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Lower Devonian Milankovitch cycles from the Hudson Valley and corresponding magnetic susceptibility record, New York State (USA)

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Uncertainties on the radiometric ages of Devonian stage boundaries are currently in the order of several millions of years. A cyclostratigraphic approach is a foremost way forward to improve the Devonian geological time scale. In order to do so, we need good continuous records on the one hand and reliable paleoclimatic proxies on the other hand. The NY Route 199 section, from New York State near Kingston in the Hudson Valley, 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 an essentially continuous deposition. The lithology consists of a mixed siliciclastic-carbonate succession with overall increasing carbonate upsection, showing various degrees of bioturbation (primarily Zoophycos, Planolites and Chondrites); colors range from beige white, to 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 in one 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. Hysteresis measurements (every 50 cm) provide a high field susceptibility of about ∼5.10-8 m^3/kg and most of the hysteresis loops are straight lines, indicating only small contribution of ferromagnetic grains. The correlation between the high field susceptibility and the overall magnetic susceptibility is high (r = 0.91), while the correlation between the ferromagnetic susceptibility and the magnetic susceptibility is distinctly lower (r = 0.17). Thus, the ferromagnetic minerals have a low impact on the total magnetic susceptibility; its variability is mostly driven by paramagnetic clay minerals. Importantly, despite being remagnetized (throughout the Appalachians, these Paleozoic rock sequences are all remagnetized during the Variscan-Alleghenian orogeny), the magnetic susceptibility reflects depositional information. Typically, lighter beds correspond to lower magnetic susceptibility values; darker beds have higher values. Milankovitch cycles are visible on the outcrop and in the magnetic susceptibility record, allowing a precise floating time framework to be constructed for this interval.