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Ocean acidification; back to basic(s)

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Rising CO_2 concentrations in the atmosphere will be a probable cause for climate change, and also affect the pH of ocean water. This, in turn, will have an impact on carbonate equilibria in the ocean, and thereby on important parts of ocean ecosystems (corals, shellfish). To restore the basicity of the oceans it is necessary to add alkalinity. This can be done by increasing the rate of weathering on land, thus increasing the flux of calcium and magnesium to the oceans. By the enhanced weathering of basic silicates, notably olivine, and the transport of the weathering solutions to the oceans the acidification can be slowed down, and ultimately even be reversed.
Enhanced weathering starts with the selection of abundantly available rock types that weather easily. Rocks containing high concentrations of olivine and/or its hydrated equivalent serpentine are obvious candidates. These can be mined and milled, and the grains spread on land, preferably in the wet tropics, where weathering proceeds fastest. Other suitable locations to spread these grains are beaches and tidal flats.
The rate of weathering on land is much faster than in abiotic laboratory experiments. This is due to the activity of, amongst others, mycorrhizal fungi, living in symbiosis with higher plants. They secrete organic acids that rapidly attack mineral grains in the soil, thereby releasing mineral nutrients, which are taken up by the plants. When the plants die, part of their mineral content is washed out and carried by rivers to the oceans. When applied to farmland an additional benefit is that the weathering products, especially Mg, serve as fertilizer.
On beaches the rate of weathering is accelerated because the sand grains are ground down by surf action. Small abraded mineral slivers weather quickly, adding alkalinity directly to the sea. On tidal flats, the mineral grains are ingested by, amongst others, lugworms. In their guts, mineral transformations proceed 700 to 1000 times faster than outside. These are the major ways by which alkalinity can be added to the oceans. The silica released by olivine weathering will promote the growth of diatoms. When these die, part of their carbon will be carried to the deep ocean, and be partly buried in ocean sediments.
Enhanced weathering is part of ongoing natural processes, making it a cheaper and more effective process to counteract climate change and ocean acidification than any of the high tech solutions proposed so far.