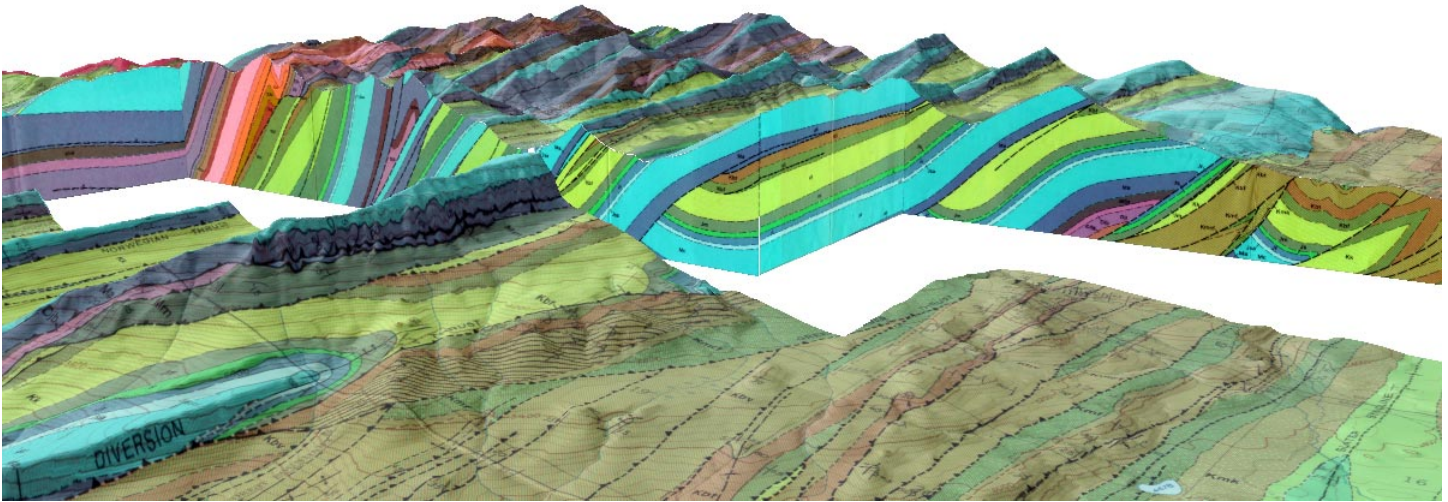# Visualize 3D Geology Using Manifolds

The Display process in TNTmips allows you to combine subsurface geological cross-sections or geophysical profiles with surface data to create revealing 3D perspective block diagrams and fence diagrams. The illustrations on both sides of this page provide a number of examples of 3D views that use *manifolds* to depict cross-sections. (For an introduction to manifolds see the Technical Guide entitled *Manifolds in 3D Views.*)

To create a fence diagram from a set of intersecting cross-sections, georeference the vector or raster objects representing the cross-sections with 3D control points using the Manifold model, then add the objects to a 3D group. Foreground-background relationships at the intersections of the cross-sections are automatically resolved in the view using the 3D control point information from each manifold surface. You can use the standard Viewpoint Controls to view the fence diagram from any direction.

