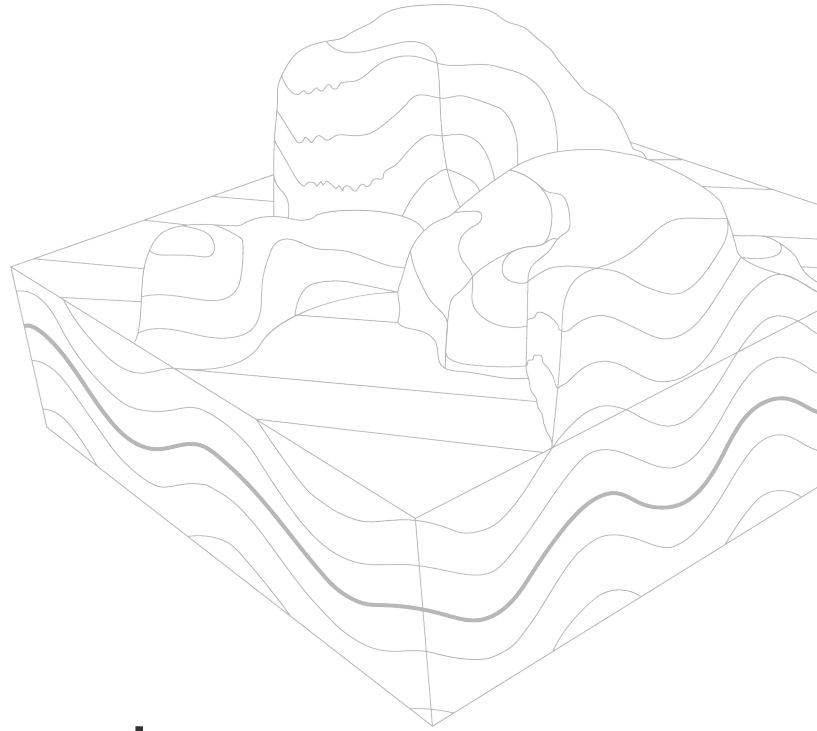




Lesson plan

Topography and contour lines: the shape of a surface

Learning objectives:

- Understand what contour lines represent on a topographic map
- Use contour lines on a 2D map to anticipate the 3D topography of a surface

Key Visible Geology skills:

- Use contour lines on a 2D map to anticipate the 3D topography of a surface
- Apply pre-made topographies to a block
- Create new topography from contour lines

Timelines:

- Workflow 1 – 3: ~15 min
- Questions and exercise: ~30 min

Glossary:

