STATEMAP
Gorham-BG

Bedrock Geology of Gorham Quadrangle

Jackson County, Illinois

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Location and Introduction

The Gorham Quadrangle is located east of the Mississippi River about seventy-five miles southeast of St. Louis, Missouri, in southwestern Jackson County, Illinois. It has high sandstone bluffs on the east side and a bedrock island called Fountain Bluff on the west side of the quadrangle. Alluvium covers about half of the quadrangle, with Pleistocene outwash and gravel train deposits from two of the most recent glaciations, along with Holocene-age sediments from the Mississippi River, which is less than one mile to the west. Thickness of the alluvium averages from 150 to about 200 feet. The Big Muddy River, which cuts through the center of the quadrangle, is an underfit stream that meanders near the eastern bluffs.

The youngest bedrock is Middle Pennsylvanian in age, occurs in the northeast corner of the quadrangle, and is blanketed with the southern-most extent of Illinoian glacial deposits. Regionally, bedrock strikes northwest and dips to the northeast one to three degrees. The oldest rock is Lower Devonian and is exposed in the southwest corner of the study area. A four-square mile area south of Cedar Creek, in the southeastern corner of the map, contains numerous small normal faults with steeply dipping rock units.

How This Map Was Made

Primary data was systematically located on a topographic base and collected in field notebooks. Four-hundred and seventy-five notes were taken by the authors on bedrock exposures, in addition to those of Allen L. Weedman (SIUC), W. John Nelson (ISGS), and Donald K. Lumm (ISGS). Two stratigraphic boreholes were drilled by the ISGS, GH#1 and GG#1. GH#1 permeated Chesterian formations at a total depth of 240 feet. This hole was used to calculate the amount of displacement across the Pomona Fault. GG#1 reached Chesterian fault blocks beneath Caseyville cover and was drilled to a total depth of 410 feet. Ten oil and gas boreholes drilled by Phillips Petroleum Company were used to delineate the Pomona Fault and Rattlesnake Ferry Fault (part of the Ste. Genevieve Fault Zone) beneath the alluvial bottoms. Thin-sections of some of the Chesterian formations were made, examined and described. Additionally, Nelson and Lumm (1985) performed a thorough examination of the Ste. Genevieve Fault Zone, which was very helpful in understanding the geologic context of the Gorham Quadrangle.

Stratigraphy

Devonian, Mississippian and Pennsylvanian strata are exposed in the quadrangle. The oldest unit, the Clear Creek Chert (Emsian, Lower Devonian), is exposed along one of the main faults of the Ste. Genevieve Fault Zone (SGFZ) as a small sliver in Walker Hill in the southwest corner of the quadrangle. The Grand Tower Limestone (Eifelian, Middle Devonian) occurs above the Clear Creek and along a smaller splay fault in Walker Hill.

The oldest Mississippian unit is the Salem Limestone, which is projected into Walker Hill from exposures in the Altenburg Quadrangle. The Salem occurs in a fault sliver of the SGFZ. The St. Louis Limestone overlies the Salem, which are both included in the Valmeyeran Series (Middle Mississippian). The Ste. Genevieve Limestone overlies the St. Louis and is the oldest unit in the Chesterian Series.

In the southeastern quarter of the quadrangle, middle to upper Chesterian units are moderately exposed. The Tar Springs Sandstone, Menard Limestone (including the Vienna and Waltersburg horizons), Palestine Sandstone, Clore Formation, and Degonia Sandstone are exposed. The lower part of the Kinkaid Limestone overlies the Degonia Sandstone where it is not removed by the extensive late Mississippian erosion surface, the sub-Absaroka unconformity (Sloss 1963). These units are mapped as Elviran undifferentiated in areas of poor exposure and complex structure.

Pennsylvanian units exposed include the Caseyville Formation (Morrowan), lower Tradewater (Atokan) and upper Tradewater (Desmoinesian). A local thin limestone of basal Demoinsian age (Rexroad et. al. 1998) was mapped in a small area (Sec.14, 9S, 3W), and is equivalent to the Seville Limestone of Fulton County, Illinois, the Curlew Limestone of western Kentucky, and the Perth Limestone of Indiana. The biostratigraphy was verified by conodonts.

