The European Network of Excellence on Geological Storage of CO_2
Association

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Zoback and Gorelick paper: unreliable conclusions

In a recent paper titled "Earthquake triggering and large-scale geologic storage of carbon dioxide", published in the Proceedings of the US National Academy of Sciences, Zoback and Gorelick made strong statements regarding:

- The possibility that the integrity of the cap rock (i.e. the layer overlaying the reservoir which ensures the permanent character of the storage) could be damaged by even small earthquakes triggered by injecting large amounts of CO_2.

- The difficulty therefore to find reservoirs large enough to store the huge amounts of CO_2 that will be required to fulfil the objectives of reduction of greenhouse gas emissions.

This paper has already provoked numerous comments from many scientists and experts around the world, since Zoback's and Gorelick's conclusions are not supported by facts or data. CO_2GeoNet experts would like to provide further clarification of the issues at stake.

In terms of the risk of triggering earthquakes that would permit leakage of CO_2:

- Experience from many natural oil and gas fields (i.e. natural 'storage' sites) occuring in seismically active areas, where there is no evidence of any significant leakage, shows that natural seals can resist even large earthquakes.
- Experience from injections activities worldwide related to Oil&Gas, geothermal, waste disposal and storage operations does not show the triggering of large scale earthquakes or the breach of cap rock integrity.
- There are a few cases in which water and gas injection schemes have led to small earthquakes, but these are exceptions and these earthquakes can be inferred by modelling. The earthquakes produced and, by inference, the associated fault movements are smaller than the ones that could occur in the same geological scenario in case of absence of fluids.
- Fluid injection or extraction does lead to microseismic movements that cannot be felt by humans and are only detected by very sensitive sensors. These movements do not constitute a danger for cap-rock integrity; on the contrary, monitoring them is an important tool for tracking fluid migration in underground reservoirs.
- There is limited evidence of the effect of fault movement on CO_2 storage, but the recent experience on the CO_2 storage pilot of Nagaoka in Japan is that no leakage was detected from even a large earthquake.

We consider therefore that the risk of damage to caprock integrity has been very much overstated by Zoback and Gorelick, and we assess that the risk of leakage through such a mechanism is very limited. Furthermore, it is important to point out that the possibility of breaching the seal by injection of CO_2 is a risk factor that is routinely assessed in both the preliminary characterization of storage sites and in the risk management plan that drives the lifecycle of a storage project. A potential injection site that was found to have a significant risk will not therefore proceed to development in any case.

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Regarding overall storage capacity:

- Current assessments of storage capacity worldwide point to excess capacity and not shortage, as suggested by Zoback and Gorelick.
- Indeed, these assessments need to be firmed up through careful characterisation studies and appraisal of each potential site.

The Zoback and Gorelick paper expresses serious doubts about the future of this technology as a powerful means to mitigate global climate change.

The CO_2GeoNet European Network of Excellence - with the accumulated knowledge on CO_2 geological storage of more than 300 scientists from 13 leading research institutes – states that Zoback and Gorelick paper does not develop a logical and consistent scientific reasoning and its conclusions are not supported by available data. We therefore maintain our position that this technology can be deployed in a safe and efficient manner to reduce CO_2 emissions and, in doing so, it can provide a substantial contribution to climate change control.