- See page 3



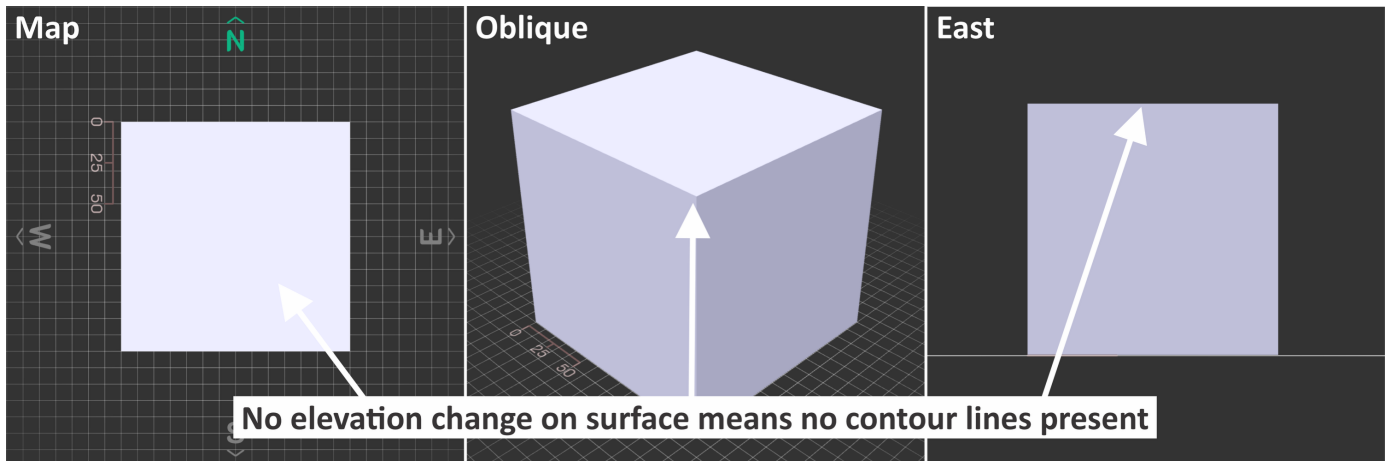
Workflow

1. To start, let's remove any colourful layers from our block so we can focus on the shape of the block.

Layers -> click on the bin image within each layer to remove them until the whole block is grey -> apply)

① Learning observation!

The top surface of the block is unmarked as there is no change in elevation, so the surface must be flat!

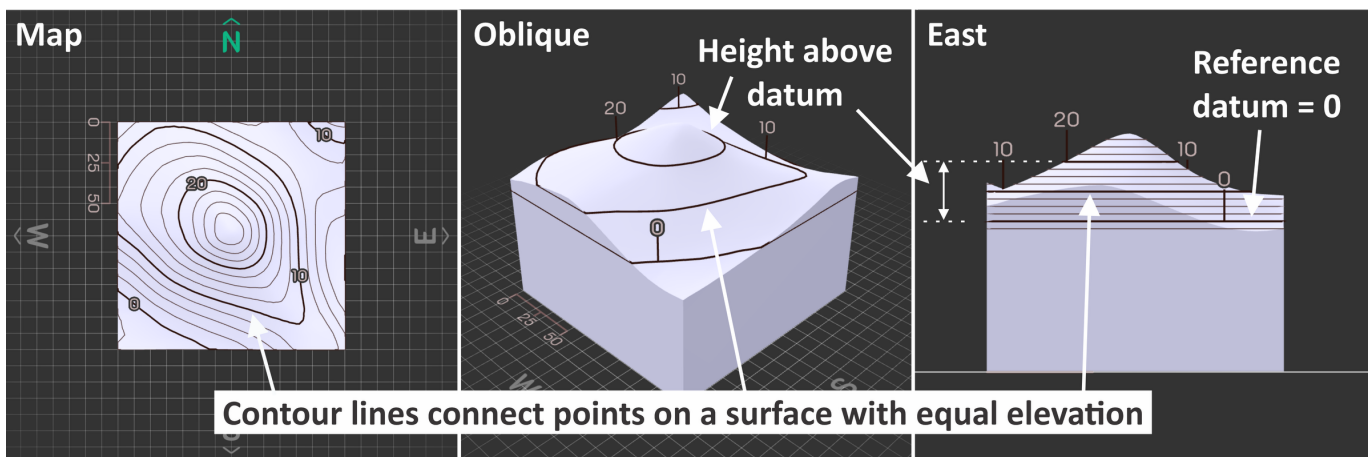


2. Now let's introduce elevation changes (i.e., topography) to the top surface of the block and see how this is represented by contour lines (solid black lines with a number attached). Start by adding the pre-made hill topography.

Topography -> Hill

① Learning observation!

For an uneven surface, topographic contour lines connect points of equal elevation (i.e., height) above or below a set reference point (also known as a 'datum', usually mean global sea level). The numbers show the **vertical** distance from the datum, typically in either meters or feet. For example, a "10" contour line connects all the locations on a surface that are exactly 10 units above the datum. Imagine walking around a hill so you never go up or down, just across!



3. Let's explore this concept further. Look at each of the different pre-made topographies in Visible Geology and see how the contour lines reflect the shape of the upper surface. For each one, look at it in both 3D and the top-down 'map' view.

Questions

- Is there a difference in how contour lines reflect topography between convex and concave topography?
- In map view (top-down), how do the shapes of the contour lines relate to the topography of the upper surface?

