Somewhere, Beyond the Sea: Advancing Geochemical Sensor Technologies for Biological and Abiotic Analyses on Ocean Worlds

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In 1872, the *HMS Challenger* set out on the very first oceanographic expedition. It was also a life detection mission. Faced with demonstrating the existence of life down to the deepest ocean depths, the six scientists and nearly two-hundred crew sailed for four years collecting chemical, geological and biological samples from the far reaches of our world.

Today, modern oceanographers explore the ocean through a combination of human-operated and autonomous instruments. Here we present some of the latest developments -as well as the lessons- from exploring our own inner space. We will discuss technologies and methods that have helped us (and our community) bring autonomy to the exploration of our ocean. We will also present our data from recent efforts aimed at examining the relationships among abiotic and biological processes in our ocean. These technologies and methods can help us unlock the mysteries of the cosmos, in particular that enduring question of whether life exists on other celestial bodies. We posit that fostering a rich and extensive collaboration among ocean and space scientists is critical if we are to advance our understanding of other ocean worlds, such as Enceladus and Europa, beyond the scope of current missions and technologies. In essence, it may be our increasing ability to peer into the ocean depths that will allow us to better peer into the cosmos.

Figure 1) The prototype *Autonomous Benthic In Situ Sampler (ABISS)* prior to deployment in the summer of 2017. The ABISS is designed to autonomously make fine-scale geochemical measurements, and collect-co-registered samples for later geochemical and microbial analyses.

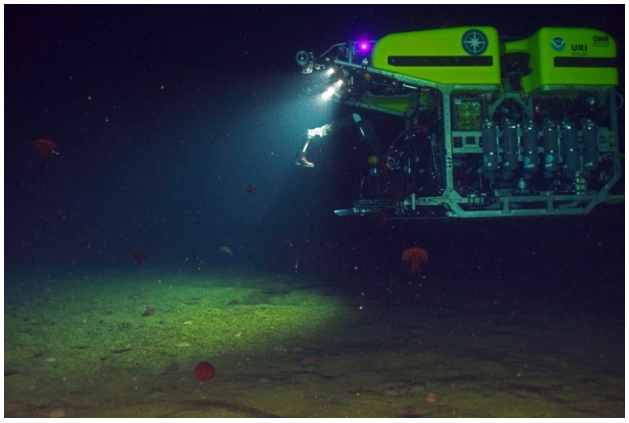

Figure 2) The *ABISS* uses an advanced optical modem to communicate at broadband speeds through water. Here we used the optical modem package to take a "selfie" of the ROV Hercules that was used during these operations.