# Glacial-interglacial changes in atmospheric CO2 – A smörgåsbord of marine biogeochemical forcings

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Several decades have passed since ice cores analyzed for air bubble gas composition first revealed that atmospheric $CO_2$ at the height of the last glacial was some ~90 ppm lower than at the end of the Holocene. At the current count, some 20-30 different mechanisms have been hypothesized to explain this phenomenon. However, none come close to achieving a ~90 ppm change by themselves, particularly when additional paleoceanographic data constraints are taken into account, such as observed changes in the depth in the ocean at which carbonates are no longer preserved in the sediments. The answer to the 'glacial $CO_2$ question' must therefore lie in a less aesthetically pleasing but much biogeochemically richer, combination of processes – at a minimum, involving reorganizations of ocean circulation, changes in sea surface temperatures, sea-ice extent, and biological productivity, together with interactions occurring between the ocean and deep-sea sediments. Here we present a critical assessment of the relative importance of the different marine biogeochemical forcings of the Earth's atmosphere. We will also discuss recent develoments in model-data intercomparison (such as the creation of synthetic sediment core records in Earth system models) that can help us better interpret the paleoceanographic record and understand what the ice core $CO_2$ record is trying to tell us.