Lateral variations important to note in this quadrangle occur in the following Chesterian formations: Hardinsburg Sandstone (only occurs in the subsurface), Waltersburg Sandstone, Menard Limestone, Clore Formation and Degonia Sandstone. The Hardinsburg Sandstone thins to the west and is only 20 feet thick in the Gorham Quadrangle. It is mainly composed of dark gray, silty shale in the study area. Sandstone is recognized farther east in the Glendale Quadrangle where it ranges from 60 to 100 feet thick (Devera 1991). Similar to the Hardinsburg Sandstone, the Waltersburg Sandstone also “pinches out” to the west. It is represented in this area by shale only. The Menard Limestone contains a 20 foot thick öolitic limestone in the lower part which is not developed farther east in the deeper part of the basin. The Clore Formation also has an oolite bed that has only been found in this quadrangle and in the Wolf Lake Quadrangle (Devera 1993). Of note, no other area has yielded öoids in the Clore. The Degonia Sandstone is thicker on the western side of the Illinois Basin—thickness ranges from 100 feet of sandstone in this quadrangle to 40 feet of shale and siltstone about 40 miles to the east.

Structural Geology

Overview

The quadrangle lies on the eastern edge of the Ozark Plateaus Physiographic Province. The St. Francois Mountains

of Missouri are about 50 miles west, the Ouachita Mountains are about 350 miles southwest, and the Appalachian Mountains are about 350 miles southeast of the quadrangle. The tectonic stresses that caused uplift of these mountain belts were probably transmitted into the foreland, to some degree, and ruptured pre-existing faults in the region.

The Gorham Quadrangle has two large fault zones that trend nearly parallel, and they both strike west to northwest. The Rattlesnake Ferry Fault in the southernmost part of the quadrangle is part of the larger Ste. Genevieve Fault Zone and has displacements between 700 to 1,500 feet, up-thrown on the south side. Fault planes were not observed in the quadrangle, which limits the amount of structural interpretation that it possible. It has been documented as a high-angle reverse fault by Nelson (1995). The Pomona Fault, two miles to the north, is probably also a high-angle reverse fault, up-thrown on the south side, with 100 to 400 feet of displacement. Another set of faults occurs between the Rattlesnake Ferry Fault and the Pomona Fault Zone. This zone includes about 14 faults that trend north-northwest and have smaller offsets, between 50 to 80 feet. Faulting appears to be confined to the upper Chesterian formations in this quadrangle and in the Cobden Quadrangle (Devera and Nelson 1995). This fault cluster is herein called the Wolf Creek Fault Zone (WCFZ) where it was first discovered in southeastern Gorham.

Rattlesnake Ferry Fault Zone (RFFZ)
The Rattlesnake Ferry Fault Zone (RFFZ) is one part of the southern leg of the Ste. Genevieve Fault Zone in Illinois. Numerous segments of the Ste. Genevieve Fault Zone have been named in Illinois i.e. Pomona, Atwood and Delta (Nelson, 1995).

Exposures of the RFFZ lie just south of the study area in the Wolf Lake Quadrangle (Devera 1993) and has about 1,500 feet of displacement with the northeast side downthrown. It is projected into the Gorham Quadrangle under the alluvium in Oakwood Bottoms, along the southernmost part of the map and partly exposed on the southeastern side of Walker Hill. On Walker Hill (southwest corner of the map), the Grand Tower Limestone (Eifelian) is juxtaposed with Salem and St. Louis Limestones (Valmeyeran Series). There is about 700 feet of displacement down to the north across this structure. In the Wolf Lake Quadrangle on the east bluff, Middle Devonian rocks are exposed on the south side of the RFFZ whereas Middle Chesterian rocks are exposed on the north side.

Pomona Fault Zone (PFZ)
The Pomona Fault was mapped by Desborough (1958), Pickard (1963), and Satterfield (1965) as a northwest-trending high-angle fault with about 150 feet of displacement. The Pomona Fault actually occurs as a zone of deformation in the Pomona Quadrangle—it occurs as several en echelon fault traces where the structure steps over and turns to the west (Seid et al. 2007). The orientation of the en echelon faults along the PFZ suggests right lateral oblique slip movement along the Pomona Fault Zone.

