Preparing the physical modeling facility to simulate injection/storage of fluids and gases in complex structures

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ABSTRACT

The physical modeling facility has been used for many years to simulate real world acquisition experiments with great success. The system uses models to acquire data to test processing techniques and interpretation methods that have been developed to create an understanding of structure using seismic data more accurately.

To that end, steps have been taken in recent years to simulate real world acquisition techniques more accurately. Being able to simulate activities currently being carried out in a smaller, very repeatable way, will be useful to create a database that can be used to determine or predict how varying factors can effect real world acquisition results.

Knowing that gas injection is an area of interest, we devised a scale model for physical modelling of seismic surveys monitoring gas injection into a geological water-saturated porous zone. The goal of this model will be to simulate 2D and 3D surface surveys as well as VSP acquisition in both land and marine environments. With the accurate repeatability of the modeling facility various time lapse experiments can be carried out to determine how injecting over time will change the results of a survey.

ACKNOWLEDGEMENTS

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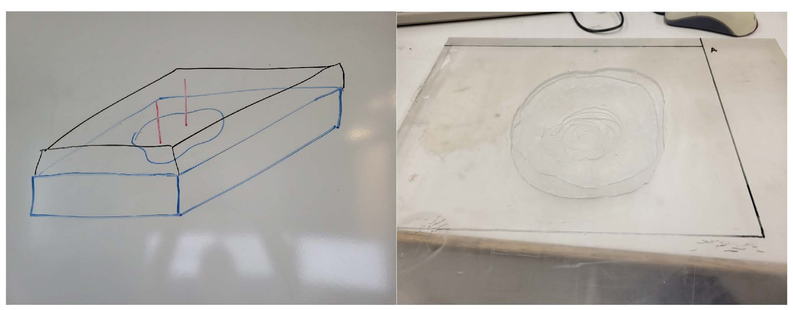

FIG. 1. The initial design created on a white board on the left with the void cut out of the model piece on the right. The model was created free hand in this case. The void was cut using a plunge router to create several layers of depth with the centre being the deepest point.

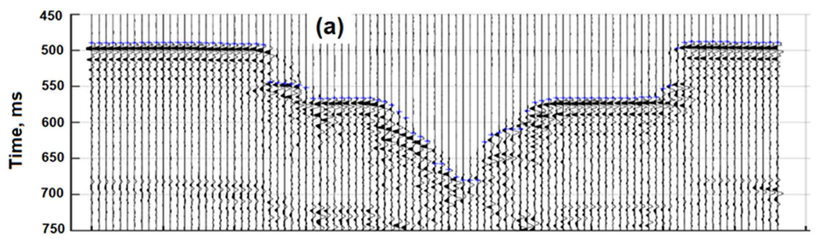

FIG. 2. A 2D common offset gather acquired in a marine setting over the model.

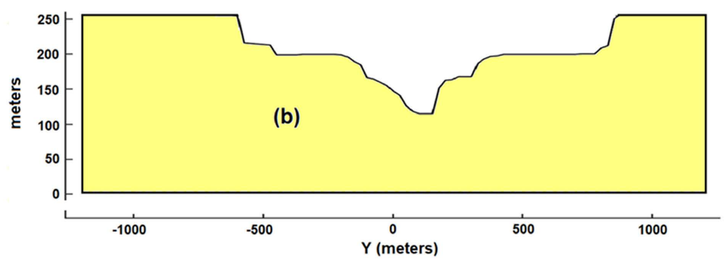

FIG. 3. The interpreted results of the 2D common offset gather acquired in a marine setting over the model.

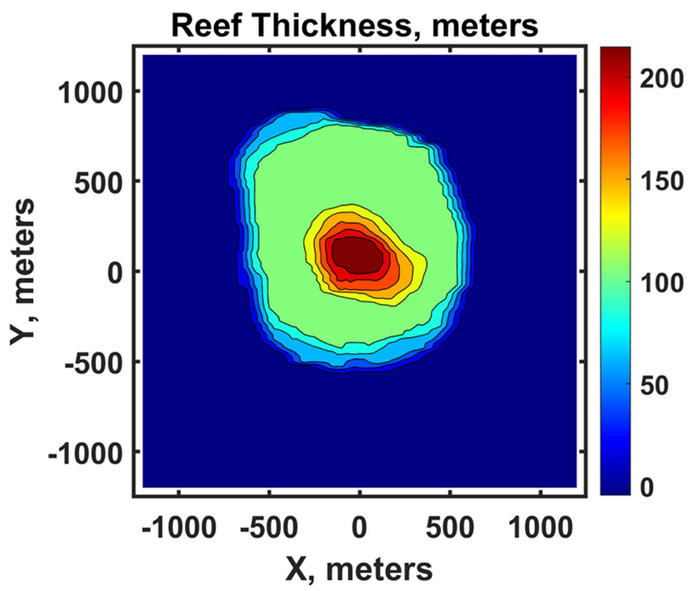

FIG. 4. 3D survey results of the mound model.

