Active Faults in Malawi Workshop

For this exercise you will need:

1. A 3D printed model of a fault
2. The corresponding topography map
3. A ruler
4. A calculator

The aim of this exercise is to identify: (1) whether the fault you have been provided with is active, (2) to measure the how much the fault slipped in an earthquake by measuring the height of its scarp, and (3) to calculate the magnitude of the earthquake that caused the fault scarp.

Begin by looking carefully at the 3D model and the topography map.

Questions to answer:

1. **What features can you identify that indicate that the fault is active?**
   Try to identify 4-5 factors that indicate that the fault is active.

2. **Can you identify a fault scarp?**

If you have correctly identified a fault scarp, you should begin the process of estimating the magnitude of the earthquake that formed the fault scarp.

To estimate the magnitude, you first need to calculate the seismic moment (the force) of the earthquake. To do this, use the equation:

Equation 1

Seismic moment = shear modulus x rupture area x slip

In order to use this equation, you need to calculate the rupture area and measure the earthquake slip. **Use the 3D model to measure the slip in meters.**

Note, the 3D models have been vertically exaggerated. Make sure you convert your measurement of the scarp height back to the original scale. Make sure that you use the same and correct units when using equation 1.

Slip (m):

To calculate the rupture area you need to measure the length of the fault. **Use the topographic map to measure the length of the fault in meters.**

Fault length (m):

You should now multiply this value by the width of the fault. As you are unable to measure this directly, we have to assume a value. **You can use a value of 40,000 m** (this is equivalent to the fault having a dip of ~60° and a depth of ~35km).

Fault area (m^2):

You should assume 32,000,000,000 Pa for the shear modulus (this is typically used in earthquake studies on the continents). **Now use equation 1 to calculate the seismic moment.**

Seismic moment (Nm):

To convert the seismic moment to moment magnitude use the equation:

Equation 2

Moment magnitude = 2/3 x log(seismic moment) – 6.06

Use your calculator to work out equation 2. **What is the magnitude of the earthquake that formed the scarp you have identified?**

Moment magnitude:

Advanced questions:

a) What assumptions have you made about the size of the scarp?
b) How could you improve your reliability of the magnitude that you have estimated?
c) The recurrence interval of a fault is the time (typically in years) between earthquakes along the fault. If we assume these faults have an average slip rate of 1 mm/yr, and all this slip occurs during large magnitude earthquakes, what are these fault's recurrence interval? *(hint: divide the slip measured from the scarp height by the fault slip rate)*