Dear Dr. Algeo,

Thank you very much for carefully reading our manuscript and your detailed and insightful comment. This discussion will significantly help to improve the quality of this study. Please find our step by step reply (AR) to the Referee comments (RC) below:

RC#1: What is the water depth on the platform top and would the Great Bahama Bank represent a better example than the Late Pennsylvanian Midcontinent Sea of North America?

AR: Due to the location on an elevated high at the northern edge of the Adriatic Carbonate Platform (ACP), we expect an overall shallow marine setting. This is also what the carbonate facies tells us. Water depths above 100 m are unlikely. Given the dimensions of the ACP, however, water depths of 100 and more meters are expected elsewhere. Strictly referring to the portion of the ACP we discuss here, yes, the setting would indeed be similar to the Great Bahama Bank. Overall, when comparing ACP and LPMS with mean water depths of ~50 m, the LPMS might be a better analogue due to its complexity, dimension, and wide range of palaeobathymetries. Summing up, it makes certainly sense to refer to the Bahamas AND the LPMS depending on the question in mind.

RC#2: Flow of hypersaline water masses leaving the platform top and creating a mechanism to drive lateral advection or upwelling of open-ocean waters onto the platform top.

AR: Assuming usual paleo-temperature reconstructions of the Cretaceous (Larson and Erba, 1999; Jenkyns, 2003), a greenhouse setting associated with strong evaporation on the platform-top is likely. This process would strengthen our hypothesis of upwelling hypoxic basinal water masses on the platform-top. Nevertheless, the impact of such a mechanism and its implications needs to be further investigated and will be discussed in a revised version of the manuscript.

RC#3: Al concentration curve plotted next to redox sensitive trace elements (As, V and Mo).

AR: Figures will be added in a revised version of the manuscript, showing the redox sensitive trace element values, normalized to Al. These figures provide information that Al hardly influences the redox sensitive trace elements and does not weaken their information concerning seawater oxygen levels. Furthermore, a figure will be added to demonstrate the Al content of every sample, following Ling et al. (2013), who established an Al maximum value of <0.35 % for a primary seawater signal. In our samples we observe values below 0.15 %, mostly around 0.05 %.

RC#4: Redox sensitive trace elements reflect platform-top conditions.

AR: In general, the redox sensitive trace elements show the redox conditions on the platform top. Due to the increased uptake of these elements during basinal black shale deposition, their concentration will be reduced on the platform top, where they indirectly provide information about the redox conditions in deeper areas.

RC#5: Do REEs represent a hydrogenous source?

AR: In order to avoid a detrital origin of the REE signal, all samples were carefully screened (thin sections and SEM analysis) for the presence of automicrite. The term “automicrite” was defined by Neuweiler and Reitner (1992) and refers to micrite that formed *in situ* by microbial activity inducing the nucleation and precipitation of mainly fine-grained Mg calcite crystals.

It is here important to note that it has been previously documented that automicrite is an excellent archive of paleo-seawater chemical composition, notably for the REE pattern (Olivier and Boyet, 2006; Della Porta et al., 2015). A large majority of the REE pattern measured in automicrite in our study show a typical marine pattern, supporting the interpretation that the REE represent a hydrogenous source. These pattern will be shown in an updated version of our manuscript. Furthermore, figures of the Y/Ho ratio, Sc concentration and LREE/HREE ratio will be added, supporting hydrogenous source of the REEs.

In this reply, we provide a first raw version of the new figures in the attached material.

The Y/Ho ratio remains between 40 to 50 for most of the samples. Some samples show even higher ratios, but no sample is showing values below 35, indicating a terrigenous source.

The LREE/HREE ratio is below 1.0 for all of the samples but we can observe an increase in the ratio during the complete section from values around 0.4 (section meter 12) to values close to 0.9 (section meter 27).

The Al content is quite low and stable and mostly oscillates around 500 ppm (0.05%), significantly below the suggested maximum for a hydrogenous source of 0.35% (Ling et al., 2013). The same applies for Sc, where the highest measured concentration in our samples is close to 0.3 ppm, much lower than the maximum concentration (for seawater) of 2 ppm, as suggested by Ling et al. (2013).

RC#6: U isotope ratios and Ce/Ce record global signal to reducing conditions in the larger Tethys Ocean basin. Only the redox sensitive trace elements provide information about platform top and if they are controlled by clay content, there is no evidence for changes in redox conditions on the platform top.*

AR: The Al and Sc concentrations show that the concentrations of redox sensitive trace elements are not controlled by a change in the clay content.