You can create more complex block and cutaway diagrams by displaying one or more cross-section manifolds in combination with a surface geologic map, shaded-relief geologic map, or image. If the
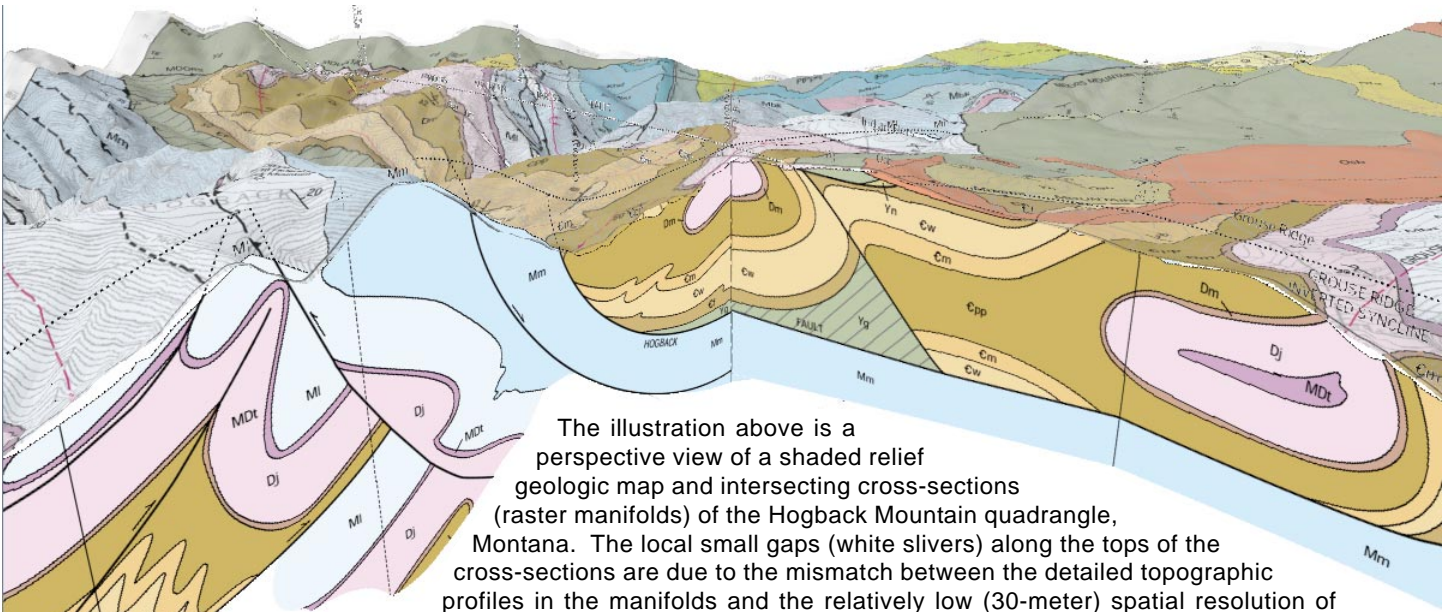
The illustration above is a perspective view of a shaded-relief geologic map and cross-sections from the Castle Reef and Arsenic Peak quadrangles, Montana, USA. A binary raster mask was used with the map drape to render portions of it transparent, revealing the subsurface manifolds. In the 2D view to the right, bold black lines show the lines of cross-sections (manifolds) shown in the perspective view and the orange graphic shows the field and direction of view. Masks were also used with these raster manifolds to limit rendering to desired portions of each section.
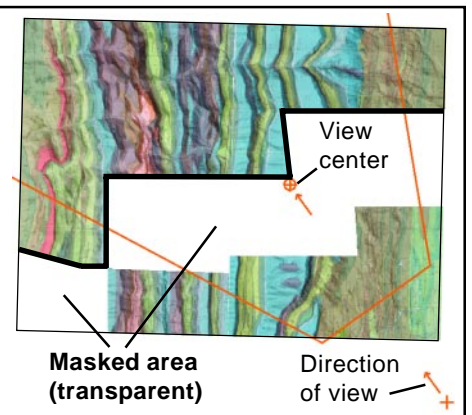
lines of the cross-sections are at the edges of your map or image, the subsurface manifolds will not be obscured by the data layer(s) draping the terrain surface. If the sections cross the interior of the map, you can use a binary *transparency mask* with a drape raster to mask out (make transparent) the portions of the drape that would otherwise obscure the cross-sections. You can also use a raster mask directly with a raster manifold to mask out marginal annotations or parts of the section that you don't want to render in the view.
