# A Controlled Source EM System
## For Investigating Shallow Seafloor Structure

The Woods Hole Oceanographic Institution operates a magnetic-dipole seafloor EM system that can be used to map the electrical structure of the uppermost 20 meters of seafloor, which is related to porosity.

Potential targets include:

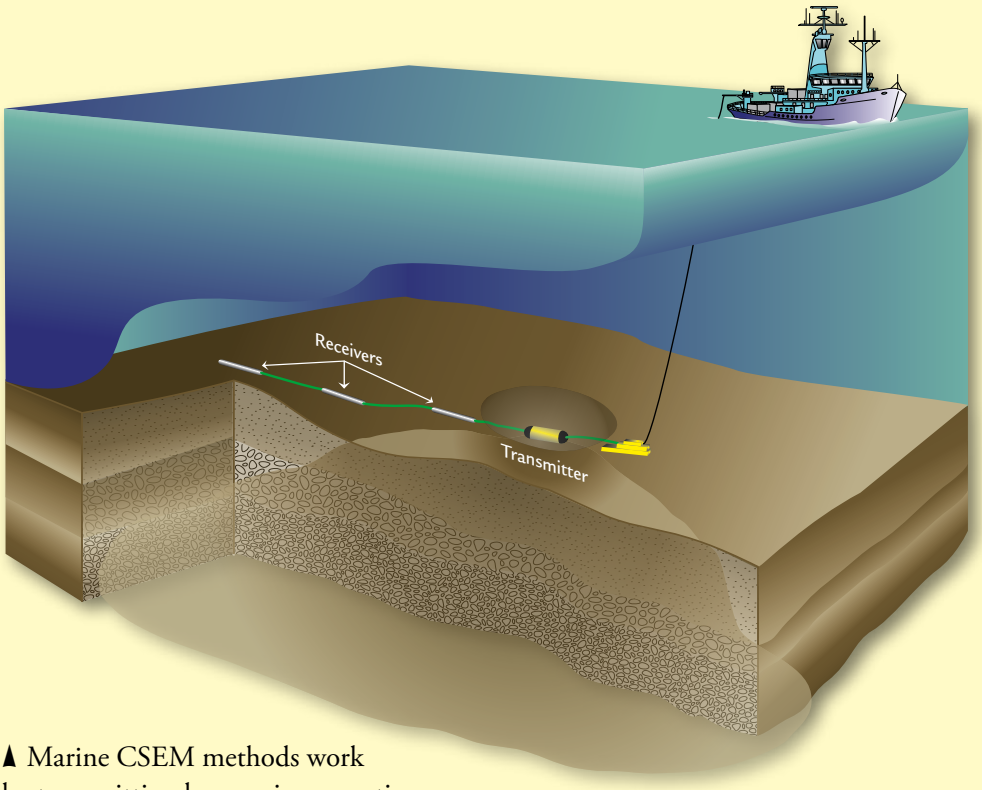
- **Groundwater Discharge in Nearshore Areas**
- **Shallow Gas Hydrates**
- **Fluid Flow Related to Slope Stability**
- **Sand/Gravel Resources**

The system is available for commercial or academic contracts. For nearshore shallow water work it can be deployed from fairly small vessels (larger than 15 meters) that have a stern A-frame. Deeper water work requires a winch with a 0.680" or equivalent co-axial conducting cable.