4. Feeling confident? Let's apply what we've learned and create some topography! There are two ways we can do this in Visible Geology: either by sculpting the shape of the block manually, or by drawing contour layers reflecting the topography we want to see. You now have the knowledge and skills, so let's do both! Overleaf are two 3D images of topography in Visible Geology and two 2D topographic maps.
- For each image of topography, visualise what a 2D contour map looking down on that block might look like. Then, use the *draw contours* tool in Visible Geology to draw that map (e.g., concentric circles of contour lines represent a hill!). Visible Geology then creates a 3D block from the contour lines you've drawn: compare your created 3D block with the image and see if you were right!

Topography -> New -> Draw contours -> Preview -> give it a name -> Save & Return

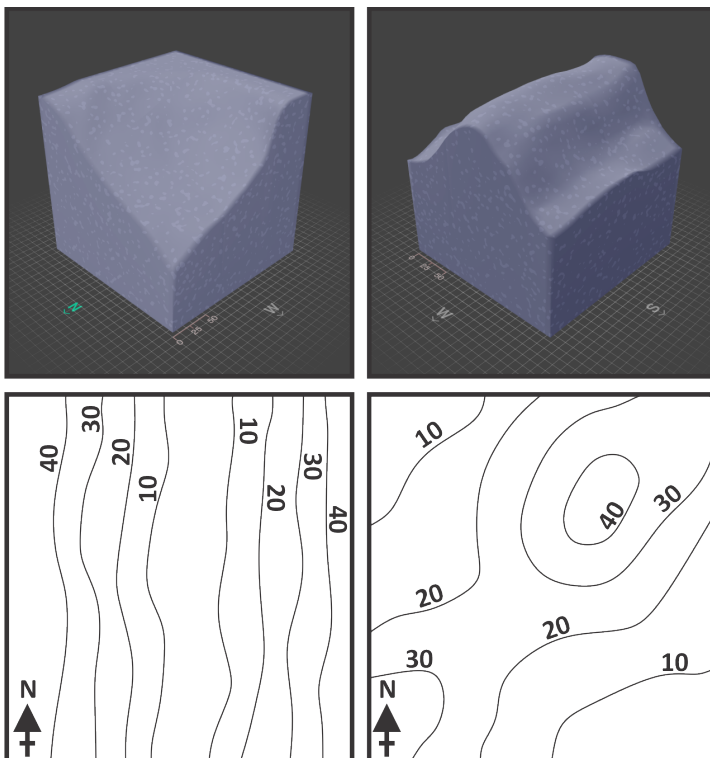
Topography -> scroll to the bottom and your new design will be last

- For each 2D contour map, visualise what that topography might look like in 3D. Then, use the *sculpt terrain* tool in Visible Geology to shape a square block into that same topography (e.g., if you think it's a valley, create a valley!). Visible Geology then automatically applies contour lines to the shape you've created. Compare the contour lines from your created shape with the starting map and see how close you were!

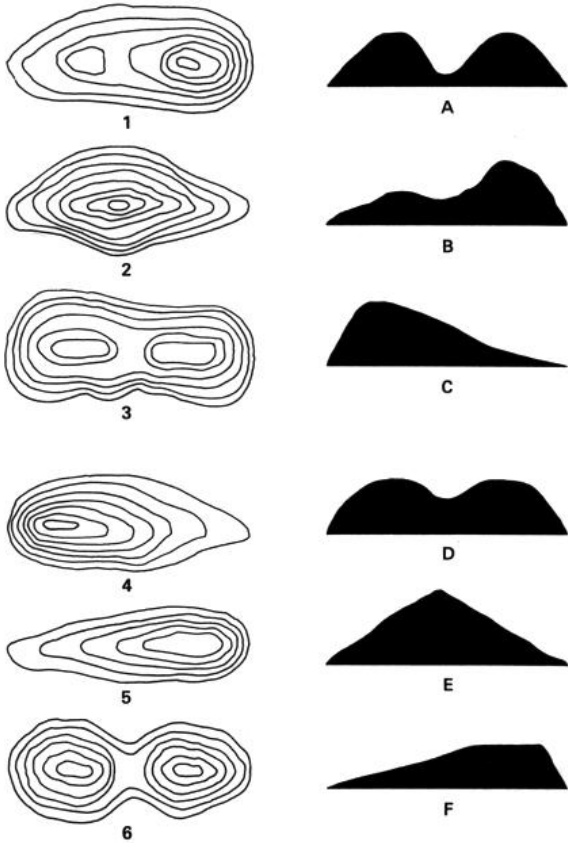
Topography -> New -> Sculpt Terrain -> give it a name -> Save & Return

