Paleosols and Paleoclimate of the Prince Creek Formation, Arctic Alaska, during the middle Maastrictian global warming event

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During the Late Cretaceous the long-term global cooling trend was interrupted at ~69 Ma by an intense greenhouse episode known from terrestrial records as the Middle Maastrichtian Event (MME). In the paleo-arctic, we identified the MME in the lower Catnwell Formation (~64º N paleolatitude; 69.5±0.7 Ma U–Pb age) characterized by a fluctuation in the carbon isotope composition of atmospheric CO_2 from more negative (−6.6 ‰) to less negative values (−6.3‰). We assume the presence of the MME in the coeval Prince Creek Formation (~75-85º N; 69.2±0.5 Ma $^{40}Ar/^{39}Ar$ age) by chronostrati-graphic correlation with the lower Cantwell Formation. Reconstruction of mean annual precipitation (MAP), meteoric water composition and mean annual temperature (MAT), suggests a strong variability of MAP, an increased MAT and an increased latent heat transport, over a period of 10^4 years, consistent with reported data of the global-scale climate phenomenon MME. 1,200–3,900 mm/yr and 350–1,000 mm/yr are, respectively, the highest and the lowest MAP interval obtained using carbon stable isotopes. The average MAP value of 1,254±181 mm/yr calculated using climofunctions agrees with the higher MAP interval and is consistent with independent estimates of paleoprecipitation from fossil plants. MAT values ~12.5±4.4°C are consistent with warm month mean temperatures obtained previously from paleobotanical data. Estimates of atmospheric CO_2 concentration indicate higher levels of ρCO_2 (~1.2 PIAL, pre-industrial atmospheric levels) but not as high as previously predicted for the MME (~4 PIAL), a drawdown probably related to CO_2 consumption by silicate weathering and consequently carbon burial. The $d^{18}O$ value of meteoric water calculated from bentonitic smectite is ~ -24‰, assuming a mean annual temperature of 6.3°C, which is a more ^{18}O-depleted value when compared with previous data of meteoric water calculated from siderite. This confirms highly $d^{18}O$-depleted precipitation in the Late Cretaceous paleo-Arctic. These data strongly support previous studies from the Prince Creek Formation that have suggested the Mid-Maastrichtian global warming event (MME) as a plausible explanation for an intensified hydrological cycle that enhanced latent heat transport, resulting in increased rainout effects.