

Monitoring Caldera Unrest at the Yellowstone Caldera: A Global Positioning System (GPS) Crustal Deformation Study and Hot Springs Temperature Study by the Eastern Illinois University Geology Field Camp

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The purpose of our study is to monitor caldera unrest at the Yellowstone Caldera by annually collecting GPS data and hot springs temperatures from a network of data collection points. Although the data collected in this study can contribute to more detailed monitoring efforts of the caldera, the primary goal of this project is to provide an on-going, hands-on field experience for undergraduate geology majors at the Eastern Illinois University Geology Field Camp.

On 6/29-7/1/1999, and 7/28-6/29/2000 we deployed 3 Trimble 4000Ssi receivers at pre-established GPS control stations in the park. During a 48 hour interval each year, data was collected from 8 different control stations along a NW-SE traverse across the Yellowstone Caldera. The GPS team sets up each station and trains 2 field camp students in overall instrument monitoring before leaving them with the receivers for 4 hour intervals. All students (20-24) take turns using and monitoring the equipment during data collection.

Following the 1999 survey, the data was processed and a set of 8 GPS baseline coordinates was established. During the 2000 GPS campaign, the 8 control stations were re-occupied. After reduction of the data collected during the 2000 campaign, it was compared to the baseline data. Our results indicate that all of our data stations were displaced horizontally with components of southerly and westerly motion. Vertical motion, in the form of subsidence, also occurred at almost all stations. Southerly displacement of our stations was the least, ranging from 1 mm to nearly 2 cm, whereas westerly displacement ranged from about 1 cm to over 2 cm. With the exception of one control station, subsidence ranged between 3 and 10 cm. Maximum horizontal and vertical displacements occurred in the northern section of the network.

Although subsidence rates of up to 3 cm per year have been reported for the Yellowstone caldera, our subsidence values are significantly higher and may have associated errors. A review of the data collecting and processing procedures has not yet produced an insight into the potential source of error. Network adjustments that we applied may be contributing to the suspect results. We will continue to assess our data and report changes that result from the elimination of any error(s). A more detailed report of this study, including data tables and a map is available at: <http://wilkes1.wilkes.edu/~gis/yellowstone/yell2k/>

A second component of our study is monitoring hot springs temperatures at selected thermal areas within the Yellowstone Caldera. After consultation with park officials, 3 areas in the Lower Geyser Basin were chosen for our study including thermal areas along Rabbit Creek, White Creek, and Sentinel Meadows. On 6/28 and 6/29/2000, faculty members led small groups of students through these thermal areas to measure hot springs temperatures that will serve as baseline data for our study. Each thermal feature was first evaluated for safety and the best

location to measure its temperature. Then, using two Omega thermocouples, students measured the temperature of the hot spring, and recorded the highest temperature obtained. The location of each measurement point was determined precisely in terms of latitude and longitude using a roving GPS unit carried by one student.

During two days of data collection, all students learned to use the thermocouple and the roving GPS unit. Temperatures and locations of about 100 thermal springs were determined and recorded in the GPS data logger. This data was subsequently used to prepare digital maps of the study areas that indicate hot spring locations and their associated temperatures. Hot springs in the Sentinel Meadows area mostly measured in the 90's, with several as high as 94°C. These consistently high temperatures qualified Sentinel Meadows as the overall hottest of our 3 study areas. Rabbit Creek and White Creek thermal features were more variable, with temperatures ranging from about 40 to 93°C. In June 2001 we plan to return to the exact locations that the 2000 data was collected and take new temperature measurements. We will then be able to assess any changes that have taken place during the last year. Maps and data tables for this study can be viewed: <http://oldsci.eiu.edu/geology/camp/YNP/ynpres.htm>.