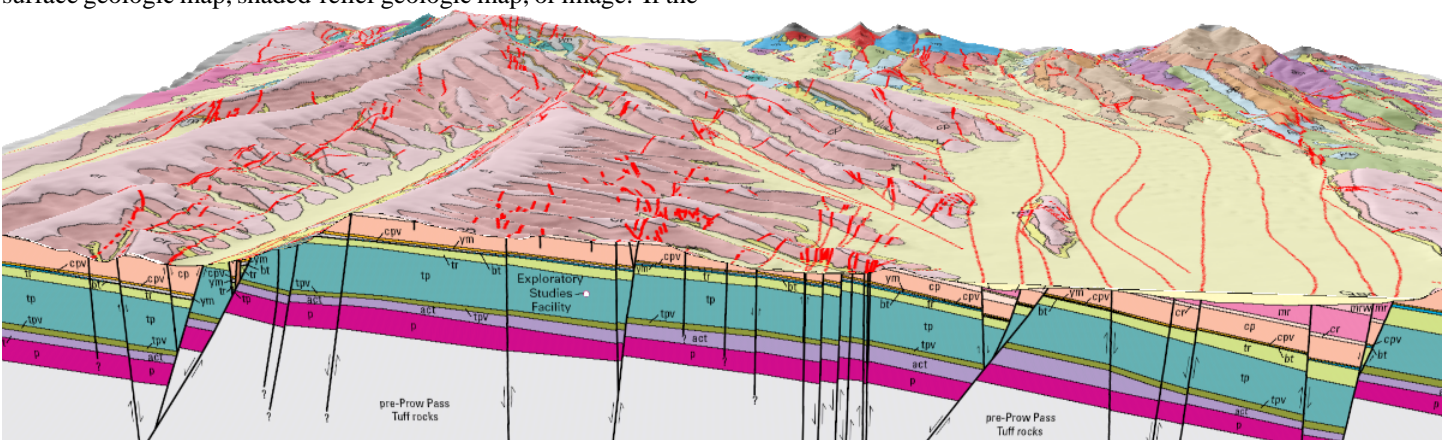

Perspective view of a shaded-relief geologic map and cross-section (raster manifold) of the Yucca Mountain area, Nevada, USA. The map drape and the raster manifold are each displayed with a transparency mask to control which portions of each object are visible.

The illustration above is a perspective view of a shaded relief geologic map and intersecting cross-sections (raster manifolds) of the Hogback Mountain quadrangle, Montana. The local small gaps (white slivers) along the tops of the cross-sections are due to the mismatch between the detailed topographic profiles in the manifolds and the relatively low (30-meter) spatial resolution of the elevation model used for the terrain surface layer.

Raster drapes of the ground surface in displays with geologic cross-section manifolds are not limited to geologic maps. Try combining your cross-sections with a shaded relief or satellite image, such as the pan-sharpened natural-color Landsat 7 image shown in this illustration of the Castle Reef and Arsenic Peak Quadrangles, Montana, USA.
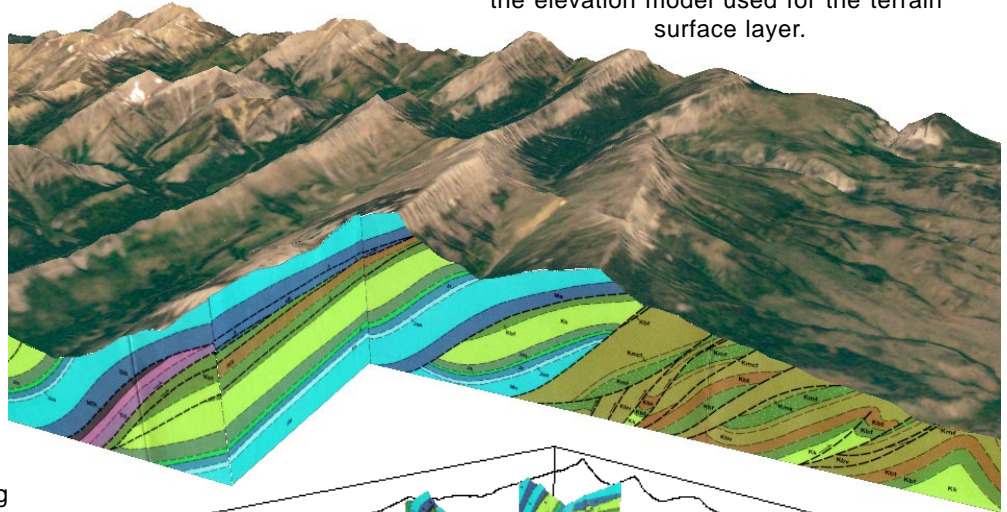
You can display multiple intersecting cross-section manifolds without surface-drape layers to create fence-diagram displays. The example at right shows four cross-sections from the Castle Reef Quadrangle, Montana, USA. Three sections perpendicular to the structural trend are connected by one section parallel to the major structures.
