Forum Reply

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Paleozoic echinoderm hangovers: Waking up in the Triassic

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We thank Hunter and McNamara for their comment (Hunter and McNamara, 2017b) on our recent Geology paper (Thuy et al., 2017) on the discovery of Paleozoic echinoderms surviving into the Triassic. Hunter and McNamara refer to their latest paper describing a new stem group ophiuroid from the Permian of Australia (Hunter and McNamara, 2017a) to question the validity of our results. In fact, however, their discovery fills the Latest Paleozoic stratigraphic gap predicted by the Triassic holdovers we described in our paper, and thus even corroborates our conclusions. Neither the new ophiuroid of Hunter and McNamara nor the data set in the supplementary data of their paper alter the validity and novelty of our discovery. We show that Paleozoic stem group ophiuroids unexpectedly survived beyond the end-Permian mass extinction into the Triassic, which makes them "hangovers" (or holdovers, if Hunter and McNamara prefer a more sober term), irrespective of whether the Triassic records were preceded by a stratigraphic gap or not.

The new Permian ophiuroid described by Hunter and McNamara (2017a) might or might not suggest a biogeographical separation of stem group and modern ophiuroids in the latest Paleozoic. In the assemblages we studied, however, both groups unambiguously co-occurred, irrespective of the type of paleo-environment or the paleo-latitude (Thuy et al. 2017, our table 1 and figure 3). Whether there was a latitudinal or bathymetric trend in the relative abundance of the stem group ophiuroids cannot be assessed with the data currently available.

Furthermore, Hunter and McNamara (2017b) argue that we failed to identify correctly the Triassic stem group ophiuroids. We agree that there is a certain superficial resemblance with the lateral arm plates of *Furcaster*. After careful examination of both published and unpublished records of *Furcaster* lateral arm plates at an early stage of our investigations in preparation of the *Geology* paper, however, we came to the conclusion that these resemblances are, indeed, purely superficial. Characters of diagnostic value in ophiuroid skeletal parts predominantly pertain to microstructural features (e.g., Thuy and Stöhr, 2016) that cannot be readily appreciated when superficially comparing plates. In the present case, *Furcaster* shows significant differences in outer surface ornamentation and, most importantly, in the arm spine articulation structure in comparison with *Ophioflabelum*, precluding a closer relationship between the two.

At the present state of knowledge, eospondylid affinities seem the most plausible for *Ophioflabelum*, especially when compared to *in situ* lateral arm plates of articulated specimens of the type species *Eospondylus primigenius* from the Lower Devonian Hunsrück Slate in Germany. Unfortunately, published descriptions of Paleozoic articulated ophiuroids mostly fail to describe and illustrate the lateral arm plates in such way that they can be directly compared with dissociated lateral arm plates retrieved from sieving residues, and the description by Hunter and McNamara (2017a) is not an exception in this respect.

Therefore, we agree with Hunter and McNamara (2017b) that "more focus should be placed on better systematic treatment of the taxa" and fully endorse their proposal for a "shift away from bulk abundance studies based on uncertain systematic data."

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