Lasts decadesâ€™ evolution in sub-bottom profiling

Most sub-bottom profilers of the 60s, 70s and 80s were only designed to generate cross-sectional images of seabed sediment layering and other sub-bottom features. The data were degraded by system limitations such as narrow bandwidth, nonlinear and un-calibrated electronics, low signal-to-noise ratio of filtered data, source ringing, poor pulse repeatability and poor temporal and spatial resolution.<P>

Frequency Modulated pulses (taken from RF Radar Technology) addressed these limitations. A quantitative sub-bottom profiler was introduced in the mid 1990s so that the reflection seismogram has the wide dynamic range required for signal processing procedures in sediment classification methods. These procedures, which initially calculate the acoustic impedance and attenuation as a function of sub-bottom depth, have a high sign-to-noise ratio, a repeatable and precisely defined acoustic pulse and high temporal and spatial resolution.

Sediment volume scattering and electronic and ambient noise are reduced by using (1) signals with a large time-bandwidth product, (2) correlation processing, and (3) arrays with high spatial resolution. Since the FM sonar transmits pulses with a large time-bandwidth product and uses matched filtering, variation of the transmitter and receiver beam pattern as a function of frequency is a major consideration in designing the transmitted waveforms. The result is a sonar aperture that is nearly free of side lobes and produces sub-bottom images with almost no visually detectable hyperbola.

In the early part of this decade, this FM pulse technology has been applied to research into a swath sub-bottom profiler. This could very well be the next big step in sub-bottom profiling:?consider it as a multi-beam sub-bottom profiler.

BOSS (buried object scanning sonar) is a wideband FM sonar that generates three-dimensional imagery of buried, partially buried and proud targets. An omni-directional spherical projector transmits an FM pulse with a frequency band of 3 - 20 kHz to illuminate the seabed in all directions. A hydrophone array measures the backscattering from the seabed and the data are focused to form an image of the seabed. The focused data are stored in a 3D matrix, where matrix indices correspond to focal points under the seabed. The sonar operator uses three orthogonal multi-aspect image projections to view top and side views of buried targets. This new technology is in the advanced stages of research, with a system being used in the field to collect data for evaluation. No images are released for publication yet. We have something very exciting to wait for in the hydrography field.