



NATIONAL ACADEMY OF SCIENCES

Office of the President

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The Rockefeller University
1230 York Avenue
New York, NY 10065

Vice Admiral Paul Gaffney
Fellow, Urban Coastal Institute
Monmouth University
400 Cedar Avenue
Long Branch, New Jersey 07764

Dear Jesse and Paul:

As a charter member of the ocean exploration community, I am sending my very best wishes for success at your upcoming workshop at Rockefeller University at the end of October and my congratulations to Bob Ballard on the occasion of his receipt of the Ocean Champion Award. Since the *Report of the President's Panel on Ocean Exploration* launched the US effort in ocean exploration 16 years ago, a number of events have underscored how essential our mission is to vastly improve knowledge of the marine environment.

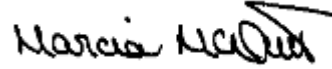
The greatest mystery of all unfolded over many months in 2014 when 239 souls disappeared without a trace after flight MH-370 vanished in the depths of the Indian Ocean. The massive search effort from many nations was hampered by inadequate understanding of terrain and currents, in addition to the inability to narrow down the possible crash site. For example, the resolution of the satellite-derived map that guided the Bluefin-21 AUV, the main search tool, was but ± 250 m vertical and 15 km horizontal. These uncertainties in terrain were large relative to the plane's dimensions.

In 2013, more than 6300 residents in the Philippines perished in Typhoon Haiyan, the deadliest storm ever to strike that nation. While there are some physical arguments why Haiyan and other tropical storms, such as the recent hurricane Matthew, have grown in intensity fueled by excess heat absorbed in the upper ocean, a recent National Academy of Sciences study (*Attribution of Extreme Weather Events in the Context of Climate Change*) stopped short of having sufficient observational evidence to conclude that such storms are indeed becoming stronger and therefore more deadly. Public safety benefits from better understanding of the changing nature of coastal hazards in a warming world. But beyond this immediate hazard, we lack understanding of some basic processes of heat exchange between the surface and the deep sea. Future predictions are therefore highly uncertain on the ocean's ability to continue to absorb heat, and CO₂, our planet's primary mitigation for atmospheric warming.

Over the past decade and a half the great surprises have come from sampling life in the ocean on all scales, from the macroscopic to the microscopic, and placing it in its ecological context. Given the dependence of humanity on protein from the ocean, we require better understanding of marine food webs, their stable states, tipping points that send them to other, perhaps less productive states, and what triggers those shifts.

I urge the workshop participants to think of creative ways to conduct exploration, to leverage investment to maximize the information return, and to increase data dissemination to multiply the scientific yield. For example, Cubesats have “democratized” space, providing access for pennies on the dollar. Similarly, new commercial tools, although still in their infancy, hold the promise of ushering in the citizen science era of ocean exploration. The task we face is simply too large to continue to use 20th century tools if we hope to make a dent in the problem.

Sincerely yours,

A handwritten signature in black ink that reads "Marcia McNutt". The signature is written in a cursive style with a prominent flourish at the end.

Marcia McNutt
President