Brooks Revisited

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ABSTRACT

The first CO_2 injection well was drilled in 2015 at the Containment and Monitoring Institute's Field Research Station near Brooks, Alberta. We used well logs from the new well to compare our pre-drill depth estimates of formation tops with those encountered in the well. Our estimate of the depth of the target Basal Belly River Formation, which we had derived from the seismic data interpretation tied to existing wells, was about 3.5 m high. Our estimate of the top of a 2-m thick sand near the top of the Medicine Hat Formation was 3 m high. Our predictions of the shale content in the Belly River Formation above the target injection zone are supported by gamma ray log and lithology data from the new well.

We created synthetic seismograms from the dipole logs acquired in the new well. The PP and PS data show good character match between the seismic data and the synthetic seismograms. We also updated the post-stack joint PP-PS inversion to 550 m by using the new dipole logs.

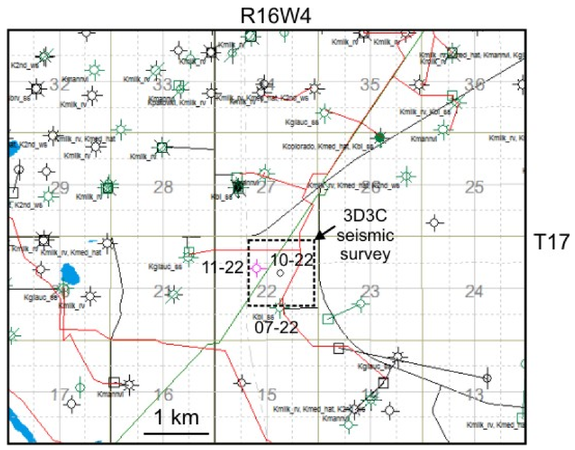

Figure 1. The study area near Brooks, Alberta. The new injection well is 10-22-017-16W4M.

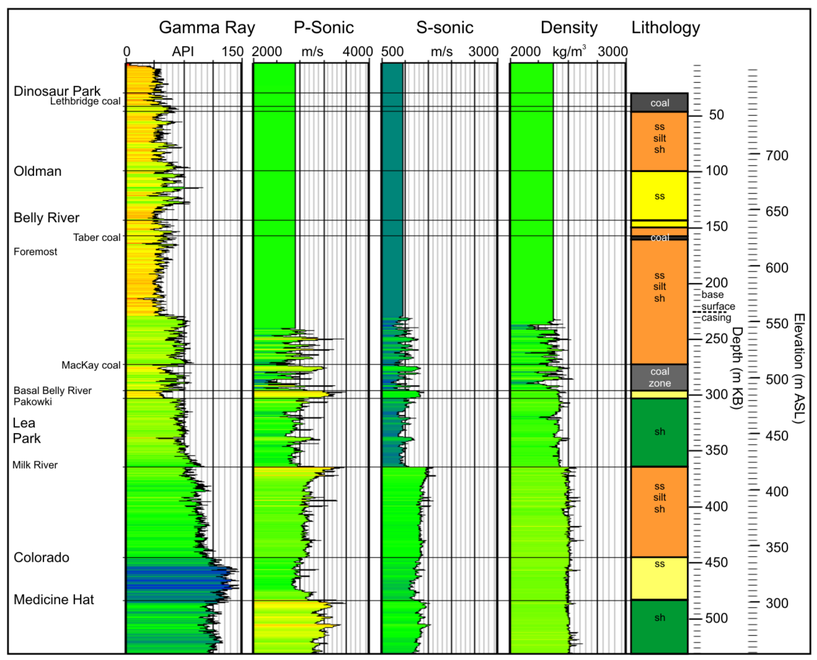

Figure 2. Gamma ray, sonic and density logs from the new well, and the lithology (courtesy Schlumberger).

We predicted the depth of the top of the Basal Belly River sandstone to be 492 m, a thin sand near the top of the Medicine Hat Formation to be 284 above sea level (ASL), and the Basal Belly River to be 5-7 m thick. The sand tops came in at 489.5 m and 281 m ASL, respectively, and the Basal Belly River sandstone is 6.5 m thick. Based upon the maps of gridded well tops and the traveltimes from the 3D seismic data interpretation, we had expected the top of the Basal Belly River sand to be at a depth comparable to that in 07-22-017-16W4M, which is 492.6 m ASL .

Figure 2 shows the gamma ray, P-wave sonic, and density logs from this well, and the interpreted lithology (courtesy Schlumberger). Surface casing was set to 226 m KB, and the gamma ray log is uncalibrated above this depth while the other logs do not start until below this depth.

Figure 3 is an expanded view of the lower Belly River correlated to the two other wells in Section 22. The background is coloured green and yellow to indicate shale-prone or sand-prone zones, based upon the gamma ray log values.

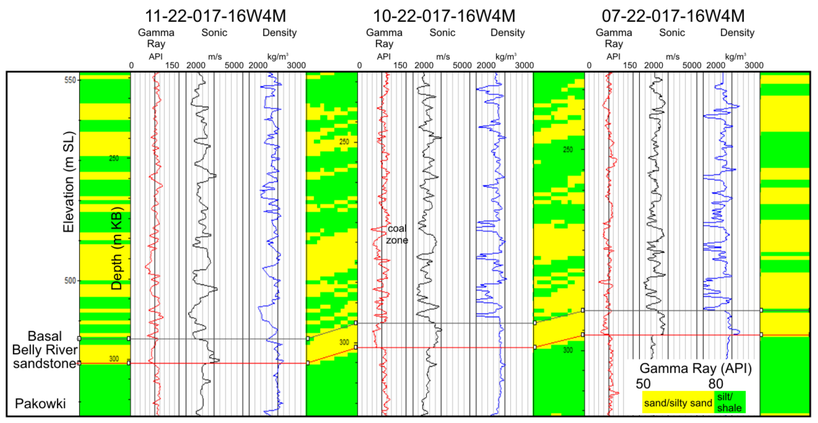

Figure 3. Correlation of the Basal Belly River through the three wells in Section 22.

