

ECOJUSTICE REPLY TO PTRC RESPONSE TO SOIL GAS STUDIES

On January 19, 2011, the Petroleum Technology Research Centre (“PTRC”) released its *Response to a Soil Gas Study Performed by Petro-Find GeoChem Ltd.* (the “*PTRC Response*”). In the *PTRC Response*, the PTRC expressed the opinion that the soil gas studies conducted by Petro-Find GeoChem Ltd. (“Petro-Find”) on behalf of the Kerr family did not contain any substantiated evidence to support the claim that the CO₂ found on the Kerr property originated from the Weyburn reservoir. Further, the PTRC stated that the phenomena observed at the Kerr property can be explained by near surface processes including microbial generation of soil CO₂ and methane.

The Kerrs have observed dead animals on their property, gas under pressure entering ponds on their property and what appears to be a hydrocarbon sheen on the ponds. These phenomena are not normally associated with the microbial generation of soil CO₂ and methane and the cause remains unexplained. The uncertainty associated with the Kerr property underlies the need for a thorough investigation of the property.

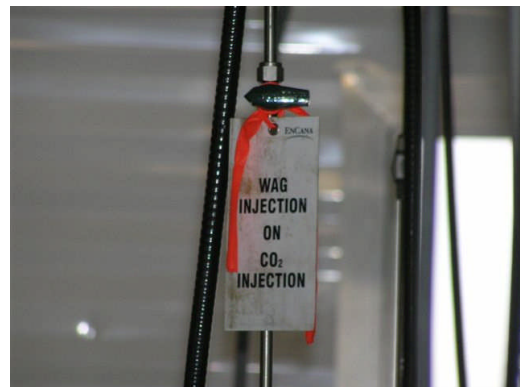
It is Ecojustice’s position that the *PTRC Response* leaves important questions unanswered. Ecojustice wishes to clarify the facts with respect to certain aspects of the *PTRC Response*:

PTRC Response: “...the Kerr property...is located at the southern margin of the Weyburn oil field, but over 2 km away from any CO₂ injection wells.”

Facts:

The Kerrs are unable to confirm if there are any CO₂ injection wells within two kilometres of their property. Well records for the 06-30-5-13 well located on the Kerr property, the 10-30-5-13 well located approximately 300 metres from the Kerr property and the 16-30-5-13 well (the “16-30 well”) located less than one kilometre from the Kerr property indicate that these wells are water injection wells.

However, the adjacent photograph taken in January 2008 at the 16-30 well shows a tag indicating a water-alternating-gas or “WAG” line on CO₂ injection. It is not known which well this line was serving. On April 15, 2010, Cenovus contacted the Kerrs to advise that a CO₂ detection alarm had





been triggered due to a gas and water leak at the 16-30 well. According to Cenovus, the leak was contained within the well enclosure. Clearly, there is CO₂ injection infrastructure within one kilometre of the Kerr property.

There are nine injection wells within 1.6 kilometres of the Kerr property which the Kerrs have been told are water injection wells although the tag on the 16-30 well indicates that some wells may be WAG wells. In addition, there are 10 production wells and 6 abandoned wells within 1.6 kilometres of the Kerr property. There is one production well, one water injection well and two abandoned wells directly on the Kerr property. In addition, four horizontally drilled bore holes from two production wells run directly under the Kerr property. There are two saltwater injection pipelines on the Kerr property, one of which is active and one is abandoned. There is an oil pipeline crossing the property. The injection, production and abandoned wells provide potential pathways for CO₂ to reach the surface and the pipelines are possible sources of contamination.

Despite the abundance of petroleum development infrastructure on and near the Kerr property, the Saskatchewan Ministry of Energy and Resources has placed the onus on the Kerrs to prove that the observed phenomena are related to petroleum development.

PTRC Response: “In this instance, carbon isotopic compositions cannot distinguish between ubiquitous, indigenous biogenic soil gas and anthropogenic gas because of the overlap in carbon isotopic signatures of biogenic soil-gas CO₂ and the Weyburn-reservoir CO₂.”

