Research Background

Since the Paris Agreement of UNFCCC was passed, the needs of honouring its commitment to develop the ocean, the largest natural carbon reservoir in the planet, and using ocean alkalinity for carbon sequestration have been reinvigorated. The scheme of using natural ocean alkalinity for carbon sequestration, which is one-time seawater scrubbing into ocean for CO₂ emissions reduction, was put forward at the beginning of this century, but temporarily excluded due to cost (the amount of water) and other reasons, and it is the rarest mitigation strategy in the literature now. However, the technology of using natural alkalinity one-time seawater scrubbing for SO₂ emission reduction has become mature and widely adopted. At the end of the last century, it was still greatly discouraged by the energy industry (limited to a few of small-scale industrial applications). But since this century, it has developed into a mainstream desulfurization choice of coastal thermal power in the world in a cost-effective and safe way, with wider application globally.

Belonging to the same fossil energy air emission control strategy via using marine natural alkalinity, seawater scrubbing desulfurization and decarburization are inseparable in the process from source to sink, so it is necessary to re-study the feasibility of natural ocean alkalinity for carbon sequestration as climate mitigation strategy.

Research Method

Firstly, analyzing the field data of power plants and other facilities (total over 8 GW), in which there are seawater scrubbing desulphurization projects with a certain decarbonization capacity, and summarizing the experiences, laws and parameters related to carbon capture and storage. According to the above all, analyzing the different needs of seawater desulphurization and decarburization, and different requirements of marine natural alkalinity, to rejudge the affordability of marine mitigation program—seawater scrubbing and capturing CO₂ into ocean, and propose a cost-effective implementation that meets the currently national and international environmental emission regulations.

Then focusing on the consequences and impacts of scaled using marine natural alkalinity in a long term. Evaluating several seawater scrubbing projects in Europe (the UK, Norway, etc.) and Asia (China, Japan, India, Indonesia, etc.) of more than 20 years, including preconstruction prediction of marine environmental impacts, emission tracking monitoring after commission, and the current situation of the environment, especially the field investigation of the project with
significant function of marine carbon storage, which has been in operation for a long time. Based on this, it can make a preliminary estimation of long-term impact and global potential for scaled application of the ocean carbon sequestration negative-emission strategy.

Conclusion and Discussion

- In the actual interwoven processes of seawater scrubbing $\text{CO}_2$ and $\text{SO}_2$, their final reaction products and environmental impact factors are the same, especially, there is no difference in ocean carbon storage based on bicarbonate ions. In view of the above technical fact, it can be stated that there is indeed a considerably scaled and long-term experience in using natural ocean alkalinity to control air emissions of $\text{CO}_2$ and $\text{SO}_2$ from fossil energy.

- This experience is currently mainly desulfurization, and decarburization is a supplement, and will transfer to be mainly decarbonisation in the future, and it is still possible to maintain the inherent advantages of safety, legality and cost-effectiveness. For example, the cost of capture and storage of $\text{CO}_2$ can be less than $5/\text{t}$, or even less than $1/\text{t}$ (only reuse cooling water of the power plant).

- Adoption of the natural engineering method to construct a low-risk climate mitigation strategy which is gradual, reversible and controllable. Conditional use of marine natural alkalinity based on the cushioning properties of marine carbonate systems; the characteristic, absorbing or releasing large amounts of $\text{CO}_2$ while still maintaining pH, is a major manifestation of the superb buffering capacity of complex and open marine buffer systems.

- The preconditions of using natural marine carbon reservoirs should be as follows: Firstly, it should serve as a relief measure of seriously inadequate carbon budgetary to ensure the achievement of the climate goal, which is clearly indispensable during the transition to 100% sustainable energy. Secondly, it should not merely serve as a justification for the continued use of fossil fuels, or not to treat the oceans as the sole destination for anthropogenic carbon emissions. Thirdly, mitigation strategy must be cost-effective, because this is actually a sign of significant net emission reduction function.

- The commercial projects of using natural ocean alkalinity should be launched as soon as possible, meanwhile commissioning further international cooperation for research. In this way, there will be a breakthrough of actual dilemma of CCS technology soon, as well as providing necessary and meaningful scaled experiments and empirical conditions to the further research for exploring solutions to using of natural marine carbon reservoirs in larger-scale applications, including issues of potential ocean acidification and its artificial increase of ocean alkalinity.

- The practical steps to start the commercial projects allow for the deployment of lower carbon capture rates (less than 30%) as a priority which is a "low hanging fruit" option, and it can immediately achieve scaled emission reduction that is meaningful to mitigation. For example, there is less or no additional cost in the coastal power plants with the option which is more cost-effective to gas power plant and also beneficial to the widespread deployment of marine facilities such as marine transportation and direct air capture.

- The international should put a high value on the problems of how to timely break through the current plight of mitigating strategy through mature and fruitful technology experience, and then drive more technologies that are feasible for the soft landing of climate change, for fear of the increasing risk of hard landing.