

## **Applications of GigaPans to Geoscience Education and Research**

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Geology is an inherently visual science, but geoscientists often have few visual resources (e.g. single scale field photographs and hand samples) to record and present information about landscapes and outcrops. The GigaPan technology allows us to expand these resources to include visualization at multiple scales within a single panorama. These panoramas are key for assisting educators, as exploring diverse geologic settings and collecting data outside the classroom helps students to understand geological processes and builds problem solving skills. Unfortunately, significant amounts of field work (which allow students to observe outcrops, landscape features, and geologic concepts and processes at a variety of scales) are difficult or impossible to incorporate into classes, particularly large introductory courses, for both financial and logistical reasons. Panoramas acquired for research purposes are valuable for recording field data (precise visual location of samples within an outcrop) and later analysis that cannot be completed in the field.

We have incorporated GigaPan technology into the classroom by developing virtual field experiences that allow students to view outcrops or landscapes at a variety of scales. Using panoramas is advantageous because they encourage students to explore and to be actively engaged with the image. They are also well suited for open-ended, inquiry-based exercises. In large lecture settings, panoramas are used mainly for exploration and observation to illustrate concepts. Panoramas geolocated with Google Earth help to illustrate the relationships between outcrop-scale features and regional geology. Introductory lab exercises employ both panoramas and hand samples to give students hands-on experience in rock identification and observation while exploring landscapes. Intermediate and advanced courses challenge students to integrate information from panoramas and hand samples to make interpretations beyond what they can directly observe. With the addition of petrographic thin sections, students are expected to make interpretations from field data and observations from the landscape scale down to the microscopic scale. Plans to create additional panoramas of hand samples and thin sections are being developed in order to make these materials accessible to a wider audience. Panoramas of research locales are being utilized along with analysis of other field data to explore local variables such as slope and the relationship with weathering, location of field samples, and identification of small scale outcrop features.