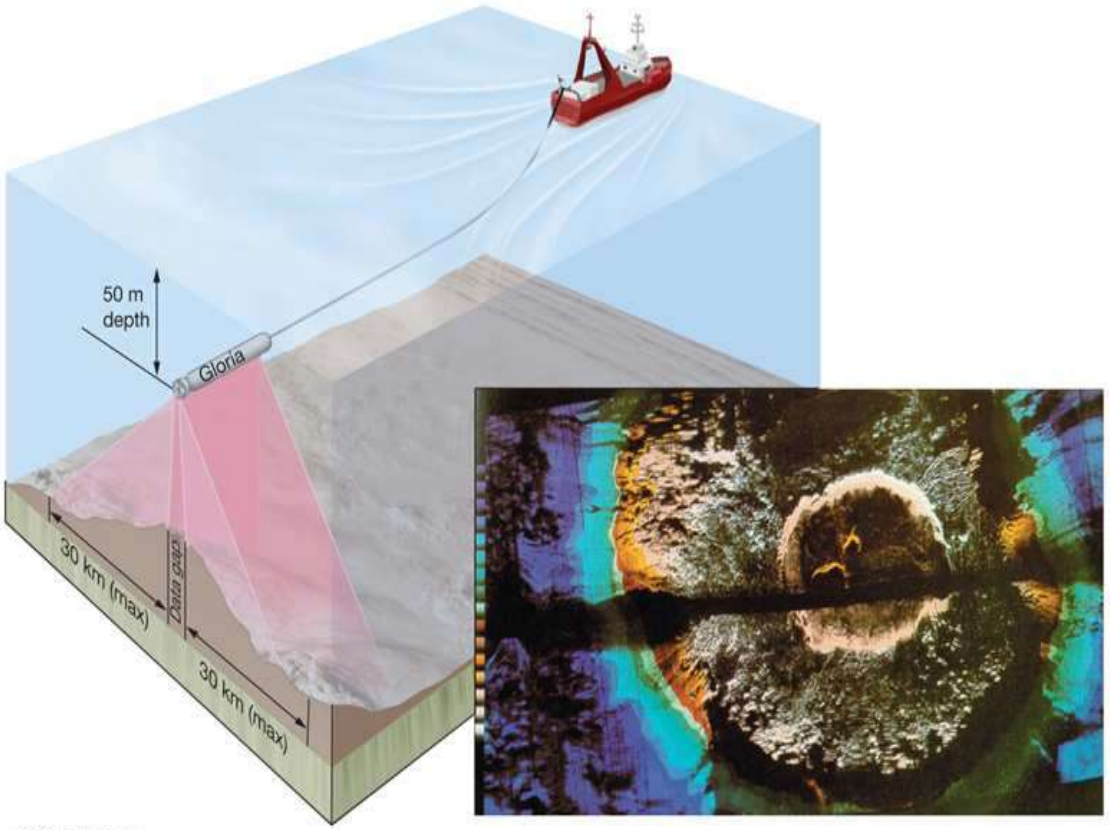
$$D=0.5(t)*S$$

- It takes in to account the factors of **temperature, pressure and salinity** to calculate the actual sound speed.

