STRUCTURAL FEATURES IN THE SYRACUSE AREA

by

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The sedimentary formations of the Syracuse area have a regional southward dip of about 40 to 50 feet per mile modified in places by small faults and subsidence structures.

Faults

A number of thrust faults with a few feet to a few tens of feet of throw are known in Onondaga County. The faults cut the Silurian and Devonian limestones and dolomites but have not been found in the Hamilton shales above. As most of these faults strike N 65 to 75 W and dip mainly southward, they probably were formed by stresses of the Appalachian orogeny.

A fault in the quarries of the Solvay Process Division of the Allied Chemical Corporation at Jamesville appears to grade eastward into a monocline on the south side of Seneca Turnpike near Sweet Road. This structure was described by Schneider (1897) who thought it to be the one mentioned by Vanuxem (1842, p. 149). In the quarry the fault dips about 35 degrees southwest and has a throw of about 16½ feet (Meaker, 1958, p. 95). The first good exposure of the monocline is in the bed of the small stream that flows northward down the hillside on the south side of Seneca Turnpike a short distance west of Sweet Road (Fillmore Corners). At the bottom of the slope the Onondaga limestone is almost vertical suggesting some fault displacement in addition to the monoclinal flexure. The monocline is exposed again about 500 feet south of Seneca Turnpike in the stream course about 1700 feet east of Fillmore Corners (Stop 1, Trip E). Here the maximum dip is less and there is no visible evidence of faulting. At both of the exposures of the monocline the Onondaga limestone is displaced vertically between 20 and 25 feet (Schneider 1897, p. 460) (Meaker, 1958, p. 97).

One of the largest faults known in the Syracuse area formerly was exposed in old quarries near the junction of LaFayette Road and Seneca Turnpike in the southeast corner of the Syracuse West quadrangle. This fault has the usual WNW strike and, according to Luther (1895, p. 293), dips south 20 degrees and displaces the Manlius and Onondaga limestone 42 feet. The fault exposed on the north side of the upper quarry at the Onondaga County Penitentiary in Jamesville, 3½ miles southwest, may be the same one. At the quarry it strikes about N 70 W, dips about 20 degrees southwest, and has a throw of about 31 feet (Meaker, 1958, p. 93).

Four small thrust faults with throws of 2 to 4 feet cut the Fiddlers Green dolomite in Fiddlers Green Gorge at Jamesville (Schneider 1905, p. 308-310) (Hopkins, 1914, p. 39, pl. 9 & 10). Harrington (1952, p. 106) found three thrust faults in the Manlius quadrangle all with strikes near N 70 W. One has a throw of about 47 feet, another 14 feet, and the third is undetermined. Several more were found by Tolley (1957, p. 139-143) in the Canastota quadrangle. One of these, with a throw of 36 feet, is a continuation of one of the faults in the Manlius quadrangle to the west. Another about 0.4 mile north of the village of Perryville in the south central part of the quadrangle strikes about N 80 W and has a throw of about 80 feet, the largest throw of any of the known faults.

Joints

Two main sets of joints, one that strikes near north-south and the other near east-west, and two minor sets that strike northeast and northwest are present in the Syracuse area (DeGroff 1954). Many joints of the north-south set are unmineralized shear joints with associated feather joints, others, particularly in the vicinity of thrust faults, contain calcite veins with dolomite and minor fluorite, quartz, and solid hydrocarbon. Most of the peridotite dikes in central New York appear to be in the fractures of this set.

Inclined joints that strike about N 70 to 75 W and dip 30 to 80 degrees either north or south are locally developed in the limestones in the Syracuse area, especially near thrust faults. Some of the inclined joints are continuous vertically for many tens of feet, others are limited to a particular bed or group of beds and end upward against a shaly parting. They are particularly well developed in the Clark Reservation limestone which has long been known as the "diamond blue" because of the polygonal diamond-shaped blocks produced by the inclined joints. The oolitic texture of this limestone may account for its brittleness and ease of fracturing. Good examples of inclined joints can be seen in the lower penitentiary quarry near Jamesville (stop 8, Trip C) and in the southern part of the road cut on Route 11 (stop 13, Trip C).

A study of the stylolites in the limestones and dolomites of the Syracuse area has shown that nearly all of the steeply inclined transverse stylolite seams strike northwest, averaging about N 74 degrees W (Dunkerley, 1950, p. 42-49). These stylolite seams have the same orientation as the east-west joints and are thought (Dunkerley, 1950, p. 50) to have originated from these joints under the directed stresses of the Appalachian orogeny.

Folds

No anticlines or synclines other than small ones associated with thrust faults and sag structures are known in the Syracuse area. Dips greater than the normal regional dip of about 50 feet per mile are common in the carbonate rocks along the plateau front, but most of these are caused by sag structures and some by thrust faults. Folds formed by the Appalachian orogeny have been mapped as far north as Cortland. (Bradley and Pepper, 1938) (Wedel, 1932, map 1). According to Wedel (1932, p. 24), the Firtree Point anticline (also known as the Portland Point anticline) dies out eastward near Cortland.

Small monoclinal folds are common on the hanging wall side of the thrust faults. These, like the faults, normally strike about N 70 degrees E in the Syracuse area. The best example of such a monoclinal fold is the one described above that borders the south side of Seneca Turnpike in the northeast corner of the Jamesville quadrangle.

