**Oases for Life and Pre-Biotic Chemistry: Hydrothermal Exploration of the Mid-Cayman Rise.** C.R.German[1], A.D.Bowen[1], M.L.Coleman[2], D.P.Connelly[3], D.Honig[4], J.Huber[5], M.V.Jakuba[6], J.C.Kinsey[1], M.D.Kurz[1], J.McDermott[1], K.Nakamura[7], C.M.Sands[3], J.S.Seewald[1], J.Smith[5], S.Sylva[1], C.L.Van Dover[4], L.Whitcomb[8] & D.R.Yoerger[1], [1]Woods Hole Oceanographic Institution (Woods Hole, MA 02543, USA; cgerman@whoi.edu), [2]Jet Propulsion Laboratory, California Institute of Technology (4800 Oak Grove Drive, Pasadena, CA 91109, USA), [3]National Oceanography Centre Southampton (Southampton, SO14 3ZH, UK), [4]Marine Laboratory, Duke University (Beaufort, NC 28516, USA) [5]Marine Biological Laboratory (7 MBL Street, Woods Hole, MA 02543, USA), [6]Australian Centre for Field Robotoics, University of Sydney (Darlington 2006 NSW, Australia), [7]AIST (Tsukuba, Ibaraki 305-8567, Japan)., [8]Johns Hopkins University (3400 N.Charles Street, Baltimore, MD 21218, USA).

**Introduction:** Thirty years after the first discovery of high-temperature submarine venting, the vast majority of the global Mid Ocean Ridge system remains unexplored for hydrothermal activity [1]. Of particular interest are the world's ultra-slow spreading ridges, which were the last to be shown to host high-temperature hydrothermal activity [2-6] but may host systems particularly relevant to pre-biotic chemistry and the origins of life [7-10]. Here we report the first systematic exploration for and characterization of hydrothermal venting along the short (~110 km), deep (> 5000 m), ultra-slow-spreading (<20 mm $yr^{-1}$) and geographically isolated Mid-Cayman Rise (MCR) in the Caribbean Sea (Fig.1). This work, funded through NASA's ASTEP program, was carried out aboard the RV *Cape Hatteras* in October-November 2009 and represents the first scientific field program funded to use WHOI's new hybrid deep submergence vehicle, Nereus, first in AUV mode then in ROV mode. Prior to this work, evidence for hydrothermal venting had been found on every active spreading center investigated, including the comparably ultra-slow spreading SW Indian and Arctic ridge. We show that the MCR, one of Earth's slowest-spreading and most isolated seafloor spreading centers, hosts three distinct styles of hydrothermal venting - including the deepest vent-sites yet known - that render it an ideal natural laboratory for continuing studies of evolutionary biology, astrobiology and the origins of life.

The scientific motivation for our field work was three-fold. Along the MCR, the ridge-axis is so deep that vents can occur at depths greater than all previously known vent systems, with the potential to extend the known limits to these extreme systems in terms of pressure, temperature, and vent-fluid chemistry. Further, hydrothermal circulation through ultramafic rocks may enhance abiotic synthesis of organic matter: a present day analog for the prebiotic chemistry involved in the origin of life on early Earth and, potentially, other planets. Finally, metazoan organisms colonizing vents are renowned for their endemicity, their physiological and biochemical adaptations to the extreme chemical and physical conditions encountered and for differences in species composition from one ocean basin to another. Identification of organisms colonizing vents of the MCR offer a critical opportunity to build upon our understanding of the dispersion of vent species and the potential role of the rise of the Isthmus of Panama (dating from ~5 Ma) as a vicariant event leading to the evolutionary divergence of Atlantic and Pacific vent faunas. A long-term goal of our 4-year study is to assess the relative importance of abiotic organic synthesis versus recycling of bio-organic material and/or chemical energy as the primary energy source for any ecosystems discovered.

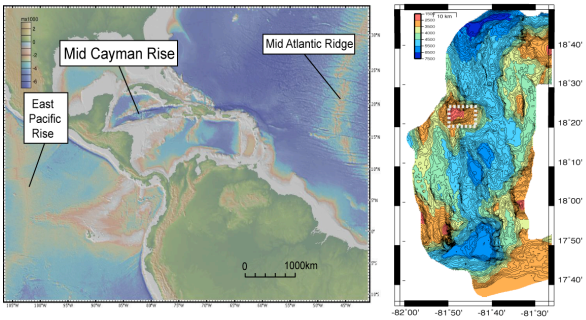


**Fig.1:** Left: map showing isolation of the Mid-Cayman Rise in the context of the global Mid-Ocean Ridge system. Right: detailed bathymetry of the chosen study area (data from LeRoy & Lepinay, *unpubl.)*

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