Earthquakes Alignments Linked to Hydrocarbon Sweet-spots in the Western Canadian Sedimentary Basin

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Alternate fault activity can be demonstrated using 4D views of earthquakes in areas where seismic events are frequent. Examples studied and published by the author includes the December 26th 2004 Aceh earthquake that led to the infamous tsunami and the New Madrid Seismic Zone in the central part of the USA known for a sudden 90 degree change in river pattern in 1812.

For this subsequent study, the Canadian government available data that was used encompasses 11,800 earthquakes in Western Canada, 1,024 of which are located in Alberta.

The general picture in British Columbia is that of many major west-plunging and south-plunging seismic planes. In Eastern BC, our 3-D earthquake analysis shows a series of large seismic trends of similar strikes but variable dips, these are subparallel to hydrocarbon trends from the Rocky Mountain Foothills further to the East.

In Alberta, the number of earthquakes recorded does not allow identification of any major plane encompassing many seismic events. However, 2D and 3D analyses covering Alberta, BC and part of Montana unraveled deep seated patterns of direct interest to the oil industry: many anomalous producers are perfectly aligned with seismicity trends.

Thus, in Alberta a different series of rules and methods had to be applied to decipher patterns of interest. Rule 1: as earthquakes are commonly located at the crossing between faults, each earthquake site can be used to define two separate fault trends. Rule 2: regular spacing between faults can be used as a guide to define the structural grain in the Alberta Plains.

A map based approach and some outstanding results will be outlined with three selected structural directions common in Alberta, North 93, North 9 and North 72 degrees. The former corresponds to deep seated faults commonly reactivated in left lateral strike-slip mode, the other two directions are respectively the antithetic and synthetic Riedel shears. Examples of Hydrocarbon sweet spots linked to such earthquake trends will be taken from Paleozoic carbonate and Cretaceous sandstone fields.