The logs run in the new injection well included both P-wave and S-wave sonic logs, which we used to create synthetic seismograms. We generated a PP multi-offset synthetic seismogram (Figure 4) using a wavelet extracted over a 200-800 ms window from traces around the well location. The target Basal Belly River unit is thin (6.5 m), and is close to the tuning thickness for the wavelength of approximately 45 m. The character match is good and we are able to confirm the tops of the Basal Belly River, Milk River and Medicine Hat formations.

In Figure 5 we show the tie for the PS synthetic seismogram with the PS seismic data. The wavelet was extracted over a 0-1000 ms window from traces across the survey. The character match is very good and we are able to identify reflections to a PS time of 0.8 s.

We also ran a new post-stack joint PP-PS inversion using only the dipole logs from the new injection well. Figure 6 shows the inverted Vp/Vs for line 101, plotted on the PP seismic data. We intend to compare this estimate of Vp/Vs with that obtained in the future after CO_2 injection.

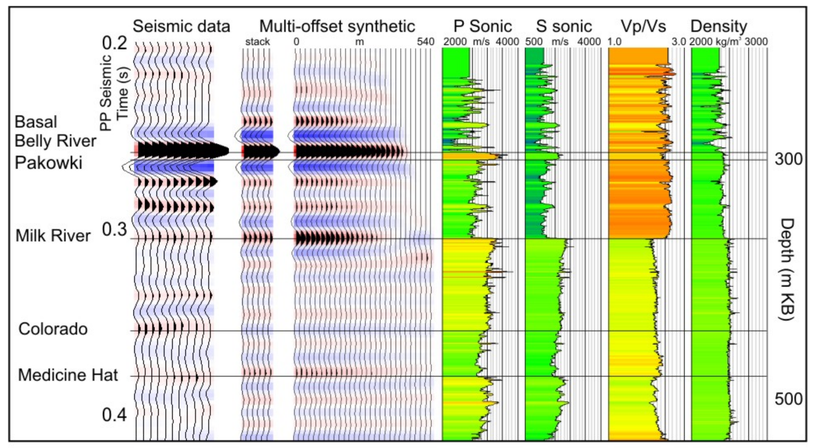

Figure 4. Multi-offset PP synthetic seismogram correlated to the PP seismic data.

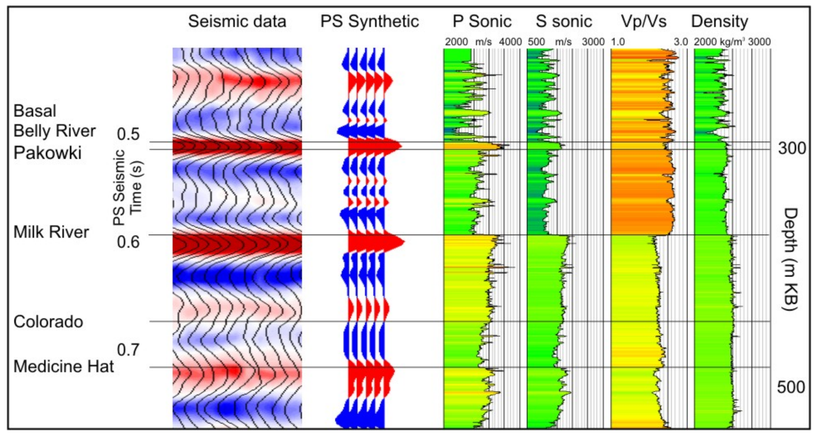

Figure 5. PS synthetic seismogram correlated to the PS seismic data.

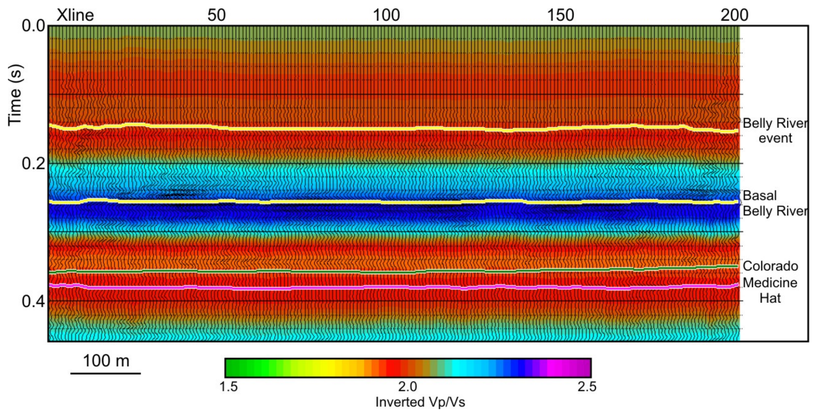

Figure 6. Vp/Vs from the joint PP-PS post-stack inversion.

ACKNOWLEDGEMENTS

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