Well Integrity and CO_2 injection: Interface debonding in a cased and cemented wellbore as a potential risk

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Wellbores enable access to underground formations for hydrocarbon recovery or gas storage. They are essentials but are also, by their own nature, piercing the geological seal above the reservoir formation of interest. Thanks to the very low permeability of cement (typically less than 0.1 mDarcy); sealing of oil wells by cementing steel tubular to the rock has, for more than a century, provided the key method to avoid hydraulic communications between the different fluid filled formations and the earth surface. Leaks from a cased and cemented well, if any, are known to occur only through defects: mud-channel (in case of poor cement placement), cracks within cement and more importantly micro-annulus at the casing / cement or / and cement / formation interfaces. This last category of defects can lead to substantial leakage rate. Its importance has been recognized by the oil and gas industry since the 1960's leading to the study of cement "bonding" properties.

In this talk, after a brief introduction to well cementing, we will review the complete loading history of a cemented completion from cement placement to routine well operations. We then more precisely focus on modeling and experiments performed to investigate the de-bonding of the casing/cement or cement/formation interfaces induced by fluid injection (e.g. CO_2 storage, hydraulic fracturing etc.).