A Machine Learning Approach to Represent Carbonate Heterogeneities in Forward Stratigraphic Models

The ability of modern computers to run complex numerical simulations of sedimentology allows sedimentologists and stratigraphers to predict based on geological constraints what the pattern of sedimentation should be, and compare this to control data (wells, outcrop, seismic). This powerful approach, known as forward stratigraphic modelling, is commonly used. However, forward stratigraphic models usually are based on simple laws to mimic what happens at geological timescale. For instance, diffusion is often used to explain how sediments moved across the seafloor. This yields useful deterministic pattern of sediments that are broadly consistent with geological control points at a large scale. But what these models cannot do well is represent statistically small-scale (meters or less) heterogeneities. However, these could be important for our understanding of the system.

This PhD project is building on the expertise from the carbonate research group both in forward stratigraphic models and in machine learning. The PhD student will be tasked with investigating the ability of modern machine learning to reproduce small scale heterogeneities in carbonate systems within the context of a large-scale, deterministic diffusion-based model.

We intend to use our DionisosFlow software to model carbonate ramps and platforms at the finest scale possible, which is typically around 0.5-1 km grid scale. Then, the PhD candidate will test multiple machine learning methods, from well-established techniques (SVM, Random Forest) to more advanced neural network approaches (CNNs, RNNs). The goal is to use modern patterns in reefs and ramps to more realistically represents heterogeneities at the meter scale. The candidate PhD will be at the forefront of modern techniques, and will be very employable at the end of this PhD. This work could thus lead to a career in academia, the energy industry or even computer sciences.

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Group website: www.carbonateresearch.com
Minimum requirement for candidates: UG degree in geology, computer science, math or physics, 1st class degree, UK citizen
Good to have skills (but not essential): a master's degree, proven ability to publish papers by being lead or co-author on a paper, experienced with carbonates, some experience in coding is desirable but by no means essential (but need to be willing to learn).