ESTIMATING WELLBORE PERMEABILITY OF POTENTIAL CO2 LEAKAGE PATHWAY

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Large-scale geological storage of CO2 is likely to bring CO2 plumes into contact with a large number of existing wellbores. Estimating the flux of CO2 along a leaking wellbore requires a model of fluid properties and of transport along the leakage pathway. The leakage pathway in wells that exhibit sustained casing pressure or casing vent flow is analogous to the rate-limiting part of the pathway in existing wellbores along which CO2 may leak. Thus field observations of casing pressure and flow rate can be used to estimate transport properties of a CO2 leakage pathway.
Two sets of wellbore data are used to estimate the wellbore permeability. One data set has 13 US offshore wellbores and the other includes more than 300 w ellbores in British Columbia (BC), Canada. The offshore wellbores exhibit sustained casing pressure and the pressure versus time at wellhead is measured. The BC w ells has sustained casing vent flow and the flow rate and flowing pressure are recorded at surface. Based on the available data, we model gas leakage along the wellbores and estimate the effective permeability of the pathway. An example BC well that has a high flow rate of 2000 m3/day yields an effective permeability of 20 darcies, which is equivalent to an aperture (micro fracture) or separation between casing and cement of 0.4 mm width. Extending to more wells we provide a probabilistic distribution of effective permeabilities of leaky wellbores.