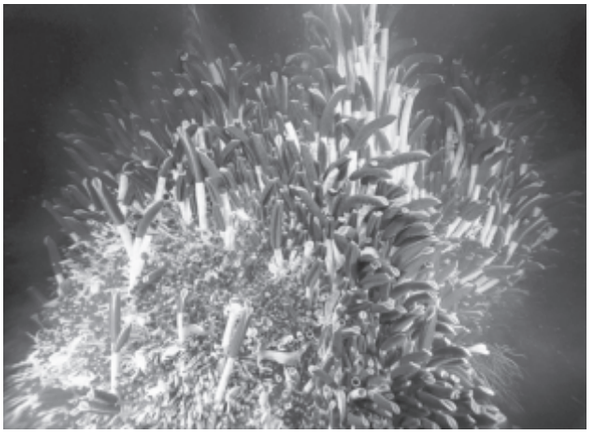


A tubeworm community shot featured in *Volcanoes of the Deep Sea*.

she visited an "other-worldly" place: "They should have sent a poet." Learning to describe in writing the spectacular world of deep-sea vents is a wonderful way to get students thinking and communicating.

Ad**VENT**urous PROJECTS

What follows are two examples of projects that focus on the vent story as a springboard for learning. The learning opportunities this story presents are as vast as the sea itself; it is up to educators to decide how best to incorporate them into specific learning environments.

A GIANT-SCREEN FILM: *VOLCANOES OF THE DEEP SEA*

Released in 2003, *Volcanoes of the Deep Sea* is the first larger-than-life look at a world that could very well be one of the last frontiers on Earth. The footage is nothing short of awe-inspiring, as is the tale of mystery that unfolds throughout the film. The film is showing at IMAX theatres throughout the country (http://www.volcanoesofthedeepsea.org/)

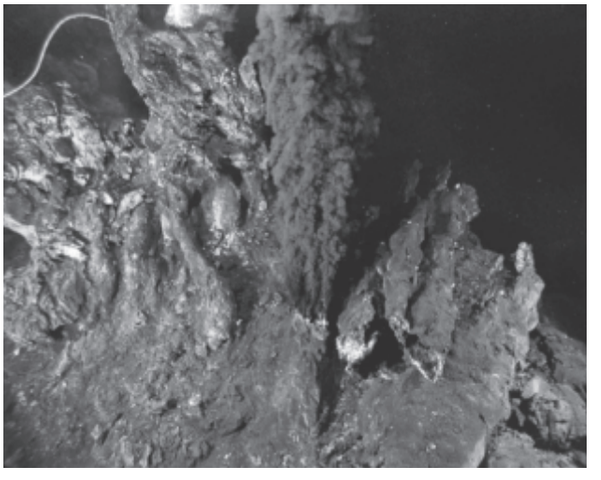
To help students and teachers make the most of the film, a team of education specialists developed a comprehensive outreach program that includes a Teachers Guide, an educational video, and a "Deep Ocean Institute" for formal and informal educators. Designed for the everyday teacher (as in, one with limited resources and time!) educational activities reinforce and expand upon the concepts presented in the film. Critical to the development of the program was the team's participation in the film's expedition that sailed from the Azores to Bermuda and intellectually transported the team inside and out of the process of scientific discovery. The "Deep Ocean Institute" held at Rutgers University (spearheaded by Janice McDonnell) was also a test run for the outreach products to ensure that they met the needs of educators worldwide.

TEACHER'S GUIDE

- Designed for use before and/or after a visit to see the film.
- Accessible and adaptable to any school teacher's need.
- Adheres to the National Education Standards and the "No Child Left Behind" mandate. Activities are easy to do and use simple materials easily obtained by any school teacher.
- Unique to the guide is its commitment to improving science communication; a plethora of opportunities for science reading and writing are found throughout the guide. Each chapter begins with a compelling background story that can be used as a reading comprehension activity. Many activities consist, in part, of a writing element; most chapters contain a "Writing Prompt," a paragraph meant to inspire students to think beyond the topics covered in the activities, and then write about them.
- Targeted at middle school students, but easily adapted to higher and lower grades.

CHAPTERS:

- Exploration: Discover the Mystery of the Deep Dark Sea
- Geology: Get the Drift on the Mid-Ocean Rift
- Biology: Who's Who in the Sunless Deep?
- Paleontology: Unsolved Mysteries of the Deep
- Communication: Get the Scoop on the Deepest Story Ever
- Technology: Flip the Switch and See What You've Been Missing



A hydrothermal vent.

