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Acoustic Wave Stimulated Enhanced Oil Recovery

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High demand and the finite oil deposits will be a problem in the future. To temper the impact of a shortage in crude oil, a lot of research in the field of enhanced oil recovery (EOR) is worldwide ongoing. Using seismic waves to stimulate recovery of oil is known as seismic-EOR. The development of a stimulation procedure using seismic sources and the evaluation of the obtained data in a real oil field is the aim of the project WAVE.O.R. The project is funded by the German scientific society for oil, gas and coal (DGMK).

The Technical University of Freiberg (TUBAF) and the German Research Center for Geosciences (GFZ) in Potsdam developed a flooding cell connected with magnetostrictive actuators as sources for seismic energy. This device is eligible to survey the impact of different seismic stimulation parameter like frequency, alignment, amplitude and rock characteristics on oil recovery.

The obtained laboratory data of flooding experiments using seismic waves were analyzed for key features like water breakthrough point, oil recovery and oil fraction. New approach has been developed, which consists of the connection of a principal component analysis with a clustering algorithm. This new technique allows us a better understanding and thus prediction of the recovery behavior of oil bearing sediments.

The experiments show promising possibilities to enhance oil recovery with seismic stimulation. Especially the combination of different frequencies between 100 Hz and 4000 Hz had a positive impact on oil recovery. The responsible mechanisms were identified and discussed.

Data obtained with the laboratory device will be applied in a field test using a borehole device developed by the GFZ in the project “Seismic Prediction While Drilling” (SPWD). For this purpose experiments are conducted to obtain the radiation pattern of the seismic sources used by the SPWD device in a borehole. In addition, the development of a control setup for the 1-D actuator array is an aim of the research. This project shows the possibilities of enhanced oil recovery established by the development of new seismic borehole equipment.