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Author(s):
Gelwick, Katrina; Pazzaglia, Frank; Kodama, Kenneth; Corbett, Lee; Bierman, Paul; Caffee, Marc

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Decoupled lithostratigraphy, orbitally-driven climate, and tectonics for a middle Pleistocene stratigraphic section in the Northern Apennines, Italy

Katrina Gelwick[1], Frank Pazzaglia[2], Kenneth Kodama[2], Lee Corbett[3], Paul Bierman[3], and Marc Caffee[4]

[1]Geological Institute, ETH Zürich, Zürich, Switzerland (kgelwick@ethz.ch)
[2]Department of Earth and Environmental Sciences, Lehigh University, Bethlehem, Pennsylvania, USA
[3]Geology Department, University of Vermont, Burlington, Vermont, USA
[4]Department of Physics, Purdue Rare Isotope Measurement (PRIME) Laboratory, Purdue University, West Lafayette, Indiana, USA

Cyclical patterns in the lithology of terrestrial Pleistocene sedimentary deposits are traditionally interpreted as the result of exogenic interglacial-glacial cycles, with deposition accommodated by constant basin subsidence. Recent challenges to this model propose that autogenic surface processes inherent to hillslope, fluvial, and marine systems can both obscure exogenic signals in the sedimentological record and encode their own quasi-periodic signal that mimics exogenic cyclicity. We used rock-magnetic cyclostratigraphy to test the canonical climate-driven sedimentation model for terrestrial Pleistocene sedimentary cycles against competing tectonic- and autogenic process-modulated sedimentation models with a continuous 60 m exposure of middle Pleistocene fluvial sedimentary cycles located at the edge of the actively subsiding Po foreland basin in the Northern Apennines of Italy. We correlated magnetic susceptibility, sampled at 40 cm intervals, to orbital cyclicity to generate a high-resultion age model anchored by terrestrial cosmogenic nuclide (TCN) burial ages, optically stimulated luminescence (OSL), and magnetostratigraphy. Two new ^{26}Al-^{10}Be burial ages are 160±320 ka and 680±310 ka (2σSE); the age of a third buried sample is consistent with continuous exposure and thus recent burial. We mapped the age model into section lithostratigraphy and then compared to the global benthic δ^{18}O stack to determine whether sedimentary cyclicity coincides with glacial-interglacial cycles. In addition, we calculated paleo-erosion rates based on the ^{10}Be concentration of six samples distributed through the age model and find that they range from 244±23 to 444±52 m/Ma, which bracket the modern TCN-determined erosion rate of the Enza River of 351±40 m/Ma. Results show no clear correlation between lithostratigraphy, glacial-interglacial climate cycles, or paleo-erosion rates, indicating that the stratigraphy is probably not driven by exogenic climate forcing. Rather, based on the decoupling of lithology and paleo-erosion rates and the little variation in paleo-erosion and modern erosion rates (<20%), the cyclicity is best explained by periodic autogenic delta processes in a system where accommodation space in the depositional basin is limited. These findings exemplify the complex interplay of tectonics, climate, and autogenic processes in the generation, transport, and deposition of sediments. Results of this study contribute to the

ongoing debate over whether signals generated by large scale, exogenic forcing can survive transport to be preserved in the sedimentary record and help define the temporal and spatial scales at which these processes operate.