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In Situ Accurate Flow Diagnostic using Innovative Ultra Compact Production Logging Tool

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Abstract

Quantifying downhole flow in deviated wells and multiphasic environments requires to determine robust and accurate phase holdups with low detection levels, estimate flowspeed in absence of working mechanical flowmeter measurements, whilst toolstring length and well access may challenge the acquisition survey.

A compact array production logging (PL) tool was designed with miniature sensors based on MEMS technology (microelectromechanical systems) with centralised measurements as well as collocated `

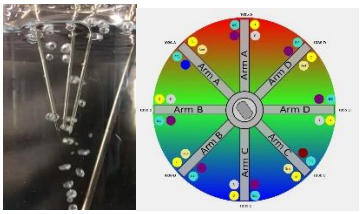

Figure 1: Local Array Probes and Cross-section of 2 combined Array Production Logging Tools.

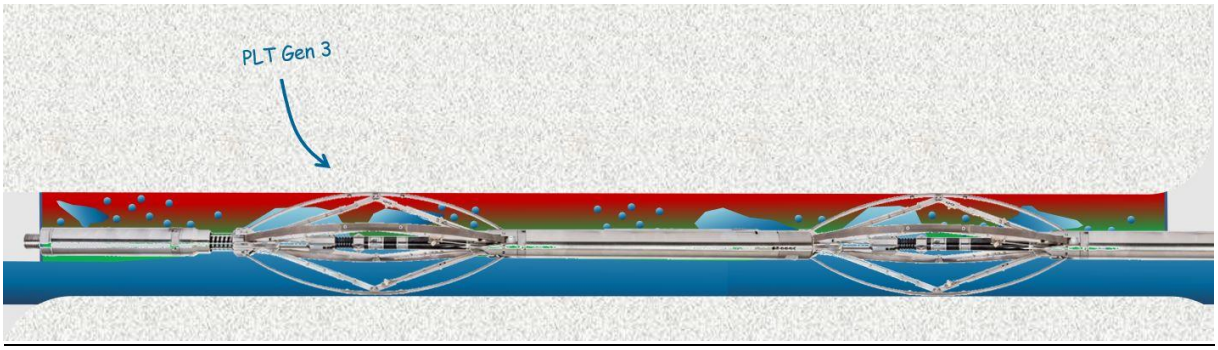

Figure 2: Array PL Tool Gen 3- SPE#196188 [2]

The tool compactness and weight showed major benefits in unconventional wells in a joint distributed fiber optic survey [5] of access and constraining the multiphasic flow profile with carbon rod as a taxi. In wells with very small fluid fractions of less than 3% and with water recirculation, point holdup sensors coupled with micro-spinners allowed to measure hydrocarbon flowrates where conventional sensors failed in that objective [8]. The ground breaking Doppler measurement allows to measure flow speed in low flow environment and presence of debris in suitable conditions

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([3],[4],[6], [7], [9]). As much as for oil and gas well, the dynamic characterization of a geothermal reservoir is key to understand early on the reservoir heterogeneity, connectivity and deliverability and to optimize the production of a geothermal power plant. Even with a comprehensive set of static measurements at various scales (seismic, logging, core) and its inferred dynamic predictions, the dynamic behavior of a reservoir can only be appreciated through dynamic testing. In situ dynamic testing was carried out in a multi-lateral deviated producer and in an injector drilled through a Jurassic limestone in Paris Basin [10]. Flow profile acquired across the reservoir section with the PLT string was compared to cumulative permeability from the static description, which highlighted higher level of heterogeneities than assumed.

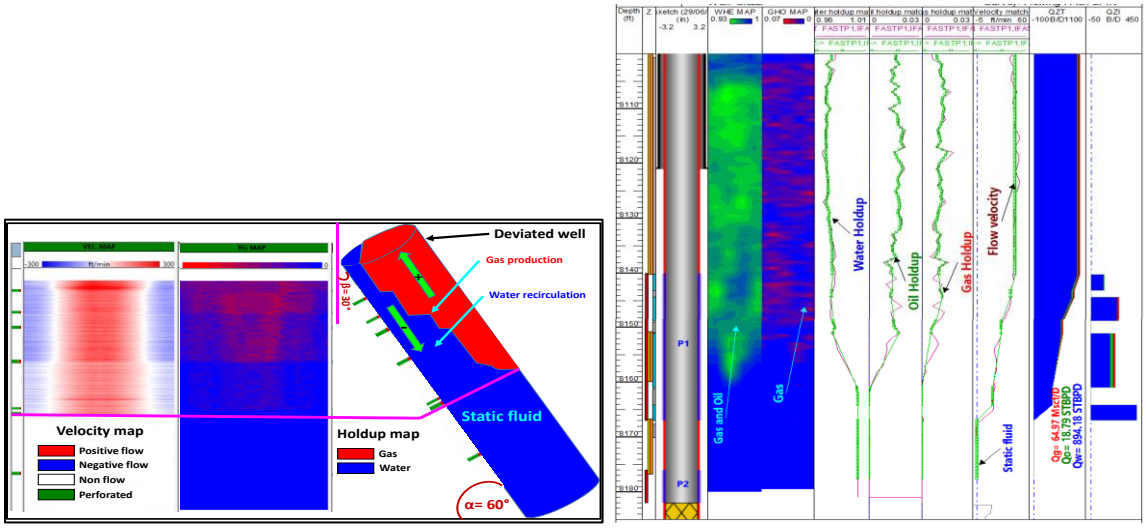

Figure 3: Water recirculation, SPE 205803 ref. [8]

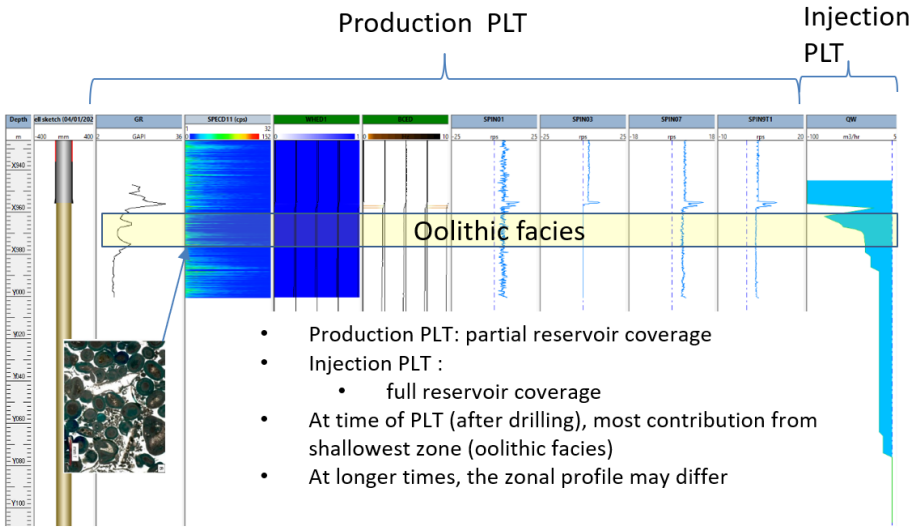

Figure 4: PLT acquired in geothermal Producer and Injection Wells [10].

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BIO

Virginie Schoepf is a senior petrophysicist in Openfield Technology and is a member of the SPE, SPWLA and IAH. Virginie started her career with Schlumberger as a development engineer in France and later moved to a log-analyst role in production petrophysics. She held the position of petrophysicist ENGIE (former GDF SUEZ) and BP. She holds a MS degree in geophysics from Ecole de Physique du Globe de Strasbourg.