The biogeochemical properties of an extensive bloom of the coccolithophore, *Emiliania huxleyi*, at the shelf break in the northern Gulf of Biscay was investigated in June 2006. Total Alkalinity (TA) values in the water column showed strong non-conservative behaviour indicative of the impact of calcification, with the highest TA anomalies (up to 26 μmol.kg⁻¹) in the high reflectance coccolith patch. Partial pressure of CO₂ (pCO₂) values ranged from 250 to 338 μatm and the area was found to act as a sink for atmospheric CO₂. Overall, pCO₂@13°C (pCO₂ normalized at a constant temperature of 13°C) in the water column was negatively related to TA anomalies in agreement with an overall production of CO₂ related to calcification. Hence, the calcifying phase of the *E. huxleyi* bloom decreased the sink of atmospheric pCO₂, but did not reverse the direction of the flux. Rates of pelagic respiration up to 5.5 mmol O₂.m⁻³.d⁻¹ suggested a close coupling between primary production and respiration and/or between organic carbon content and respiration. Benthic respiration rates were quite low and varied between 2 and 9 mmol O₂.m⁻³.d⁻¹, in agreement with the fact that the study area consists of sandy sediments with low organic matter content. Benthic respiration was well correlated to the chlorophyll a content of the top 1 cm of the sediment cores. Evidence was found for dissolution of CaCO₃ due to the acidification of superficial sediments in relation to the production of CO₂ and the oxidation of H₂S in the oxic layers.