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Marine mesocosm bacterial colonisation of volcanic ash

Verena Witt, Corrado Cimarelli, Paul Ayris, Ulrich Kueppers, Dirk Erpenbeck, Donald Dingwell, and Gert Woerheide

Department of Earth and Environmental Sciences, Ludwig-Maximilians-Universität (LMU) Munich, Germany

Volcanic eruptions regularly eject large quantities of ash particles into the atmosphere, which can be deposited via fallout into oceanic environments. Such fallout has the potential to alter pH, light and nutrient availability at local scales. Shallow-water coral reef ecosystems – "rainforests of the sea" – are highly sensitive to disturbances, such as ocean acidification, sedimentation and eutrophication. Therefore, wind-delivered volcanic ash may lead to burial and mortality of such reefs. Coral reef ecosystem resilience may depend on pioneer bacterial colonisation of the ash layer, supporting subsequent establishment of the micro- and ultimately the macro-community. However, which bacteria are involved in pioneer colonisation remain unknown. We hypothesize that physico-chemical properties (i.e. morphology, mineralogy) of the ash may dictate bacterial colonisation. The effect of substrate properties on bacterial colonisation was tested by exposing five substrates: i) quartz sand ii) crystalline ash (Sakurajima, Japan) iii) volcanic glass iv) carbonate reef sand and v) calcite sand of similar grain size, in controlled marine coral reef aquaria under low light conditions for six months. Bacterial communities were screened every month by Automated Ribosomal Intergenic Spacer Analysis of the 16S-23S rRNA Internal Transcribed Spacer region. Multivariate statistics revealed discrete groupings of bacterial communities on substrates of volcanic origin (ash and glass) and reef origin (three sands). Analysis of Similarity supported significantly different communities associated with all substrates (p=0.0001), only quartz did not differ from both carbonate and calcite sands. The ash substrate exhibited the most diverse bacterial community with the most substrate-specific bacterial operational taxonomic units. Our findings suggest that bacterial diversity and community composition during colonisation of volcanic ash in a coral reef-like environment is controlled by the physico-chemical composition of the substrate. Knowledge on pioneer bacterial colonisation may increase our understanding on the resilience of coral reefs to natural "catastrophes", such as volcanic ash fallout.