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The seismic interpretability of a 4D data, a case study: The FRS project

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Summary

The goal of this paper is investigating about the seismic interpretability of a reservoir by synthetic models and test the methods on the real data and reservoir simulation result for the FRS project.

The Field Research Station (FRS) is a project developed by CMC Research Institutes, Inc. (CMC) and the University of Calgary. During the injection CO_2 in the shallow target layer (300 m depth), dynamic parameters of the reservoir as pressure and brine/CO_2 saturation will change, and they can be derived from the fluid simulation result.The injection is in the shallow target because it will have a glance on the gas leakage procedure and detection by the geophysical methods. For the project, the injection strategy is five years' CO_2 gas phase injection with a constant bottom hole pressure equal to 49.4 bar.

In the first part of the seismic modeling, we used some synthetic velocity models to compare seismic responses of a reservoir with different saturation, pressure, and plume size.Based on the synthetic models, there is an amplitude change in the reservoir and a time delay in the deeper levels because of velocity change. The effect of time delay disappeared after migration with the realistic velocity model.

The seismic models show that the well seismic methods included VSP and Cross Well can have a better amplitude due to gas injection, and because of lower noise content in these methods, we expect to map the reservoir properties in the early injection step by the well seismic acquisition.

The surface seismic models show the smaller amplitude content than well seismic methods due to injection.So with considering the surface related noises, the monitoring by surface seismic is not possible in the first years, but when saturation and plume size are increasing, it can be a useful method for imaging of reservoir.However the surface seismic can generate a better image condition comparing well seismic.