We agree that uranium isotope ratios are likely to record a shift towards more reducing conditions in the Tethys Ocean basin. Due to its short residence time (compared to uranium) of a few hundred years, Ce/Ce* can still be used to reconstruct local palaeoredox conditions (Sholkovitz and Schneider, 1991; Shields and Stille, 2001).

RC#7: Difficult to make a shallow watermass oxygen-depleted because of the fast exchange with the atmosphere.

AR: Indeed, there is an exchange of oxygen with the atmosphere. But given the greenhouse climate combined with strong evaporation rates during the Early Aptian, ongoing carbonate production (due to the microencrusters mass occurrence) as well as the production and integration of CO_2 in the open ocean (Ontong Java; Jenkyns, 2003) the loss of oxygen could have been stronger than the absorption of oxygen from the atmosphere. We here refer to the kettle-effect described by Skelton and Gili (2012). Please also note that the present world knows > 300 oxygen depleted coasts, implying that yes, it is possible to make a shallow water mass oxygen depleted. This also depends on wave activity, as waves are major agents in actively transporting gasses into the ocean surface water. In a protected, low-energy setting and low wave activity (due to wave-seafloor interaction), these processes seem to work.

RC#8: What is the exact origin of automicrite?

AR: Automicrite was defined by Neuweiler and Reitner (1992) and refers to micrite that formed *in situ* by microbial activity inducing the nucleation and precipitation of mainly fine-grained Mg calcite crystals.

RC#9: What are the petrographic or field criteria used to distinguish automicrite from detrital micrite?

AR: We provide several text blocks in the paper that deal with this point. Here is the short version: In the field, automicrite is recognized as a fine-grained homogenous carbonate ooze with a characteristic weathering color that differs from the host detrital micrite. In this study, the occurrence of automicrite is often associated with the occurrence of the microencrusting organisms *L. aggregatum* and *B. irregularis*. Note, field observations need testing under the SEM!

A recrystallization of the material would lead to an increase of different grain sizes, and generally a shift away from a rather homogenous to an inhomogeneous grain size. We found no evidence for this during SEM analysis. We acknowledge the work of Algeo et al. (1992) and will add a paragraph on the diagenesis of automicrite in the discussion part of a revised version of the manuscript.

RC#10: How is it possible to show changes in redox conditions and not in some covariant factor (such as water temperature) was the main biotic stressor?

AR: What we learnt from recent international research initiatives such as BIOACID is the following: Most marine organisms tolerate one stressor to some degree. They, however, give up rather quickly if for example high temperatures PLUS low pH act in parallel, to give one example. Here, we explicitly do not exclude high seawater temperatures and salinity etc. as additional stressors and we state this in the discussion. Obviously, in a fossil setting such as this one here, the fundamental question, which of the stressors (oxygen level, salinity, temperature, pH etc) was the main “killer” must remain to some degree unresolved. We have some circumstantial evidence though. For example, the high carbonate production rates are not in agreement with low seawater pH. We see a decline of oxygen sensitive organisms and a “bloom” of organisms that are (arguably) less sensitive to low oxygen levels etc.

The focus of this study is on oxygen depletion as driving mechanism for the biological change on the platform top. Arguments include the fact that biotic patterns are in parallel to patterns in seawater dissolved oxygen levels. Temperature as well as salinity etc. may have added to the overall “doom scenario” for rudist-coral communities.

Minor matters:

- Past events being described used present tense
    - Will be corrected in a revised version of the manuscript
- What is an “out-of-balance” ecosystem?
    - An ecosystem that recorded a sudden change in dominant biota (a term commonly used by ecologists)
- What is the evidence for an increased sedimentation rate?
    - A change in the microencruster morphology (increase of vertical growth forms)
- Some grammatical problems
    - Will be taken care of in the revised version

Thank you for your very constructive comments,

Sincerely yours,

A. Hueter on behalf of all co-authors.

Algeo, T.J., Wilkinson, B.H. and Lohmann, K.C. (1992): Meteoric-burial diagenesis of Middle Pennsylvanian limestones in the Orogrande Basin, New Mexico: Water/rock interactions and basin geothermics. *Journal of Sedimentary Petrology*, 62(4), https://doi.org/10.1306/D426797E-2B26-11D7-8648000102C1865D.