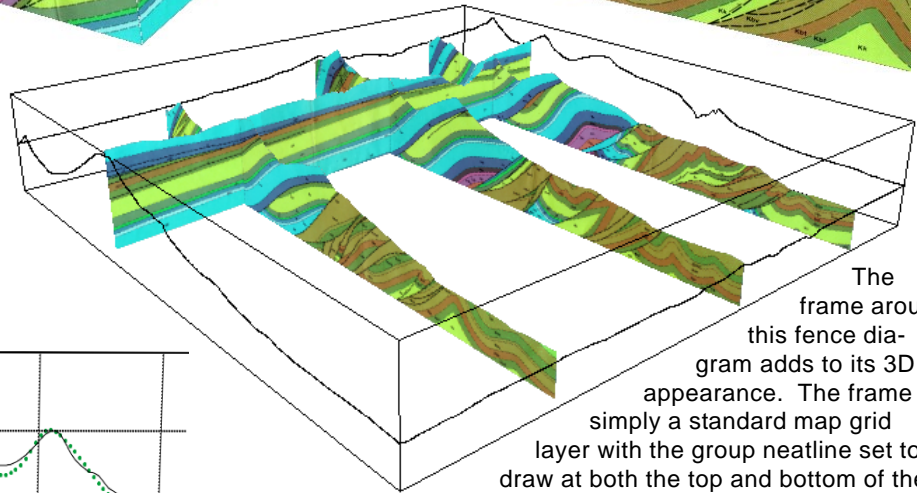
The frame around this fence diagram adds to its 3D appearance. The frame is simply a standard map grid layer with the group neatline set to draw at both the top and bottom of the elevation range.
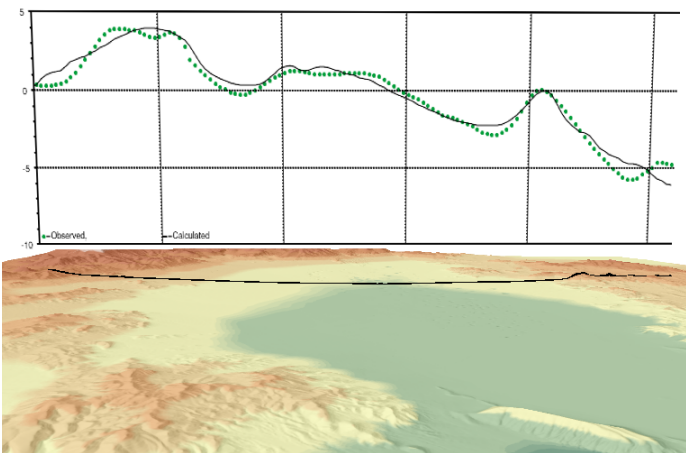
Perspective views can include manifolds depicting any type of geological or geophysical profile data. The perspective view at left shows a manifold profile plot of the observed (greendots) and modeled (solid line) basement gravity anomaly across Yucca Flat, Nevada, USA (gravity values in milligals). Control point elevation values were assigned to the plot raster so that it appears to float above the transect line (black line draped across the terrain). The terrain is shown in color shaded relief.