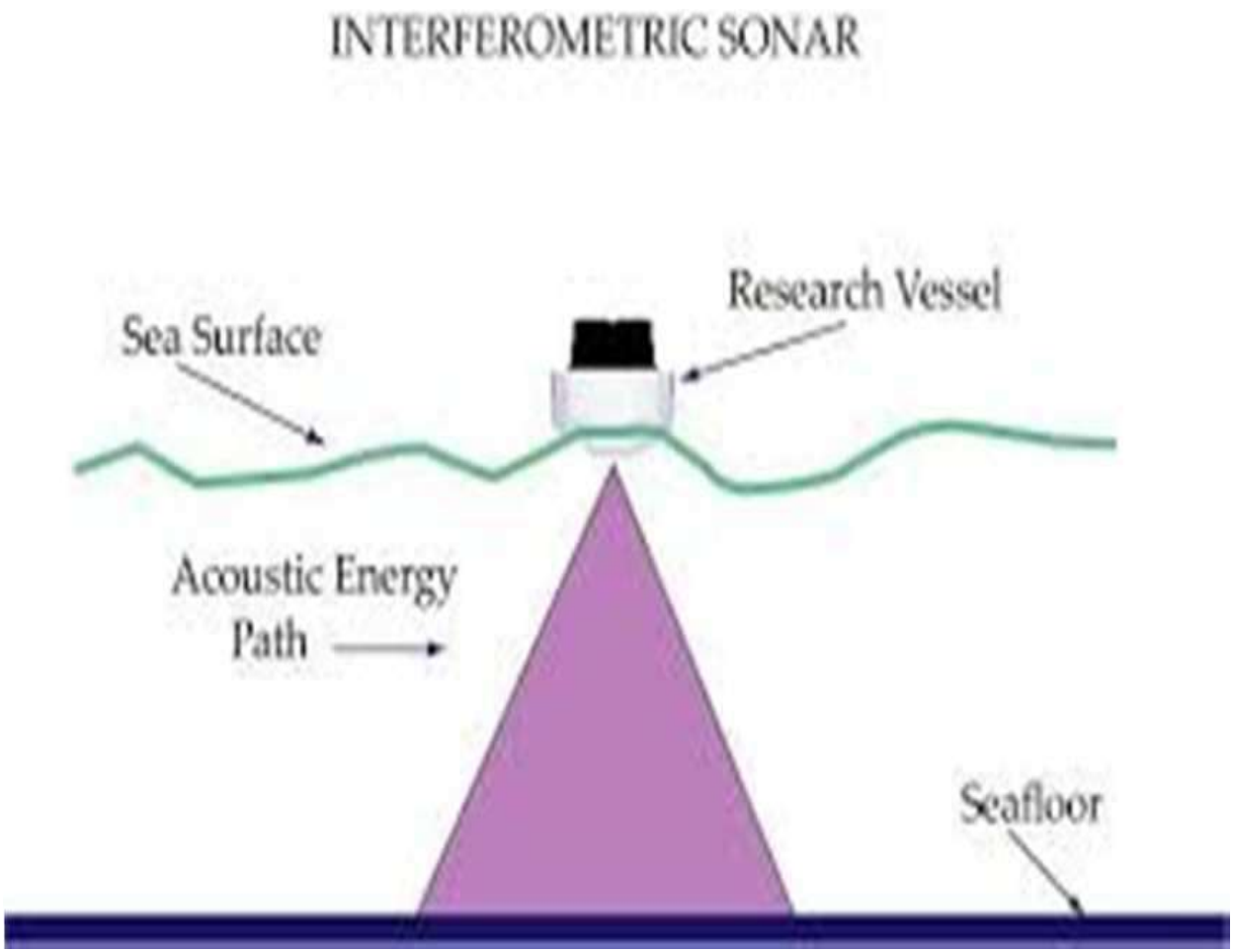
Modern Echo Sounding

- Modern Acoustic Instruments
- Side scan sonar
- GLORIA (Geological Long-range Inclined Acoustical
- instrument)
- Sea MARC (Sea Mapping and Remote Characterization)
- This can be towed behind ship to provide very detailed
- bathymetric strip map
- Multi-beam echo sounder

Side Scan Sonar



Inter-ferometric Sonar



Multi Beam Sonar

Increased:

- **Bottom Coverage**
- **Productivity**
- **Resolution**
- **Confidence**

Vertical Beam Echo-sounding (VBES)
Used from 1939 to the present
Better coverage than lead-lines

