3D Modeling the Geology of the Sanctuary of Zeus, Mt Lykaion

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For geoscientists collaborating with non-geologist colleagues in team-based efforts, communicating the meaning and significance of geologic map products can be the supreme challenge, primarily because geological maps appear to be two-dimensional, when in fact they are four-dimensional in character. Thus non-geologists normally will not be able to visualize the structural geometries, let alone the geological history that emerges from 'seeing' the 3D and 4D nature of geological relationships. This problem can be surmounted when basic geological map products are transformed into 3D structural models, and presented through animations.

In 2008, when I was completing his mapping of the Sanctuary of Zeus, I anticipated the challenge of communicating the geological map relationships to the ~50 team members (professionals and students) drawn from a broad range of disciplines: archaeology, classics, architecture, design, art, history, conservation, landscape ecology, paleobotany, geochronology, philosophy, and more. It was with this communication challenge in mind, as well as testing the efficacy of the geologic map, that I sought help from Alan Gibbs, CEO, Midland Valley Exploration (MVE). A partnership was established through which MVE applied its MOVE software to my field data. I provided to MVE in ARCmap shapefiles. MVE created a 2.5D geological map draped onto a DEM so that visualization of the relationships between geology and topography became more obvious. Then, again using its MOVE technology, MVE built virtual cross-sections in ways that conformed as tightly as possible to all surface data, including mapped locations and measurements of contacts, bedding, and formation thicknesses. Furthermore MVE, through trial-and-error testing, applied best fit solutions to macroscopic fold shapes in ways consistent with map relationships, inferred mechanical stratigraphy, and well chosen panoramic photographs of fold styles viewed in normal profile. Where the virtual cross sections and geological map data were not solidly compatible, Davis and MVE modelers would together create check-lists of relationships to be field tested by Davis. In this way the geological mapping was completed in 2010, not for the normal reasons ('no more time or money'), but through the achieving of a tight correspondence between the virtual cross sections and the geological map. The virtual cross sections then became the skeleton for expanding the 3D model into a volume containing all of the formations and faults as coherent surfaces.

The final iteration will be the addition of archaeological information to the DEM. In particular the final model will contain the locations of all built structures and activity areas, as mapped by David Romano. The 3D combining of topography, geology, and archaeology will permit a relative ease in communicating the tripartite relationships. Moreover, the built structures and activity areas may no longer be viewed by non-geologists as simply 'placed' on Earth's surface, but instead as 'attached' meaningfully to alluvium, colluvium, bedrock, structure, and geomorphology.