Review Sinnesael et al. Cyclostratigraphy of the Middle to Upper Ordovician successions of the Armorican Massif (western France) using portable X-ray fluorescence

The manuscript of Sinnesael et al. present new portable XRF data obtained from an Ordovician succession from western Brittany (France). The sequence stratigraphy was previously published. The succession corresponds to the record of an open marine environment, with deposits covering from the shoreface to the lower offshore. This change in environment trigger changes in type of sediment deposited (sand vs. clay) but also change in sediment rates, with higher sediment rates in more proximal deposits.

I understand from the manuscript that the section is protected and no sampling was performed because of this reason. Measurements were thus performed *in situ* using spectral gamma ray and portable XRF (pXRF). Spectral analyses were performed from the potassium content approximated from the spectral gamma ray and pXRF. Two members were analyzed: the Morgat Mb., consisting of claystone deposited in a lower offshore environment, and the Kerarmor Mb., representing alternations between claystone and sandstone deposited in an upper offshore to shoreface environment.

From the spectral analyses done on the K series, the authors conclude that the Morgat Mb. Contains an excellent record of the Milankovitch cycles, unlikely to the Kerarmor Mb. The authors attribute the inability of spectral analyses to identify the sedimentary record of the Milankovitch cycles in the Kerarmor Mb. to the highly unstable sedimentation rate, demonstrating that the sequences, the processes and environments at the origin of the deposits have to be identified before applying Fourier analyses, and their derivative methods, on a sedimentary series. To be franc, this conclusion brings little novelty. This is a useful reminder that cyclostratigraphy, before being a statistical challenge, is a geological challenge. If one wants to suggest to have the record of the Milankovitch cycles, they have to prove first that they have climatic and/or eustatic cycles which average period is within the range of the astronomical cycles. From a Fourier analysis, this is possible to find a frequency content that mimics the astronomical cycles, with however no climatic or eustatic significance. Relying only on a Fourier transform done from a geophysical signal is thus not enough, especially if event deposit, such as storm deposits, are included in the sampling and the frequency analysis. This shall be obvious, and one might consider this conclusion as naive. This is however sometimes forgotten in publications.

Saying that, I find the spectral analyses of the Kerarmor Mb. superficial, in a sense that, knowing that the time of deposit of sandstone beds can be regarded as instantaneous compared to the time needed to deposit the claystone beds, the authors should try spectral analysis of the K content on the section “sandstone-free”, i.e. removing data and thickness of the sandstone beds from the series to only keep the decantation deposits, which sedimentation rate and variability of K content was probably much more stable. In complement, the authors could use the study of Dabard et al. (2015) to convert the sequences they attribute to the precession cycles to they expected average period (so they make an orbital tuning from the sequencing of Dabard et al., 2015) to remove the variations in the sedimentation rate obviously depending on the sandstone beds only.

In general in this manuscript, I find the graphic representation of the spectra unclear. The description of the spectra is also extremely superficial. I redid the spectral analyses. Below are the spectrum and the power spectrogram of the K content in the Morgat Mb. It appears that the frequency the authors chose (1.5 m, 0.5 m and 0.3 m) are not the highest powers or confidence levels regarding a red noise. Can the authors explain their choice? Is it based on their stratigraphic continuity? What is the origin of the other frequencies?