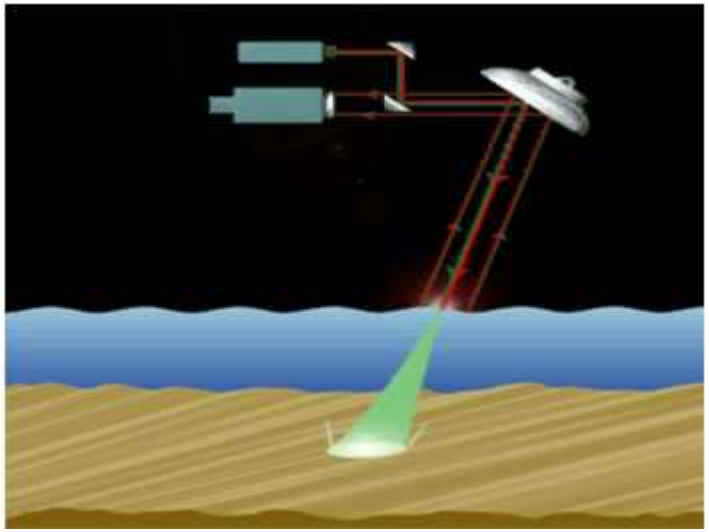
Airborne LIDAR

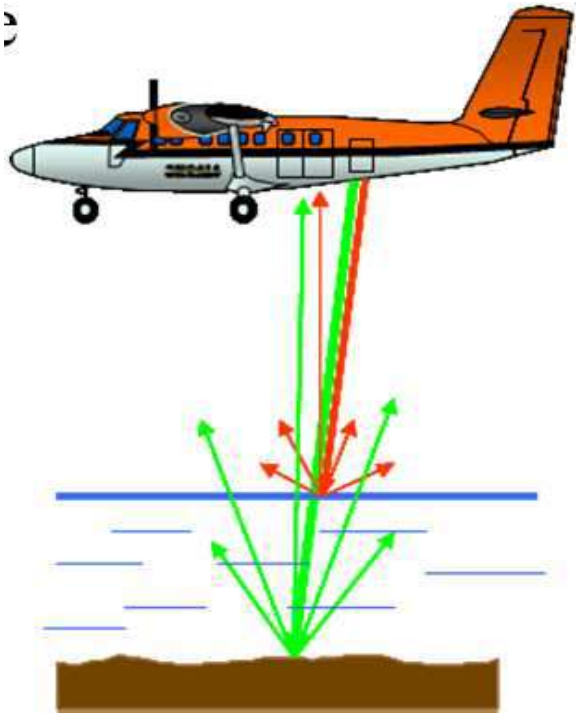
Airborne laser scanning technology to survey both land and coastal waters in a single approach, employing a technique known as

Airborne LIDAR Bathymetry (ALB) or Airborne LIDAR Hydrography (ALH) which uses state-of-the-art LIDAR Technology to measure sea bed depths and topographic features rapidly and accurately.

