Very Deep Ocean Storage of CO\textsubscript{2} – Further considerations

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Abstract

A previous paper by the author “Potential for Very Deep Ocean Storage of CO\textsubscript{2} Without Ocean Acidification: A discussion Paper” raised interest at GHGT-13, and after the proceedings were published. That paper studied enclosed basins in ocean floor trenches deeper than 4-5000 metres, where very large volumes of liquid CO\textsubscript{2} could be stored and converted into stable solid CO\textsubscript{2} hydrate. The principle criticism of this concept is the assertion that ocean acidification would eventually occur as the stored CO\textsubscript{2} dissolved in overlying ocean water. That matter is addressed by considering the global carbon cycle. At present, about one third of the anthropogenic CO\textsubscript{2} discharged to the atmosphere dissolves in the surface water of the oceans. Ocean acidification is being observed. The annual carbon flux from the atmosphere to the ocean surface is about 9% of the carbon content of the atmosphere. The annual carbon flux from deep ocean water to surface ocean water is about 0.3% of the carbon content of the deep ocean. Therefore, a marginal tonne of CO\textsubscript{2} placed on the deep ocean floor instead of into the atmosphere, would transfer to surface water about 30 times more slowly. To the extent that the CO\textsubscript{2} stored on the ocean floor remains there permanently as a CO\textsubscript{2} hydrate and does not dissolve, the surface water acidification rate would be even less. Another criticism made of this deep ocean CO\textsubscript{2} storage concept is that recent deep-sea filming has identified marine life forms in very deep ocean trenches. There is concern that some species might be adversely affected by use of enclosed basins on the ocean floor for CO\textsubscript{2} storage. It is argued in this paper that the existence of very deep ocean observation capability provides a means to survey and assess potential storage locations and to observe the progress of CO\textsubscript{2} storage trials to ensure that adverse environmental effects are avoided. This paper revisits the comparison of storage of CO\textsubscript{2} as a stable hydrate in deep ocean trenches with storage of CO\textsubscript{2} as an unstable supercritical fluid in geological formations. It is suggested that deep ocean storage has greater certainty, replicability, and capacity than geological storage. The delivery of captured CO\textsubscript{2} to a remote ocean location might use LPG transport technology. If liquid CO\textsubscript{2} is delivered at 80 bar pressure, no additional energy input would be required at the floating platform. In addition to CO\textsubscript{2} reception and delivery to an ocean trench, an outline assessment is made of the concept of the geostationary floating platform being a redundant super-tanker, which also accommodates Direct Air Capture equipment. It is estimated that such an autonomous design might potentially target the transfer of up to one million tonnes of CO\textsubscript{2} per year directly from the atmosphere to the deep ocean. Revenue from that CCS activity might contribute to the economics of the platform. These concept-level considerations are offered to stimulate discussion of research and development topics that might contribute to addressing climate change and ocean acidification in the long term.