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Multi-Seismic Attribute and Petrophysical Studies for a Low-Temperature Geothermal Field in the Netherlands

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ABSTRACT

This study shows an integrated framework for characterizing a potential geothermal reservoir in a prospective field near the city of Emmen, which is adjacent to the Schhonebeck oilfield in the Netherlands. The Schhonebeck is an old, depleted oilfield, which has some potential for geothermal exploration. Recent studies indicate the economic viability of a 1.5 megawatt thermal (MWth) geothermal plant in this area, without government subsidies. The study area is situated on the western flank of the Lower Saxony Basin, spanning over Germany and Netherlands. The basin formed due to the Mesozoic crustal extension and wrench faulting. The basin underwent several igneous intrusions, and some parts of the basin also went through rapid subsidence, followed by structural inversion (during the Cretaceous period), resulting in local thermal anomalies.

The study utilizes one large 3D seismic survey and three wells with conventional wireline logs and temperature data. The temperature gradient varies between 1.6 degF/100 ft to 2.27 degF/100 ft. Based on the petrophysical data and regional mapping, the top depth and average thickness of the Cretaceous Bentheim sandstone reservoir are 4800 ft and 200 ft, respectively. It has a porosity of ~25%.

Different seismic attributes such as coherence and curvature are used to delineate structural features. The most-negative curvature attribute was found to be the best seismic attribute to illuminate the intersecting normal fault network. The Bentheim sandstone is also affected by several basement-rooted faults. There are two fault orientations: N–S (younger) and E–W (older). A large graben structure affected the Bentheim reservoir. Future work involves studies on the potential of fault slip and induced seismicity due to water injection. Such studies can also be helpful to convert depleted oilfields, close to population centers, to geothermal fields.

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