COMPARING COAL SEAM GAS TO SHALE GAS.... WHAT CAN AUSTRALIA LEARN FROM THE US EXPERIENCE?

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Dr Duncan has 22 years of experience in university-level teaching and research in the areas of geological and environmental sciences and 10 years of experience in hydrology and resource management with the Virginia Geologic Survey. He is currently the Co-Principal Investigator on several grants focused on stray methane gas and possible groundwater contamination related to hydraulic fracturing of shale gas reservoirs. His current research focuses on scientific, environmental and public policy aspects of unconventional natural gas production, the water-energy nexus, and carbon capture and storage. He has a particular interest in risk analysis, decision making, and legal/regulatory issues related to shale gas extraction, hydraulic fracturing, CO_2 sequestration, CO_2-EOR, and energy production.

Issues associated with hydraulic fracturing of shale gas and tight gas sands in the US have ignited an international controversy over the environmental impact of such development. The documentary *Gaslands* has become one of the primary drivers for engendering public concerns in the US. In a similar vein the views expressed in the movie have been a source of concern to Australians, particularly in rural areas where coal seam gas (CSG) development is occurring or may occur in the future. This presents several issues that should be considered in the context of development of CSG in Australia:

1. Are the hazardous conditions portrayed in *Gasland* (and similar reports) substantiated by scientific facts?
2. To what extent are the issues raised about shale gas in the US applicable to the development of CSG in Australia?

In this opinion piece I will attempt to give the reader some insights into the issues raised by *Gasland* and into how the movie should be evaluated. I will also discuss whether information on shale gas development in the US is directly applicable to CSG development in Australia.

WHAT ABOUT GASLAND?

Although *Gasland* is presented in the guise of a fact-based, investigatory, journalistic endeavour, a few aspects of the movie should be of concern to the thoughtful viewer. First, no credible scientist is listed in the credits as acting as a consultant for the production. Second, although many of the issues shown in the movie had been investigated by government agencies, none of the results of these investigations are mentioned, and none of the investigators are interviewed.

Some of the most dramatic scenes are those showing home owners setting their tap water on fire. The movie's director (and host) Josh Fox portrays the methane coming out of the well water as coming from nearby (presumably leaking) gas wells. 'Taps on fire' makes for compelling television and Fox uses these images repeatedly. He shows examples from Colorado, Texas and Pennsylvania. What he does not report is that it is well documented that natural methane contamination has existed in the groundwater in these areas apparently forever. It is a preexisting,

A fracking rig in a farmer's field in Colorado, US.

natural phenomenon. This has been documented in scientific reports, data from the US Geologic Survey, court cases, and in investigatory articles in the *New York Times*.

The first home owner interviewed by Fox whose tap can be set on fire is Renee McClure. In his interview, Fox holds up the results of an investigation of the McClure's water well chemistry conducted by the Colorado Oil & Gas Conservation Commission (COGCC), the state regulatory agency. Referring to this report, Fox asks McClure if she realises her water well is badly contaminated with Trichloromethane. Curiously this report does not support any of the movie's points. The report states that the methane coming out of the McClure's tap has been isotopically fingerprinted as being of biogenic origin, and does not come from the gas being produced in the nearby gas well. The report also clearly states that no contamination associated with hydrocarbon production has been identified in the extensive chemical analyses completed of water samples from the McClures' well. So what is the significance of Fox's charge that well is contaminated by Trichloromethane? This is a chemical that, as a scientist, I would not expect to be associated with natural gas or hydraulic fracturing fluids. In fact, the laboratory contracted by the COGCC uses this chemical as a "spike", a chemical added to the sample by the laboratory to make sure their analytical systems are functioning up to specifications. Unfortunately this kind of misinformation is the rule rather than the exception in Fox's movie.

Space prevents me from documenting a myriad of similar factual errors in the movie that undercut most all of it points. The *New York Times*, not known as a defender of the gas industry, in an article entitled: "Groundtruthing Academy Award Nominee 'Gasland'" provided analysis of 20 major issues raised in the movie where the point being made was not supported by documented facts. The COGCC has also written a report documenting numerous factual errors in the Colorado section of the movie and complained that although their Executive Director made himself available to be interviewed for the movie, they had no opportunity to correct the record.