SHOALS

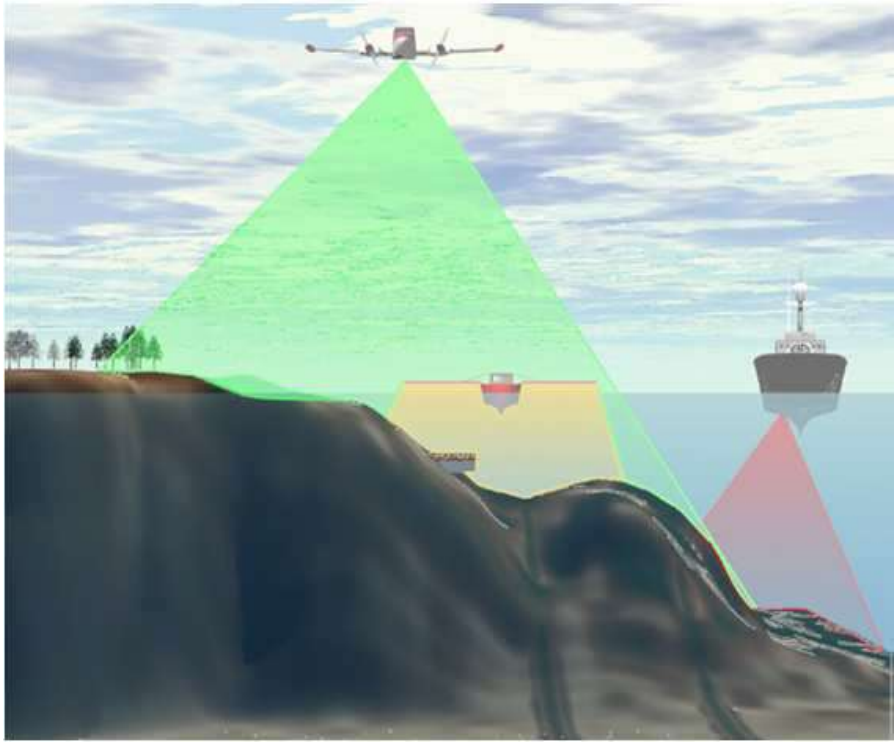
- Green pulses (532 nm) reflected
- from bottom
- N-IR (1064 nm) laser pulses
- reflected from water surface