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Sholkovitz, E.R. and Schneider, D.L. (1991): Cerium redox cycles and rare earth elements in the Sargasso Sea. *Geochim. Cosmochim. Acta*, 55, 2737-2743, https://doi.org/10.1016/0016-7037(91)90440-G.

Skelton, P.W. and Gili, E. (2012): Rudists and carbonate platforms in the Aptian: a case study on biotic interactions with ocean chemistry and climate. *Sedimentology*, 59, 81-117, https://doi.org/10.1111/j.1365-3091.2011.01292.x.

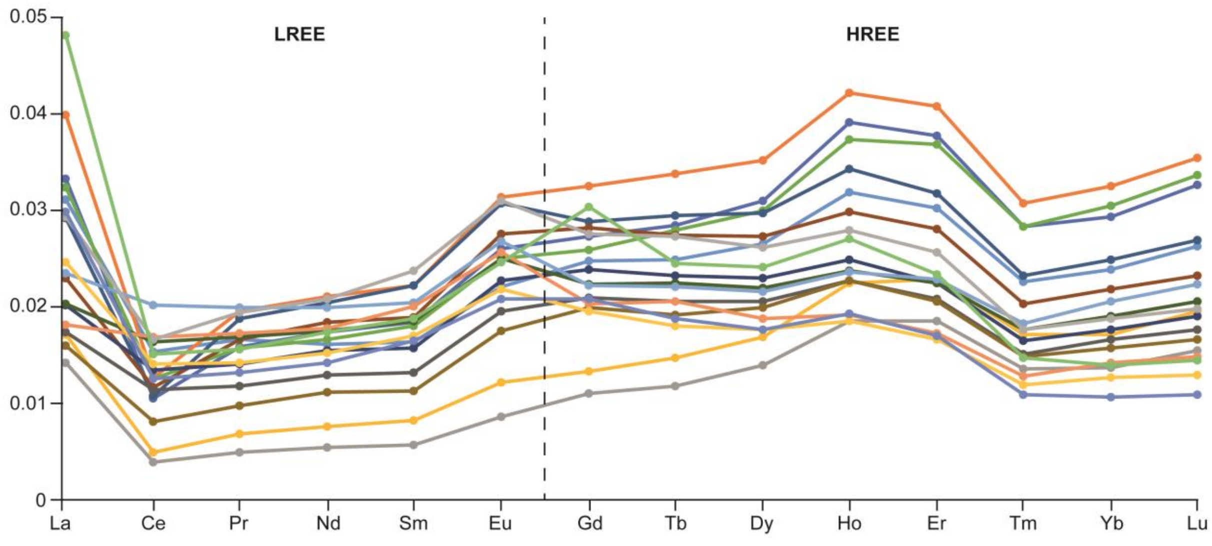

Fig. 1: REE patterns of all samples used for calculating the Ce-anomaly values. The patterns indicate seawater origin and an enrichment of HREE compared to LREE. For terrigenous source, a bell-shaped pattern would be expected.

