GeoWell: Monitoring of gravel packing and cement pumping with distributed fiber optic strain sensing

Martin Lipus, Co-Autoren: Dr. Thomas Reinsch, Dr. Cornelia Schmidt-Hattenberger, Dr. Jan Henninges, Prof. Dr. Matthias Reich
GFZ Potsdam, 6.2. Geothermische Energiesysteme

Keywords: Well integrity, fiber optic

Borehole integrity is a fundamental challenge in the successful and sustainable utilization of hydrocarbons and geothermal energy. This study investigates the monitoring potential of fiber optic distributed strain sensing (DSS) which is permanently installed behind casing of a low temperature geothermal well in Berlin, Germany. Similar to fiber optic distributed temperature sensing (DTS), which is established in industry applications for more than 2 decades, each location of the fiber additionally conveys information about the mechanical stress state when interacting with a laser pulse which is sent through the fiber. Laboratory as well as analytical work was done to quantify the effect of load changes on a fiber which is embedded in a complex multilayer downhole cable. The presented field data shows results from two work stages of the well completion – the gravel packing and cementation. Due to the density difference of gravel and drilling fluid, a strain effect is measured on the cable which correlates with wireline gamma-gamma density logging data that was measured simultaneously. Subsequent consolidation of the gravel head, which remained unrevealed by the logging campaign, was captured by the fiber optic cable in form of an increasing mechanical load on the cable. During cement pumping, fluid shear stresses generate a measureable strain on the cable. The magnitude of these forces can be used to estimate rheological parameters such as fluid density and viscosity of the pumped medium. A laboratory experiment was conducted to verify the measurements. DSS measurements have the potential for a novel approach to understand and quantify cement jobs in real-time. AcknowledgementsThe study has received funding from the European Union’s Horizon 2020 research and innovation program under grant agreement No 654497.