**Downhole Gravity Gradiometry: A New Technique for Prospect and Reservoir Modeling?**

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With modern E&P geophysics, potential field methods have overcome their classic limitation to reconnaissance surveys; nowadays they are standard procedures for prospect level applications, and reservoir scale studies are no longer exotic.

Over the last decade new tools for measuring gravity gradients emerged on the oil and gas exploration market. As their focus lies particularly on detecting rock density contrasts in short to medium distances, borehole utilizations are obvious. Compared to surface measurements gradient surveys in a well would benefit from the closer distance of the instrument to the causative sources, i.e. to the geological targets.

Gravity gradiometry in boreholes was described first in 1989, and a few studies addressed possible applications. However, motivated by novel downhole instrument developments, and with advanced 3D modeling, inversion and visualization tools available, the integration of gradient data from wells into modern interpretation workflows can be realized, and their benefits for geological reliability evaluated.

Thus the focus of our study is on the interpretation side, and a couple of scenarios aiming to reduce subsurface uncertainty (or model ambiguity) will be presented. All forward calculations and inversion routines are based on a 3D voxel model with a flexible density allocation and an adaptive geometry definition by horizon grids and triangulated geobodies.

In the first case we discuss 4D reservoir monitoring applications with borehole gravity gradients, and why the expected results are feasible up to distances of 10s to 100s of meters. The second example demonstrates the value of surveying directional gradients in the well, particularly for identification of dipping horizons. Finally, the benefits of integrating downhole gravity tensor data into classic 3D structural interpretation are estimated by applying advanced inversion evaluation tools. It is shown that a typical base of salt horizon could be defined significantly better if gradient data from a well were available.

This study's results show that subsurface modeling can increasingly benefit from borehole gravity gradiometry, not only due to the decreased distance to the target, but also due to its lateral sensitivity. Proper constraints and parameter correlations as well as appropriate modeling and inversion tools are required to gain maximum advantage of the method, extend its limitations, and fully integrate it into joint interpretation workflows.