BGP-T1: **Lithology Determination by Cluster Analysis of Borehole Geophysical Data: Case Study of the Sedimentary Basin in Thuringia, Germany**

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In sedimentary basins, the identification of the lithological composition of rocks recovered from deep drilling and the characterization of their physical properties are essential to describe a basin's reservoir potential and to understand the functioning of its fluid systems. However, as coring is expensive, boreholes are often only partially cored and sometimes not cored at all. Thus, to identify lithology from geophysical logs would provide very valuable information.

In order to estimate lithology from borehole geophysical data, we evaluated several cluster analysis algorithms (Ward hierarchical clustering, k-Means, Mean-Shift and DBSCAN). We also tested high-dimensional clustering with the DBSCAN algorithm employing several geophysical logs (gamma log, density log, caliper log, porosity log, sonic log) to extract an amount of information as high as possible.

We focus our analysis on the Thuringian Basin (Germany), a well-confined, easily accessible intra-continental sedimentary basin by applying density-based spatial clustering (DBSCAN) to the 1179 m meter deep scientific borehole EF-FB 1/12, drilled in the center of the Thuringian Basin during the recent INFLUINS deep drilling campaign. Extensive borehole geophysical measurements were undertaken along the whole depth to determine the borehole characteristics and in-situ rock geophysical properties in the open hole. In addition, rock physical properties were characterized on all core samples (533 m in total) with a Multi-Sensor Core Logger (MSCL) in corporation with the Federal Institute for Geosciences and Natural Resources (BGR) in Berlin-Spandau. These core measurements were used to improve a cluster analysis with DBSCAN algorithm for boreholegeophysical data.

We were able to characterize the lithology of the EF-FB 1/12 borehole with minor restrictions due to uncertainties. With the help of the DBSCAN algorithm, it was possible to reveal sequences of changing lithology on the meter-scale. Thus, sub-formations like the Middle Dolomite (6 m thick) of the Middle Muschelkalk (Triassic) were automatically identified, as well as embedded layers of anhydrite and mudstone (a few meters thick) in between the rock salt of the Salinarröt-formation in the Upper Buntsandstein. Information from MSCL measurements allowed a validation of the cluster analysis results for almost the half of the borehole section length.