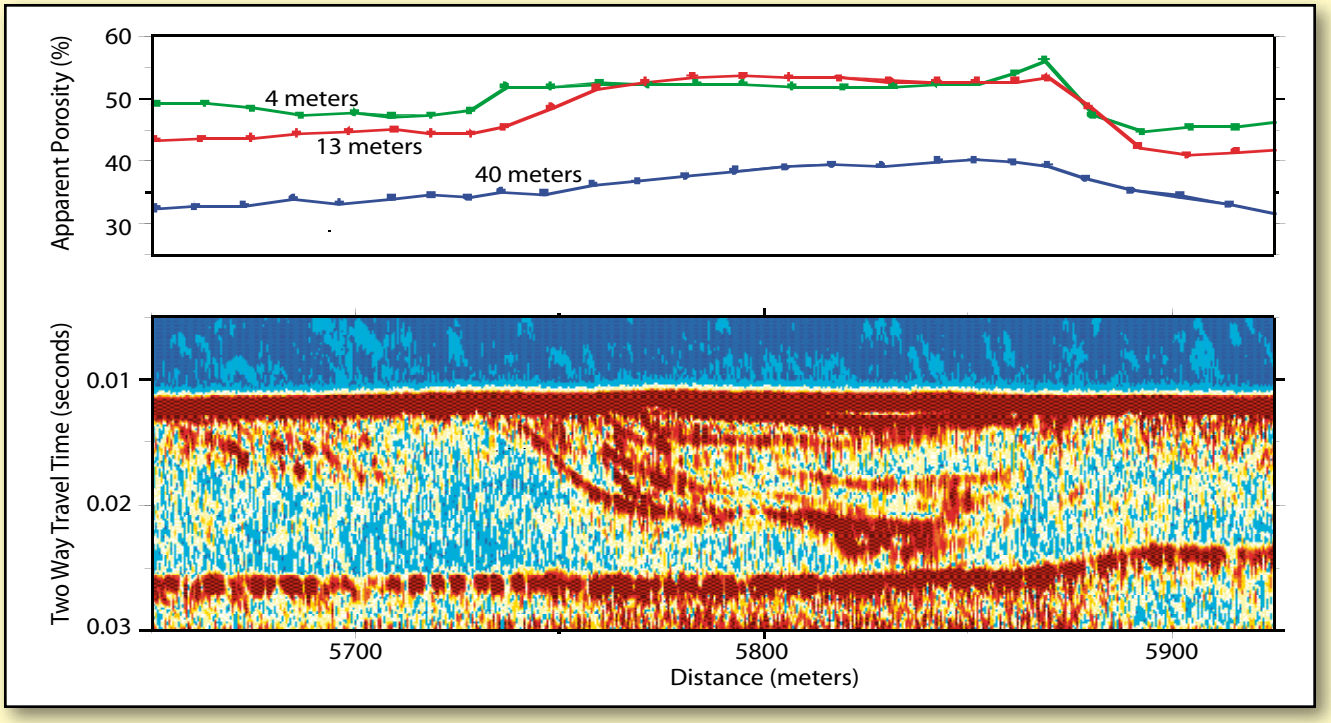
▲ A photograph of the towed EM system on deck. The system consists of a transmitter (large cylinder) connected to the ship by a 0.680 conducting cable.

The transmitter generates a suite of harmonic magnetic fields. These fields are measured by three receivers (smaller cylinders) lowered behind the transmitter at separations of 4 meters, 13 meters and 40 meters providing information to depths of up to 20 meters subsurface.

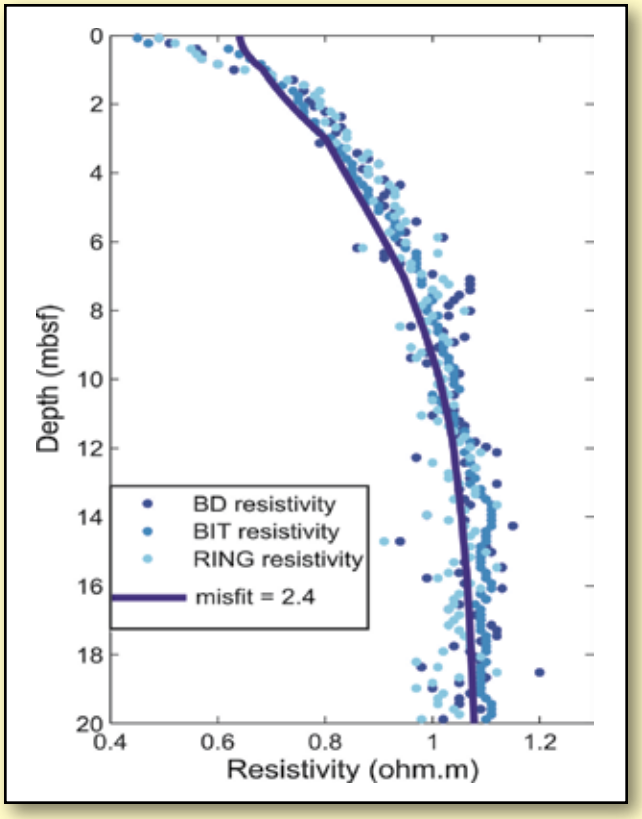
The system is towed along the seafloor at speeds of 1-2 knots and records data in real time on board ship. The present system has been used in water depths ranging from 10 meters to 1,300 meters and is rated to depths of 2,500 meters.




▲ Marine CSEM methods work by transmitting harmonic magnetic fields that decay with distance according to the skin depth of the media. The fields decay more rapidly in the more conductive seawater than in the subseafloor, making measured fields more sensitive to sub-bottom structure than conventional DC resistivity methods. Unlike other large scale CSEM methods, our system is a profiling tool that can be used to make maps of surficial properties.




▲ An example of data collected by the WHOI EM System, off North Carolina. Top panel shows raw data from the system displayed as apparent porosities, one profile for each of the three receivers. In the figure the green symbols are the porosities measured by the 4 meter receiver which senses over the top 2 meters of seafloor. The 40 meter receiver looks deeper, averaging over 20 meters of seafloor. Below is a chirp seismic profile over the same area. The channel sequence seen in the seismic profile is manifest in the EM through increases in apparent porosity related to changes in the fill material within the channel.




◄ An example of a resistivity profile (blue line) derived from inverting data from the EM System in the Gulf of Mexico (1,300 meters water depth). Blue dots are measurements made during adjacent drilling operations.

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