School of Rock 2009: a hands-on, research-based expedition for Earth and ocean science educators aboard the JOIDES Resolution during the IODP 321T Expedition

School of Rock 2009: um programa educativo baseado na investigação e actividades práticas, destinado a professores de Ciências da Terra e do mar, realizado a bordo do JOIDES Resolution durante a Expedição IODP 321T

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ABSTRACT: The purpose of School of Rock 2009 was to bring an international group of teachers from the U.S., France, Japan and Portugal together for two weeks to travel aboard The JOIDES Resolution and allow them to become familiar with the science that goes on aboard the ship. Now they are using the things they learned to enhance the teaching of science in their schools, conduct in-service presentations to share ideas with other teachers, and encourage their students to become the next generation of marine scientists.

KEY-WORDS: School of Rock, JOIDES Resolution, IODP, education and outreach

RESUMO: O objectivo do programa educativo School of Rock 2009 foi reunir, durante duas semanas, um grupo de professores dos EUA, França, Japão e Portugal a bordo do JOIDES Resolution e permitir que eles se familiarizassem com a ciência realizada a bordo do navio. Agora eles estão a utilizar aquilo que aprenderam para melhorar o ensino das ciências nas suas escolas, realizar apresentações, partilhar ideias com outros professores e incentivar os seus alunos para fazerem parte da próxima geração de cientistas do mar.

PALAVRAS-CHAVE: School of Rock, JOIDES Resolution, IODP, educação e divulgação

1. INTRODUCTION

After the success and scientific achievements based on the cores obtained by the U.S. drilling vessels Glomar Challenger and JOIDES Resolution during the Deep Sea Drilling Project (DSDP) and Ocean Drilling Program (ODP), which revolutionized our view of Earth history and global processes through ocean basin exploration, the Integrated Ocean Drilling Program (IODP) came up as the result of an international cooperation to develop a marine research program that
explores the Earth's history and structure as recorded in seafloor sediments and rocks, and monitors subseafloor environments. IODP greatly expands the reach of the previous programs by using multiple drilling platforms, including riser (D/N Chikyu), riserless (D/N JOIDES Resolution), and mission-specific (e.g. Vidar Viking drillship), to achieve its scientific goals. The program's principal themes are (1) The deep biosphere and the subseafloor ocean, (2) Environmental change, processes and effects and (3) Solid Earth cycles and geodynamics (IODP, 2001).

IODP has three Implementing Organizations responsible for the management of the ships and platform operations. The European Consortium for Ocean Research Drilling (ECORD) Science Operator (ESO), that conducts mission-specific operations; the Center for Deep Earth Exploration (CDEX), that conducts riser platform operations and the U.S. Implementing Organization (USIO), that conducts riserless drilling operations.

While IODP's central mission focuses on fundamental scientific research, there is an important role for educational outreach (IODP, 2001). Since 2005 USIO started taking advantage of transits between scientific operations to carry out seagoing hands-on and research-based education workshops named School of Rock (SOR) aboard the D/N JOIDES Resolution (The JR). The latest edition took place between June 23rd and July 5th 2009, during the IODP expedition 321T Cores, CORKS and Hydrogeology on the Juan de Fuca Ridge from San Diego, CA (U.S.A.) to Victoria, BC (Canada).

2. SCHOOL OF ROCK 2009

The JR's science party is specific to each mission, with the skills and science disciplines chosen especially to achieve the mission’s goals. The JR’s crew includes technicians, cooks, curators, and the people who operate the ship and the drilling process, and many more. Both science party and crew comprise people from different countries. The purpose of School of Rock 2009 (SOR’09) was to bring an international group of teachers (Photo 1) from the U.S., France, Japan and Portugal together for two weeks to travel aboard The JR and allow them to experience first hand the science that goes on aboard the ship. The SOR’09 curriculum focused on the sub-seafloor observatories called Circulation Obviation Retrofit Kits (CORKS) in Holes U1301A and U1301B and the hydrogeologic, monitoring and sampling experiments conducted there.

The JR is a large ship - 143 meters long - and has a seven story high unit that houses the scientific facilities, and a drilling derrick that rises 63 meters above the water line. The derrick is capable of drilling in waters from around 90 meters to 8200 meters deep and can hang a total of 9000 meters of pipe. Drilling is conducted to extract cores of sediment and rock from the seafloor that are brought aboard and used for a variety of scientific studies dealing with Earth’s climate history, movement of water through Earth’s crust, how the Earth’s plates move, and many others. No drilling was conducted during the SOR’09; however the derrick was used to lower a pipe string about 2760 meters down to the seafloor to repair two permanent monitoring stations, embedded in boreholes in the seafloor. These stations had been installed at an earlier date but were not functioning properly due to leakage of seawater into the boreholes. The repair involved inserting the pipe string into the boreholes - a huge task at such a depth - and pumping cement from the ship into the boreholes to seal them.

