Geophysical Research Abstracts
Vol. 17, EGU2015-15118, 2015
EGU General Assembly 2015

Environmental risks associated with unconventional gas extraction: an Australian perspective

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Coal seam gas is naturally occurring methane gas (CH4) formed by the degradation of organic material in coal seam layers over geological times, typically over several millions of years. Unlike conventional gas resources, which occur as discrete accumulations in traps formed by folds and other structures in sedimentary layers, coal seam gas is generally trapped in low permeable rock by adsorption of the gas molecules within the rock formation and cannot migrate to a trap and form a conventional gas deposit. Extraction of coal seam gas requires producers to de pressurise the coal measures by abstracting large amounts of groundwater through pumping. For coal measures that have too low permeabilities for gas extraction to be economical, mechanical and chemical techniques are required to increase permeability and thus gas yield. One such technique is hydraulic fracturing (HF).

Hydraulic fracturing increases the rate and total amount of gas extracted from coal seam gas reservoirs. The process of hydraulic fracturing involves injecting large volumes of hydraulic fracturing fluids under high pressure into the coal seam layers to open up (i.e. fracture) the gas-containing coal layers, thus facilitating extraction of methane gas through pumping. After a hydraulic fracturing operation has been completed in a coal seam gas well, the fracturing fluid pressure is lowered and a significant proportion of the injected fluid returns to the surface as “flowback” water via coal seam gas wells. Flowback water is fluid that returns to the surface after hydraulic fracturing has occurred but before the well is put into production; whereas produced water is fluid from the coal measure that is pumped to the surface after the well is in production.

This paper summarises available literature data from Australian coal seam gas practices on i) spills from hydraulic fracturing-related fluids used during coal seam gas drilling and hydraulic fracturing operations, ii) leaks to soil and shallow groundwater of flowback water and produced water from surface impoundments, iii) risks from well integrity failure, and iv) increased gas in water bores.