Using Rock Types to Interpolate Petrophysical Properties

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In order to interpolate petrophysical properties (porosity, permeability, water saturation, Net/Gross) in a petroleum reservoir, geologists sometimes use the concept of rock types — a rock with a well identified porous network resulting from a geological history and leading to well defined petrophysical laws at field scale. They first establish a rock type map constrained at the wells and conforming to a depositional and diagenetic model. They then assign petrophysical parameters using petrophysical relationships established per rock type and possibly per layer. When variability within rock types is low, a simplification is to assign each rock type its average petrophysical parameters, which then amounts to "painting" the rock type map petrophysically.

While this approach is geologically appealing, it is far more difficult to implement than a standard geostatistical interpolation of the parameters by kriging or cokriging, ignoring rock types. It assumes (i) that we have defined rock types in cored wells, (ii) that we can extend them to uncored wells, and (iii) that we can extend the rock types to the whole field.

Given the difficulty to interpolate a categorical variable such as a rock type number we propose a simplified stochastic model whereby the geologist draws mini/mode/maxi rock type contours from which a rock type probability vector is assigned to each grid node. Rock types are then simulated using a P-field technique. For petrophysical parameters we have the choice between classic Monte-Carlo using distributions adapted to each rock type, or more elaborate conditional simulations if matching the wells is important. A case study will be presented.