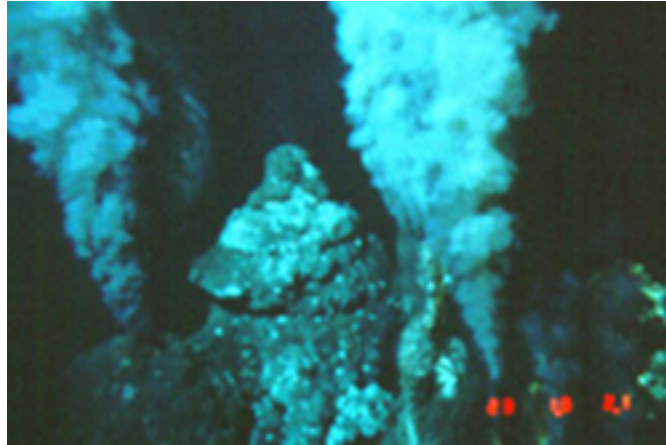


2.011 Ocean Systems Design Challenge

Spring 2006



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Introduction:

You have been hired by an oceanographic research institute to find, map and collect data (especially temperature) from a field of hydrothermal vents in the Atlantic. There are many types of hydrothermal vents but generally they are formed by rifts in the earth's crust near the bottom of the ocean. Water from a chamber under the sea floor is heated by the molten earth below and rises to the surface, due to buoyancy. The water temperature is very hot (400°-750°C), but these vents still serve as a home to millions of microorganisms.

This year's 2.011 challenge will focus on designing and building an ROV outfitted with the necessary instrumentation to map and investigate a simulated vent field in a pool or tank. This project will give students a chance to collect data about the field from the sensors they build themselves. Points will be awarded for robustness, sensitivity, versatility of the vehicle, operability, and how useful the information will be for future scientific discovery.

After completing the pool trials, we will venture to the Charles River or Boston Harbor to "field test" our ROV.

Step 1: Planning your vehicle

Break out in small groups and brainstorm. Consider which instruments are crucial for the mission, and which instruments you would like to have on the vehicle (wish list). Also consider, based on your choice of instruments, what the performance characteristics for your vehicle need to be (e.g. maneuvering, forward/reverse swimming, up/down diving, etc.), and what you might be interested in working on for this project.

Step 2: Designing the Vehicle

Collectively determine a preliminary instrumentation proposal, while keeping in mind the missions it will be involved in.

Regroup and share the information obtained from the brainstorming exercise. Consider each proposed instrument to assess its relevance to the project, estimated cost, usefulness, feasibility (can it be completed in the time allotted, do we have/can we quickly learn the skills needed to build it), and overall student interest (is one person particularly excited/against about building a certain instrument?).

Next consider the actual vehicle design and configuration. Is the prototype frame sufficiently large and well designed for our needs? Are there enough places to mount equipment? Where should the motors be placed? Are there hydrodynamic/stability issues to consider? Where will the electronics go? What else should be considered? If the ROV is designed for the diving well of the MIT pool (about 16-20ft? deep), will it be limited in the “real-world”.

Step 3: Build the ROV platform and test

After the design phase, the ROV will be built and tested. There are three main parts, the structure, the motors (the required motors and some extras, just in case), and the control box. Once the components are built we will assemble the vehicle and test the ROV platform for seaworthiness and controllability. At this step we can also review how well our design/ideas worked.

Step 4: Build and test sensors

Once the ROV is built, sensor groups will be formed to design, and build the instrumentation. Each group will design, build and test an instrument of their choosing. The instruments will give students the opportunity to assess a need, design a solution, build a prototype, test, and report on the outcome. Instruments will be developed to obtain data for the challenge and open water dives. This step will take up most of the term.

Step 5: Face the 2.011 Challenge

The real test of the equipment will be acquiring data from the challenge and determining whether it is accurate and useful. And further “field exploration” will be performed.