Physical control of the spatial and temporal diversity of microbial mats at a shallow-water hydrothermal vent

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Shallow-water hydrothermal vents are ubiquitous but poorly studied geothermal environments. The active hydrothermal emissions of the Milos hydrothermal system support complex microbial mats, which are fundamental in engineering the environmental niche in which extremophiles thrive. Because of the shallow depth, the mat community is wiped out during every major storm, when swell and wave action increase, and then it reconstitutes itself over a brief period of time (days). Here we report the results of a joint geochemical and microbiological survey of the microbial mats of Milos Island, and analyze the spatial and temporal evolution of the mat community following a major storm. Our results show that *Epsilonproteobacteria* dominate the mat community, although significant variability is present within the system. The observed variability correlates with spatial profiles and *in situ* measurement of temperature and sulfide carried out over a 6 days periods, showing that tides, winds, and abrupt geodynamic events generate intermittent mixing conditions lasting for several hours to days. Microbiological analyses and computer models show that the fine scale spatial variability of the microbial community is ultimately controlled by the geochemistry of the hydrothermal fluids and the physical interaction of the seawater with the benthic boundary layer. Diversity and metagenomic analyses of the mature mat provide further information on the metabolic potential of the community and on the influence of environmental factors on ecosystem functioning.