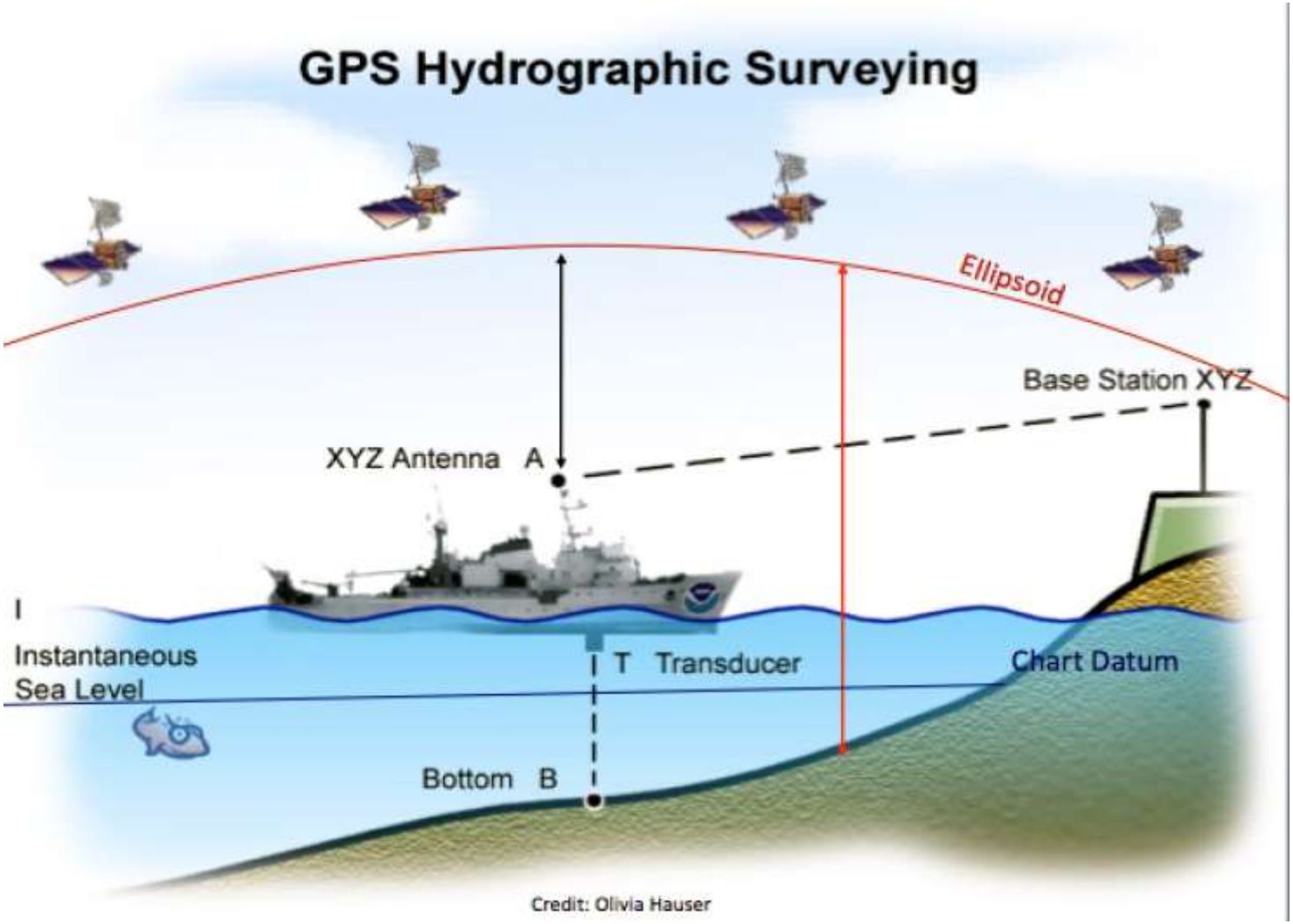




SHOALS

Simultaneous costal zone survey, both land and water under one approach




GPS Hydrographic Surveying
Ellipsoid
Base Station XYZ
XYZ Antenna A
I
Instantaneous
Sea Level
T Transducer
Chart Datum
Bottom B
Credit: Olivia Hauser

Aerial Photography

•Photo Bathymetry was used to measure water depth for shallow water with depth not more than 30m

- Refraction of light passing from water to air layers should becorrected first.
- Both single aerial photo and overlapping photos can be used.
- Covered area is limited by camera focal length
- Depth limitation is the most serious disadvantage.

