

## **BOREHOLE GRAVITY EXTENDED TO HIGHLY DEVIATED WELLS.**

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In response to current horizontal well technology, the latest borehole gravity logging tools are now capable of measurements in wells deviated from vertical to past horizontal. Historically oil and gas field borehole gravity data have been presented in the form of deep investigation, through casing, density logs, where the borehole gravity density is proportional to the vertical gravity gradient. This provides an excellent way to measure total porosity in heterogeneous carbonate reservoirs due to the large sampling volume. However the simple BHG density calculation is no longer applicable in horizontal wells and the data are similar to surface gravity profiles with differences due to being imbedded within or in close proximity to the target horizons.

Data acquisition in highly deviated wells brings new challenges largely associated with tool positioning. One mode of running the tool involves using a tractor to push the tool to the end of the well and then pulling back along hole to pre-set station locations. This can result in noticeable cycles of tool sticking and then rapid up-take, making it challenging to place a tool accurately at a pre-determined location.

Data processing for highly deviated BHG well logs has to take into account the well geometry to establish accurate 3 dimensional coordinates for each gravity station. Latitude corrections and terrain effects also assume more significance.

Time lapse monitoring of gravity changes in can be made much closer to or within the reservoir. The difference signal between logging runs is then solely due to the changes in the reservoir fluids or changes in porosity associated with formation fracturing. Data from single logging runs are influenced by all surrounding rock formations.