Facts:

The PTRC is correct that the $\delta^{13}\text{C}$ isotope value measured by Petro-Find falls within the range for biogenic CO₂. However, the Petro-Find soil gas samples were taken at a depth of approximately 1 metre in order to limit the influence of biogenic sources of CO₂. The $\delta^{13}\text{C}$ isotope value of -22.0 found in the Petro-Find study is close to the $\delta^{13}\text{C}$ isotope value of -20 for the injected CO₂.¹

Background CO₂ soil gas isotopes were never measured on the Kerr property prior to the commencement of CO₂ injection. The PTRC, Cenovus and the Saskatchewan Ministry of Energy and Resources have never sampled for CO₂ on the Kerr property. The PTRC excluded the Kerrs’ water well from the 2006 and 2009 farm water well sampling program.

¹ M. Wilson and M. Monea [ed.], *IEA GHG Weyburn CO₂ Monitoring & Storage Project, Summary Report 2000-2004*, (2004) Proc. 7th International Conference on Greenhouse Gas Control Technology, Vancouver (Regina: Petroleum Technology Research Centre)[*Summary Report*] at p. 85.



Additional isotope and chemical composition studies of the injected and sampled soil gases could provide a more definitive comparison of the injected and sampled gases.

PTRC Response: "...these average and extreme [CO₂ soil gas concentration] values [in the Petro-Find study] are well within the range of [European Union] results from their July-2001 survey during which a maximum value of 12% was measured and many areas within the main and background grids showed values in excess of 3%."

Facts:

The *PTRC Response* refers to soil gas studies carried out by the British Geological Survey between 2001 – 2003. Soil gas samples were taken at approximately 360 locations in each of the three years. Out of those samples, a single sample had a CO₂ concentration of 12.5%. All other samples were below 10%. The median CO₂ soil gas concentrations were less than 1.5% in 2001, and less than 1.0% in 2002 and 2003.²

The Petro-Find study sampled 26 locations on the Kerr property on July 29, 2010. The highest CO₂ soil gas concentration found was 11%. The average of the 26 samples was 2.3%. The average of 2.3% found on the Kerr property is above the 95th percentile of the samples taken by the British Geological Survey in 2002 and 2003, and above the 75th percentile of the samples taken in 2001.³ Therefore, the Petro-Find results are not "well within the range of [European Union] results" as suggested by the PTRC. This would suggest that the CO₂ concentrations found on the Kerr property are anomalies that warrant further investigation.

The PTRC, Cenovus and the Saskatchewan Ministry of Energy and Resources have never sampled for CO₂ on the Kerr property.

PTRC Response: "There is no credible evidence that the surface lineaments proposed by Petro-Find indicate a 1.5 km deep open fault."

Facts:

Many small scale structural faults have been identified above and below the reservoir in the Weyburn field, including the presence of open faults.⁴ It is not known if these faults extend through the regional seal and could act as a potential

² *Ibid.*, Fig. 2.64 at p. 134.

³ *Ibid.*

⁴ Sandor Sule, Zoltan Hajnal and Bhaskar Pandit, "Integrated Tectonic and Petrophysical Investigation of the Williston Sediments in and around the Weyburn CO₂ Sequestration Reservoir", Proceedings, 2007 Canadian Society of Petroleum Geologists/Canadian Society of Environmental Geologists Convention, at 346; Robert Bunge, "Midale reservoir fracture characterization using integrated well and seismic data, Weybrun field, Saskatchewan", Paper presented at the American Association of Petroleum Geologists Annual Meeting, Boulder, Colorado, June 3-6, 2001.



migration pathway for CO₂.⁵ Leakage of Mississippian oils into the Lower Watrous cap formation is known to occur.⁶ The possibility of reactivation of the Souris Valley Fault through an increase in pressure resulting from CO₂ injection has been identified as a risk requiring further study.⁷ PTRC's own report states that there is a need for a better understanding of natural faults and fractures surrounding the storage reservoir.⁸

PTRC Response: "The anhydrite cap has retained over 1.4 billion barrels of oil in the Weyburn reservoir for millions of years. Moreover, for leakage to reach the surface this would require breaching a further 1,500 m of strata, including 5 major geological barriers totaling 800 m in thickness."

Facts:

The *PTRC Response* provides its own reply to this assertion when it states that there are "thousands of wells drilled in the area." Each of these wells has breached the geological barriers that previously confined the oil.

In theory, abandoned wells are cemented through the cap rock strata to prevent gas migration to the surface. However, a study of abandoned wells in the Wabamun field in Alberta found that proper cementing through the cap rock could not be confirmed for 4 of 27 (or 15% of) abandoned wells studied.⁹

In the Town of Calmar, Alberta, an Imperial Oil natural gas well that was drilled and abandoned in 1954 was found to be leaking to the surface when a developer noticed gas bubbling in a pool of water in 2007.¹⁰

The PTRC confirmed in August 2010 that it has not conducted any field investigations of the integrity of abandoned wells in the Weyburn field.

