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Do Earthquakes in Colorado Follow the Gutenberg-Richter Law?

The objective of this study is to determine whether the Gutenberg-Richter (GR) Law holds for earthquakes in Colorado. The GR Law is an empirical relation that states that, on average, the number of earthquakes in a region grows by a factor of 10 for each reduction of a unit in earthquake magnitude. The USGS catalog of earthquakes shows that about 75 magnitude 3.0-4.0 earthquakes and 7 magnitude 4.0-5.0 earthquakes occurred between 2000 and 2009 in Colorado. These numbers agree with the GR Law, which, given the number of magnitude 3.0-5.0 earthquakes, would predict about 6 magnitude 2.0-3.0 and 60 magnitude 1.0-2.0 earthquakes in Colorado per month. No complete earthquake catalog exists for earthquakes smaller than magnitude 3.0 in Colorado, so to test whether the GR Law holds for smaller earthquakes in Colorado I needed to process raw seismic data, measure wave travel times, and locate and compute magnitudes for the events myself. I acquired raw seismometer data from the IRIS DMC for the month of June 2009 from more than 100 seismic stations in and around Colorado, measured P-wave travel times for 130 seismic events, located these events in and adjacent to Colorado, determined their magnitudes, and discriminated the mining events from the earthquakes using Google Earth. Ninety-four of the events are in Colorado, of which I determine 20 to be earthquakes. Although many mining events with magnitudes less than 2.0 are observed, earthquakes with magnitudes from 1.0-3.0 in Colorado do not follow the GR Law. I observe 13 magnitude 2.0-3.0 earthquakes, but only 7 (rather than the expected 60) at magnitude 1.0-2.0. This shortage of small earthquakes in Colorado is consistent with other tectonically inactive regions, probably resulting from faults having healed so that earthquakes with magnitudes less than 2.0 are relatively rare. The GR Law is used around the world for predicting the likelihood of large earthquakes from observations of the occurrence of the more numerous smaller earthquakes. The fact that Colorado's small earthquakes do not follow the GR Law may be relevant to predicting the likelihood of large earthquakes in Colorado.