Case study

- Hamreen reservoir

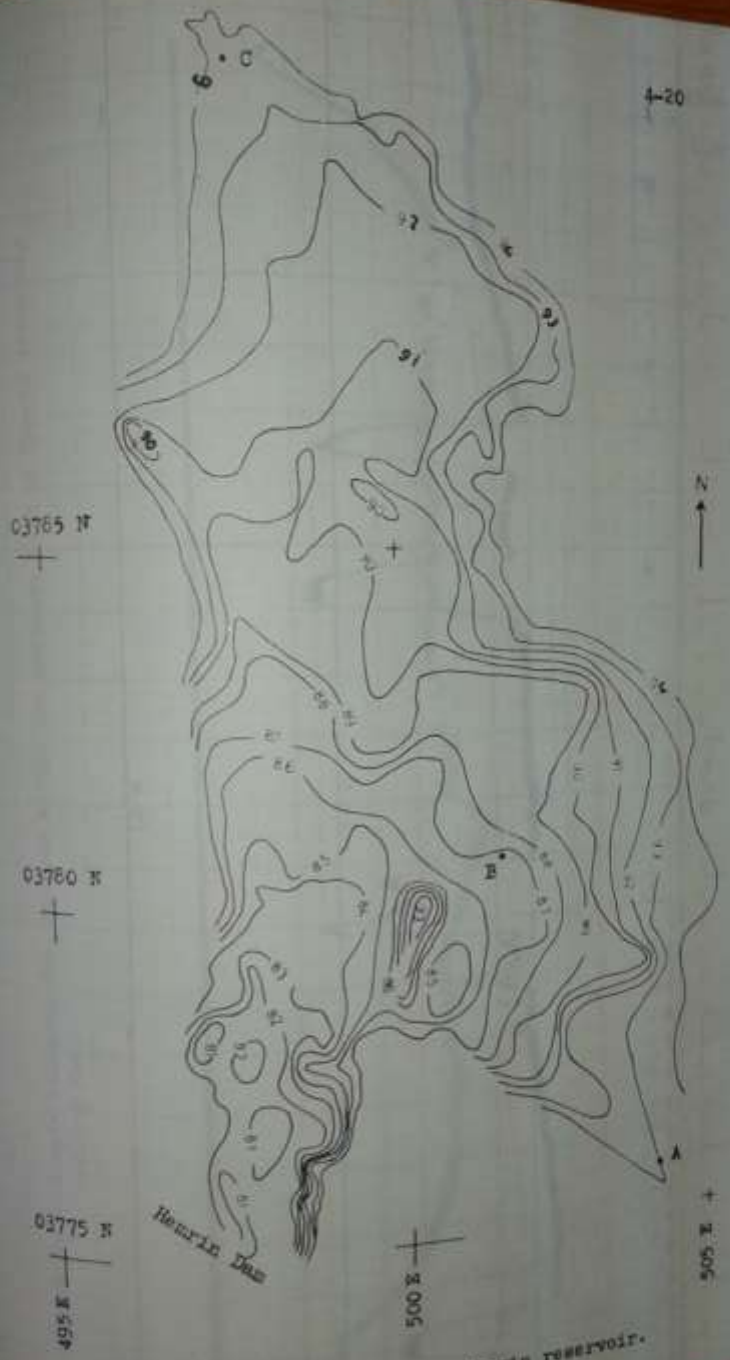


Figure 4-6: Bathymetric chart of Hemrin reservoir.