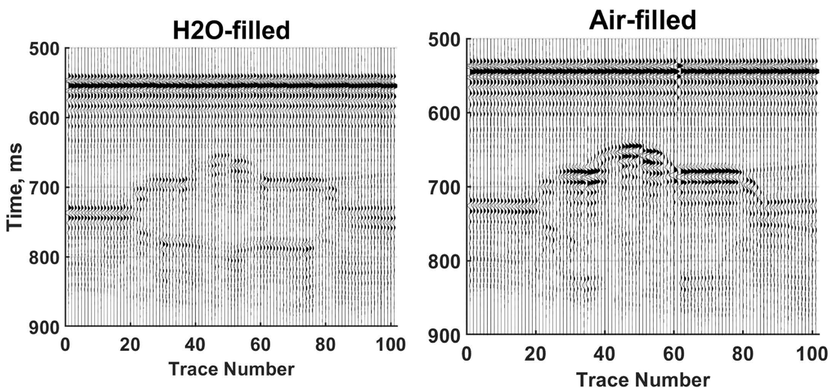

FIG. 5. 2D survey results of the mound model at the two extreme conditions. Water filled on the left, and Air filled on the right.

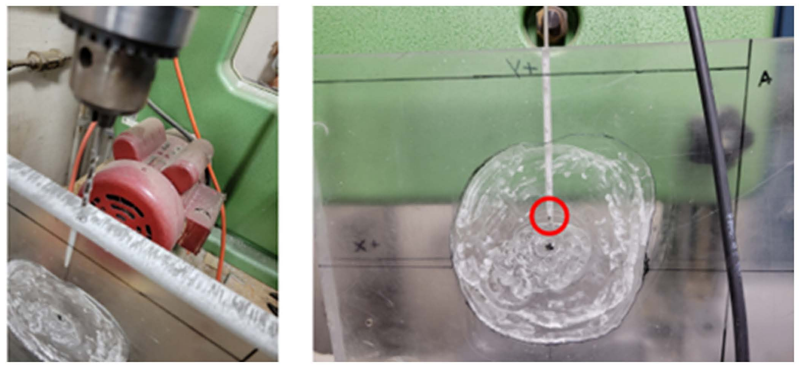

FIG. 6. Adding and injection location. The decision to install it through the side of the model was made to prevent it from interfering with the modeling system's transducers.

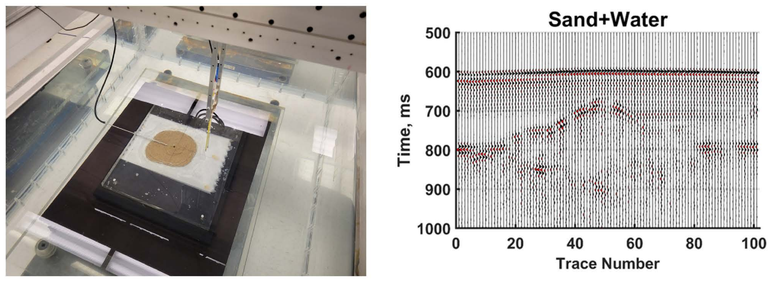

FIG. 7. 2D survey carried out over the "pre-injection" model. The mound in the model was filled with sand and water.

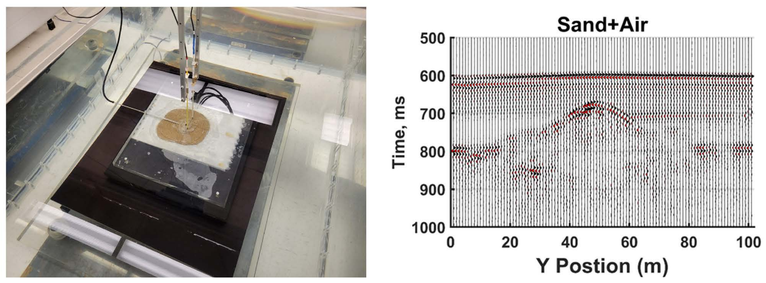

FIG. 8. 2D survey carried out over the "post-injection" model. The model had a small volume of air injected in to the sand at the injection point.

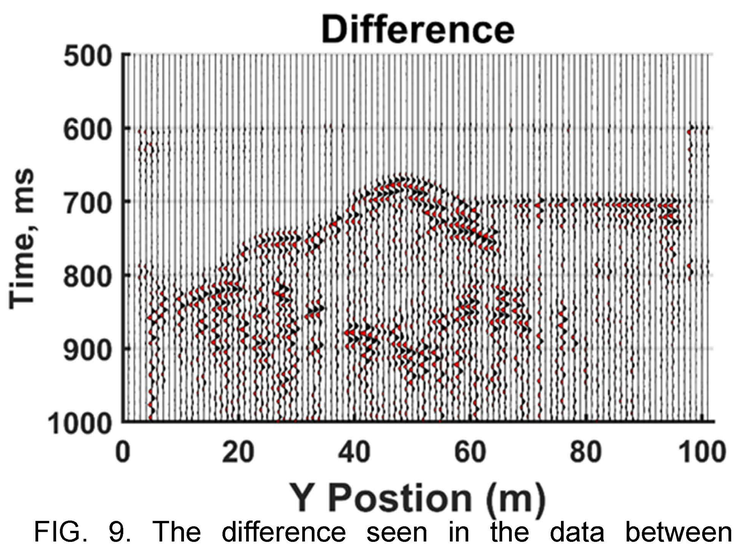

FIG. 9. The difference seen in the data between the water/sand and some air/sand results.

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