The Stress Regime of the Liard Basin, western Canada

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GeoConvention 2012:Vision

Summary

As part of the Federal Geo-mapping for Energy and Minerals (GEM) Program, an in-situ stress analysis was undertaken in Liard Basin region to assess regional stress orientations and magnitudes; and determine what influences create local perturbations (Bell, 2012). Stress trajectory maps provide useful information for hydrocarbon production strategy. Induced fractures at depth are likely to be vertical and aligned with the maximum horizontal stress. Also, fractures in such orientations are more likely to be open and thus provide preferred flow pathways for formation fluids. The study area includes northeastern British Columbia and adjacent Yukon and Northwest Territories. Only 49 wells were found suitable to provide stress orientation information, all but two from borehole breakout orientations. Accordingly, some of the conclusions must be considered preliminary. A regional horizontal stress trajectory map is broadly consistent with that of the broader Western Canada Sedimentary Basin (Fig. 1). A pronounced deflection of the regional stress trajectories is evident within the area bounded by the mountain front and the Bovie Fault. Local perturbations may relate to proximity to faults close to the foothills, or to the Slave Point edge/Arrowhead Salient farther east.

A broad regional selection of 64 wells provided density log data from which vertical stresses and effective vertical stresses were mapped. Vertical stress magnitudes were mapped at various depths. At depths of 500m and 1500m, they display complex local variations superimposed on a general trend of westward-increasing magnitudes.

Horizontal minimum stress data are limited by a regional scarcity of leak-off test data, and what data were available were concentrated in only two areas. Accordingly, these data are more generalized and apply to a somewhat more restricted area. Finally, vertical stress and minimum horizontal stress magnitude estimates were used to model maximum horizontal stress gradients and magnitudes using breakout simulation techniques, for 27 wells where well-developed breakouts were available. From these models a preliminary map of the regional S_{Hmax} gradient was also produced (Fig. 2).

