

## **3D sub-bottom profiling – high resolution 3D imaging of shallow sub-surface structures and buried objects**

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New developments in sub-bottom profiling brings 3D reflection seismics, routinely used in hydrocarbon exploration, to the shallow survey market by down-scaling the conventional techniques to achieve decimetre resolution imaging of the top tens of metres of the sub-surface in three dimensions. These advances have been made possible by improvement in digital data acquisition and position accuracy. Shallow high resolution sub-bottom profiling currently still relies mainly on single-channel 2D methods. In contrast to the 2D methods that produce individual vertical cross-sections of the sub-surface, the 3D method combines data collected over the survey area into a data volume. The data can then be viewed in any orientation independent of the acquisition direction, delineating structures and objects in three dimensions with enhanced data quality and resolution. The GeoChirp 3D system, developed in collaboration between GeoAcoustics Ltd and the National Oceanography Centre, Southampton, UK, consists of a surface towed wet-end that comprises GeoChirp source transducers, operating on a bandwidth of 1.5 to 13 kHz, and 60 hydrophone groups mounted on a rigid array. It is positioned using RTK-GPS and GPS based attitude systems. The integrated deck-end hard and software component combines sonar and navigation data into industry standard SEG-Y format that are processed and interpreted using readily available software packages. The technology has been extensively applied in small object detection and identification surveys, including controlled mine detection and recognition experiments as well as marine archaeology, engineering and geological and geophysical projects. A number of GeoChirp 3D data examples are discussed to emphasize the potential of the technology to contribute unique information towards the investigation of these survey targets.