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Exceptionally preserved Milankovitch cycles in Lower Devonian argillaceous limestone of the Hudson Valley, New York State (USA)

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Uncertainties on the radiometric ages of Devonian stage boundaries are currently on the order of several millions of years. A cyclostratigraphic approach is the foremost way forward to improve the Devonian geological time scale. To do so requires well-preserved continuous records, as well as reliable paleoclimatic proxies. The NY Route 199 section, from Kingston, in the Hudson Valley of eastern New York, is a road cut outcrop, which exposes most of the Schoharie Formation. It corresponds to the upper portion of the Emsian Stage (upper Lower Devonian, ~400 to ~394 Ma), with essentially continuous deposition. The lithology consists of a mixed siliciclastic-carbonate succession with overall increasing carbonate upsection, showing various degrees of bioturbation (traces includes primarily Zoophycos, Planolites and Chondrites); colors range from white to beige, brown or dark grey. The quality of most of the outcrop is so remarkable that the color variations by themselves permit recognition of Milankovitch cycles, with prominent bundles of light and dark beds. One type of cycle expression is represented by a succession of about six darker beds nested between lighter beds, which is interpreted as six precession cycles within a short eccentricity cycle (precession in the Devonian was ~17 kyr).

Samples were collected every 2 cm through 38 m of the section for magnetic susceptibility measurements. On top of these measurements, we provide elemental geochemistry, carbon isotopes and hysteresis measurements (every 50 cm) to constrain the depositional setting and the diagenesis. Hysteresis measurements show that despite being remagnetized (throughout the Appalachians, these Paleozoic rock sequences are all remagnetized during the Variscan-Alleghenian Orogeny), the magnetic susceptibility reflects depositional information. The geochemistry and carbon isotopes give insight into the occurrence of oxic/reducing conditions and detrital inputs. Milankovitch cycles are visible on the outcrop and in the magnetic susceptibility record, allowing a precise floating timescale framework to be constructed for this interval.