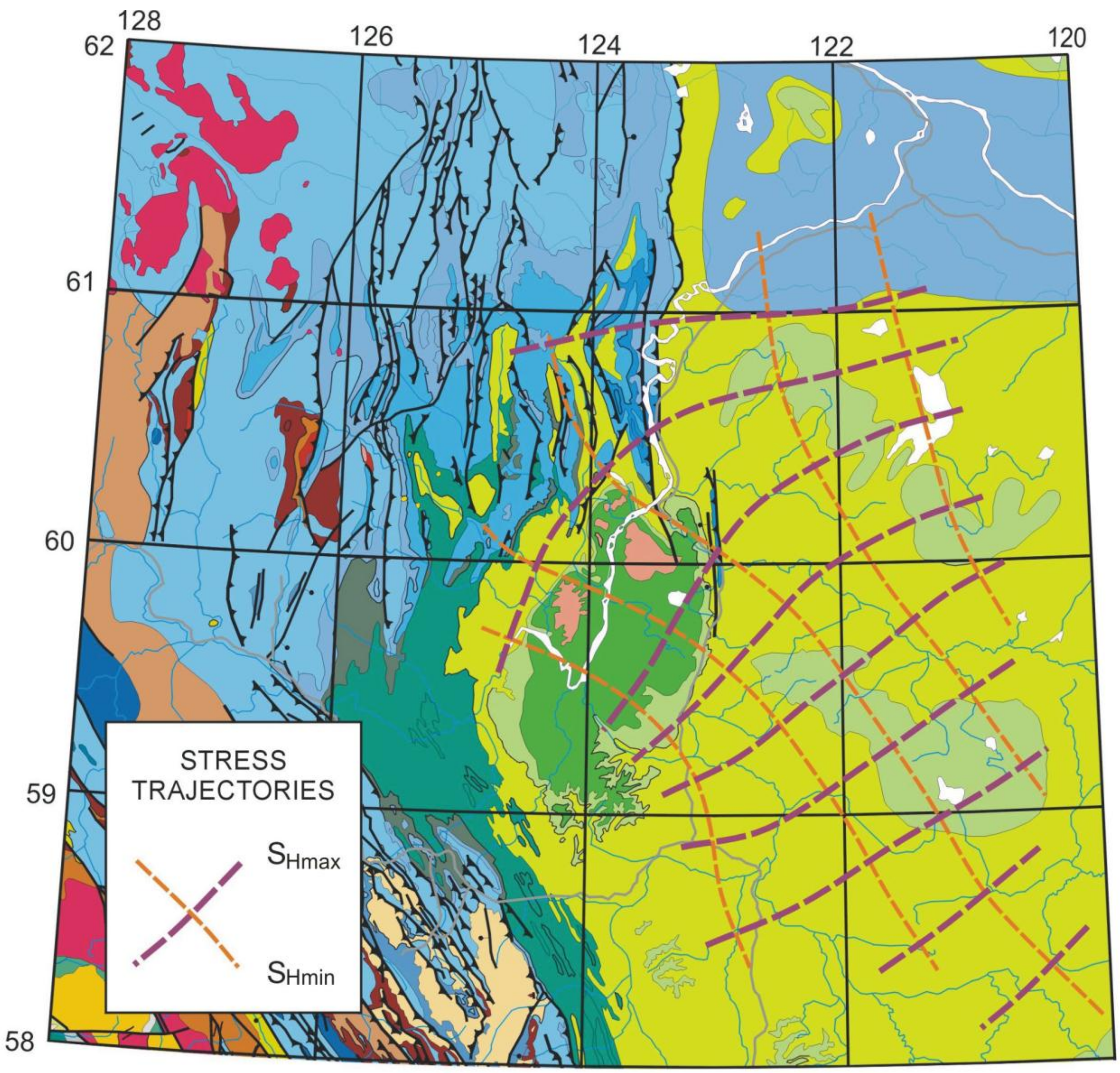

Figure 1. Horizontal stress trajectories across Liard Basin, inferred from orientations of breakouts and drilling-induced fractures (Bell, 2012).

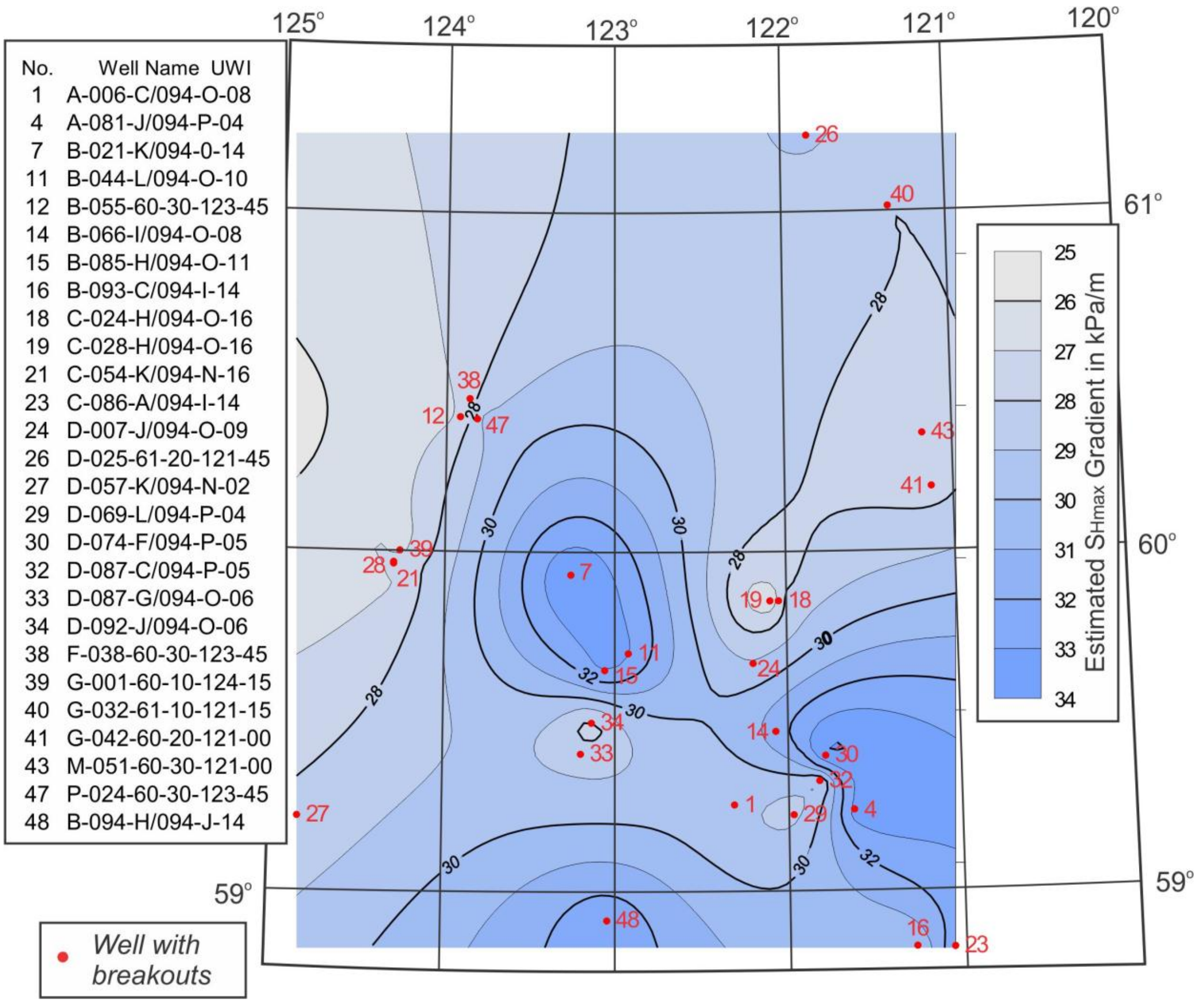

Figure 2. Contour map of estimated S_{Hmax} gradients derived from S_{Hmax} magnitudes based on modelling breakout failure in 27 wells in Liard Basin (Bell, 2012).

References

Bell, J.S., 2012, In-Situ Stress Orientations and Magnitudes in the Liard Basin of Western Canada: Geological Survey of Canada, Open File 7049, 1 CD-ROM.