In the Gorham Quadrangle, the Pomona Fault Zone trends west-northwest and has between 100 and 400 feet of displacement. Six oil test holes found the Beech Creek Limestone about 400 feet higher on the south side. The PFZ is mostly concealed by alluvium and the lower Pennsylvanian sandstones of Horseshoe Bluff. A fault splay that brings the Caseyville/Tradewater contact 100 feet higher to the south may occur in the PFZ between Horseshoe Bluff and Chalk Bluff. The topography near the mouth of Cedar Creek suggests that this fault strikes northwest. It is unknown if the PFZ extends into Fountain Bluff because the Pennsylvanian does not appear to be affected in this area.

Wolf Creek Fault Zone (WCFZ) (new name)
These faults appear to be contained between the RFFZ and PFZ. They trend N10°W to N30°W. The deformation is stratigraphically limited to Upper Chesterian units—the Palestine Sandstone through the Kinkaid Limestone. The Menard Limestone below and the Caseyville Formation above are both horizontal and not affected by the deformation, as verified by core hole GG#1 in Sec. 25, 10S, 3W. A traverse down Wolf Creek yields bedding that dips to the east on all of the faults, whereas, a traverse down Caney Creek yields bedding that dips to the west on all of the faults except near the mouth, where the dip reverses to the east. The Menard Limestone also occurs in Caney Creek (NW, Sec. 25, 10S, 3W) as horizontal beds within the creek and the bank.

This area has undoubtedly undergone polyphase deformation, or multiple periods of deformation under different stress fields. The cause of this faulting may be related to Pennsylvanian paleochannels but could possibly be caused by transpression between the Pomona Fault Zone and the Rattlesnake Ferry or Ste. Genevieve Fault Zone in late Mississippian-early Pennsylvanian time. Field evidence and kinematic indicators are consistent with left-lateral oblique slip (Nelson 1995). Seid et al. (2007), however, concluded that from a more regional perspective, the N-NW en echelon faulting along the Pomona Fault Zone is consistent with right-lateral oblique slip. Since fault planes are not exposed in the quadrangle, detailed structural analysis is difficult. Further study of the Wolf Creek Fault Zone is needed.

Nelson provides a sketch of the “slump blocks” of the WCFZ in the Cobden Quadrangle (Devera and Nelson 1995) to the southeast, and it was suggested that they were rotational fault blocks that slid down by gravity. The fault planes are thought to be listric and merge at a shallow detachment zone in the upper shaly part of the Menard Limestone. Nelson believed that these faults were related to the Pennsylvanian paleochannels documented by Bristol and Howard (1971).

Another hypothesis is that these are normal faults and were

produced by extension between the Pomona and Rattlesnake Ferry Fault Zones. Extension along a NE-SW trend could produce a similar feature—a basin and range style of deformation at a much smaller scale. The detachment fault would occur above the Menard Limestone within a shale bed.

In addition, small-scale growth faulting in the Pennsylvanian sandstones was documented in the adjacent Pomona Quadrangle (Seid et al. 2007), as was small-scale thrust faulting in the Wolf Lake Quadrangle (Devera 1993). These types of structural features have also been observed within the Cobden Quadrangle (Devera and Nelson 1995).

Economic Geology

Coal

Black fissile shale with powdered coaly coke is exposed in the eastern part of the quadrangle, which may correlate with the Rock Island Coal member of the lower Tradewater Formation in the Pomona Quadrangle. In Sec. 25, 9S, 3W, 2000'EL, 2000'SL, it is a 2 foot thick zone underlain by 1 inch of light gray underclay.

The Murphysboro Coal is mined in the Murphysboro Quadrangle (Jacobsen et al. 2007) to the northeast but was not found to outcrop in the study area. It is likely present in the subsurface of the northeastern quarter of the quadrangle, about 60 to 100 feet above the Rock Island Coal.

Oil and Gas

There were many oil test holes drilled in the Big Muddy River bottoms, though all were dry. The electric logs from these holes were used to map the structure of the Pomona Fault and the Rattlesnake Ferry Fault Zone in the subsurface.

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This map has not undergone the formal Illinois Geologic Quadrangle map review process. Whether or when this map will be formally reviewed and published depends on the resources and priorities of the ISGS.

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