[start with a block ~W = 250, H = 140, D = 250, if it's too small it will be hard to apply the topography detail!]

Topography -> scroll to the bottom and your new design will be last



5. Finally, let's double down on this. Below are six examples of 3D features represented by contour lines (1 – 6) and six side-on profiles of these 3D features (A – F). Match each set of contour lines to the corresponding side profile!



Glossary:

Elevation: the height of a point above a reference datum.

Datum: a fixed point or surface that everything else is related to. For topography this is normally the mean global sea level (m.s.l.).

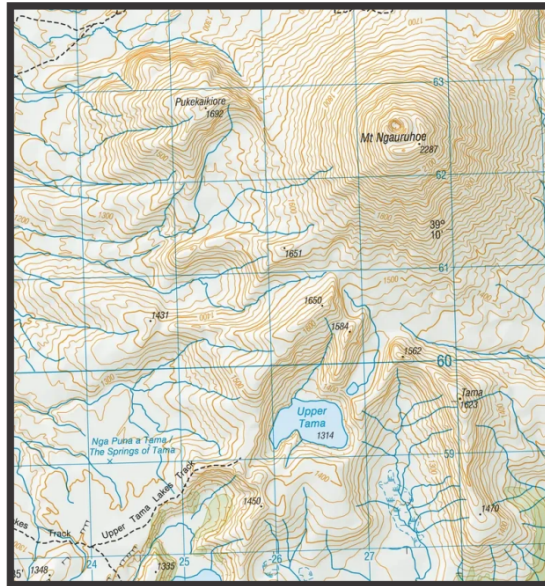
Topography: the shape of a surface.

Contour line: A line connecting points on a surface at the same height above or below the reference datum.

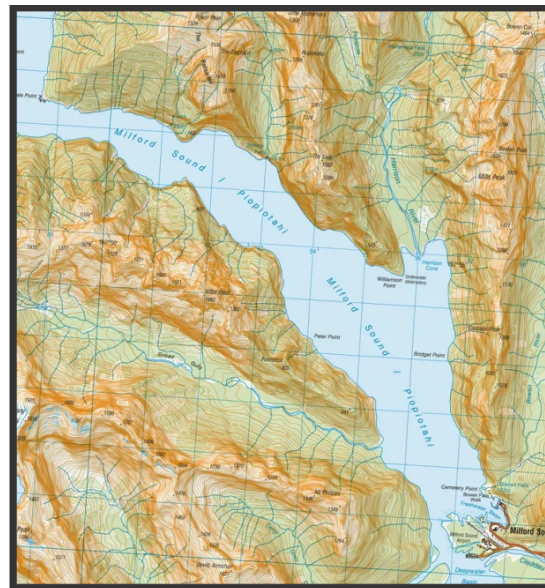
Convex: curves outwards.

Concave: curves inwards.

Real-world examples



The cone of Mt Ngauruhoe (a.k.a. Mt Doom in *The Lord of the Rings*; left) represented by tightly spaced concentric contour lines on a topographic map (right). Tongariro National Park, Aotearoa/New Zealand. Photo by Henry Hoult.



The steep sided fjord of Milford Sound (left) represented by tightly spaced contour lines along valley sides. Fjordland National Park, Aotearoa/New Zealand. Photo by Henry Hoult.