The Routine Application of Non-Seismic Geophysics to the Direct Detection of Gas Charged Quaternary Channels in Alberta and British Columbia

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Since 1993, the existence of very shallow (less than 100 m depth) Quaternary gas reservoirs have been known to exist in northwestern Alberta. These reservoirs are Quaternary glacial meltwater channels with a till or lacustrine clay trap. The reservoirs have been produced only since 1998. Individual wells in the Sousa field have reached flow rates of as high as 4.4 mmcf/d (6-13-112-24W5). Cumulative production in wells in the Rainbow field have exceeded 1 bcf. Due to the extremely shallow nature of the prospects, seismic reflection has been unsuccessful in exploring for these gas charged channels. Not only is seismic reflection incapable of imaging the specific physical property of diagnostic interest, resistivity, but the fold coverage of a typical reflection survey is inadequate for the required resolution. The use of tighter group spacings, higher frequency geophones, and customized processing techniques for seismically imaging near surface features on a production scale would be cost prohibitive.

Since 1999, cost-effective two-dimensional (2-D) geoelectrical imaging techniques have been applied to this prospect with spectacular results, not only in imaging the channels, but in directly detecting economic gas deposits. The product of a 2-D imaging survey is a true geoelectric section, that is, a cross-section of true resistivity versus true depth. Since 1999, over 3,000 km of this type of data collection has been carried out in northwestern Alberta. Over 1,000 km of these surveys have been carried out elsewhere in Alberta in search of a similar play concept.

The practical implementation of 2-D resistivity in field exploration has only been available since 1997. Only since then has there been the combination of solid state relay units capable of addressing hundreds of electrodes, the moderately powered transmitters capable of putting sufficient current into the earth, and robust inversion algorithms and software capable of handling large volumes of “pseudo” resistivity and depth data and produce “true” geoelectric sections.

This presentation will show numerous examples of electrically imaged gas charged channels, both in northwestern Alberta and elsewhere in the Alberta. The fundamental physics behind the method, field implementation, 2-D electrical inversion, logistical constraints, and inherent limitations of the method will also be discussed.