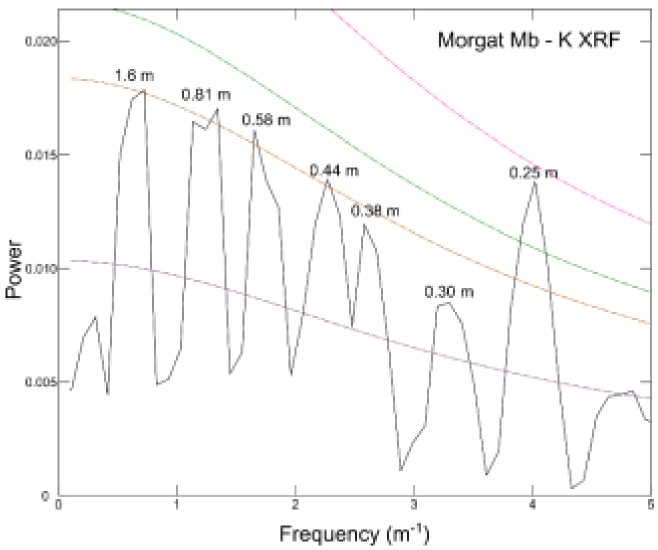

Figure 1: 2π-MTM spectrum of the pXRF K content from the Morgat Mb. Purple line is median smoothing; brown line 90 % confidence level; green line 95 % CL and pink line 99 % CL.

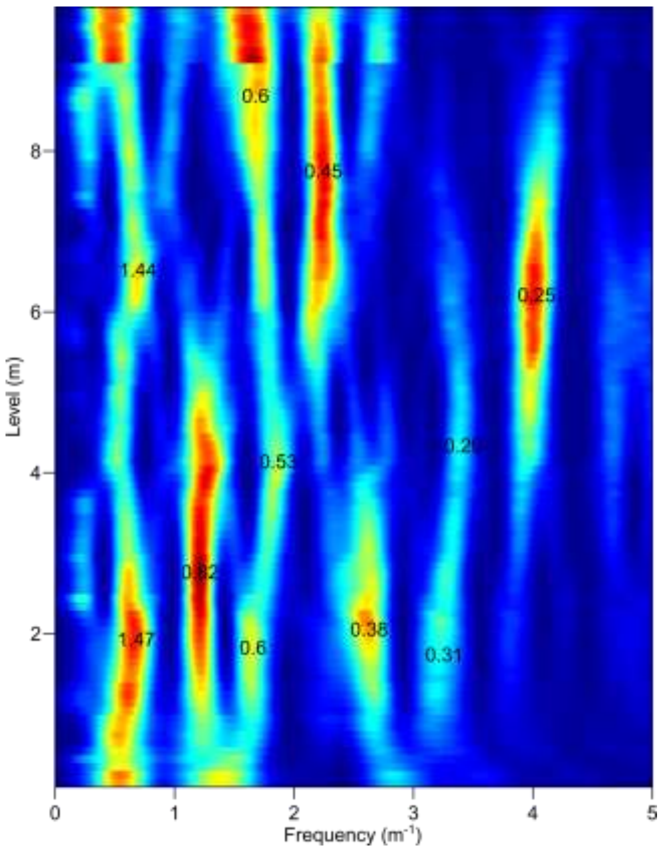

Figure 2: Evolutive Fourier transform of the pXRF K content from the Morgat Mb. The red lines are spectral peaks. The blue color indicates the spectral background. The Fourier transform were done on 5-m intervals.

In the chapter of the spectral analysis of the Kerarmor Mb., the author apparently experienced difficulties in calculating the long-term trend, which surprised me. In short sections, it may indeed not be trivial, however in this case, applying a locally weighted scatterplot smoothing curve with a coefficient of 0.5 allows the lowest frequencies to be decreased to low values while preserving the spectral peaks at higher frequencies. Notice that with this procedure, no spurious peak is produced at low frequencies, following the recommendation from Vaughan et al. (2011).