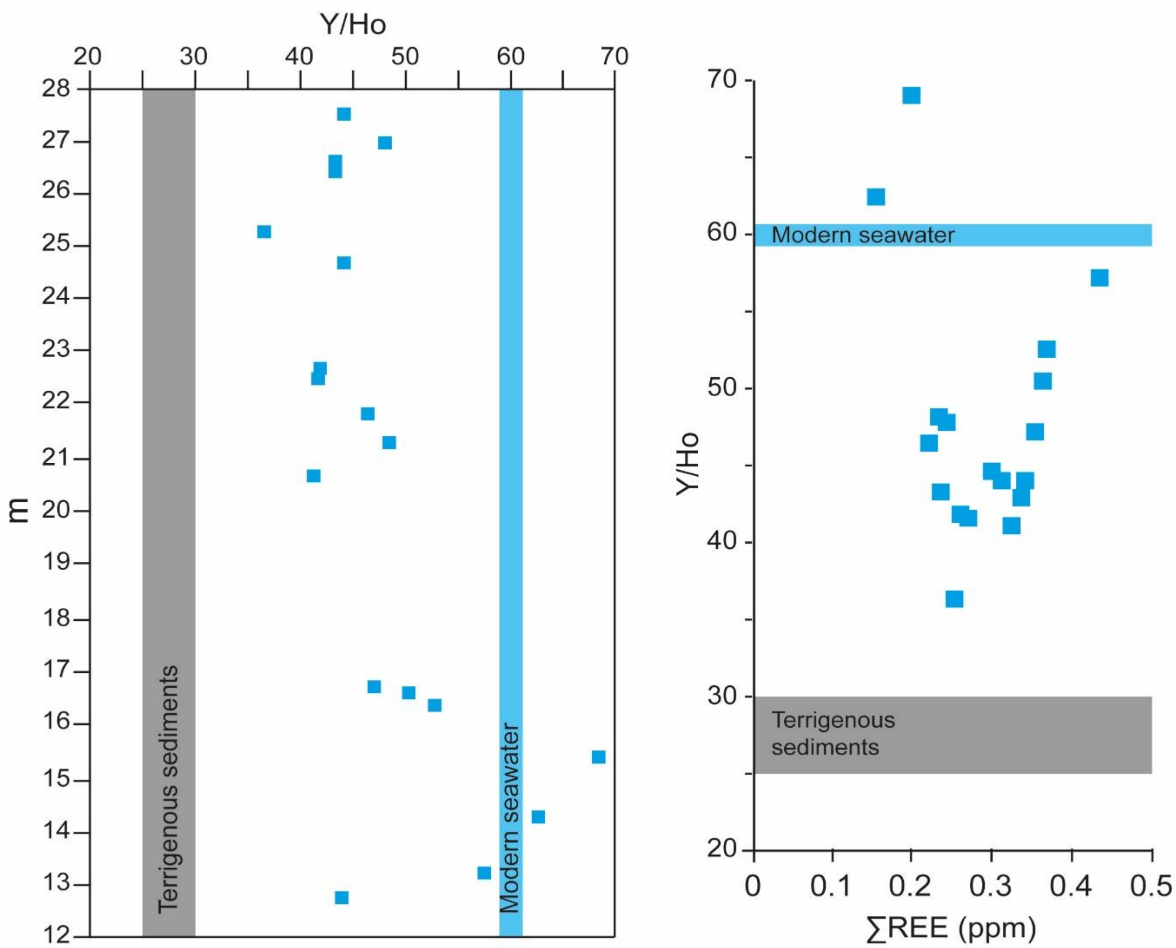

Fig. 2: The Y/Ho-ratios plotted against the profile meters (left side) and against ΣREE. All samples are ranging between a Y/Ho ratio of 36 and 70, with a cluster around a ratio of 45, clearly indicating a hydrogenous source of the measured signal.

