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Analyze an Outcrop Using Photo-Realistic Modeling

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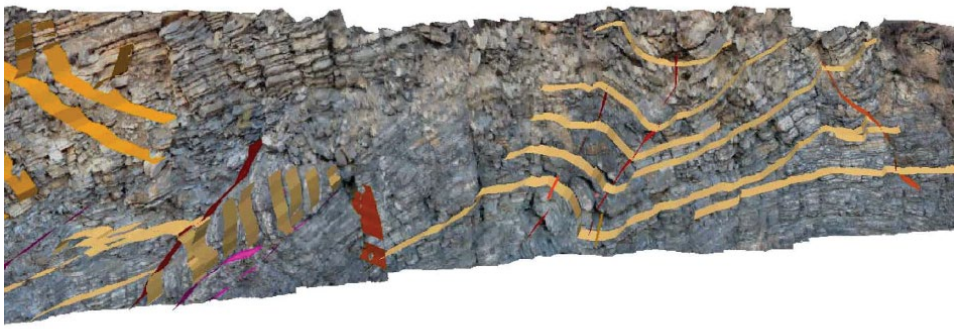
Geologists who study outcrops in search of potential oil reservoirs can measure a geological outcrop from an office chair. Using a photo-realistic model of a geological feature in ArcGIS, geologists can interact with a 3D image and measure the entire outcrop. A photo-realistic model of a geological outcrop is a digital replication of the outcrop that is accurate in scale and appearance. This is done by draping high-resolution photos (to 1 mm per pixel) onto a TIN mesh of a lidar-derived model to create an accurate, lifelike replica of the outcrop.

The geologist imports this model into ArcScene and uses GeoAnalysis Tools, created by Geological & Historical Virtual Models, LLC (GHVM), to study the outcrop in GIS. The outcrop model is either georeferenced or geo-oriented so that measurements are comparable to those the geologist would make in the field.

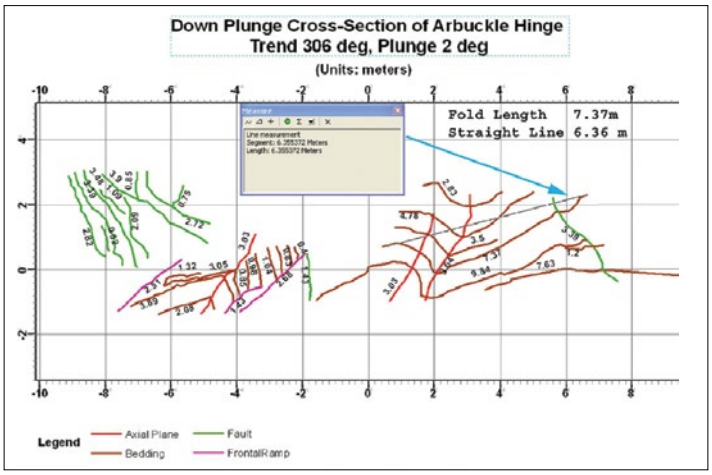
After importing the model as a multipatch file into the database, the outcrop image is closely inspected. By rotating the image, one can see all sides of the outcrop and zoom to see specific features. Geologists can also measure feature orientation and dimensions, create down-plunge cross sections, identify and annotate sedimentary facies, make rapid bed thickness measurements, and add stratigraphic columns and hyperlinks to the data table.

In ArcScene, the user can inspect the rock, whether it has a height of 100 meters or 2 meters.

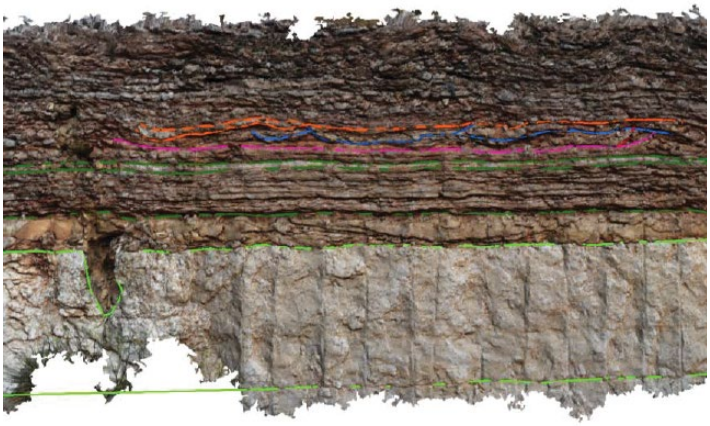
↑ A photo-realistic model representing a geological outcrop can be turned, measured, and analyzed in GIS.