On the rare occasion that Josh Fox has been publicly confronted with any of the factual errors in the movie, he has passed his lack of veracity off as irrelevant. And perhaps it is irrelevant. *Gasland* the movie should be evaluated not as if it was a scientific analysis or even as a work of journalism, but rather as a highly skilled piece of propaganda. Unfortunately most of the viewers of this movie will see it as a fact-based documentary, and of course that is the ingenuity of Fox's work.

COMPARING COAL SEAM GAS TO SHALE GAS

Clearly a key question for Australians reading about issues associated with shale gas in the US is: "how relevant are these issues to coal seam gas in Australia?". In general the differences between shale gas and CSG are probably more significant than their similarities. For much of the rest of this article I will focus on these differences and detail those things in the shale gas record that are inappropriate to link to CSG.

High-volume high pressure hydraulic fracturing is essential for the production of gas from shale and tight gas sands. Some have assumed that "high-volume hydraulic fracturing" of shale gas reservoirs "in many aspects is similar to CSG". In fact shale reservoirs always require fracturing, whereas most CSG wells (and many fields) do not. Shale gas reservoirs are typically at greater depths and substantially higher pressures than for CSG fields.

Some in Australia have assumed that methane emissions from CSG development will be similar to those for shale gas. In 2011 researchers at Cornell published a paper suggesting that methane fugitive emissions are up to 7.9% over the lifetime of a well, with much of the leakage well completion, during pipeline transmission, and distribution. In the scenario put forward by these researchers the largest methane loss is in the first few days of the completion of the wells, during what is called flowback. During flowback the well produces part of the water injected into the well for fracturing. This water alternates with pulses of gas at increasingly high pressure, until the flow becomes purely natural gas and production begins.

For shale gas the gas production rate builds rapidly to its maximum values over the first few weeks of the well's production. CSG wells, by contrast, typically produce little if any natural gas immediately after completion. Rather, production gradually builds up over a period of months and years.

As a result the shale gas methane emissions rates are largely irrelevant to CSG development. Statements to the effect that the uncertainties in the amounts of methane released during extraction, processing and transportation are so large that CSG cannot claim to be an energy source with a relatively low GHG profile are simply not based on sound science.

WHAT ABOUT GROUND WATER CONTAMINATION?

Web pages are rife with stories about the contamination of groundwater by shale gas and CSG activities. In the five years that I have been conducting research into the environmental impacts of shale gas and CSG development, I have not found any documented examples where there is compelling evidence that either has resulted in contamination of drinking water aquifers. I have found several examples where limited contamination has occurred in association with tight gas sand wells, however, in each case the cause can be linked to improper well design and cementing problems.

In one or two cases in the US, it has been suggested that there is evidence that hydraulic fracturing fluids have leaked during the fracturing process, and resulted in the contamination of freshwater aquifers. In one case in wells near Pavillion, Wyoming, recent resampling by the US Geological Survey failed to confirm earlier indications, and in the other case in West Virginia the evidence lacked credibility.

SO DOES THIS MEAN THAT SHALE GAS DEVELOPMENT DOES NOT POSE ANY RISKS?

Shale gas development is an industrial activity that clearly involves a variety of hazards. Conducted according to accepted best practices and well regulated, the evidence suggests that it can and is being done with a low risk of damage to the environment and a very low risk to the safety and health of the general public.

Much of what is available on the internet regarding the environmental and health risks of shale gas development is a distorted mélange of misinformation. This misinformation has probably distracted some regulatory agencies' attention away from the most serious risks. My research has suggested that in the US the highest risks to groundwater associated with shale gas development come from accidental spills during the surface transport of diesel fuel and fracturing chemicals. These risks in the US appear to be similar to other activities that transport similar quantities of fluids, such as supplying petrol stations.

CONCLUSIONS

The track record for coal bed methane (CBM) development in the US is a better analogy for the environmental impact of CSG in Australia, as CBM and CSG are two names for the same activity. The development of CBM in the US has been proceeding for well over 30 years at a very large scale and its track record can be used to evaluate some aspects of the future impact of CSG in Australia. It is perhaps significant that the environmental impact of the CBM in the US is seldom mentioned in the CSG debate. I hope to compare these two scenarios in a future article for *Water Journal*.

Dr Duncan recently spoke at the Unconvcentional Gas Thought Leadership Seminar Series hosted by AWA and the National Centre for Groundwater Research & Training. Please turn to page 46 for a report on the series.