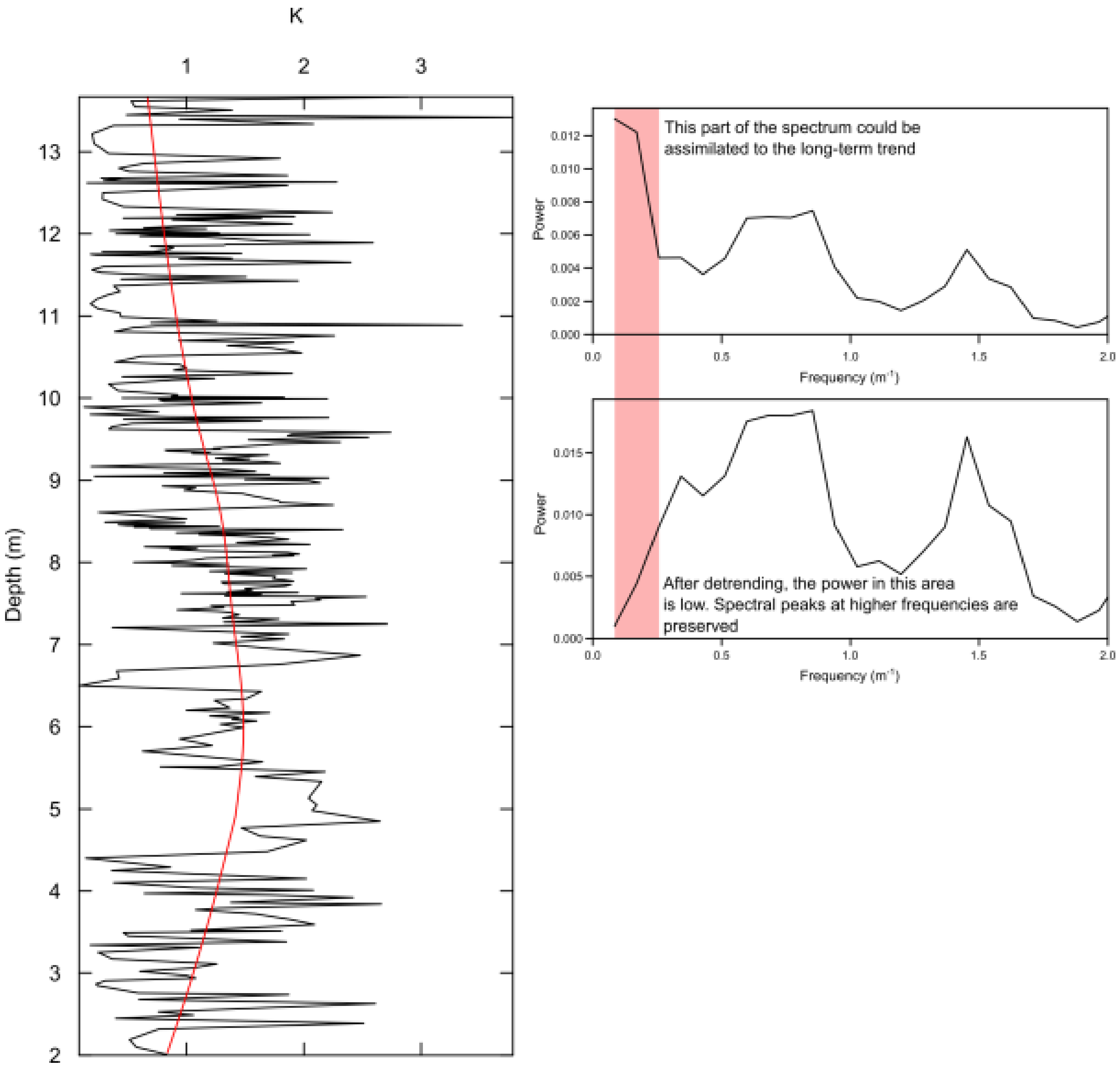

Figure 3: Detrending of the pXRF K content of the Kerarmor Mb. Top right figure is the spectrum before detrending (only the average of the series is set to 0 for clarity). Bottom right is the spectrum after detrending applying a LOWESS with a coefficient of 0.5.

In summary, I find the description and the design of the experiment extremely superficial, and additional work is needed in my opinion. So, at the moment I am not convinced by the design of the study and I think extra work is needed to make this manuscript suitable for a publication at gchron.

Below are typographical corrections I found:

Line 138: SiO2: the “2” must be in index

Line 333: “We now can”: this is actually “We can now”

Line 393: “more higher”: remove “more”

Line 403: “one can”: repeated twice, remove one of the two