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Planktonic foraminiferal Mg/Ca ratios: How a temperature proxy becomes an indicator of global bottom water calcite-saturation states

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The effect of the calcite-saturation state of bottom waters, which is defined as difference between the *in situ* carbonate concentration and the carbonate concentration at saturation, on the preservation of carbonates in sediments is still under debate. Estimates of carbonate preservation to reconstruct the relative vertical position of a sample with respect to the lysocline depth are often based on properties of the bulk sediment (e.g., carbonate content, colour, coarse-to-fine fraction ratio), which are also controlled by processes at the sea surface. Additionally, such relative positions were derived from planktonic foraminiferal fragmentation (i.e. the proportion of fractured foraminiferal tests due to dissolution-induced calcite thinning related to the relative position of the lysocline). A quantitative indicator of the calcite-carbonate state, however, will be introduced here. We present a study on tests of ten planktonic foraminiferal species from various sediment-surface samples exposed to bottom waters characterized by supersaturation through undersaturation with respect to calcite. Our data reveal that above a calcite-saturation state of $\approx$20 μmol/kg, planktonic foraminiferal Mg/Ca ratios are unaltered compared to their primary signal, which was recorded during test formation at similar calcification temperatures. Below $\approx$20 μmol/kg, Mg/Ca ratios linearly decrease with decreasing calcite-saturation states. Similar effects of dissolution on multispecies Mg/Ca ratios from the fairly supersaturated tropical Atlantic as well as from the much more corrosive tropical Pacific suggest planktonic foraminiferal Mg/Ca ratios to be a globally valid indicator of bottom water carbonate-saturation states.