GCRL-123759-CurrentDHV *50 5/31/05 8:48:45 AM

Volume 21 • Number 3 • 2005

UNLEASHING THE POWER OF THE DEEPEST STORY ON EARTH

BY KRISTEN M. KUSEK

IN RECENT YEARS *I have had the privilege of working on a host of hydrothermal vent-related projects in virtually every medium (e.g., website, print, book, video, oral presentation) with scientists, teachers, informal educators, writers, and producers. Regardless of the project, one lesson stands out: never underestimate the power of one of the simplest learning tools available–a good story–to inspire creativity, learning, and questioning. The story of the vents is a great story used to spark interest in a surprisingly diverse array of subjects–from science and technology, to the arts and science communication. At its core is an action-packed drama of discovery, mystery, and wonder. This article is dedicated to exploring what makes the vent story a great one, and sharing examples of new and established education outreach initiatives that use the "hook" of the mid-ocean ridge story as a springboard for learning.*

A TASTE OF THE STORY

The setting is the largest geologic feature on Earth: 46,000 miles of underwater mountain range where Earth's crust is born. This place has never seen the sun and is home to a surprising number of bizarre animals that thrive on chemical energy from Earth's belly.

WHAT MAKES THE RIDGE SUCH A GREAT STORY?

Until about 30 years ago, the mid-ocean ridge was a story largely out of sight and therefore out of mind–and certainly not mentioned in textbooks. Today, the ridge story is more accessible through websites and outreach projects. It continues to be a hot topic as new vent sites are discovered and a better understanding of this deep environment progresses worldwide. With the development of sensor-laden observation platforms that will continuously shine a light on this pitch-black world, the story of the deep is likely to quicken in pace and action in the near future, and we will be there, on the deep scene in around-the-clock, CNN fashion.

The story of the deep packs quite an educational punch. It lends itself to teaching students in original, compelling ways about any number of subjects including biology, chemistry, geology, physics, the history and nature of science, technology, the spirit of discovery, the need for effective science communication, the need to responsibly explore, and manage places we cannot readily see–the list goes on. As such, it is like educational duct tape: you can use it to connect just about anything.

As a science writer, I am trained to focus on what makes a story "good." Three of the main criteria used to define a good science story are: fascination value, importance, and timeliness[1]. All criteria are met by the vent story.

Describing the fascinating aspects of deep, hydrothermal vents could fill up an entire issue of *Current*. It is certainly amazing to students to learn that life can exist in complete darkness and under extreme pressure below miles of seawater. What would their reaction be if told that life might have begun in a similar environment? Would they believe some microbes that live at the bottom of the ocean might help improve environmental cleanup efforts, or hasten the discovery of cures for human diseases? What else can be learned from this environment? In addition, students love a bit of "guts and gore," and there is nothing bloodier than the guts of a vent-dwelling tubeworm.

Among the interesting aspects related to this story is how few people are aware the largest geologic feature on Earth is at the bottom of the sea and that feature plays an important role on the planet. A study conducted for the National Science Foundation in the mid-90s showed fewer than half of those surveyed understood it takes a year for the Earth to revolve around the sun[2]. It seems safe to assume that even fewer people know much at all about the deep-sea environment, where the sun doesn't shine!

In a world that seems devoid of any remaining unexplored "frontier," the deep sea is proof that discovery is far from dead. New species, for example, are still discovered regularly. The ridge story helps make sense of our world: how it works, how it may have started, and what can be done to ensure its story never ends. Hooked yet?

In addition, the vent story can be a tool used to improve science communication skills. We live in a time of dizzying scientific and technological progress. It has never been more important to have a scientifically literate society capable of communicating and appreciating issues relevant to society. Few would argue that today's point-and-click generation of students with nanosecond attention spans needs to improve their ability to communicate, a skill necessary no matter what profession they choose.

The vents are an inspiring theme to write and talk about, and the spectacular images captured in recent films can elicit poetic verses from the most pedestrian writer! Borrowing from Jodie Foster's classic line in the movie *Contact* when

GCRL-123759-CurrentDHV *49 6/2/05 4:58:46 PM

- Also included: Fast Facts, Writing Prompts, Glossary of Terms, National Standards covered in each activity
- You can download a free copy of the Teacher's Guide (www.volcanoesofthedeepsea.com).

