Neotectonics 5

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INTRODUCTION

At first glance, Illinois appears to be rather quiet tectonically. Despite the occasional present-day tremors that occur within Illinois and the great historical New Madrid earthquakes of 1811 and 1812 in the Missouri “boothell” area, geologists have traditionally viewed Illinois as part of the “stable craton,” deep within the continent and far removed from dynamic areas such as the West Coast. The New Madrid earthquakes have generally been seen as anomalies.

Earth scientists now recognize that Illinois has active faults and a recent history of large earthquakes. Four discoveries support that view:

1. Surface faults in southernmost Illinois have undergone large movements during the past 2 million years and in one place possibly underwent very small movements within 5,000 years of the present.
2. Large earthquakes (magnitude 6 to 7.5) liquefied river sediments in large areas of Illinois during the past 12,000 years.
3. Active tectonic stress is forming new faults and fractures and causes roof failure in underground mines.
4. Some earthquakes in Illinois are centered on zones of weakness in the crust that are hundreds of millions of years old.

This chapter on neotectonics, or “new tectonics,” addresses recent and ongoing earth movements, particularly those associated with earthquakes. This area is one of many where geological processes have a direct impact on human activities.

QUATERNARY FAULTS AT THE SURFACE

Although faults are present throughout Illinois (see Chapter 3, Tectonic History, and Chapter 4, Structural Features), most show no signs of recent activity. Until the mid-1990s, no definitive evidence had been found for faulting in Illinois since the Cretaceous Period (65 million years ago). Recent investigations at the southern tip of the state show that some faults there underwent large movements during the Pleistocene. The best examples are in Massac County, near Metropolis and Joppa (Figure 5-1), where the main activity took place during and before the Illinois Episode of the Quaternary Period, more than 125,000 years ago.

The only other place in Illinois where a geologist has suggested Quaternary faulting may exist lies just north of St. Louis. Rubey (1952) mapped a unit that he named the Grover Gravel of late Tertiary age on the uplands of Calhoun County. The unit is composed of well-rounded pebbles, cobbles, and boulders of purple, red, white, and black quartzite and chert. The map shows the gravel ranging from 0 to 20 feet (6 m) in thickness. Rubey concluded that the Grover Gravel was higher on the north side of the Cap au Grès Faulted Flexure than on the south side, indicating post-Tertiary movement on the Cap au Grès. During recent mapping of the Brussels and Winfield Quadrangles by Seid (2008a, 2008b), no gravel exposures were seen in place. Gravel was found along upland streams coming off the Dividing Ridge in Calhoun County, but the gravel’s elevation could not be determined. On the maps by Rubey (1952) and Harrison (1997), the Tertiary gravel unit is overmapped (i.e., overestimated), which makes the unit appear much thicker than it probably is. The distribution, thickness, and elevation of the Grover Gravel are so poorly constrained that post-Tertiary deformation cannot be supported.

Southernmost Illinois

Numerous faults displace Quaternary sediments in the Mississippi Embayment at the southern tip of Illinois. Although suspected by some early geologists, those faults were not documented until the late 1990s. Early reports of Quaternary deformation (Shaw 1915, Ross 1963) lacked well-defined evidence, and closer inspection of some reported sites indicated that landsliding or other non-tectonic processes had been at work (Kolata et al. 1981). Detailed geological mapping at a scale of 1:24,000 and a dedicated program of drilling, trenching, and geophysical studies were required to prove Quaternary tectonic faulting in the northern Mississippi Embayment.

The Quaternary faults of southernmost Illinois are part of the Fluorspar Area Fault Complex (Figure 4-2, Chapter 4, Structural Features; see also Chapter 13, Quaternary Paleoclimatic). These faults originated as part of a “failed rift” (Reelfoot Rift) and have been active repeatedly since Cambrian time. The New Madrid Seismic Zone lies within the Reelfoot Rift.