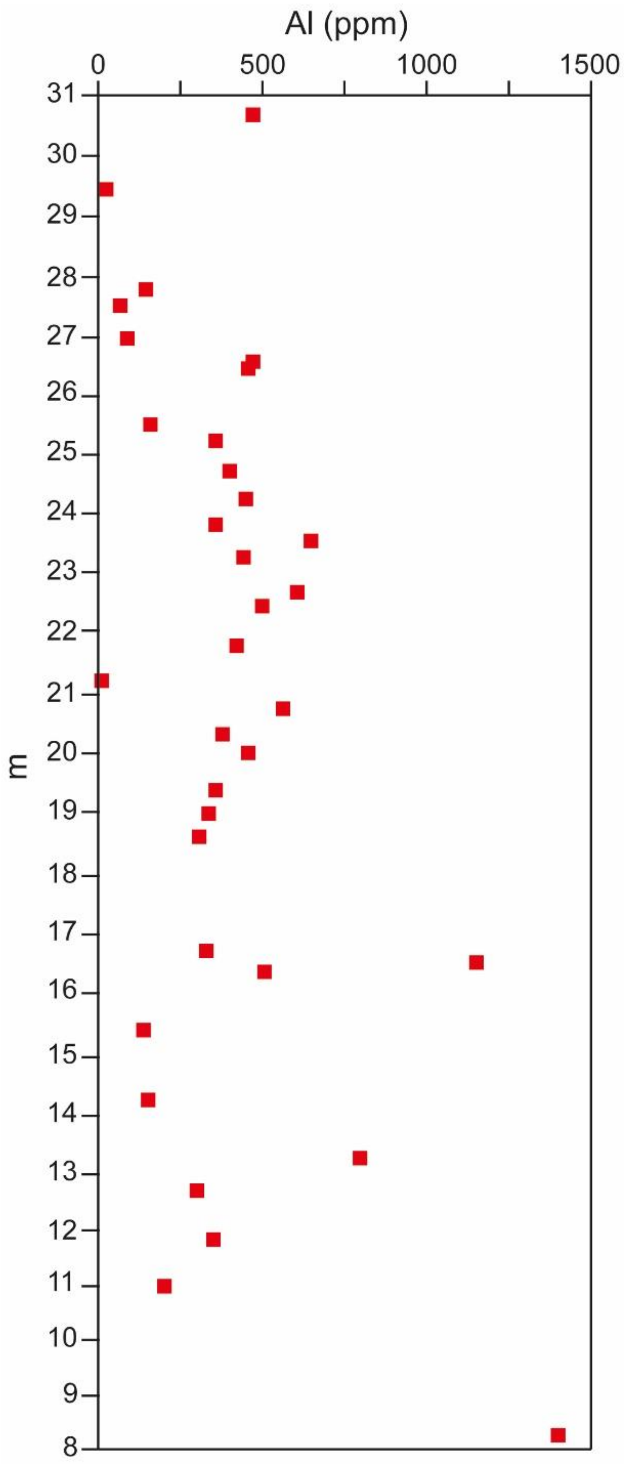

Fig. 3: The concentration of Al plotted against the section meters. Al concentration remains stable throughout the complete measured interval. All values are significantly below the suggested maximum of 3500 ppm for seawater origin (Ling et al., 2013).

