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A Transitional Hydrothermal Vent Field on the Milos Shelf (Aegean Sea, Greece): Bimodal Distribution Influenced by Tectonics and Sea-Level Change

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Hydrothermal vents are typically divided into “shallow” or “deep-sea” based on an approximate 200 m depth limit. Here, we describe the discovery of hydrothermal venting on the shelf of Milos Island, Greece, in intermediate water depths (100–220 m). Through high-resolution geophysical surveys combined with in situ chemical, physical, and optical measurements conducted by the ROV MARUM-SQUID, we identify three clusters of vents—Aghia Kiriaki, Paleochori–Thiorychia, and Vani—aligned with ENE–WSW and NW–SE active fault systems.

Our results reveal a bimodal distribution of venting, with peaks at roughly 130 m and 180 m water depth. The shallower vents, which may have been subaerial during Late Pleistocene lowstands, are spread over large areas of pitted seafloor covered primarily by white microbial mats on semi-lithified sediments through which CO_2 gas and warm water come up gently. In contrast, the deeper vents exhibit more focused and vigorous venting of hot water (up to >180°C) and CO_2 gas through sulfide-sulfate chimney structures that are coated with thick microbial mats. We propose that this bimodal pattern reflects the combined influence of tectonic faulting—directing hydrothermal fluid flow—and historical sea-level fluctuations that periodically exposed parts of the shelf. Our findings underscore the importance of geological context in shaping the spatial distribution and characteristics of hydrothermal systems, and they highlight the need to consider transitional-depth vents when examining the continuum between nearshore and deep-sea hydrothermal environments.