Subsidence Structures

In many places along the plateau front the strata exposed on limestone and dolomite benches and in quarries have sagged down locally to form structural depressions of irregular shapes and sizes. These structures have been noted and speculations made about their origin for over a hundred years, but no comprehensive study was made of them until the work of Phillips (1955).

The sag structures are known to occur from Madison County on the east to Genesee County on the west. The evidence strongly favors their origin by local solution of bedded gypsum and subsidence of the overlying strata. Solution of salt does not seem to be important in their formation. Expansion due to hydration of anhydrite to gypsum has been suggested as the cause of structures along the plateau front but none that could be attributed to upward distension of the beds from this cause are known.

Many of these structures have been observed as far west as LeRoy in Genesee County and in every case the strata have sagged down relative to the surrounding area with no evidence of upward movements. In 1963 a small scale subsidence structure was exposed in the foundation excavation for the communications building on the Syracuse University campus. A bed of gypsum about 3 feet thick in the Syracuse formation had been dissolved near a joint causing local subsidence of the overlying strata. Examples of subsidence structures will be seen in the General Crushed Stone Company's quarry (stop 4, trip C), and in an old gypsum quarry (stop 6, trip C).

The Syracuse, Camillus, and Bertie formations of the Salina Group contain beds of gypsum, and because of this subsidence structures have been observed in carbonate rocks from the Syracuse formation up through the Onondaga limestone. The gypsum of the middle member (Forge Hollow) of the Bertie formation is said by Luther (1895, p. 267) to be 65 feet thick at the Heard gypsum quarries between Syracuse and Fayetteville (stop 6, trip C). It probably is responsible for most of the structures. Those in the Fiddlers Green dolomite member, which underlies this gypsum member, formed from solution of stratigraphically lower gypsum beds.

The subsidence structures are best developed along the plateau front and near deep valleys where there has been deep ground water circulation. Fairchild (1909, p. 13) noted that limestone benches stripped of overburden by glacial meltwaters allowed ready subsurface drainage and were especially favorable for the formation of the subsidence structures.

These structures vary considerably in size and shape. According to Phillips (1955, p. 77-78) they range from a few feet to about 25 feet in depth. The slope of their sides is largely determined by the angle of dip of the beds into them which usually ranges from a few degrees to 25 degrees. Even higher dips have been observed in a few places. Many are elongated parallel to an important joint set. As they increase in size they may develop flat floors (Phillips, 1955, p. 81). Some are large enough and deep enough to be shown by depression contours on the $7\frac{1}{2}$ minute topographic maps. A number are shown this way in the southwestern corner of the Syracuse East quadrangle, particularly on the north side of the Rock Cut cross channel where the thick gypsum member of the Bertie formation is at moderate depth.

The subsidence structures are generally considered to be post-glacial. Gilbert (1891, p. 231) and Fairchild (1909, p. 13) were of this opinion and Phillips (1955, p. 93-95) reached the same conclusion. They would not have been preserved as the present topographic features if they had been overridden by glacial ice. Post-glacial origin is illustrated by a subsidence structure at the southeast end of the small drumlin at Syracuse University's SkyTop in the southwestern corner of the Syracuse East quadrangle. Part of this structure is under the edge of the drumlin and some of the side of the drumlin has slumped into it.

Unconformities

Smith (1929, p. 32) recognized unconformities in the Syracuse area below the Bishop Brook limestone, the Oriskany sandstone, and the Onondaga limestone. The Bishop Brook limestone, considered to correlate with the Coeymans limestone farther east (Rickard, 1962, p. 78), is known only on the hill northeast of the village of Manlius. The small disconformity at its base also is known only in this area (Smith 1929, p. 32).

The pre-Onondaga erosion that followed the deposition of the Oriskany sandstone apparently removed or reworked most of this sandstone, and with it the pre-Oriskany unconformity. This has complicated evaluation of the relative importance of these erosion intervals. In the eastern part of the state these unconformities are absent and, according to Oliver, (1954, p. 625) are only slightly developed as far west as the Richfield Springs quadrangle. West of this quadrangle the unconformities become more important and the Onondaga overlies successively lower formations. Oliver (1954, p. 625) is of the opinion that the multiple unconformity represents considerable time, but that most of the erosion is pre-Oriskany as "pre-Onondaga erosion involved only the partial removal and reworking of the Oriskany sandstone".

Smith (1929, Fig. 14) has shown that this multiple unconformity at the base of the Onondaga limestone in the Syracuse area ranges in stratigraphic position from the top of the Bishop Brook limestone near Manlius east of Syracuse to the top of the Olney limestone in the central part of the Split Rock quarries about 3 miles west of Syracuse. West of the Split Rock quarries the unconformity rises again so that in the vicinity of Skaneateles Falls it is near the top of the Jamesville limestone. Still farther west it descends gradually to the top of the Cobleskill a few miles west of Auburn. The pre-Onondaga disconformity will be seen at several of the stops of trip C. Cooper (1935, p. 787) has reported a disconformity at the base of the Tully limestone. Evidence for this is based on the disappearance of faunal zones westward.

Uneven contacts and a few inches of pebble conglomerate indicate the presence of widespread diastems at the top of the Vernon shale (Leutze, 1955, p. 59), at the top of Elmwood B (Fernalld, 1953, pl. 80), and at the top of Elmwood C (Johns, 1953, pl. IIIA and B). Evidence also has been found for the presence of a diastem at the top of the widespread dolomite bed in the lower part of the Thacher limestone.

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