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Impact of faults and fractures in mudstone seal rocks of porous-media underground hydrogen storage reservoirs – Case study in Taranaki, New Zealand

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Hydrogen is projected to account for at least 10% of the global energy system in 20 years and is a critical component of the future zero-emissions energy system. Underground storage of green hydrogen in Aotearoa New Zealand (ANZ) will take advantage of intermittent surplus of renewable electricity at low cost, balance seasonal fluctuations in energy supply and demand, and provide a strategic reserve of energy. This poster is part of a larger research programme primarily focused on investigating the potential for underground hydrogen storage (UHS) in Taranaki, ANZ. Here, we explore the potential for UHS in porous rock formations of depleted gas reservoirs with particular focus on the role of seal integrity for storage.

In this project the overarching goal is to improve understanding of whether mudstone seal strata have the potential to prevent leakage of hydrogen from Taranaki reservoirs. The primary focus is to characterise the geometries of fault and fracture systems in seal strata, their impact on its bulk permeability and to identify the pressure conditions required to promote the loss of seal integrity. In this poster we use Formation Micro Imagery (FMI) together with stratigraphic and fault/fracture mapping of core from petroleum wells to identify fracture densities, orientations and properties in both seal and reservoir rocks. Interpretations of seismic reflection lines in Taranaki and analogous outcrop observations are used to understand the geometries and permeability properties of fault zones.

Preliminary results indicate that fractures are present in both reservoir and seal rocks. The densities of fractures increase with proximity to regional fold hinges and faults, and with increasing carbonate content. Questions remain about under what conditions fractures are open and capable of transmitting hydrogen. The poster outlines preliminary results, proposed research pathways and invites discussion.