Have you ever wondered what makes the earth rumble and shake? Veronica Prush, a graduate student in the Earth and Planetary Sciences Department at the University of California, Davis, described earthquakes and faults in her captivating presentation for a course entitled, “Ecogeomorphology: Grand Canyon”.

An earthquake occurs when two pieces of the earth suddenly slide past each other (Fig. 1). This is similar to the “waves” produced when you snap your fingers. As you push your fingers together at an angle, the motion of pushing together creates friction that keeps them from moving. However, as you continue to force them past each other, you overcome this friction and your fingers slip. As they slide quickly past each other the energy is released as a ripple of sound waves. Similarly, as the pieces of the earth slide past each other, energy is released as seismic waves. These waves radiate outwards from the fault in a wave-like fashion, similar to ripples on a pond when you throw a pebble into it. The two pieces of earth slide past each other along a weak region known as a fault; this region is like the one where your fingers meet when you snap them, on a much larger scale. As these waves of energy propagate out from the fault they cause the earth to shake, which results in the phenomenon that we experience as an earthquake.

There are different types of faults that describe the type of motion caused by the two pieces of earth moving relative to each other. Geologists call the block considered stable the footwall, while the other that moved is called the hanging wall. For example, a normal fault exists where the hanging wall moves down relative to the footwall (Fig. 1), whereas a thrust fault occurs when one piece is “thrust” upward relative to the other. Most faults have some combination of side-to-side and up-and-down movement, so they are characterized as a percentage of the various types of fault motion.

Yet, how do we actually know that faults record movement? Many faults show evidence of past motion because they have brought together rocks that were previously far apart. In some cases, earthquakes leave behind evidence of fault activity, such as surface cracks or cliffs. Thus, we can observe evidence of faulting in many locations throughout the world where there has been previous tectonic activity.

Faults are expressed in many ways in the Grand Canyon, including as fault surfaces, breccia zones, and folds. In the Grand Canyon, faults can be seen in most of the canyon’s rock layers. One famous example is the Bright Angel fault. The Bright Angel fault can be viewed in the southern part of the canyon, is oriented northwest, and is responsible for creating the Bright Angel Canyon, a famous hiking trail for visitors.

Breccia zones, made of broken fragments of rocks and minerals cemented together, are also evidence of an earthquake. Tectonic breccias are the result of two pieces of earth sliding past each other and grinding and milling pieces of earth off of each side of the fault. The fault acts a layer which groundwater can easily penetrate and the minerals surround the resulting fragments of rock, cementing them at the location where the fault moved.

In the Grand Canyon, folding occurs as a result of stress on a region from an earthquake that does not cause the landscape to snap, but instead deforms and bends it. Fold types include synforms, a downward fold similar to a valley, antiforms, which bends the earth up in the shape of a mountain, and monoclines, where the earth sags to create one very steep side with a horizontal top. In the Grand Canyon, most of the folding features are monoclines, which can be seen as steep cliffs with a flat surface above and below. One such example in the Grand Canyon is the East Kaibab Monocline, which extends north from the San Francisco Peaks volcanic field in Arizona for 150 miles to Bryce Canyon, Utah.

Faults are a fascinating feature of the landscape. The history of the earth can be “read” in the rock layers, and faults and other deformations of the landscape provide us with visual evidence of previous earthquakes.