
Quarry Resources

10th October 2019

Peter Bray
Golden Bay Cement
By email

Dear Peter,

You have asked for an opinion on the suitability of Portland geology for CO₂ sequestration.

Geological Sequestration requirements

Captured CO₂ would be compressed to ≈100 bar so that it would be a supercritical fluid. In this fluid form, the CO₂ could then be injected deep underground, typically around 1 km.

The important parameters in determining a good site for carbon storage are rock porosity, rock permeability, absence of faults, and geometry of rock layers. The medium in which the CO₂ is to be stored ideally has a high porosity and permeability, such as sandstone or limestone. The porous rock must be capped by a layer of low permeability which acts as a seal, or caprock, for the CO₂. Once injected, the CO₂ plume will rise via buoyant forces, since it is less dense than its surroundings. Once it encounters a caprock, it will spread laterally until it encounters a gap. If there are fault planes near the injection zone, there is a possibility the CO₂ could migrate along the fault to the surface, leaking into the atmosphere, which would be potentially dangerous to life in the surrounding area (Reference: Wikipedia

https://en.wikipedia.org/wiki/Carbon_sequestration#Geological_sequestration

Portland Geology

There are no drillholes at Portland that are deep enough to show the geology in the target zone at around 1000 m depth. However, enough is known of the geological sequence to make some reasonable inferences. Drilling at the quarry shows that uppermost layer is made up of fine-grained

mudstone and argillaceous limestone which is part of the Northland Allochthon. These beds are highly deformed by faulting and folding and are likely to be up to 300 m thick. They are weakly permeable and therefore would make a good cap rock.

Below these beds is the Onemama Formation, which consists of highly calcareous sandstone to sandy and pebbly bioclastic limestone, with intercalated centimetre- to metre-thick beds of dacitic tuff. These beds can be seen at Paradise Quarry and are unlikely to have the porosity required to store CO₂. They are probably less than 200 m thick so are too shallow in any case.

Onemama Formation is known to overlie greywacke, which is the basement rock in the area and is many kilometers thick. The liquid CO₂ would therefore need to go into the greywacke. The greywacke in this area is a mix of semi-metamorphosed argillite, siltstone and sandstone. It has a low primary porosity, but often has shear and fracture zones which give it secondary porosity. The lack of primary porosity makes it unsuitable for sequestration.

In general, the geology of the area is quite variable with some significant fault zones which could allow CO₂ to migrate to the surface. This would create significant risks for residents in the area as CO₂ is heavier than air, and as shown by the Lake Nyos disaster (from a release of volcanic CO₂) can result in significant casualties (reference: https://en.wikipedia.org/wiki/Lake_Nyos_disaster)

A more detailed assessment would require drilling down to the sequestration zone.

Regards,

Keith Miller