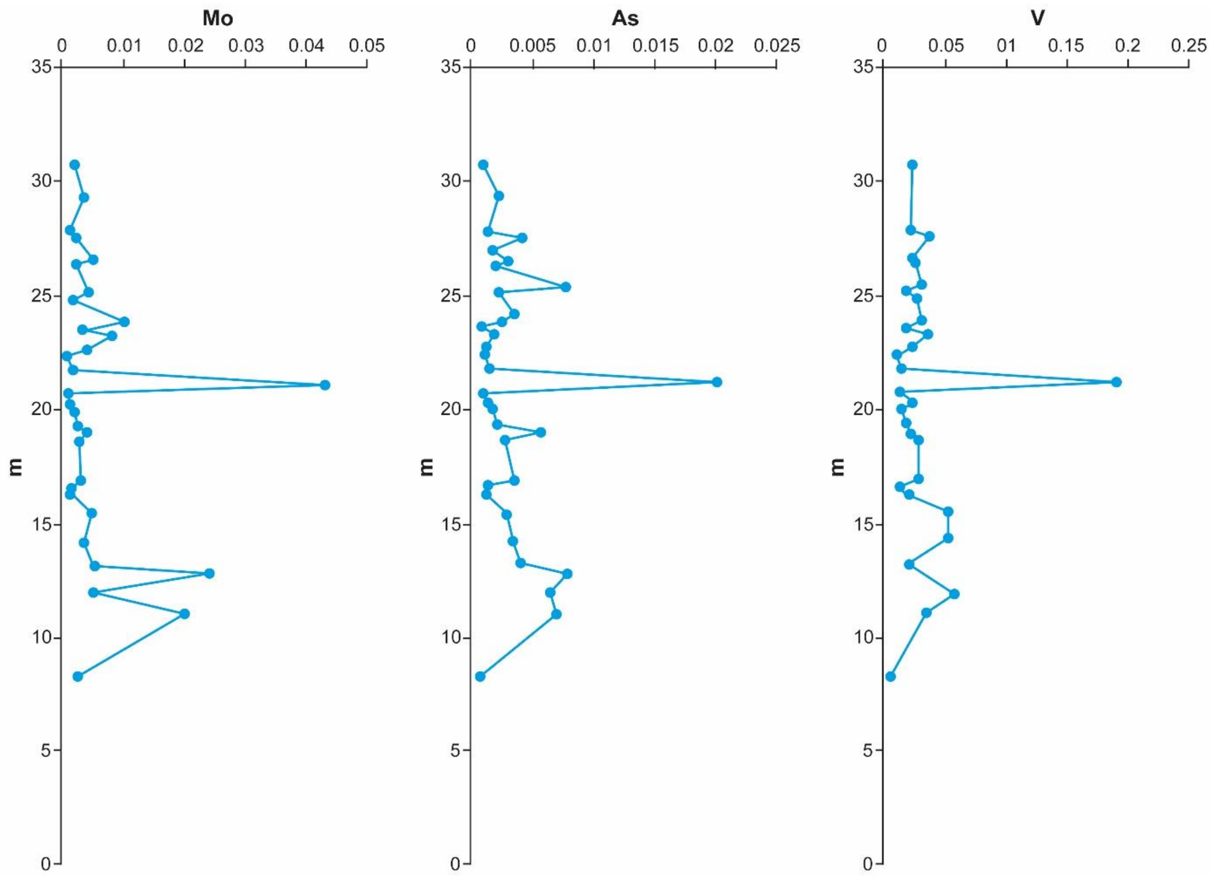

Fig. 4: Redox sensitive trace element concentrations normalized to Al concentrations. The trend of increasing trace element concentrations from section meters 8 to 10, followed by a decrease at section meter 13.5 is confirmed. An extremely low Al concentration value at section meter 21.2 is seen in all of the trace elements, but absent in the original Fig. 4, meaning that this Al value is not influencing the redox reconstruction for this part of the section. Since a single sample has such a low Al concentration, surrounded by samples with significantly higher Al concentrations, a measurement error must be assumed. However, an overall trend of Al having highly influenced the redox sensitive trace elements cannot be confirmed.

Table 1: Rare Earth Elements normalized to the Post Archaen Australian Shale (PAAS).

Sample	La	Ce	Pr	Nd	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu
KAN 12.8	0.031	0.015	0.016	0.016	0.016	0.022	0.025	0.025	0.026	0.032	0.030	0.023	0.024	0.026
KAN 13.2	0.040	0.013	0.019	0.021	0.022	0.031	0.032	0.034	0.035	0.042	0.041	0.031	0.032	0.035
KAN 14.2	0.014	0.004	0.005	0.005	0.006	0.008	0.011	0.012	0.014	0.018	0.018	0.014	0.014	0.015
KAN 15.4	0.017	0.005	0.007	0.007	0.008	0.012	0.013	0.015	0.017	0.022	0.023	0.017	0.017	0.019
KAN 16.3	0.033	0.010	0.016	0.017	0.018	0.026	0.027	0.028	0.031	0.039	0.038	0.028	0.029	0.033
KAN 16.6	0.032	0.012	0.016	0.017	0.018	0.025	0.026	0.028	0.030	0.037	0.037	0.028	0.030	0.034
KAN 16.85	0.029	0.011	0.019	0.020	0.022	0.031	0.029	0.029	0.030	0.034	0.032	0.023	0.025	0.027
KAN 20.8	0.023	0.012	0.016	0.018	0.019	0.027	0.028	0.027	0.027	0.030	0.028	0.020	0.022	0.023
KAN 21.2	0.017	0.011	0.012	0.013	0.013	0.019	0.021	0.020	0.020	0.023	0.021	0.015	0.016	0.018
KAN 21.85	0.016	0.008	0.010	0.011	0.011	0.017	0.020	0.019	0.020	0.023	0.020	0.015	0.016	0.016
KAN 22.4	0.020	0.013	0.014	0.015	0.016	0.023	0.024	0.023	0.023	0.025	0.022	0.016	0.018	0.019
KAN 22.7	0.020	0.016	0.017	0.017	0.018	0.025	0.022	0.022	0.022	0.024	0.022	0.017	0.019	0.021
KAN 24.8	0.023	0.020	0.020	0.020	0.020	0.027	0.022	0.022	0.021	0.023	0.023	0.018	0.020	0.022
KAN 25.2	0.018	0.017	0.017	0.018	0.020	0.026	0.020	0.020	0.019	0.019	0.017	0.013	0.014	0.015
KAN 26.4	0.029	0.016	0.019	0.021	0.024	0.031	0.027	0.027	0.026	0.028	0.025	0.018	0.019	0.020
KAN 26.6	0.025	0.014	0.014	0.015	0.017	0.022	0.019	0.018	0.018	0.018	0.017	0.012	0.013	0.013
KAN 27.0	0.030	0.012	0.013	0.014	0.016	0.021	0.021	0.019	0.018	0.019	0.017	0.011	0.010	0.011
KAN 27.6	0.048	0.015	0.015	0.017	0.019	0.024	0.030	0.024	0.024	0.027	0.023	0.015	0.014	0.014