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Location and Visualization— the Keys to Geological Education and Research

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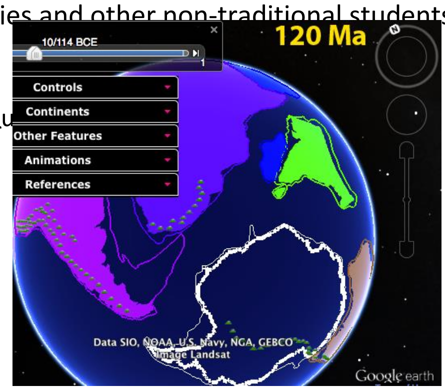
The various sub-disciplines of the geological sciences share a common goal: understanding places and their evolution through time. Key to achieving such understanding is the ability to visualize the Earth and other terrestrial bodies on a range of scales and to model the processes by which geological sites reached their present configuration.

Location and visualization are common barriers to student understanding. Students can visit only a very limited range of field sites in person and often their comprehension is hampered by a non-penetrative interpretation of surface features. In the NSF-funded GEODE project (Google Earth for Onsite and Distance Education), we are developing resources to enable students to experience a wide range of geological settings in virtual reality and augmented reality as well as in person. Using Google Earth and other virtual globes such as Cesium, students can have authentic undergraduate research experiences. Big geodata can be mined from sources such as GeoMapApp.org and IODP.org and ported to the virtual globe for visualization.

The terrain imagery on virtual globes is rarely resolved to outcrop scale. However, supplementary gigapixel photography such GigaPan and GIGAmacro enable visualization down to hand specimen or even mineral grain scale [1]. We have assembled StreetView and Photo Sphere imagery with rich geological content in a game-like educational resource called EarthQuiz [2] and have designed COLLADA models to help students analyze fold structures [3]. We created moveable KML elements that enable plate reconstructions such as Supercontinent Pangea to be animated and viewed from any latitude and longitude (Fig. 1). We have also assembled "grand tours" of Mercury, Venus, the Moon, and Mars and have assessed learning outcomes in large general education classes.

To help students visualize the hidden Earth, we created block models that emerge from the subsurface, including lithospheric cross sections and drill core records. We are experimenting with "Structure from Motion" technology to make virtual specimens [4] that can be geolocated at their collection sites and interactively inspected, and with augmented reality apps such as FreshAiR that support student fieldwork via their mobile devices. Among our innovative approaches are "Fake Field Trips" in which thematic field stops from widespread geographic regions are assembled, freeing students of the restrictions of real fieldwork. In the case of in-person fieldwork, we have developed scripts for digital mapping on mobile devices. This enables us to 'crowd-source' map making by combining input from generations of students [5]. Future plans include the pairing of local and remote students via wearable technology, thus extending field access to students with disabilities and other non-traditional students.

[1] http://gigapan.com/groups/100
[2] Dordevic, M et al. (2015) EosTrans AGU 96(14):12–16 http://EarthQu
[3] http://www.geode.net/fac
[4] De Paor, D (2013) GSA Abstr with Progs 45(1):109



[5] Whitmeyer S and De Paor, D (2014) Eos Trans AGU 95(44):397–399