Global hothouse climatic conditions prevailed during the Cretaceous (Cenomanian-Turonian) amidst the tectonic separation of southeastern Gondwana and poleward radiation of angiosperms. The fossilised remnants of the highest southern palaeolatitude (~70–80°S) forest studied to date from this important time interval are preserved within the Tupuangi Formation located on Pitt Island, Chatham Islands, New Zealand. Analysis of the preserved spore-pollen record of this fluvio-deltaic succession has enabled correlation to the Ngaterian, Arowhanan and Mangaotanean stages of the New Zealand chronostratigraphic scheme. In the absence of absolute dating, this study applied a new method of chemostratigraphic correlation in order to constrain these biostratigraphic stage boundaries, primarily the Arowhanan-Mangaotanean boundary which has previously been correlated with the Cenomanian-Turonian boundary (CTB). Global type sections of the CTB (93.9 Ma) preserve a distinct signature within the ratio of stable carbon isotopes (δ¹³C), specifically an increase in C¹³:C¹², attributed to Cretaceous Oceanic Anoxic Event 2 (OAE-2). This study aimed to identify this characteristic δ¹³C signal by analysing the stable carbon ratios preserved by coalified leaf compressions of two of the dominant taxa collected at semi-regular stratigraphic intervals (3–8m) across an approximately 400m thick section of the Tupuangi Formation. These leaves were isolated via manual preparation techniques and sieving from bulk samples. Following the removal of adhering carbon contaminants with hydrochloric acid, the fossilised material was dried and δ¹³C levels were analysed using elemental analysis isotope ratio mass spectrometry (EA-IRMS). The values obtained range between -23‰ and -28‰, which are typical of those acquired for extinct and extant C₃ plants. Statistical analyses of these data were performed to assess the inter- and intra-species variation in δ¹³C values obtained for this first taxonomically controlled profile of terrestrial carbon, facilitating comparisons with global type sections. Subsequently, this study established the benefits and limitations of taxonomically-controlled terrestrial carbon chemostratigraphy.

In this study we provide evidence for gas hydrates in the Taranaki Basin occurring off the continental margin. Modelling of the gas hydrate stability zone (GHSZ) suggests that pressure and temperature conditions for hydrate formations exist at water depths of 500 m and greater. Interpretation of high-resolution 2D and 3D seismic data reveal the presence of large deep seated faulting, polygonal faulting, seismic chimneys/pipes, mounds, pockmarks and high amplitude anomalies here interpreted as free gas. These features are linked to evidence suggesting upward migrating fluids (liquids and gas) from Late Cretaceous deposits into the shallow