Multibeam

Principle: Multibeam or swath mapping sonars transmit a broad acoustic pulse from specially designed transducers across the full swath across track. The swath width is determined by the depth of the seafloor being surveyed. The ping is emitted in a fan shape outward from the transmitter. If the speed of sound in the water column is known, the depth and position of the return signal can be determined from the receive angle and the two-way travel time. In order to determine the transmit and receive angle of each beam, a multibeam echosounder requires accurate measurement of the motion of the sonar (heave, pitch, roll, yaw, heading).

Basic features: The sound frequencies used in multibeam usually range from 70 to 500 kHz. A higher frequency instrument will most often have better resolution and accuracy than a lower frequency instrument for a certain water depth. In some cases 2 or 3 multibeam echosounders with different frequencies are combined into one system.

Resolution and horizontal precision: Multibeam sonars can provide highly accurate charts of the bottom bathymetery. The accuracy will not only depend on the frequency but also on the precision of the position of the transducer and the precision of the sound speed. In general the latest multibeam sonars have a horizontal resolution in the decimeter range, in some cases even up to the centimeter-range.

Platforms: Multibeam systems can nowadays be operated from small vessels. The sensor is normally mounted on the ship's hull or (in the case of small vessels) on a pole attached to the side of the ship. A recording system is needed on board. Recent multibeam systems also allow to record the backscatter data which allows for characterisation of the seabed (comparable to side-scan sonars).

Advantages:

- High resolving detail
- Can be operated from large to very small vessels
- Most recent systems also for very shallow water
- Very precise 3D bathymetry ((cm/dm accuracy range)
- Backscatter gives additional information (pseudo-sidescan)

Disadvantages:

- No penetration below the seabed
- More complex technique than side-scan sonar

Literature:

Nickerson, G.A.J., Royal, J. &Llewellyn, K. 2008.Using Bathymetry Data in Marine Archaeology: Improving Target Identification and Investigation. Highland Geo Report, 7 pp.

C. R. Bates, M. Lawrence, M. Dean & F. Robertson. *2011.* Geophysical Methods for Wreck-Site Monitoring: the Rapid Archaeological Site Surveying and Evaluation (RASSE) programme. *The International Journal of Nautical Archaeology*, 40 (2), 404–416.

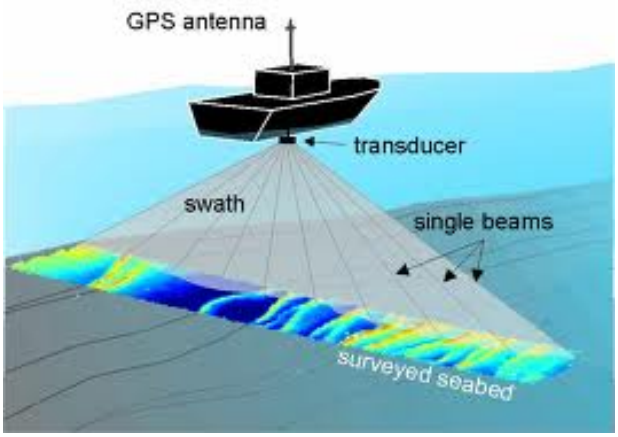

Fig.1 Schematic showing the principles of a multibeam sonar

Fig. 2 Multibeam sonar mounted on a pole (© Wessex Archaeology)

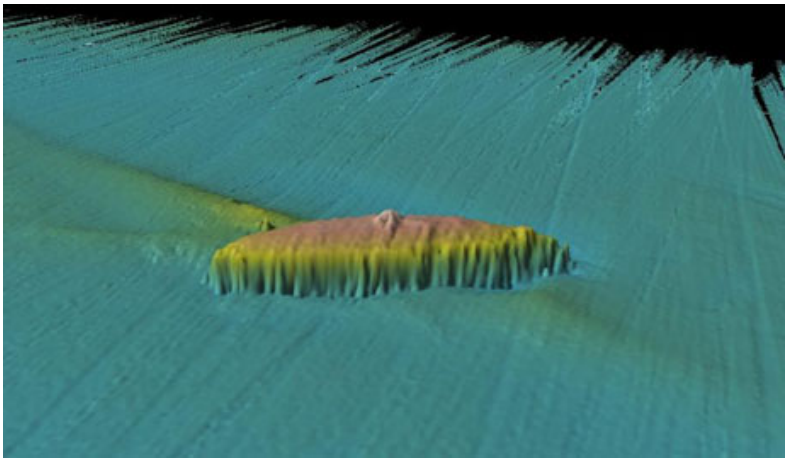

Fig. 3 Multibeam image of a ship wreck (© English Heritage)

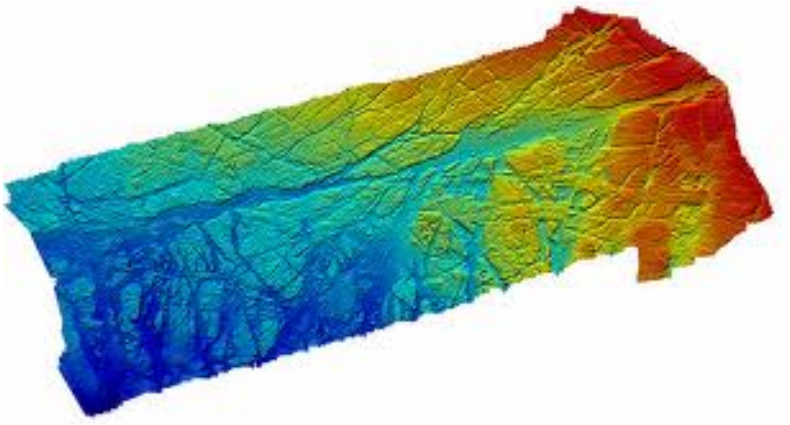

Fig. 4 Multibeam image of the site of the Bronze age and 17th century wrecks off Moor Sand, near Salcombe (© ADUS)