

## 3D Reconstruction Of A Shallow Archaeological Site From High Resolution Acoustic Imagery – A Case Study

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High resolution acoustic surveying for buried objects in the shallow waters of the inter-tidal to sub-tidal zone is a major challenge to many sectors of the marine surveying community. This is a consequence of a number of issues such as the relationship between water depth and acoustic acquisition geometry; problems of vessel induced bubble clouds reducing the signal-to-noise (SNR) ratio; and the necessity of high spatial survey accuracy in three-dimensions. These challenges are particularly acute for the marine archaeological community, who are frequently required to non-destructively investigate shallow-water (< 5 m) sites.

This paper addresses these challenges and demonstrates the potential of imaging buried objects in extremely shallow environments by describing a seamless marine archaeological and geophysical investigation of a buried shipwreck: Henry V's 'great flagship', the *Grace Dieu* (1418). The site, located in the Hamble River (UK), is typically covered by 2-5 m of water, and is partially buried within muddy inter-tidal sediments. At exceptionally low tides, during the spring equinox, a few of the marginal timbers are exposed.

The marine survey utilised three different deployment methods of a Chirp system: two 2D Chirp systems, each emitting different frequencies and accompanied by different navigational systems (DGPS versus RTK), and a 3D Chirp system with RTK positioning capability. In all cases, the source was towed over the site using diver power. Close survey line spacing, accurate navigation and decimetre scale vertical and horizontal resolution acoustic data enabled the construction of a pseudo and full 3D image of this buried wreck site. This has been calibrated against known archaeological site investigation data and an RTK-GPS terrestrial survey.

This data has identified the true plan form and dimensions of the remaining segments of the vessel, supporting the assertion that it was the most significant naval design for over two centuries. It has also been possible to identify the presence of a horizon of incoherent timbers associated with the scuttling of the vessel.