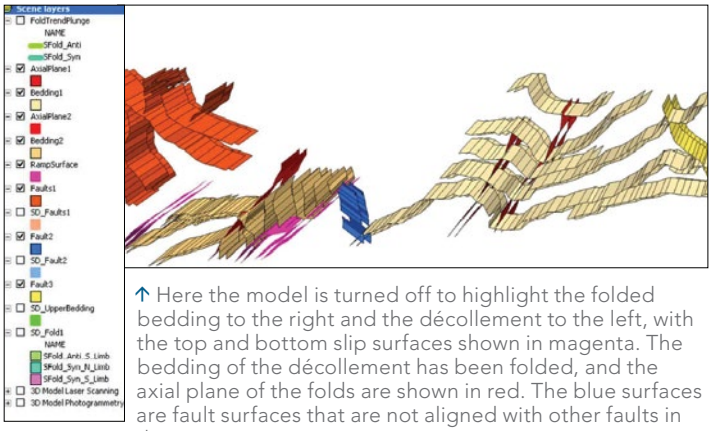
↑ GeoAnalysis Tools highlight the folded, fractured, and faulted bedding of the outcrop. The region around the anticline-syncline fold is shown with more of the bedding delineated. Axial planes for each fold are shown up to the top of the outcrop. A décollement surface is demarked with magenta. The folded bedding to the left is riding on top of the décollement slip surfaces.



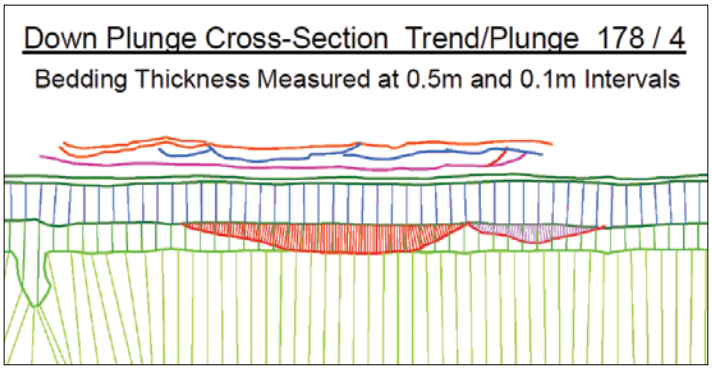
↑ A by-product of the delineation of the beds, axial planes, and faults is the creation of a down-plunge cross section of the outcrop. The user specifies the trend and plunge that define the down-plunge cross section, and then a projection plane is created. Line traces are projected onto the plane, exported to a 2D shapefile, and imported into ArcMap. ArcGIS annotation tools are used to create the grid, label the length of the line traces, and add titles and explanation to the diagram.



↑ This screen capture of the Eagle Ford Shale outcrop in south Texas delineates the feature's bedding. The geologist used the ArcGIS Auto Bedding Thickness tool on the down-plunge cross section to characterize the thinning and thickening of the beds. The down-plunge cross section was exported to ArcMap. The user selected two traces of bedding and activated the Auto Bedding Thickness tool by specifying the interval at which the bed thickness was to be measured. Note the multiple channels indicated in the beds.



↑ Here the model is turned off to highlight the folded bedding to the right and the décollement to the left, with the top and bottom slip surfaces shown in magenta. The bedding of the décollement has been folded, and the axial plane of the folds are shown in red. The blue surfaces are fault surfaces that are not aligned with other faults in the outcrop.



↑ The results are saved in a polyline shapefile, and the values are stored in the attribute table of the shapefile. The different sets of measurements can be classified and shown in different colors.

For more information about GHVM, contact Lionel White at lswhite@ghvmodels.com.

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