# Reconstruction $pCO_2$ during the Paleocene-Eocene Thermal Maximum

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## Statement of Findings

This research makes use of a novel method of calculating paleo-*p*CO2 levels using pedogenic carbonate nodules and leaf wax *n*-alkanes from paleosol horizons in the Big Horn Basin, WY dating back approximately 57 Ma. This time period referred to as the Paleocene-Eocene Thermal Maximum represents a period in Earth's history when global surface temperatures had warmed by up to approximately 14 degrees Fahrenheit. Analysis of paleo-*p*CO2 levels allows us to understand the causes for this dramatic warming event. Current soil carbonate proxies used to estimate paleo-*p*CO2 rely on bulk organic matter δ13C values, however this method of calculation is flawed since organic matter shows an isotopic enrichment over time as it degrades. As a means of improving upon past methodologies, this research takes a novel approach by using δ13C values from plant wax *n*-alkanes which have been shown to preserve much more accurately in the geologic record. By refining the method for calculating paleo-*p*CO2 levels, we hoped to more accurately assess and understand paleoenviornments as well as gain a better understanding of the effects of quantifiable increases in CO2 on global temperature change.

The findings of this research indicated that the $pCO_2$ during the PETM ranged between 500ppm and 700ppm. Additionally, results of this research also demonstrated that the calculated $pCO_2$ value depends on the sampling method of the carbonate, that is to say whether a weathered outer surface, a mixture of weathered and non –weathered surfaces, or a clean unweathered surface is used for the analysis. The $pCO_2$ values obtained with this novel *n*-alkane method are significantly different from the values obtained if the prior bulk-organic matter method is used.

Based on the findings of this research, it can be concluded that climate sensitivity during the PETM was on the order of 5-10°C, which is higher than some of today's current estimates which are on the order of 3-6°C. The findings of this research lead us to conclude that during time periods in Earth's history when there were major perturbations to the climate-feedback system, climate sensitivity was perhaps higher than is currently estimated. If this is indeed the case, then it is quite relevant in the modern time when anthropogenic $CO_2$ inputs are increasing at a rate never before seen in Earth's history.