During transit periods and also while accompanying cementing operations the teachers were involved in activities devoted to meeting with the scientists, learning what sort of research projects are carried out, and developing ways to enhance their science teaching back home. The teachers made ship tours, attended lectures, participated in a wide variety of hands-on work with seafloor cores in the various laboratories, discussed teaching strategies and spent time producing materials to be used for teaching science processes and seafloor research.

The SOR’09 was based on data-rich, hands-on, learner-focused, inquiry techniques. Teachers worked in teams to access and analyze data, sample cores, conduct authentic scientific
investigations (e.g. Sautter et al., 2010), and discuss their conclusions in exactly the same way scientists do on IODP expeditions.

3. FROM THE JOIDES RESOLUTION TO THE CLASSROOM

Just like scientists leaving an expedition, every teacher walked off the ship with a disc of the data they collected and entered into the database, the science presentations and significant publications; and all the smear slides, microfossil and sediment samples, and photos that they might need to construct powerful learning experiences with their students.

The teachers have chronicled their experiences aboard in photobook essays and narratives taped near the beginning and end of the expedition, as well as the blogs they posted on The JR webpage to communicate with students, family, and co-workers at home. A video conference was also conducted between The JR and Japanese classrooms where two classes in session were the recipients of a live ship-to-shore interaction to both schools at the same time.

The SOR’09 participants came away from this experience at sea with a vast amount of information and a new appreciation for how world class, cutting edge science is conducted. In the future they can use the things they learned in SOR to enhance the teaching of science in their schools, conduct in-service presentations to share ideas with other teachers, and encourage their students to explore the wide variety of opportunities that are out there in the world of scientific exploration. That is particularly important considering that accordingly to Silverstein et al. (2009) students that have teachers participating in research programs improve their achievements in Science.

3.1. Hands-on activities in the classroom

Inspired on the Deep Earth Academy poster «Microfossils: the ocean's storytellers» Earth Science student’s of Loulé’s local High School have replicated one of the hands-on activities done by the teachers aboard The JR. The students have been introduced to ocean microfossils and how they are used by the scientists to learn about Earth’s past climates. Using core samples obtained by The JR in the California margin (ODP Hole 1014A), and processed by the teachers during SOR’09, they have been able to observe and identify foraminifera under the binocular microscope (Sautter et al., 2010). Using planktonic foraminifer Neogloboquadrina pachyderma as a paleotemperature proxy, because it changes coiling direction from left to right when the water warms (Curry & Ostermann, 1997), they realized that climatic oscillations between warm and cold periods have occurred in the past. And they could even correlate those temperature oscillations with the latitudinal polar front movement and with changes in the patterns of ocean currents and thermohaline circulation.

Another group of students of Loulé High School studying Visual Arts were also encouraged to participate in the J/aRt contest! They learned first hand from the Portuguese SOR’09 graduate about IODP goals and the main features of The JR (e.g. length, height of the derrick) and the different people (e.g. scientists, lab technicians, cooks) that work aboard the ship. Following the presentation they created drawings and paintings featuring The JR and its work in the classroom. As a result of the work done one student was awarded with the third prize in their category. Thus her, her classroom and teachers were featured in The JR’s website, and her art has been featured in an IODP exhibit at the Maryland Science Center in Baltimore, Maryland (USA) and aboard The JR. The school also received a compilation of Deep Earth Academy printed educational materials concerning the JOIDES Resolution and ocean drilling.

4. PROFESSIONAL DEVELOPMENT EVENTS

The teachers were also asked to adapt or develop learning activities tailored for their student or museum audiences, and/or to contribute new material for The JR’s website. And each
participant was required to share their SOR’09 experiences and methods with their colleagues through at least one local or regional professional development event.

4.1. Planet Earth Lisbon Event and LABO Project

Celebrating the closing of the International Year of Planet Earth triennium (2007-2009) the Planet Earth Lisbon Event 2009 took place, in late November, at the Pavilhão do Conhecimento - Ciência Viva, an interactive science and technology museum that aims to make science accessible to all, stimulating experimentation and exploration of the physical world. During the event a conference, geared for the general public, about IODP and SOR’09 was given by the Portuguese SOR graduate and the micropaleontologist Zuzanna Stroynowski that is currently working at the Unidade de Geologia Marinha of the Laboratório Nacional de Energia e Geologia (UGM/LNEG) and participated in the expedition that followed the 321T. A booth with information about IODP and SOR was also available to the public.

Having the goal of sharing his SOR’09 experiences and methods with his colleagues at a regional level in mind, the Portuguese SOR participant has developed and started the implementation, in collaboration with several Portuguese multidisciplinary research centers and labs, of a project called LABoratório Oceano (LABO). This project aims to explore how teachers’ field research experiences, particularly in marine studies, improve classroom instruction, student engagement, and awareness of environmental issues while providing authentic learning experiences and creating awareness of interconnected global issues. One of the activities performed by the teachers involved in the project includes the adaptation to the Portuguese standards the Deep Earth Academy K-12 Classroom Activities using IODP data and core samples.

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