

# ***Interactive comment on “The 4.2-ka event, ENSO, and coral-reef development” by Lauren T. Toth and Richard B. Aronson***

## **Anonymous Referee #1**

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1. The authors stated a hypothesis that changes in ENSO activity around 4.2 ka triggered coral reef shutdown for about 2500 years (roughly between 4.1 and 1.6ka) in the Eastern Pacific. The hypothesis involved some hot topics including the late Holocene ENSO, 4.2 ka event and reef coral bleaching and mortality, therefore it sounds very interesting, but the authors did not provide direct evidences to support their hypothesis. Apart from the hypothesis itself, the authors did not provide any new information.

2. The basis of the authors' hypothesis is the mentioned “hiatus”, i.e. the vertical accretion ceased from ~4100 to 1600 cal BP (totally 2500 years) in their reef cores. On one hand, the authors did not show the detailed information about their cores, such as the reef type (fringing reef, atoll, barrier reef), the spatial distribution and the lengths of the cores. On the other hand, the authors did not tell us whether the reef also ceased

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the development laterally. Most likely, their reef changed development orientation from vertical to lateral, because of sea level oscillations. If so, such change or the 2500-year hiatus should be controlled by sea level oscillation, rather than the 4.2 ka climate and the related ENSO activities. In this case, their hypothesis is wrong. 3. Modern observations have suggested that the large-scale coral bleaching and mortality were mostly associated with strong El Niño events, which exert high levels of thermal stress to the corals. This study, however, suggested the attenuated ENSO variability and the La Niña conditions in the 4.2-ka event had suppressed coral populations, and led to the shutdown of the reef accretion. The logic seems inconsistent with the modern observations. 4. Table 1 shows the time range of the beginnings of the hiatus are wide (from 5 to 3.8 ka BP), and it is not strictly around  $\sim 4.2$  ka BP, which suggests the reef hiatus was not related to the  $\sim 4.2$  ka event. 5. Based on the high  $\Delta R$  and the low Sr/Ca-SST (Fig. 2), the authors suggested that strong upwelling occurred in  $\sim 3.8$ - $3.6$  ka BP and partially attributed the hiatus to the upwelling. However, the variations of the  $\Delta R$  and the Sr/Ca-SST are not always in phase, particularly for the last millennium. Could the authors clarify the relationship between the upwelling and the SST? 6. It is well known that ENSO variability has been closely linked with the strength of Easter Asian Summer monsoon throughout the Holocene. The Asian stalagmites, which recorded the evolution history of East Asian Summer monsoon with precise dating controls, documented the 4.2 ka events lasting only hundreds of years. However, the authors claimed that there existed a 2500-year shut down of vertical reef accretion in the tropical Eastern Pacific beginning 4.2 ka, and tied to increased variability of ENSO. 7. If the hypothesis is correct, the ENSO plays a role in climate change at 4.2 ka. What are the ultimate causes driving ENSO variability? 8. The Asian monsoon is generally suppressed during El Niño events and enhanced during La Niña events. According to the Figure 3, during the hiatus period, the tropical ocean experienced different ENSO modes, but the climate in Asian monsoon areas experienced a dry period during the 4.2 ka event. How to explain it? 9. Tectonic activity is also a possible cause to result in the stagnate of coral reef accretion vertically.

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