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Well Integrity Monitoring Using Distributed Fiber Optic Sensing

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SUMMARY

New concepts are required to accelerate the global development of high-temperature geothermal resources in a cost effective and environmentally safe way. Keeping the geothermal system in operation for several decades is challenging - yet key to economic success. Real-time monitoring of temperature and strain along the well bore is a powerful tool to evaluate the performance and integrity of installed subsurface components.

A fiber optic cable was installed behind the casing of a high temperature geothermal well in Iceland (IDDP2). A second cable was installed in a low temperature well in Germany. During cementation, distributed strain data (Rayleigh backscatter) as well as distributed temperature sensing data (Raman backscatter) was acquired. In a subsequent measurement campaign, data shall be acquired in these wells during load changes (production/injection).

In combination with concurrent laboratory investigations and conventional borehole logging data, this study will identify processes influencing the long-term integrity of casing and cement in high-temperature geothermal environments.

Introduction

In order to increase the lifetime of a geothermal well and to allow for a safe operation, the structural integrity of casing and cement is of utmost importance. In geothermal wells, large temperature and pressure changes during production/injection as well as shut-in periods lead to strong variations of the thermal and mechanical load onto the subsurface construction. To study the performance of casing and cement during varying load conditions as well as to identify processes influencing the integrity of casing and cement, this study focuses on real-time distributed fiber optic well monitoring technologies.

A fiber optic cable was installed behind the casing of a high temperature geothermal well in Iceland (IDDP2) in September 2016. A second cable was installed in a low temperature well in Berlin, Germany in March 2016. During cementation, distributed strain data (Rayleigh backscatter) as well as distributed temperature sensing data (Raman backscatter) was acquired. In combination with conventional borehole logging data, the fiber optic data is used to evaluate the cement deposition as well as the cement setting. Data will be compared to previous studies focusing on DTS data behind casing alone. Using data acquired during installation as a baseline, the temperature and strain evolution during thermal load changes, i.e. production of high temperature geothermal fluid, will be acquired in a subsequent field campaign in summer 2017. Concurrent laboratory investigations are performed to calibrate the measurement system under varying load – temperature and strain – conditions. Preliminary results from laboratory as well as field observations will be shown.

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