Geophysics field education: Better learning by doing

Robert R. Stewart, Shuhab Khan, Joe Wong*, Stuart Hall, and Christopher Liner

Department of Earth and Atmospheric Sciences, University of Houston, Houston, TX 77204
****University of Calgary, Calgary, AB T2N1N4***

THE CALL OF GEOPHYSICS

A fascination with natural phenomena, a love of the outdoors, and an interest in using advanced technologies draw many to geophysics (Marshall, 2009). In addition, the soul of an exploration geophysicist will likely harbor an energetic curiosity along with the spirit to search for something valuable. Inherent in this quest and the practice of geophysics is a field survey – with its adventure, camaraderie, and measurements. The survey is usually about imaging the subsurface to discover or define something buried. Geophysicists are thus called to make a contribution toward scientific understanding of the earth and, via conscientious resource recovery, an improvement in prosperity. Central to this endeavor is making observations and acquiring data.

RATIONALE FOR FIELD COURSES

Kastens et al. (2009) describe the geoscience "community of practice" as characterized by relying on spatial thinking, interpreting observations in terms of intertwined processes, and describing the "raw materials of nature" in symbolic terms ("cascades of inscriptions"). They note that field experiences provide a sense of scale, introduce concepts of earth processes, assist in developing the ability to integrate fragmentary information, and give practice in gathering and evaluating the quality of data. More generally, Ray (2009) suggests that "The great worth of outdoor-education programs is their focus on the elements that have always united humankind – driving rain, hard wind, warm sun, forests deep and dark – and the awe and amazement that our Earth inspires…" and "Campers develop improved co-operation and conversation skills…" As is well known, we typically divide applied geophysics into separate realms of acquisition, processing, and interpretation. Naturally, knowledge of each area can help with understandings in another. And actual measurements play a critical role in the formulation and testing of new ideas. So, the practice of our professional community, as well as the demands of the industry attached to it (Whitmeyer and Mogk, 2009), require field exposure and education. Thus, some participation in field acquisition is integral to geophysics.

In the past, some energy companies had their own field crews to undertake surveys, conduct tests, and train employees. But this "in house" ability has diminished. Other organizations are trying to fill in some of this instructional gap, such as the Summer of Applied Geophysical Experience (SAGE) partnership (Jiracek et al., 2008), the Canadian Association of Geophysical Contractors' and its Seismic in Motion event (Fernando, 2007), along with several universities including the University of Oklahoma (Witten, 2003) and University of Calgary (Lawton and Bertram, 2006).

The technical objectives of the field experience include giving students opportunities to learn to:

— frame and solve geologic problems via geophysical surveys
— organize and undertake actual field surveys
— operate geophysical instruments and other equipment
— evaluate the quality of data and make an initial assessment of it.

HURDLES FOR FIELD INSTRUCTION

Armed now with some rationale for field experience and the people interested in so doing, we nonetheless find a number of challenges to the delivery of geophysical field education: Purchasing and maintaining the equipment may be prohibitively expensive, trained instructors (professors and staff) are few, and transportation to the sites may be logistically complicated. Injury and liability are constant concerns (in 2009, we did encounter black bears in the camp, rattlesnakes on the line, and a fenderbender on the road – all without harm). And student numbers and interest vary wildly over the span of several years. Thus, in the academic world, it is only strong and long-term university programs that can consider mounting and maintaining a geophysical field school. Even there, much of the support (equipment and personnel) will come from research funds. All that being said, our key motivation arises from the students themselves, who have said about their field schools, "by far the most useful course in my undergrad" and even "It was the best 11 days of my whole life."

SUMMARY

A significant and exciting part of geophysics is its data acquisition (survey design, instruments, and measurement). As such, a complete education includes geophysical measurement and field surveying. Field camps play a role in allowing students to better understand the techniques of subsurface imaging.

FURTHER READING

Alt, D. and D.W. Hyndman, 1995, Northwest exposures: A geologic story of the northwest: Mountain Press Publ. Co.

EIA (U.S. Government Energy Information Administration), 2009, Uranium & nuclear fuel: Remediation of mill sites – Riverton, Wyoming: Accessed November 8, 2009 - http://www.eia.doe.gov/cneaf/nuclear/page/umtra/riverton_mill_title1.html.

Fernando, J., 2007, Seismic in the sun in Waiparous: The Source, CAGC, 17, 27-30.

Heasler, H.P., C. Jaworowski, R.W. Jones, R.H. De Bruin, and A.J. Ver Ploeg, 1996, A self-guided geologic tour of the Chief Joseph Scenic Highway and surrounding area, northwestern Wyoming: Wyoming State Geological Survey, Public Information Circular no. 35.

Horner, J., 2001, Dinosaurs under the Big Sky: Mountain Press Publ. Co.

Jiracek, G.R., W.S. Baldridge, A.J., Sussman, S. Biehler, L.W. Braile, J.F. Ferguson, B.E. Gilpin, D.K. McPhee, L. Pellerin, 2008, SAGE celebrates 25 years of learning geophysics by doing geophysics: The Leading Edge, 10, 1340-1344.

Kastens, K.A., C.A. Manduca, C.Cervato, R. Frodeman, C. Goodwin, L.S., Liben, D.W.Mogk, T.C. Spangler, N.A. Stillings, and S. Titus, 2009, How geoscientists think and learn: EOS, 90, 31, 265-266.

Kauffman, M., 2008, A brief history of the Yellowstone-Bighorn Research Association (YBRA) geologic field camp, Red Lodge, Montana: Northwest Geology, 37, 1-4.

Lageson, D.R. and D.R. Spearing, 2007, Revised 2nd ed., Roadside geology of Wyoming: Mountain Press Publ. Co.

Lawton, D.C. and M. Bertram, 2006, New seismic and other geophysical equipment at the University of Calgary: CSEG Recorder, 26-31.

Marshall, J., 2009, Geology's touchstones: The PEGG: Assn. Prof. Eng. Geol. Geophys. Alta, v. 37, no. 8, 26.

Myers, T.S. and G.W. Storrs, 2007, Taphonomy of the Mother's Day Quarry, Upper Jurassic Morrison formation, south-central Montana, USA: Palaios, 22, 651-666.

Ray, D., 2009, Mom and dad were right: Camp is good for you: Canadian Geographic, v. 129, no. 4, 68.

Whitmeyer, S.J. and D.W., Mogk, 2009, Geoscience field education: A recent resurgence: EOS, v. 90, no. 43, 385-386.

Witten, A., 2003, An eventful semester teaching field geophysics: The Leading Edge, 7, 616-620.

Corresponding author: Robert Stewart, rrstewart@uh.edu