TELEVISION BROADCAST: "VOYAGE INTO THE ABYSS"

"Voyage into the Abyss" is a 30-minute educational video that focuses on the story of "9° North," one of the famous hydrothermal vent sites in the Pacific Ocean featured in *Volcanoes of the Deep Sea*. The never-seen-before, high-definition imagery is commented on by expert scientists led by Dr. Richard Lutz of Rutgers University. The show also features veteran science teacher Sande Ivey who has spent months at sea aboard oceanographic vessels. In the video, she explores the main characteristics of the deep-sea environment via simple, hands-on activities that teachers worldwide can use in their classrooms to ignite student interest in this frontier.

"Voyage into the Abyss" was developed for middle school audiences but is serving a diverse community of learners, including college students studying plate tectonics. Colleagues abroad are interested in translations into their native languages or using it to teach the English language. The show, produced by Future Vision (Executive Producer: Robin Cooper), was originally viewed by millions of students via satellite. It is now available on the InterRidge website (www.interridge.org).

INTERRIDGE: INTERNATIONAL EDUCATION OUTREACH

InterRidge (IR) is an international program dedicated to joining the forces of research teams worldwide to promote the exploration of oceanic spreading centers. Currently based in Kiel, Germany InterRidge was born in 1992 when two countries decided to share resources to visit the same place on the ocean floor.

Embarking on its second decade, InterRidge is currently 2700 researchers and 27 countries strong. Current objectives include raising public awareness of the oceanic ridge environment through education and outreach initiatives. As writer and education outreach coordinator, I have assembled a team to develop two international outreach projects: a video series on various aspects of the ridge story for use worldwide; and a writer-at-sea program. This project will provide writers with unique, professional opportunities, and provide scientists with effective ways to bridge communication between scientific and nonscientific audiences.

THAT'S A WRAP

Whether told visually, or in the written or spoken word, the story of the mid-ocean ridge harnesses amazing educational power. Our job as formal or informal educators is to unleash that power in whatever way suits the needs of our audiences. "Everyone loves a good story" and if everyone hears the story of the ocean floor, maybe, just maybe, they will care a little bit more about our oceans.

ACKNOWLEDGMENTS

The author would like to thank: The Volcanoes of the Deep Sea "Board of Education", The Stephen Low Company, Dr. Peter Betzer (USF College of Marine Science), and Dr. Katja Freitag (Coordinator, InterRidge).

KRISTEN M. KUSEK is a science writer and education outreach coordinator for InterRidge, and is based in St. Petersburg, Florida. She holds dual master's degrees in marine science and journalism/mass communications, and bachelor's degrees in biology and English. Kusek's passion lies in bridging the gap between scientific and nonscientific audiences, and she has worked as a science writer and outreach specialist for about six years. She began her career by starting the Science Journalism Center at the University of South Florida St. Petersburg, and became forever hooked on the story of the mid-ocean ridge during her time as director of education outreach for *Volcanoes of the Deep Sea*, and especially following her first *Alvin* dive to the bottom of the Pacific Ocean in 1999. Kusek is a member of the Society of Environmental Journalists, NMEA, and NSTA, and is the U.S. freelance correspondent for "The Marine Scientist," a United Kingdom publication.

FOR MORE RESOURCES:

Websites:

InterRidge:
http://interridge.org

Volcanoes of the Deep Sea:
www.volcanoesofthedeepsea.com

General Audience Books:

Broad, William. *The Universe Below: Discovering the Secrets of the Deep.* Simon & Schuster: New York, 1997.

Van Dover, C. L. *The Octopus's Garden. Addison Wesley* (Reissued in paperback as *Deep Ocean Journey*): 1996.

Writing Tips for Mature Audiences:

Blum, D. and M Knudson. *A Field Guide for Science Writers.* Oxford University Press: New York, 1997.

Strunk, W. and E.B. White. *The Elements of Style.* Macmillan Publishing, Inc.: New York, 1979.

Reading for Younger Audiences:

Cole, Joanna and B. Degen. *The Magic School Bus: On the Ocean Floor.* Scholastic: New York, 1992.

