

Formation MicroScanner/ Sonic



Scientific Application

The Formation MicroScanner (FMS) sonde consists of four orthogonal imaging pads each containing 16 microelectrodes that are in direct contact with the borehole wall during the recording. The tool works by emitting a focused current from the four pads into the formation. The current intensity variations are measured by the array of buttons on each of the pads.

Processing transforms the current intensity measurements, which reflect the microresistivity variations of the formation, into high-resolution gray or color images of variable intensity. The tool string also includes a DSI-2* tool composed of a transmitter section, receiver section, and cartridge to provide several digitized waveform data acquisition operating modes.

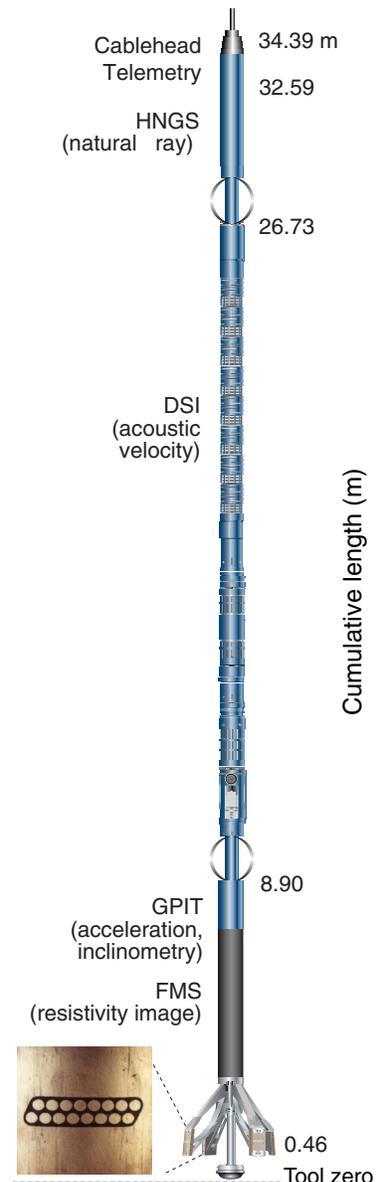
In smooth boreholes with very homogeneous bedding the depth of investigation is about 25 cm (10 in.). The vertical resolution is 0.2 in. (5 mm). The tool string can be used for:

- Mapping of bedding planes, fractures, faults, foliations, and other formation structures and dip determination
- Detailed correlation of coring and logging depths
- Precise positioning of core sections where core recovery is less than 100%
- Analysis of depositional environments
- Derived compressional and shear wave velocities

Components

The standard FMS/Sonic logging tool string consists of the following tools:

- Dipole Sonic Imager Tool (DSI-2*)
- Formation MicroScanner (FMS*)
- General Purpose Inclinometry tool (GPIT*)
- Enhanced Digital Telemetry Cartridge (EDTC-B*)/Hostile Environment Natural Gamma Ray Sonde (HNGS*)



FMS Tool String used during Expedition 351.

Additional Information

DSI-2

The DSI-2 combines high-speed telemetry with simultaneous, 12-bit dynamic range digitization of an eight-receiver array. The sonde incorporates both monopole and crossed-dipole transmitters with an eight-station array of electronically configurable hydrophones for monopole and dipole reception. Combining new dipole-based technology with the latest monopole developments into one system provides the best method available today for obtaining borehole compressional, shear, and Stoneley slownesses (slowness is the reciprocal of velocity and corresponds to the interval transit time measured by standard sonic tools).

Dipole technology allows borehole shear measurements to be made in “soft” rock as well as “hard” rock formations. Limited by borehole physics, monopole tools can detect only shear velocities that are faster than the borehole fluid velocity -- or in hard rocks only. Dipole tools overcome this fluid velocity barrier. Tool length is 15.5 m (51 ft).

FMS

FMS images can be plotted with identical vertical and horizontal scales to see features without exaggeration. However, due to physical constraints, different vertical and horizontal scales are commonly used. The images are displayed on an oriented plot, also called an azimuthal plot, because the images are positioned according to their orientation in the borehole with N in the center and S on both edges. Images from two passes of the tool can be merged and plotted together. The calipers or other curves can be plotted alongside the images as well. With an additional processing step, dipmeter calculations can be made. Standard dipmeter plots consist of borehole drift, calipers, dip angle and direction (tadpoles), azimuth frequency plots, and pad traces. Tool length is 7.72 m (25.3 ft).

GPIT

The GPIT tool provides inclinometer measurements. Tool orientation is defined by three parameters: tool deviation, tool azimuth, and relative bearing. The GPIT tool uses both a three-axis inclinometer and a three-axis magnetometer to make measurements for determining these parameters.

EDTC-B

EDTC-B is a downhole tool that combines two commonly run sensors with a high-speed telemetry downhole modem that can be used in high-pressure and high-temperature environments. The primary function is to provide high-speed (>1 Mbps) communications between the wireline tools downhole and the acquisition system at surface. Additionally, it includes a scintillation gamma ray detector that provides a measurement equivalent to that of the Scintillation Gamma Ray tool formerly used for seismic operations. The gamma ray log is typically used to depth match between logging runs.

The HNGS utilizes two bismuth germanate (BGO) scintillation detectors to measure the natural gamma ray radiation of the formation. At least one pass is made with the HNGS past the mudline for correct location of the mudline itself. HNGS may be used to determine clay type, mineralogy, and ash layer detection. Tool length is 25.88 cm (8.5 ft).