Geophysical Research Abstracts
Vol. 19, EGU2017-13685, 2017
EGU General Assembly 2017

Immediate propagation of deglacial environmental change to turbidite systems along the Chilean continental slope

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Understanding how Earth-surface processes respond to past climatic perturbations is crucial for making informed predictions about future impacts of climate change on sediment fluxes. Sedimentary records provide the archives for inferring these processes but their interpretation is compromised by our incomplete understanding of how sediment-routing systems respond to millennial-scale climate cycles.
We analyzed seven sediment cores recovered from turbidite depositional sites along the continental slope of the Chile convergent margin. These depositional systems represent the ultimate sedimentary archives before sediment gets recycled during subduction processes and provide relatively continuous and well-dated records. The study sites span a pronounced arid-to-humid gradient with variable topographic gradients and related connectivity of terrestrial and marine landscapes on the continental slope. This setting allowed us to study event-related depositional processes from the Last Glacial Maximum to present in different climatic and geomorphic settings. The turbidite record was quantified in terms of turbidite thickness and frequency. The three studied sites show a steep decline of turbidite deposition during deglaciation. High rates of sea-level rise significantly lag the decline in turbidite deposition by 3-6.5 kyrs. However, comparison to paleoclimate proxies shows that this spatio-temporal sedimentary pattern mirrors the deglacial humidity decrease and concomitant warming with little to no lag times.
Our results suggest that the deglacial humidity decrease resulted in a decrease of fluvial sediment supply, which propagated rapidly through the highly connected systems into the marine sink in north-central Chile. In contrast, in south-central Chilean systems, connectivity between the Andean erosional zone and the fluvial transfer zone probably decreased abruptly by the deglaciation of piedmont lakes, resulting in a significant and rapid decrease of sediment supply to the ocean. Additionally, reduced moisture supply may have also contributed to the rapid decline of turbidite deposition. These different causes result in similar depositional patterns in the marine sinks. We conclude that turbiditic strata can act as reliable recorders of climate change across a wide range of climatic zones and geomorphic conditions. However, the underlying causes for similar signal manifestations in the sinks may differ, ranging from maintained high system connectivity to abrupt connectivity loss.