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Geostatistics from Digital Outcrop Models of Outcrop Analogues for Hydrocarbon Reservoir Characterisation.

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In the hydrocarbon industry stochastic approaches are the main method by which reservoirs are modelled. These stochastic modelling approaches require geostatistical information on the geometry and distribution of the geological elements of the reservoir. As the reservoir itself cannot be viewed directly (only indirectly via seismic and/or well log data) this leads to a great deal of uncertainty in the geostatistics used, therefore outcrop analogues are characterised to help obtain the geostatistical information required to model the reservoir.
Lidar derived Digital Outcrop Model's (DOM's) provide the ability to collect large quantities of statistical information on the geological architecture of the outcrop, far more than is possible by field work alone as the DOM allows accurate measurements to be made in normally inaccessible parts of the exposure. This increases the size of the measured statistical dataset, which in turn results in an increase in statistical significance. There are, however, many problems and biases in the data which cannot be overcome by sample size alone. These biases, for example, may relate to the orientation, size and quality of exposure, as well as the resolution of the DOM itself.
Stochastic modelling used in the hydrocarbon industry fall mainly into 4 generic approaches: 1) Object Modelling where the geology is defined by a set of simplistic shapes (such as channels), where parameters such as width, height and orientation, among others, can be defined. 2) Sequential Indicator Simulations where geological shapes are less well defined and the size and distribution are defined using variograms. 3) Multipoint statistics where training images are used to define shapes and relationships between geological elements and 4) Discrete Fracture Networks for fractures reservoirs where information on fracture size and distribution are required. Examples of using DOM's to assist with each of these modelling approaches are presented, highlighting the principle sources of uncertainty when using digital outcrop based methods, and how these uncertainties may be addressed at both interpretation and modelling stages.