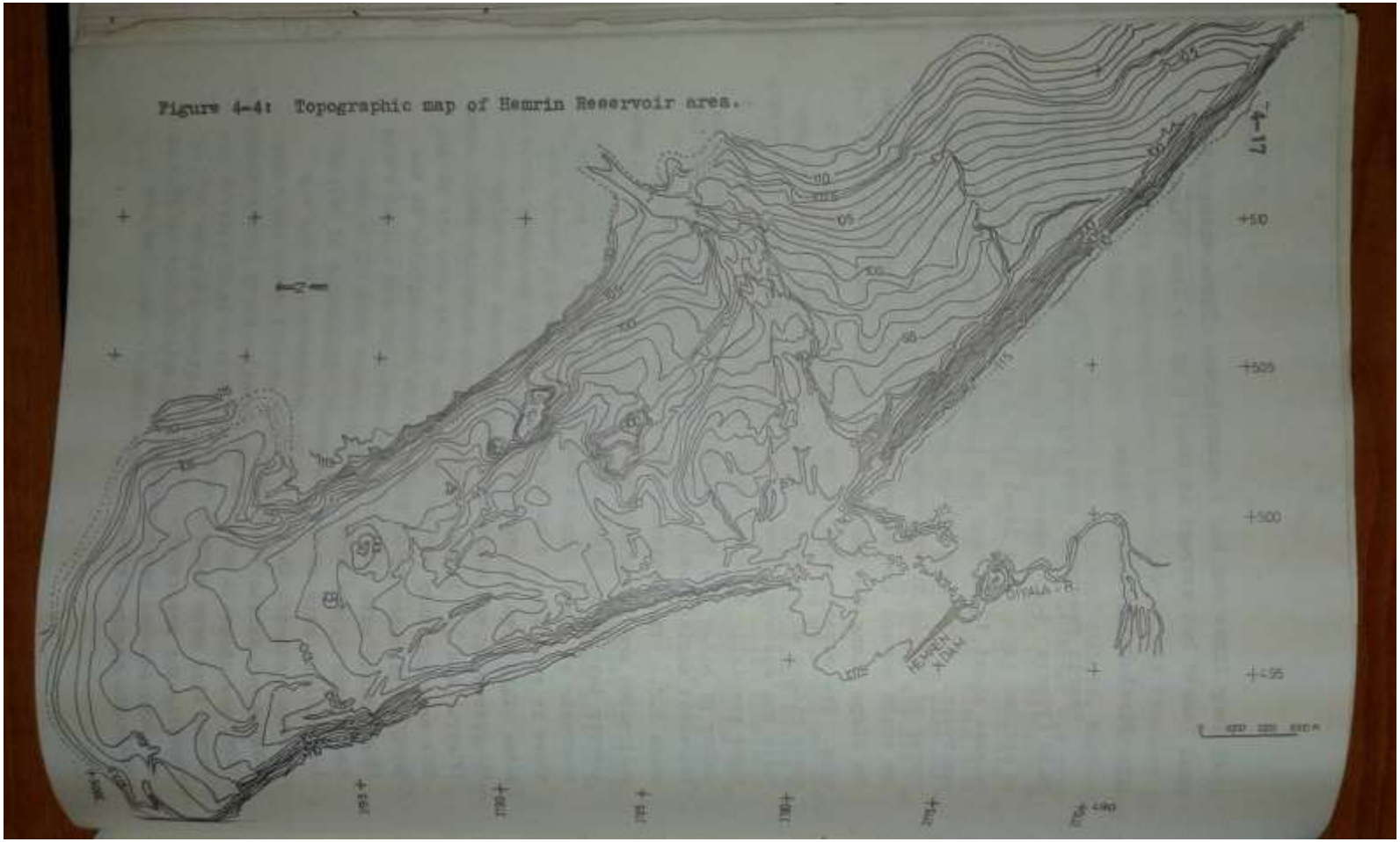
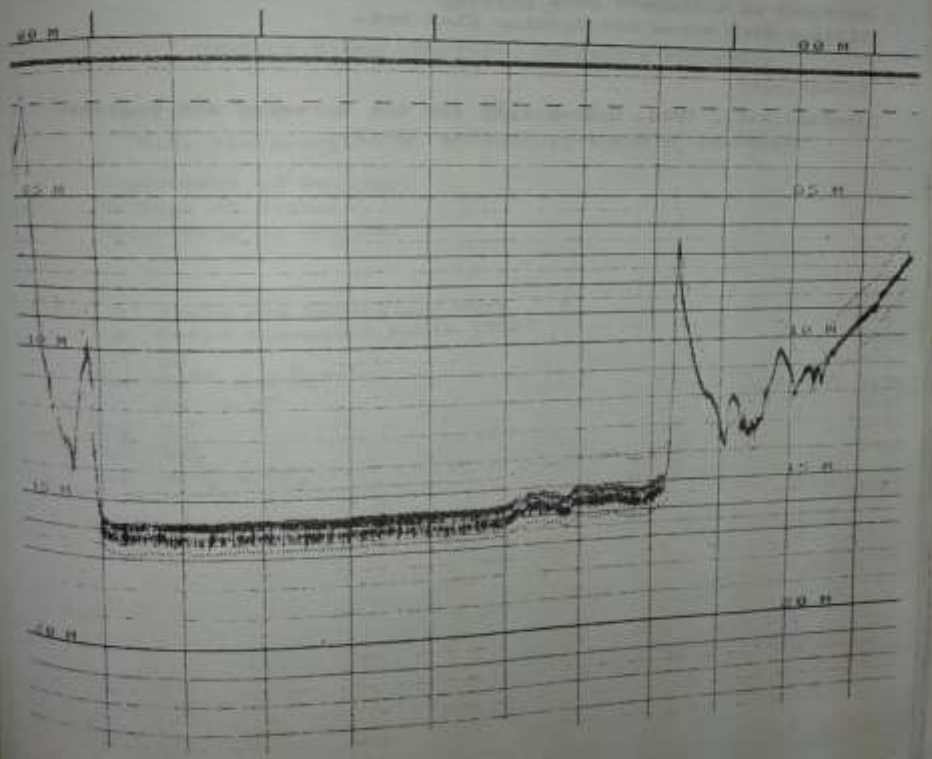


Figure 4-4: Topographic map of Hemrin Reservoir area.

Figure 4-10: Sample echogram for traverse within the south western part of Hemrin reservoir running N-S.



THANK YOU