Facies analysis of an Upper Jurassic carbonate platform for geothermal reservoir characterization

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The Upper Jurassic Carbonate platform in Southern Germany is an important aquifer for the production of geothermal energy. Several successful projects were realized during the last years. 3D-seismic surveying has been established as a standard method for reservoir analysis and the definition of well paths. A project funded by the federal ministry of economic affairs and energy (BMWi) started in 2015 is a milestone for an exclusively regenerative heat energy supply of Munich. A 3D-seismic survey of 170 square kilometer was acquired and a scientific program was established to analyze the facies distribution within the area (http://www.liag-hannover.de/en/fsp/ge/geoparamol.html).

Targets are primarily fault zones where one expect higher flow rates than within the undisturbed carbonate sediments. However, since a dense net of geothermal plants and wells will not always find appropriate fault areas, the reservoir properties should be analyzed in more detail, e.g. changing the viewpoint to karst features and facies distribution.

Actual facies interpretation concepts are based on the alternation of massif and layered carbonates. Because of successive erosion of the ancient land surfaces, the interpretation of reefs, being an important target, is often difficult. We found that seismic sequence stratigraphy can explain the distribution of seismic pattern and improves the analysis of different facies. We supported this method by applying wavelet transformation of seismic data. The splitting of the seismic signal into successive parts of different bandwidths, especially the frequency content of the seismic signal, changed by tuning or dispersion, is extracted. The combination of different frequencies reveals a partition of the platform laterally as well as vertically.

A cluster analysis of the wavelet coefficients further improves this picture. The interpretation shows a division into ramp, inner platform and trough, which were shifted locally and overprinted in time by other objects, like lagoons or reefs and reef mounts. Faults within this area seem to be influenced by the facies distribution and otherwise, the deformation along the faults also depended on different lithologies. The reconstruction of the development of the carbonate platform can give hints also to erosional and karst processes. The results will be included into a numerical modelling of the geothermal reservoir to analyze the interaction of geothermal wells.