Reactions for the precipitation of $CaCO_3$

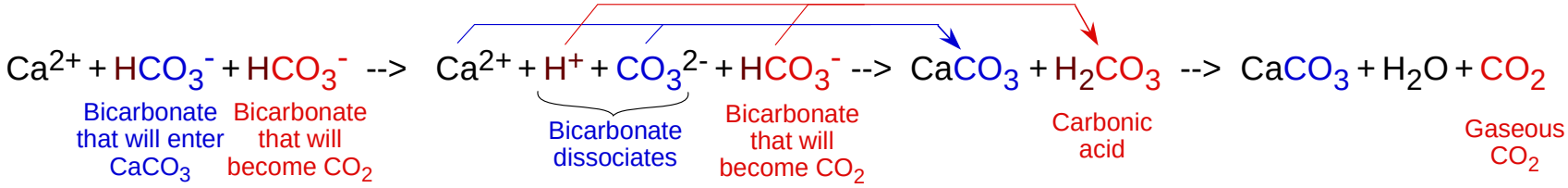
The ultimate fundamental chemical expression of the precipitation of $CaCO_3$ is this reaction:

$$Ca^{2+} + CO_3^{2-} \rightarrow CaCO_{3(s)}$$

However, the most abundant form of inorganic carbon in most natural waters is HCO_3^- rather than CO_3^{2-}. Thus, to understand natural processes, the better chemical expression for the precipitation of $CaCO_3$ is this reaction:

$$\mathbf{Ca^{2+} + 2HCO_3^- \rightarrow CaCO_{3(s)} + H_2O + CO_2}$$

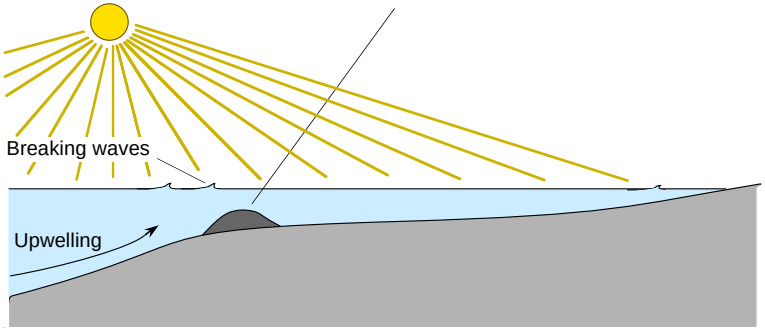
One should realize the two bicarbonate ions have very different fates. One goes into the $CaCO_3$ and the other is liberated as CO_2:



The reaction in bold letters shows that any natural process removing CO_2 from a solution favors precipitation of $CaCO_3$. That helps explain why $CaCO_3$ precipitates when

1. CO_2 degasses from dripwaters in caves,
2. CO_2 degasses from springs at which travertine forms,
3. CO_2 degasses at travertine dams,
4. CO_2 degasses with warming of seawater,
5. CO_2 degasses with agitation of seawater by waves,
6. CO_2 degasses with upwelling of seawater,
7. CO_2 is removed from water by photosynthesis.

In marine precipitation of $CaCO_3$, Processes 4 to 7 can all occur at shelf breaks (changes in slope from shallower landward to deeper seaward). These are common sites of reefs or ooid shoals.



There is a corresponding page titled "Reactions for the dissolution of $CaCO_3$".