

The CarbFix project: Carbon capture and subsurface mineralisation in basalt.

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ABSTRACT: All the carbon in the atmosphere, living creatures, and dissolved in the oceans is derived from rocks and will eventually end up in rocks, the largest carbon reservoir on Earth. The carbon moves from one reservoir to another in what is called the carbon cycle. Humans have accelerated this cycle by mining and burning fossil fuel since the beginning of the industrial revolution, causing rising atmospheric carbon dioxide (CO₂) concentrations that are the main cause of global warming. If we burn all fossil fuel on Earth at the past decades rate increase and do nothing about it, most of it will be finished in 250 years and all in 500 years. The peak concentration after 250 years will be greater than 1500 ppm, resulting in acidification of the oceans, climate warming, runaway melting of glaciers and sea-level rise.

The Intergovernmental Panel on Climate Change released a special report last October. There, modelled pathways with no or limited overshoot of 1.5°C rise in temperature above pre-industrial level, call on rapid global net anthropogenic CO₂ emissions decline, reaching net zero around 2050, followed by a large-scale carbon dioxide direct removal from the atmosphere. The direct CO₂ removal from air will be done by growing plants that turn CO₂ into biomass, which is then burned under controlled conditions in power plants, where the CO₂ is captured and stored in rocks. This is referred to as BECCS, (Bioenergy with Carbon Capture and Storage). Engineered Direct Air Capture and Storage in rocks will also be employed (DACS).

Carbon dioxide has been captured from concentrated gas streams since 1996. The captured CO₂ is compressed to a liquid stage and injected into sedimentary rocks where it can be stable for centuries and even millions of years. In 2012 the CarbFix research group developed a method where the carbon dioxide is mineralised in basaltic rocks. This is the safest way of storing carbon. This method has been employed since 2014 at the Hellisheidi geothermal power plant in SW-Iceland. In 2017, the CarbFix group employed an engineered Direct Air Capture unit at the Hellisheidi power plant where the captured CO₂ was eventually mineralized in the basaltic rocks (DACS). Again, this was the first in the world direct air capture where the CO₂ was stored as mineral (DACS). If humanity will be forced to “clean” the atmosphere in the latter half of this century, Iceland could play a significant role in the clean-up.