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Geochemical and mineralogical evidences for intensive weathering during the PETM

Hassan M. Khozyem (1), Thierry Adatte (1), Jorge E. Spangenberg (2), Gerta Keller (3), and Karl Foellmi (1)

(1) IGP, institut de Geologie et Paleontologie, Lausanne University, Switzerland (hassanmohamed.saleh@unil.ch), (2) IMG institut de mineralogie et Geochimie, Lausanne University, Switzerland , (3) Dept Geosciences, Princeton University, Princeton, USA

The Paleocene Eocene thermal maximum (55.8 million years) shows an extraordinary drop in the ratios of ∂13Ccarb and ∂13Corg, indicating that a massive amount of "light" carbon was emitted into the atmosphere in a very short time (few hundred Ky). The most likely source would have been methane from ocean sediments or land vegetation. The released CO2 is removed from the atmosphere by silicate rock weathering reactions and organic carbon burial. This balance is thought to have stabilized greenhouse conditions. The Dababiya GSSP (Egypt) is thought to be the most complete known PETM section; for this reason detailed geochemical and mineralogical studies have been achieved on 60 samples spanning the PETM interval to evaluate the rate of weathering and it's feedback. The base of the Eocene is marked by a sequence boundary overlain by silty clays deposited during low sea level (Bed 1) and followed by marly shales reflecting a progressive sea-level rise (Beds 2-5). Both organic and carbonate isotopes shows a long-term decrease starting 0.5m below the P-E boundary which is defined by the minimum in ∂13C values. The persistent shift in ∂15N to nearly zero reflects a gradual increased in bacterial activity. High Ti, K and Zr and decreased Si contents at the P/E boundary indicate high weathering index (CIA) which coincides with significant kaolinite input and suggest intense chemical weathering under humid conditions at the beginning of the PETM. Above, the presence of two negative Ce/Ce* anomalies intervals reflects anoxic conditions which prevailed during the middle PETM (Bed 2). Anoxic to euxinic conditions are also revealed by increasing U, Mo, V Fe and the presence of small size pyrite framboids (2-5μm). At the same interval, productivity sensitive elements (Cu, Ni, and Cd) show maximum concentration ratios suggesting high productivity in surface water. Upwards, phosphorus and barium tend to precipitate as oxic conditions were re-installed (upper PETM, Bed 3). These data highlight that intense weathering and subsequent nutrient inputs are crucial parameters in the chain of the PETM events, triggering productivity during the recovery phase.