NUMERICAL STUDY ON CO2 LEAKAGE DETECTION USING ELECTRICAL STREAMING POTENTIAL (SP) DATA

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We study the feasibility of detecting carbon dioxide (CO2) movement in the overburden of a storage reservoir due to CO2 leakage through an abandoned well by self-potential (SP) measurements at the surface. This is achieved with three-dimensional numerical modeling of two-phase fluid flow and electrokinetic coupling between flow and streaming potential. We find that, in typical leakage scenarios, for leaky and/or injection wells with conductive metal casing, self-potential signals originating from injection can be identified at the surface. As the injection signal is also observed at the leaky well, SP monitoring can be applied for detecting abandoned wells. However, leakage signals are much smaller than the injection signal and thus masked by the latter.

We present three alternatives to overcome this problem:

- simulate the streaming potential of the non-leaky scenario and subtract the result from the measured streaming potential data;
- exploit the symmetry of the injection signal by analyzing the potential difference of dipoles with the dipole center at the injection well; or
- measure SP during periods when the injection is interrupted.

In our judgement, the most promising approach for detecting a real-world CO2 leakage is by combining methods (i) and (ii), because this would give the highest signal from the leakage and omit signals originating from the injection well (caused by e.g. corrosion).