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The Future of Reefs in the Anthropocene. Integrated high-resolution stratigraphy as a monitoring, assisting and predictive tool

Reinhold Leinfelder

Freie Universität Berlin, Institute of Geological Sciences, WG Geobiology and Anthropocene Research, Germany (reinhold.leinfelder@fu-berlin.de)

The future of reefs depends on mitigation, management efforts and, possibly, new strategies of ‚assisted' recovery and adaptation. Correlating, monitoring and predicting Anthropocene reef eco-episodes on a regional and global scale should be based on integration and correlation of environmental skeletal proxies, other geosignals, direct measurements, ecological assessment and forecasting. This should help to evaluate the interconnected subrecent shifts of reef systems, to assess success of natural and „assisted" recovery / adaptation behaviour of reefs, and thus to focus on suitable pathways for the future of reefs. For the following pre- and intra-Anthropocene episodes, differentiated regional and global ecomaps of reef types and reef states could be developed by such methods:

15th Century - 1950: Holocene reefs started to transform since Columbian times, characterising this episode by a first anthropogenic imprint on reefs, increasing thereafter via global trade and industrialisation effects.

1950 - 2017: A great variety of geological signatures is expected at the suggested base of the Anthropocene within coral reefs, allowing to correlate this level globally across reefs and their related environmental settings (Waters et al. 2017, Leinfelder in press). Coral reef studies would benefit from additionally focusing on the nuclear fallout signals, on temperature recording, and on heavy metals, plastics etc. in coral skeletons or void and cavity infills for stratigraphic purposes. The episode is then characterised by increasing loss of reef biodiversity, accelerating from the 1970s onwards, mostly related to overfishing, nutrient runoff and other pollution, increasing temperature and acidification, being punctuated by diseases, and particularly by correlatable bleaching events and cyclon-induced coastal runoff events.

Two possible forecasts for the future of reefs encompass:

a) 2017-2100: with business as usual, coral reefs continue to face a strong, even more enhanced decline, with a possible near-disappearence of coral reefs (Hughes et al. 2018);

b) 2017-2200: with very good management and fulfilling the Paris Agreement coral reefs could continue to grow, albeit first in a completely different form, with the high-diversity, stable communities retreating in favour of more ‚volatile', short-lived, types, often with ‚atavistic' features, such as adaptations to higher nutrients, sediment runoff, deeper settings, higher SSTs, lower pH. These reefs would need to be ‚assisted' in various ways, yet they would go through a ‚vale of tears' to be monitored and assisted for the next 100 years, if not longer (cf. Hoegh-Guldberg et al. 2008, Leinfelder et al. 2012, Hughes et al. 2017). After this episode there could be a possible return to robust, resilient and long lasting new set of coral reef ecologies.

References:
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