Sedimentary record of river response to climate change: example of the Paleocene-Eocene thermal maximum in the South-Pyrenean foreland basin, Spain

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Abstract

The “Paleocene-Eocene Thermal Maximum” (PETM), is understood to be an extreme global warming event that occurred about 56 million years ago and during which, global annual temperatures are estimated to have increased by 5-8°C. An outstanding question is: in addition to the global increase in temperature, how has precipitation been perturbed during the event, and how have surface processes responded? In the southern Spanish Pyrenees, the Paleocene succession of the Tremp- Graus basin is made up of the Talarn (Danian) and Esplugafreda (Thanetian) red bed formations. The Esplugafreda section is composed of approximately 250m of reddish paleosols and contains numerous channel-like bodies of calcareous conglomerates, which are interpreted as braided channels. The Esplugafreda formation is overlain by the Claret Conglomerate—an extensive sheet-like unit which ranges in thickness between 1m and 4m of clast-supported calcareous conglomerate and pebbly calcarenites and is interpreted mark the beginning of the Eocene. The Claret conglomerate is thus proposed to be a witness of river response to a dramatic climate change, in [...]

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Available at:
http://archive-ouverte.unige.ch/unige:82342

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Sedimentary record of river response to climate change: example of the Paleocene-Eocene thermal maximum in the South-Pyrenean foreland basin, Spain

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The “Paleocene-Eocene Thermal Maximum” (PETM), is understood to be an extreme global warming event that occurred about 56 million years ago and during which, global annual temperatures are estimated to have increased by 5-8°C. An outstanding question is: in addition to the global increase in temperature, how has precipitation been perturbed during the event, and how have surface processes responded?

In the southern Spanish Pyrenees, the Paleocene succession of the Tremp-Graus basin is made up of the Talarn (Danian) and Esplugafreda (Thanetian) red bed formations. The Esplugafreda section is composed of approximately 250m of reddish paleosols and contains numerous channel-like bodies of calcareous conglomerates, which are interpreted as braided channels. The Esplugafreda formation is overlain by the Claret Conglomerate—an extensive sheet-like unit which ranges in thickness between 1m and 4m of clast-supported calcareous conglomerate and pebbly calcarenites and is interpreted mark the beginning of the Eocene. The Claret conglomerate is thus proposed to be a witness of river response to a dramatic climate change, in the form of the transformation of a braided river and floodplain system into an enormous conglomeratic braided plain (formed over at least 2000km² conservatively) indicating dramatic change in the hydrologic cycle. The conglomerate unit ends abruptly and is overlaid by fine-grained yellowish soil which mainly made up of silty mudstones with abundant small size carbonate nodules suggesting another shift in the hydrological cycle after the PETM.

Here we first present channel width/depth and grain size data collected in the southern Pyrenees (Tremp, Aren, and Serraduy sectors) in order to document river response during the climate change assumed to have occurred during the PETM. Secondly, we present preliminary results of experiments investigating river response to water discharge and sediment supply variations in a flume tank at the Surface Dynamics Laboratory of the University of Geneva. Our principal objective is to discuss the possible precipitation perturbations at the PETM and how these are transferred into the rock record of river response.