



Imaging a fossil oolitic system with GPR, insights into the exposures of the Isle of Portland (UK)

Julien Moreau, Trine L. Hansen, and Lars Nielsen

University of Copenhagen, IGN, Geology, Copenhagen, Denmark (julien.moreau@geo.ku.dk)

The Isle of Portland shows exposure of uppermost Jurassic oolitic carbonate all along its coast. The stone of Portland properties are famous as standards for concrete composition, as building material but also for sculpture. As a consequence, the Isle has been quarried intensively for hundreds of years. The regional exposure quality is very high with a potential 3D control. The site has seen generations of geologist trainees coming for field work. The Wessex Basin where the Isle is sitting contains an active petroleum system and the geologists visiting/training there use the carbonates of Portland as an analogue to equivalent Middle-East oil and gas reservoir. Surprisingly, although the site has a tremendous potential to understand the 3D architecture and the sedimentary dynamic of an oolitic system, only punctual observations of logs (1D), sometimes correlated have been published. Several studies place a shore line between the Isle and the continent striking NEE-SWW and facing towards the Channel. Facies changes are attributed to rapid sea-level variations and Walter's Law.

We have collected an extensive GPR survey of the same stratigraphic interval (The Portland Freestone). With a total of 99 GPR profiles, we have produced grids on top of most of the coastal cliffs and quarry faces. We have encountered 3 main architectures: 2-m-high bars with steep clinofolds, 10s of metres-wide channels plugged with a variety of organisms and stacked aggrading bundles of multidirectional dunesets. Our dataset does not illustrate any major unconformity which could be attributed to a sharp sea-level drop. We have interpreted our sedimentary architecture to be the result of various hydrodynamic conditions associated with a mix of wave and tide influences. The Isle shows an island barrier complex which progrades into the basin but also expands laterally filling up the available space and cannibalising itself. More proximal facies are effectively observed in the north of the island towards the former continent or lagoon. However, the survey clearly shows that the shore zone progrades broadly towards the SW, partially away from the channel, at > 90 deg. from the former reconstructions. This result suggests as we know that the Channel contain deeper facies that the oolitic shore zone system must form a large spit platform, pointing south. Illustrating a contorted and complex shoreline/barrier, contrasting with the former cylindrical view of the depositional system.

The combination of sedimentology and geophysics allowed to reevaluate the depositional system of the Isle of Portland oolitic deposits. It also challenges the sea-level reconstruction of this interval and the palaeogeographic reconstructions in the basin by showing shoreline trajectories. The multidisciplinary approach permitted to view and analyse a Jurassic depositional system almost alike what can be done on active oolitic systems. The approach has a tremendous potential to better understand cliff exposures and in particular to produce analogues of hydrocarbon reservoirs.