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Capture of an elusive mid-ocean ridge eruption and its immediate effects on the deep ocean

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During an expedition to characterize organic carbon formation and release from hydrothermal systems to the deep ocean, we serendipitously discovered an active mid-ocean ridge (MOR) eruption during an *Alvin* dive on April 29, 2025 at East Pacific Rise 9° 50'N – the first-time humanity has directly witnessed this type of volcanism. MOR eruptions are seminal events responsible for the formation of new oceanic crust, short-term devastation of local ecosystems, and large transfers of energy and soluble and volatile chemicals from Earth's interior to the deep ocean. Upon discovery of the eruption, the immediate pivot of the shipboard science party and collaborative efforts of a multidisciplinary team led to the unprecedented observation of changing seafloor and water column conditions from ~18 days before to ~96 hours after the eruption. We established precise timing of eruption onset and documented new lava flows, dispersal of volcaniclastic material, rapid microbiological recolonization, and particle transport up to 1000 m above the seafloor. We also quantified the transfer of heat and chemical species from ridge axis to ocean via the formation of a megaplume that rose above the seafloor within hours to days. Within ~11 hours of eruption onset, we recorded a widespread bottom temperature anomaly of 1-4 °C above that of background seawater, with isolated instances of temperatures up to 10 °C. Notably, post-eruption O2 concentrations were consistently elevated (~99.5 μM) in a well-mixed layer rising 400 m above the seafloor, indicating the entrainment of bottom waters in the early stages of megaplume formation. The resulting excess energy associated with the eruptive megaplume corresponded to a short-lived but extremely large thermal input over ~10 hours, comparable to the energy released by a one-megaton TNT explosion. Water column H2S concentrations increased 2-3 orders of magnitude after the eruption, and we estimate that total dissolved Fe flux during this period can account for up to 8% of global daily hydrothermal supply to oceans. Together, these observations paint a cohesive picture of ridge volcanism, providing critical physical, geochemical, and biological context for the observation, measurement, and modeling of MOR eruptions that affect ocean dynamics.