Further, a study conducted with respect to the Weyburn field in 2005 stated:

"Seal rock is a formation with extremely low porosity and permeability overlying an oil or gas reservoir, and it constitutes the barrier against the volume flow of hydrocarbons into the upper layers. Although a seal rock can be considered as a seal to

⁵ Sule et al., *supra* note 4.

⁶ Steve G. Whittaker et al., "Characterizing the Geologic Container at the Weyburn Field for Subsurface CO₂ Storage Associated with EOR", Proceedings, 2002, Canadian Society of Petroleum Geologists, at 3.

⁷ *Summary Report*, *supra* note 1 at 32.

⁸ *Ibid.* at 4.

⁹ Runar Nygaard, *Well Design and Well Integrity: Wabamun Area CO₂ Sequestration Project (WASP)*, (Calgary: Institute of Sustainable Energy, Environment and the Economy, University of Calgary, 2010).

¹⁰ On-line at http://www.imperialoil.ca/Canada-English/Files/8-36_background_factsheet_Final.pdf, accessed January 22, 2011.



hydrocarbons, it is erroneous to regard it as a completely impermeable layer...

The results suggest that the sealing capacity of a seal rock that seals the oil and gas in the first place may not be sufficient to seal the injected CO₂ because of the reduction in breakthrough pressure for CO₂. Therefore, reevaluation of the breakthrough pressure is necessary once a reservoir is selected as a CO₂ storage site.”¹¹

A storage reservoir will experience increased pressure due to the injection of water and CO₂. The injection pressures may exceed the original reservoir pressure. Overpressurization of the reservoir may result in leakage of CO₂ through the cap rock due to fracturing.¹² The injection of large quantities of CO₂ into a confined aquifer may increase pore pressure and movement in overlying rock units.

In the Weyburn unit, overpressurization due to CO₂ injection may reactivate existing faults and fractures. The possibility of reactivation of the Souris Valley Fault through an increase in pressure resulting from CO₂ injection has been identified as a risk requiring further study.¹³

The *Application for Approval of an Enhanced Recovery Scheme in the Weyburn Unit*, dated November 26, 1997, (the “*Application*”), states:

“Pool pressure at the time of discovery is estimated at 14 MPa. In localized areas, bottom hole pressure (BHP) dropped to as low as 2 MPa however on average the reservoir pressure stayed above the bubble point (i.e. >~6MPa). Under waterflood, the pressure has recovered to a range of 8 MPa to 19 MPa.”

Further, the *Application* states that the optimum bottomhole injection pressure for CO₂ is 24 MPa.

Given the range of pressures under the water flood, operational injection pressures are greater than the estimated original pool pressure by as much as 36 percent. In areas of the Weyburn unit where reservoir pressures dropped as low as 2 MPa, a subsequent order of magnitude increase in pressure from 2 MPa to 19 MPa could have occurred. Further, the bottomhole CO₂ injection pressure may be as high as 24 MPa or greater. Such increases in pressure could induce seismicity, result in fractures through the cap rock seal and reactivate existing faults and fractures.

¹¹ S. Li at al., “Gas breakthrough pressure for hydrocarbon reservoir seal rocks: implications for security of long-term CO₂ storage in the Weyburn field”, (2005) *Geofluids* 5:326 at p. 326 and 333.

¹² Quintessa, “Generic CO₂ Geological Storage FEP Database”, (2008) on-line at <http://www.quintessa.org/co2fepdb/PHP/> at 3.2.1 and 3.2.7

¹³ *Summary Report*, *supra* note 1 at p. 32.



Therefore, while the Weyburn reservoir may have contained oil for millions of years, the presence of abandoned well bores, the differing characteristics of CO₂ as compared to oil and the overpressurization of the formation all provide the potential for CO₂ to escape to the surface.

Summary

In summary, the *PTRC Response* provides incomplete information and fails to provide an alternate explanation for the phenomena observed on the Kerr property. The lack of definitive answers points to the need for a thorough investigation of the Kerr property which, to date, Cenovus and the Saskatchewan Ministry of Energy and Resources have been unwilling to conduct.