

## **Extending the Magnitude Range of Seismic Reservoir Monitoring by Utilizing Hybrid Surface – Downhole Seismic Networks**

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### **Abstract**

We analyze seismicity recorded over the full range from –M3 to M3 as related to a water flood injection program in a carbonate hydrocarbon reservoir at ~2km depth. Data is recorded with a hybrid monitoring seismic network comprised of downhole arrays of 4.5 Hz and 15Hz omnidirectional triaxial geophones and surface stations consisting of force balance accelerometers to increase the dynamic range of recordable signals. We analyze the seismic characteristics of these events with two goals in sight, first to assess and improve the reservoir monitoring networks capability, and second to understand the underlying generation mechanism of the larger local events. Understanding the network capability and the reservoir seismicity is fundamental towards an improved reservoir management system.