

# Boron isotopes, seawater-pH and paleo-pCO<sub>2</sub>

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Boron isotope geochemistry has gained significant momentum over the past two decades, laboratory and field calibrations have been established and the proxy has been applied over the Cenozoic and beyond. Critics of the proxy have expressed concern about differences between analytical techniques, temperature and vital effects, potential incorporation of boric acid, diagenesis, as well as  $\delta^{11}\text{B}_{\text{sw}}$  varying over multimillion-year time scales. We have synthesized the current state of understanding of this proxy as part of the process of writing a boron proxy book that addresses many critical questions. Does independent evidence for vital effects agree with proxy observations? Can boron coordination in the  $\text{CaCO}_3$  lattice tell us about which aqueous boron species is incorporated? What is the effect of aqueous boron isotope fractionation and temperature variability on boron incorporation, pH and pCO<sub>2</sub> estimates, and how good is our understanding of  $\delta^{11}\text{B}_{\text{sw}}$ ? This synthesis aims to highlight how far we have come, but also lay out remaining problems that require further validation.