# Evolution of Atmospheric $pCO_2$ from the late Oligocene to present

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Earth's climate is controlled by the concentration of the greenhouse gas $CO_2$ in the atmosphere and the quasi-periodic variations in the planet's orbital motion. On geologic timescale (million yr) tectonic activities control the atmospheric $CO_2$ budget, whereas on shorter timescale (thousand yr) the exchange of $CO_2$ between the atmosphere and deep-ocean controls atmospheric $CO_2$ concentration. Hence, to understand the long-term evolution of climate a faithful record of atmospheric $CO_2$ concentration is important. Foraminiferal calcite bound boron isotopic composition, of both planktonic and benthic specimens are established proxies of seawater pH. The coupled nature of atmospheric $CO_2$ concentration and seawater pH means quantification of atmospheric $CO_2$ concentration is possible through analysis of foraminiferal boron isotopic composition within the residence time of boron in seawater. We have reconstructed the evolution of seawater pH from late Oligocene to present (last 33 million years) by analyzing the boron isotopic composition of species specific and size fraction specific planktonic foraminifera. Specimens from DSDP/ODP Sites 588, 757, 758, 926, and 1265 were analyzed in an age, species, and site overlapping fashion to maintain continuity. We constrain secular variation of the boron isotopic composition of seawater caused by the weathering / reverse weathering driven geochemical cycling of boron, utilizing the lithium isotopic evolution record of seawater. The key observations from this study include elevated pCO2 during mid Miocene and quasi-linear drop in atmospheric pCO2 through late Miocene to Plio-Pleistocene.