

Ocean acidification; estimation from paleoen to future environments

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The rising level of CO₂ in the atmosphere is making the world's oceans more acidic. The pH could drop from 8.17 at the pre-industrial 1800 through 8.06 at modern to 7.6 by the end of this century. The pH is closely correlated with the carbonate saturation level. Modern-day surface [CO₃²⁻] varies meridionally by more than a factor of two, from average concentrations in the Southern Ocean of 105 micro-mol kg⁻¹ to average concentrations in tropical waters of 240 micro-mol kg⁻¹. This low [CO₃²⁻] is due to (1) low SST and CO₂-system thermodynamics and (2) large amounts of upwelled deep water, which is more acidic from organic matter remineralization. The undersaturation with respect to aragonite will be throughout the entire Southern Ocean and into the subarctic Pacific by 2100, when the calcite will be also close to saturation (Orr et al., 2005). Especially these severe saturation state will first occur in the winter, when the partial pressure of carbon dioxide in seawater (P_{CO₂}) values are the highest at low temperature and wind-driven mixing of subsurface water into the mixed layer (Feely et al., 2004). Ocean acidification problem regarding the production/dissolution of biogenic carbonate can be discussed with respect to decreased rate of biogenic carbonate production under the decreased degree of over saturation, dissolution of inorganic carbonate under undersaturation of seawater, and reduced pH induced by other chemicals such as sulfate ion.