TIME-LAPSE SEISMIC DATA REGISTRATION AND INVERSION FOR CO_2 SEQUSTRATION STUDY AT CRANFIELD

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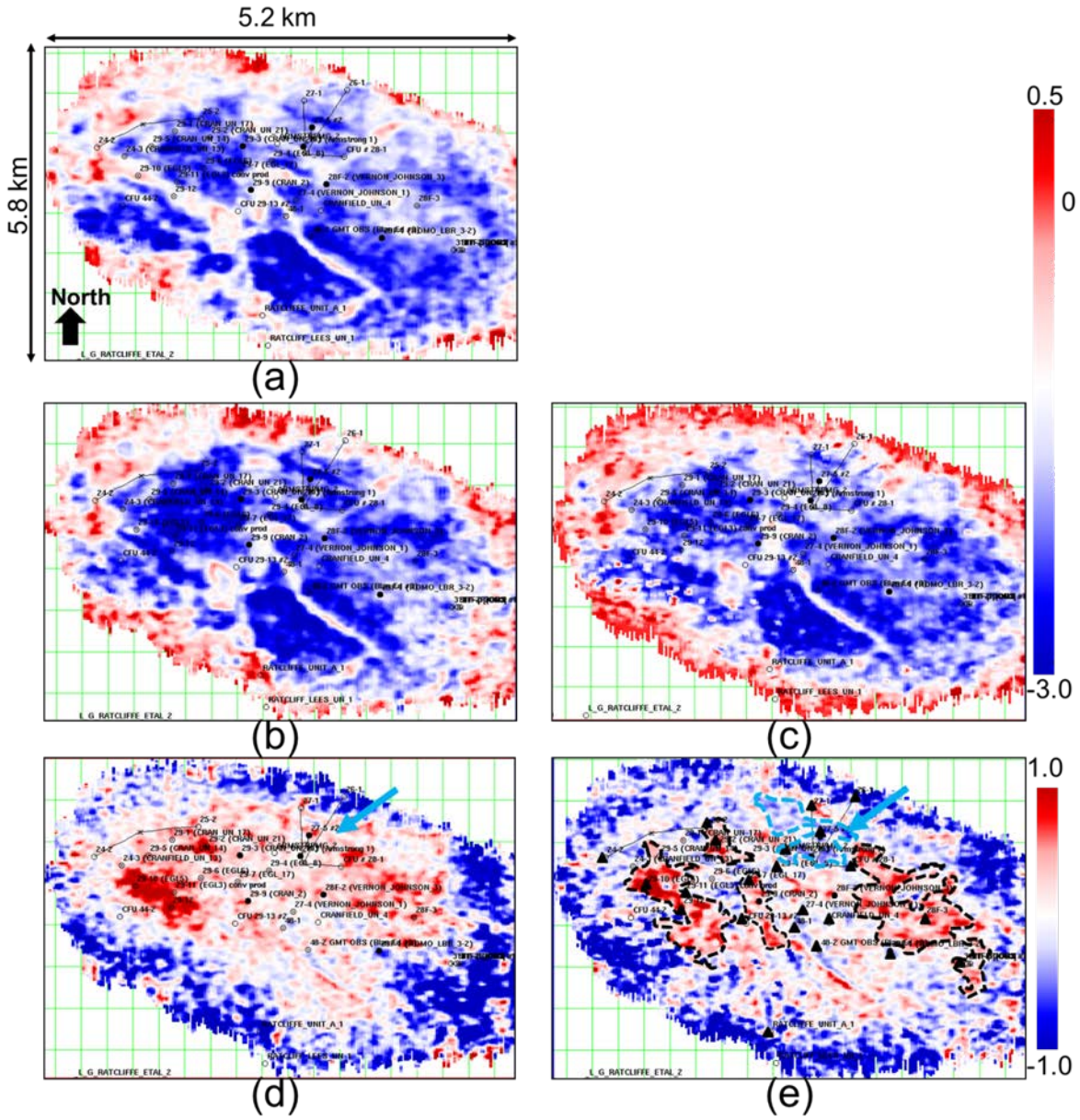
ABSTRACT

Time-lapse seismic survey for CO_2 sequestration study at Cranfield can be problematic because of misalignments between the time-lapse datasets. Such misalignments can be caused by any step of seismic data processing workflow, which may result in misunderstanding of time-lapse seismic amplitude differences. There are many matching processing methods under development, but these methods are still immature and very time consuming. We propose an efficient local-correlation based warping method to register the time-lapse post-stack datasets, which can align the time-lapse datasets without changing the original amplitudes. The application of the registration of Cranfield time-lapse datasets demonstrates its effectiveness in separating the time-shift character from the seismic amplitude signature. After registration, the time-lapse differences show improved consistence in vertical cross-sections and more localized distribution of the difference amplitudes in horizon slices, which allows us to apply a basis pursuit inversion for acoustic impedances. The inversion results show that decreases of acoustic impedances mostly occur at the top of the injection interval, which can be used as alternative rock properties to detect the subsurface CO_2 plume.



Time-lapse seismic amplitudes and their difference slices are extracted at the top of the injection interval. (a) shows the pre-injection slice; (b) and (c) show the post-injection slices before and after registration; (d) and (e) show the time-lapse difference slices before and after registration.