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Rock typing for reservoir prediction – a frequently misunderstood concept

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Studies of subsurface reservoirs aim to integrate information of various disciplines including geophysics, geology, petrophysics and reservoir engineering. The ideal workflow starts with characterising the reservoir in all its aspects and subsequently constructing tailored static and dynamic models. This workflow is independent of the study purpose, including hydrocarbon production, subsurface storage or geothermal exploitation. And, getting the basics right is a pre-requisite for studying more complex topics related to fracturing, EOR or CO_2 sequestration. Due to the nature of reservoir data, most of the information is concentrated along the wellbores. The much larger area between wells is at best covered by 3D seismics, which can provide reservoir property trends at low vertical resolution. Reservoir performance, in contrary, is dominated by the characteristics of the poorly defined inter-well space. So, high quality subsurface models require ground truth between wells. How to best estimate reservoir properties away from data points? Available tools in interpolation and property modelling include geostatistics and the use of secondary trend data like seismic attributes or facies models to steer property distribution. Good practice is, to first model the property best defined at wells and for which secondary trend data is available. This property usually is reservoir matrix porosity. Other properties are modelled using their dependence on porosity, like a porosity – permeability relation or subsequently a permeability – water saturation relation, as controls. Doing so, secondary trend data for porosity indirectly control all subsequent properties, thus subsurface resources distribution. This procedure fails in case property interrelationships are not unique. A potential solution is to classify reservoir rocks such, that property inferences are unique in each class. A jargon term of suchlike classification is “rock type”, although a unique definition is not established since rock types vary from reservoir to reservoir. An example is a North Sea oil field consisting of chalk spanning the Maastrichtian-Danian stratigraphic boundary. Lithology and porosity change only marginally at the stratigraphic boundary but nanoplankton species size, thus pore geometry changes. In this case, two rock types refer to stratigraphic zones differing, at the reservoir average porosity of 25 %, by a factor of 10 in permeability and a factor of 2 in irreducible water saturation. Another example is a condensate field in the Mediterranean, made up of fossiliferous limestone. Rocks of similar depositional facies show similar permeability but differ in porosity by a factor of 2. These two modelling rock types were found to differ in the amount of micropores but not in the permeability controlling pore throat size. Reservoir models with predictive power honour relationships of properties, particularly in the space between wells. Model construction calls for case specific rock types to be populated separately, in addition to the first property. Consequently, additional secondary trend data for this rock type model is needed. These indirectly control distribution of properties constrained to the rock types. Ideally, rock types are tailored by specialists in an interdisciplinary team – they are essentially human made. This finding contradicts industry trends propagating automatized default workflows and artificial intelligence.