

Stratigraphic forward modelling & synthetic seismic images of carbonate strata

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To date methods of stratigraphic forward modelling have tended to produce layer-cake stratal geometries forced by sea-level oscillations, with little focus on modelling more complex depositional processes required to reproduce the high degree of lateral heterogeneity observed in many outcrops and implied by subsurface data sets to be present in many reservoirs. Even clinoform geometries in such forward models are rather homogenous in terms of lateral facies transitions. Related to this, most synthetic seismic modelling carried out to date assumes that the subsurface geometry can be reasonably represented by layers within which the velocity and density structure is relatively simple. This works well provided layers are reasonably thick and sedimentary deposits reasonably homogenous. However, it does not work well when there are significant thin-layer effects (both interference effects and reflection-coefficient modification effects) and/or significant lateral facies heterogeneity.

This PhD project **fully funded by BP** (for UK/EU citizens) aims to further develop a new stratigraphic forward model CarboCAT (Burgess, 2012) to better represent multi-scale heterogeneity developed within stratal geometries like clinoforms, and to develop a method to carry out fine-scale, finite-difference synthetic seismic modelling of the wave equation within highly heterogeneous synthetic carbonate strata produced by CarboCat. This will allow prediction of the likely seismic response of reservoir heterogeneities, allowing the seismic interpreter to make better-informed interpretation of reservoir intervals imaged on seismic data.

The project will assess fine scale seismic response of highly heterogeneous carbonate strata and how these features scale-up to observed seismic response at typical seismic frequencies. It will also determine what kind of large-scale seismic architectures result from stratigraphic forward models of this type. From there, it will be possible to evaluate how reasonable standard assumptions about the nature of carbonate seismic reflections are and to what extent reflections truly represent time lines. The data for these models will be derived in large part from a tandem PhD studentships at University of Manchester.

This PhD project will provide training in stratigraphic forward model development, seismic processing and synthetic seismic modelling techniques. The successful candidate will also be expected to spend period of time in field, and therefore training will also be provided in carbonate sedimentological characterisation. The successful candidate should be highly numerate and have strong communication skills in order to integrate with co-workers at University of Manchester and BP. Training will be provided in advanced carbonate reservoir characterisation, petrophysics, stratigraphic and seismic forward modelling. The project will provide excellent training for a future career in the oil and gas industry, and will also allow a skill base to be developed that would be highly valuable for further academic study.

Burgess, P.M., 2012, CarboCAT: A Cellular Automata Model of Heterogeneous Carbonate Strata, Computers and Geosciences.