In-situ Stress Regime in Cretaceous-Age Strata of Southwest Saskatchewan

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In-situ stress regime can have a strong influence on coalbed methane (CBM) development. For example, in-situ stresses control coal permeability, hydraulic fracture pressures and geometries, and borehole stability (which is especially important in horizontal drilling operations). This paper will present the results of an investigation of in-situ stress magnitudes and orientations of selected Cretaceous-age strata in southwest Saskatchewan. Specifically, the results focus on stresses at three "benchmark" horizons:

(1) the top of the Lea Park Formation (which immediately underlies the Belly River Formation, which contains coal strata);
(2) at the top of the Mannville Group (which also contains coal strata); and
(3) the top of the Viking Formation (for which the most complete dataset of minimum horizontal stress measurements was available).

Vertical stress (σV) magnitudes and gradients have been calculated by integrating bulk density logs from 250 wells in the study area. Contour maps showing these results at the three benchmark horizons will be presented. σV magnitudes are dominantly controlled by depth, and σV gradients in these strata typically range from 22 to 23 kPa/m.

The magnitudes and gradients of the minimum horizontal stress (σHmin) have been estimated using hydraulic fracture treatment records. Contour maps showing these results at the three benchmark horizons will be presented. σHmin magnitudes are affected by depth of burial, pore pressure, lithology and erosion. σHmin gradients in the benchmark horizons typically range from 17 to 23 kPa/m.

Borehole breakout orientations were analyzed to interpret the orientation of the maximum horizontal stress (σHmax) in the study area. A horizontal stress trajectory map will be presented. σHmax orientation is approximately NE-SW throughout the study area (47°, with a circular standard deviation of 12°), with a notable inflection overlying the Swift Current Platform.

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