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Southern high latitude climate during the Jurassic - Cretaceous: new evidence from clumped isotope thermometry

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In order to understand the climate dynamics of the greenhouse world of the Jurassic and Cretaceous, it is important to determine higher latitude palaeotemperatures. With respect to the Jurassic and Cretaceous there are significant differences between temperature proxies (e.g. oxygen isotope palaeothermometry vs. TEX86) and between proxy data and climate models.

The Falkland Plateau (palaeolatitude c. 55°S) preserves fossil-bearing sediments from the Middle Jurassic – Early Cretaceous. Material derived from Deep Sea Drilling Project (DSDP) Site 511 has previously been used in climate reconstruction studies, which have yielded conflicting temperature estimates. Here we apply clumped isotope thermometry on pristinely preserved belemnite rostra to achieve estimates of marine temperatures through the Upper Jurassic and Lower Cretaceous sediments of the Falkland Plateau. These data are then compared with published oxygen isotope and organic biomarker temperature data (TEX86). The range of different proxy substrates preserved in these sediments allows a broad proxy-to-proxy intercomparison directly comparing temperature estimates from 3 different methodologies at the same time and place. Furthermore, because the clumped isotope methodology provides temperature estimates independent of the δ18OSW, δ18OSW values are also determined, improving understanding of the southern ocean isotope chemistry during the Late Jurassic and Early Cretaceous. From our analyses we infer an average temperature of 27°C for the Southern Atlantic Ocean, remarkably close to TEX86 sea surface temperature reconstructions. These data point to climate models underestimating temperatures and the amount of warming that would accompany elevated atmospheric CO_2 levels.