

**Carrying the Fire: Classroom and Field-based Teacher Training Using a Newly Institutionalized E/PO Product.** Steven D. Kadel<sup>1,2</sup> and David A. Williams<sup>1</sup>; <sup>1</sup>School of Earth and Space Exploration, Arizona State University, Box 871404, Tempe, Arizona, 85287-1404 ([s.kadel@cox.net](mailto:s.kadel@cox.net)); <sup>2</sup>Physical Sciences Department, Glendale Community College, Glendale, Arizona.

**Introduction:** Two years ago, we embarked upon an E/PO project that involved the following components: 1) Image-based exercises, in English and Spanish-language versions, that familiarize the user (teacher and/or student) with the variety of volcanic deposits, landforms and eruption styles observed on Io; 2) Equivalent image-based data on volcanic landforms and eruptions on Earth, including 3-D terrain models and fly-overs via the widely available GoogleEarth™ resource; and 3) A field study of volcanic landforms in north-central Arizona that simultaneously provides real-world context for the features discussed in the exercises and college credit for participating K-12 teachers [1]. We have produced a set of standards-based exercises that compare volcanic landforms and processes on Earth and Io, which can be accessed at <http://europa.la.asu.edu/education/activities/wof/wof.html>. In addition, this project has led to the creation of a formal and recurring college course, which is geared towards pre- and in-service secondary school educators. The course was first run in Fall 2008, and will be offered again in May of 2009.

**Io Exercises:** In these exercises, images of a variety of volcanic landforms on Io are presented, particularly in areas where active volcanism has been observed during the *Voyager*, *Galileo*, and *New Horizons* Missions (**Figure 1**). See [2] for an up-to-date review of the geology of Io. The exercises are focused on understanding the variety of volcanic landforms and processes observed and inferred on the surface of Io. Exercises are presented in an easy-to-navigate clickable map format.



Fig. 1. Explosive eruption on Io captured by *New Horizons* in 2007.

**Earth-based Exercises:** Images of effusive and explosive mafic volcanic landforms and deposits on Earth are presented, covering volcanoes in North America, Hawaii, Europe and Africa. Emphasis is

given to recently observed eruptions at various locations around the world. Perspective and overhead views, as well as fly-over/-around video clips from GoogleEarth™ are included for enhanced visualization and student engagement impact (**Figure 2**).



Fig. 2. Perspective view of SP Crater and lava flow, Arizona, from GoogleEarth™.

**Newly Instituted College Course:** In order to provide maximum impact and permanence of this E/PO project, we have successfully instituted a weekend field course through Glendale College (**Figure 3**). This course, entitled GLG231AA: Special Topics in Geology:

#### Glendale Community College

GLG231AA

0.5 Units

Special Topics In Geology. Volcanoes of Arizona -- Flagstaff Area, May 16-17, 2009

This course is an excellent opportunity for teachers and non-teachers alike to become more familiar with the geology and landscape of the many volcanoes of north-central Arizona, centered on the Flagstaff area. The class includes a half-day seminar on Saturday morning, May 16, 2009 in PS-167, followed by an overnight field expedition to observe and interpret various volcanic features and phenomena. The spectacular and rare vistas of Stoneman Lake, Sunset Crater, Cinder Lake, SP Crater, and Red Mountain (among others) will be explored with an eye towards the lava flows, volcanic mountains, and craters that these various types of eruptions have produced. During the seminar and field trip, which will be conducted both in English and Spanish, these volcanic landforms will be compared and contrasted with volcanic landforms on Jupiter's moon Io, the most volcanically active body in the solar system. During the field trip, the class will visit locations pictured in geology and earth science textbooks. Ample opportunities for sample collections (where permitted) and photography will exist and are highly encouraged. Students must pay a lab fee of \$25.00. Interested students should contact the instructor, Steve Kadel, email him at [s.kadel@gmail.com](mailto:s.kadel@gmail.com).  
45624 LEC FLDTRP Arranged Staff

Class meets: May 16, 2009 - May 17, 2009

Fig. 3. College catalog entry of new geology course supporting the Worlds of Fire E/PO project.

Volcanoes of Northern Arizona, incorporates the half-day introductory teacher training seminar, in which students are given an in-depth overview of volcanic processes on Earth, followed by a similar treatment for volcanism and volcanic features observed on Io. This seminar is followed by a day-and-a-half field excursion to observe volcanic features within a 50-mile radius of Flagstaff, Arizona. This excursion provides teachers with hands-on experience with cinder cone volcanoes, basaltic lava flow fields (Figure 4), lava tubes, intermediate to felsic stratocones (Figure 5), felsic domes, and a phreatomagmatic maar complete with ultramafic lower crustal xenoliths (Figure 6). This field course provides 0.5 credit-hours of continuing education college credit for registered participants through Glendale Community College, and can be taken more than once due to the flexible scheduling of volcanic localities. Plans for a future expansion into volcanic localities in New Mexico and SE Arizona are under way and should be realized in a recurring 2-credit summer course beginning in 2010. Participants complete and submit detailed field journals with photos and descriptions of the volcanic features studied. The field excursion (and the classroom training seminar) can be presented concurrently in both English and Spanish, depending on the needs of the student cohorts involved.



Fig. 4. GLG 231AA students in basaltic hornito, Sunset Crater, AZ.

This program provides an overview of the basic volcanic processes and landforms common to Io and Earth, and the data sets and techniques used to study them. The multiple data types, as well as the immer-



Fig. 5. GLG 231AA students at San Francisco Peaks stratocone.

sive field excursion, provide a meaningful and content-rich experience, as well as a user-friendly, ready-made set of tools and resources for the participating teachers to take back to their respective classrooms. In addition,



Fig. 6. GLG 231AA students on rim of Colton Crater maar, AZ.

the ongoing availability and flexible field component involved with the college course provides a follow-through for this project that is open-ended and can provide meaningful E/PO for educators and the interested public for many years to come.

**References:** [1] Kadel, S.D. and D.A. Williams (2007) *LPSC XXXVIII*, 2132.

[2] Lopes, R.C.M., and Spencer, J.R., 2006, *Io After Galileo*, Springer/Praxis, Chichester, UK, 342 pp.