Geophysical Research Abstracts
Vol. 13, EGU2011-11746, 2011
EGU General Assembly 2011

3D structural and stratigraphical models from laser scan outcrop datasets

Kenneth McCaffrey (1), Richard Jones (2), Jamie Pringle (3), Alodie Bubeck (2), Maxwell Wilkinson (1), and Gerald Roberts (4)

(1) Earth Sciences, Durham University, Durham, United Kingdom (k.j.w.mccaffrey@durham.ac.uk), (2) Geospatial Research Ltd, Earth Sciences, Durham University, Durham UK, (3) School of Physical and Geographical Sciences, Keele University, Keele, UK, (4) Department of Earth and Planetary Sciences, University College London, London, IK

Rapidly developing methods of digital acquisition, visualization and analysis allow highly detailed outcrop models to be constructed, and used as analogues to provide quantitative information about structural and sedimentological architectures from reservoir to sub-seismic scales of observation. Terrestrial laser-scanning (lidar) and high precision GPS are key survey technologies for data acquisition. 3D visualization facilities are used when analysing the outcrop data. Geological interpretations of outcrop datasets (e.g., fault or bedding traces) can be extended into the subsurface using geometric, probabilistic, or deterministic methods. Another approach is to use geological heuristics to constrain the subsurface interpretation. This approach can help to limit the number of possible interpretations when creating multiple realizations. Deterministic methods encompass both invasive and non-invasive approaches. Invasive methods include mining and quarrying, as well as small-scale excavation of unconsolidated sediments. Behind-the-outcrop boreholes are only slightly invasive, and can provide very useful constraint of the subsurface. In contrast, geophysical methods such as near-surface seismics and ground penetrating radar (GPR) allow indirect imaging of the subsurface and are non-invasive. Outcrop data can also be used to calibrate numerical models of geological processes such as the development and growth of folds, and the initiation and propagation of faults. The resultant data can be used as input for object-based models, can be cellularized and upscaled for use in grid-based reservoir modeling or used as input into probabilistic hazard models.

In the first example, excellent coastal exposures of Namurian turbidites near the Bridge of Ross in County Clare, western Ireland, provide a case study in which several different types of digital outcrop data are combined and co-visualized in a 3D model. In vertical sections on opposite sides of the outcrop a small-scale turbidite channel is marked by an erosional base and inclined interbedded sandstones and mud-clast conglomerates. The observed channel margins can be traced through the subsurface using 3D GPR.

In the second example, fault scarps in the Italian Apennines are the surface expressions of repeated earthquakes on active normal faults. Using a combination of laser scanning and GPR we have developed a method from which the surface to subsurface characteristics and spatial extent of relevant scarp-forming processes can be characterised with high spatial resolution. From these models, we can construct a record of slip rates and earthquake magnitudes over seismic cycle time-scales.