Acoustic and electromagnetic principles are the main modern ones used for imaging. The ultimate ocean floor images should combine several different data such as stereoscopic control, back scatter, large-area mosaic photography and other. Traditional bathymetric images become more and more precise as data bases amplify and navigation accuracies improve. Because of sea level variations caused by ocean and atmospheric dynamics, vertical ship motions or by geoid undulations water depth is physically most appropriate measured as a departure from the geoid. The first but incorrect quantitative estimates of ocean depth were made by using tides or breakers, which were thought to mark shallow water.

In the 19th century it was thought that ocean depth could be measured directly by gravity because ocean basins were thought to strongly disturb the earth’s gravity field for ocean water is much less dense than rock. But because of isostasy a rise in the earth’s mantle compensates the deficit in density of the water mass. Anyhow there still exists a positive correlation between the topography of the seafloor and free-air anomaly and geoid undulation. The space-borne altimeter SEASAT displays satellite altimetry data as gravity anomaly or geoid undulation which provide “proxy” views of the seafloor topography.

Magnetic anomalies measured by aircraft can also be used to acquire generalized bathymetry images where shipboard soundings are sparse. Magnetic anomalies are related to the depths of igneous rocks rather than ocean floor because they are much stronger magnetized than sediments. Actually aeromagnetic data is mostly used to locate seamounts, fracture zones or other features and as a control in countering widely spaced soundings or as a basis for designing surveys.

Electromagnetic imaging
The electromagnetic spectrum ranges from gamma rays to the longest radio waves. The limit for electromagnetic waves in seawater is given by the “skin depth”, the distance to which the waves can penetrate. The propagation rate of electromagnetic waves is frequency dependent, in contrast to acoustic waves, and also restricted by scattering from suspended matter and water molecules and by absorption. So clear seawater is most transparent in the blue and blue-green band and turbid/coastal water is most transparent in the green or yellow-green band.

The radar usually uses the microwave part of the spectrum for active or passive remote sensing so that a “bathymetric proxy” of the sea-surface shape can be supplied.

Broadband infrared imagery (“thermography”) is used to observe dynamic geologic processes in the 3-5.5 μ and 8-14 μ bands and to study volcanism in the 3-5.5 μ band.
In submarine regions the electromagnetic spectrum can only be used in the visible-light spectrum for bathymetry.

**Optical imaging**
A huge variety of optical imagery is available to map subaerial oceanic crust such as airborne stereo-photogrammetry, spaceborne scanner systems and the Large Format Camera aboard Space Shuttle. Because only the blue to blue-green bands are transmitted submarine color photography is less reasonable than subaerial photography. “Argo” for example is towed system that creates real-time television images of the sea floor.

**Acoustic imaging**
The sound speed in water increases with increasing water temperature, salinity and pressure. So it varies with season, day time, depth, geographical attitude and nearness of rivers or melting ice. In contrast to electromagnetic waves the speed of sound waves is chiefly frequency independent but wave-front spreading, reflection/refraction at interfaces and absorption diminishes the waves in water. The absorption of sound in ocean water is more effective than in freshwater.
Narrow-beam echo sounding is advantageous to obtain data in regions where topography is irregular but side echoes still are problematic on steep slopes. In contrast to that multibeam echo sounding is one of the best techniques to map the ocean floor fast and accurately. The returned signal combines back-scattered and reflected sound. Same is essential for side-scan sonars which measures the echo intensity on each of a number of narrow beams.
Side-scan sonars can be separated into long-range (10-60 km swath), mid-range (2-10 km swath), short-range (<2 km swath) and ultra-long range (basin-wide).