

Brown water lakes are more efficient in producing dissolved inorganic carbon by light

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Lakes play an important role in the global carbon cycle. They can release CO₂ to the atmosphere, and we need to know how much CO₂ is released in order to estimate the impact on global climate change. In lakes, CO₂ is mainly produced by organisms (for example, bacterial respiration). But if we only consider this way of CO₂ production, the estimation of CO₂ release will be inaccurate. In fact, CO₂ is also produced by absorbing light. This is a pure chemical and physical process, without the participation of any organisms. The organic matter in lake water can absorb light and degrade into inorganic carbon, including CO₂. In some lakes this process is fast, while in other lakes quite slow. For example, if we collect water samples from two different lakes and put them under the sunlight in the same period of time, the amount of CO₂ produced in each sample by absorbing light will not be exactly the same, because the organic matter in these two lakes are different.

Because the efficiency of CO₂ production varies among lakes, it is necessary to study the variations and the reason of variation. My thesis focuses on how the efficiency of CO₂ production is related to other factors: do the lakes from the same area have similar CO₂ production efficiency? Will the lakes have similar CO₂ production efficiency if they have similar water color or pH, or total phosphorus and nitrogen concentrations?

In order to answer the questions above, experiments were conducted using lake water from all over the world. My supervisor and I asked colleagues in our limnology department to collect water samples from different continents and climate zones: Spain, Canada, Panama, Germany, and China... And I also collected some samples from Sweden. I put the samples inside a solar simulator, which has a lamp that gives out light similar to sunlight. I measured inorganic carbon concentrations once before putting samples inside solar simulator, and once after taking them out. The difference of these two measurements is the inorganic carbon produced by absorbing light.

The results show that the efficiency of CO₂ production is related to water color: lakes with a dark water color (brown water lakes) have high efficiency of producing CO₂, and clear lakes have low efficiency. This relationship is linear, which means we can estimate the efficiency by water color. Also, brown water lakes have organic matter from terrestrial source (from the soil), while clear water lakes have organic matter produced in themselves (produced by algae, etc.). The difference in sources of organic matter might be the reason of the difference in the efficiency of CO₂ production.