GCRL-123759-CurrentDHV *51
6/2/05 5:00:59 PM

The *Volcanoes of the Deep Sea* education outreach team poses on the R/V *Atlantis* with Captain Gary Chiljean (front) and film director Stephen Low (far right). From left to right: Sande Ivey, Nancy Doolittle, Teresa Greely, Kristen Kusek, Kristin Thoms, and Kathleen Heidenreich.

Language Arts/Reading:

Verne, Jules. *Twenty Thousand Leagues Under the Sea.* Nelson Doubleday, Inc.: New York, 1956.

REFERENCES

Blum, D. and M Knudson. *A Field Guide for Science Writers.* Oxford University Press: New York, 1997.

J. Hartz and C. Chappell. *Worlds Apart: How the Distance Between Science and Journalism Threatens America's Future.* First Amendment Center: Vanderbilt University, 1997, p. 38.

PHOTO CREDITS:

Page 50: Courtesy of Richard Lutz, Rutgers University

Page 52: Courtesy of K. M. Kusek

ACTIVITY: *VOLCANOES OF THE DEEP SEA*

Excerpted from the Teacher's Guide at www.volcanoesofthedeepsea.com

LIGHTS, CAMERA, ACTION!

Filming *Volcanoes of the Deep Sea* was challenging on many fronts. The scientists and filmmakers worked in a symbiotic relationship to ensure the success of the adventure: the team lit and filmed a spectacular world never captured so clearly before, creating an invaluable tool for scientists. The film crew relied on scientists to guide the expeditions, provide the scientific background behind the subject of the film, and collaborate on overcoming the obstacles of filming in the deep ocean. … By far the greatest challenge to filming in the deep was light. With zero light at the bottom of the ocean, the filmmakers needed to provide their own. In total, 4400 watts of special light were used to illuminate the ocean floor, an area approximately three quarters the size of a football field: a much greater area than divers ever see on standard science dives with the submersible *Alvin*.

MATERIALS (PER LAB GROUP)

Tap water
1 eyedropper
White paper
Preparation notes
Cardboard shoebox without a lid
Three test tubes (each 6-in or 15-cm tall)
1 teaspoon table salt
Small flashlight
Pencil

This exercise requires the room to be as dark as possible. If you have access to a sealed darkroom, do this activity in it. Before class, prepare a box and materials for each lab group. Stand the box on a short end with the open side facing you. Make a hole on the top side, wide enough to insert and suspend a test tube. Cut out three pieces of white paper per box that fit inside the bottom. Label the papers 'Test Tube #1,' 'Test Tube #2,' and 'Test Tube #3.' Prepare a simple saltwater solution (1 teaspoon of salt per 1 cup of water).

WHAT TO DO

Divide the class into lab groups giving each group an assembled Black Box and all the materials. Have students do the following:

Step 1: Insert one test tube into the hole, and place the paper labeled 'Test Tube #1' at the bottom of the box. One student shines the flashlight down through the test tube, aiming at the white paper. Another student uses the pencil to trace the outline of the beam that is emitted on the white paper. Remove the test tube and paper. Fill the second test tube with tap water, leaving a small amount of space at the top, and insert it into the hole. Place the paper labeled 'Test Tube #2' at the bottom. Shine the flashlight down through the test tube and trace the beam on the white paper. Remove the test tube. Fill the third test tube with the saltwater solution, leaving space at the top, and insert it into the hole. Place the paper labeled 'Test Tube #3' at the bottom. Shine the flashlight down through the test tube and trace the beam on the white paper.

Step 2: Class discussion: have the students determine the relationship between the test tube contents and the width of the light beams emitted by examining the shapes cast by the light on the paper.

RESULTS

The light beam shone through Test Tube #1 should look like a sharp bulls-eye: large, bright, well-defined rings. With Test Tube #2 (water), the light circle is smaller, not as bright, rings not as well defined. This signifies that the water absorbs and scatters the light. With Test Tube #3 (saltwater), the salt absorbs and scatters the light beam even more. Just a hint of a circle from the light beam is visible.

As illustrated in this exercise, water scatters and absorbs light. In addition to salt, seawater contains many particles–such as those from animals and microbes–that scatter and absorb light. The scattering and absorption properties of water presented great challenges to the filmmakers in *Volcanoes of the Deep Sea.* The team had to find just the right amount of light to illuminate the deep-sea scenes well enough to film them for viewing on the IMAX screen. Shining too much light would have become a problem.

GCRL-123759-CurrentDHV *52 6/2/05 5:01:23 PM