A 3-D digital model of Peak Cavern, Castleton, Derbyshire, U.K., integrating cave survey, geophysics, geology and archaeology

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The Lower Carboniferous Castleton Reef is a complete outcrop analogue for a reef knoll oil field. The typical stratigraphic association of volcanics, reef limestones, onlapping deep marine black shale source rock and distal turbidites. Bitumen deposits occur in the Windy Knoll cave in the crest of the reef. Several large cave systems are known within the reef limestones, of which we discuss Peak Cavern and the overlying Cavedale.

We have applied conventional surveying techniques (using a total station theodolite) to create a detailed, 3-D CAD model of the cave entrance.

Wenner resistivity pseudo-sections along 4 of the terraces showed clear evidence for a domed shape of sediments at about 2m depth, falling off towards the cave’s entrance.

Ground Penetrating Radar (GPR) investigations have been undertaken through the accessible part of the cave and over benches cut into the cave earth fill. The velocity profiles show two distinct layers, the slower Pleistocene deposits overlie the faster Carboniferous Limestone. Reflection events within the cave deposits suggest domal accretion on the underlying cave floor.

Over the last 400 years the cave has been in use as home and factory to a community of Ropemakers who were responsible for fashioning the benches (Ropewalks), and latterly as a show-cave catering for mass tourism since the Victorian era. Today over 40,000 people visit the cave annually.

The cave has a rich archaeological history but due to its size traditional approaches to cave excavation are inadequate. The combined results of geophysical and topographical investigations will permit very targeted investigations to reveal the stratigraphy and chronology of archaeological and palaeontological deposits.

The 3-D geometry and the spatially located imagery have been integrated into a 3-D digital model. Fly-through visualisation sequences can then be constructed for virtual field trips. Now that the diverse information can be seen in context and interesting GPR sub-surface features identified, key-hole archaeology will be possible to investigate specific targets.