The Suffield Fault, Stark County, Ohio

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INTRODUCTION

Studies of basement tectonics define a major fault zone in the continental plate near latitude 40°N extending from the Early Mesozoic Gettysburg basin in Pennsylvania westward into Ohio (Root and Hoskins 1977). It is mapped as a series of large, subvertical east-west trending faults in the Blue Ridge, Great Valley, and Valley and Ridge. Westward on the Appalachian Plateau it is recognized from subsurface mapping and geophysical studies. This feature, the Transylvania fault, is believed to have originated in the Precambrian and to have reactivated during the Middle Ordovician Taconic orogeny, to a major degree during the terminal Paleozoic Alleghanian orogeny (Root and Hoskins 1977), and to a lesser degree during Early Jurassic faulting of the Atlantic Cycle rift basins (Root 1985).

The Transylvania fault zone has been extended across Ohio by Gray (1982). Structure contour maps on top of the Mississippian Berea and Devonian Onondaga Formations and unpublished maps on the Silurian Packer Shell (Gray 1982) define five, high-angle faults that extend northward from East Liverpool, Columbiana County, to Berea, Cuyahoga County (Fig. 1). At the level of the Onondaga, maximum vertical displacement across the Akron-Suffield faults is 60 m (200 ft) and across the Highlandtown fault is 72 m (240 ft), with the northeast blocks upthrown (Gray 1982). Although the structures are well defined by subsurface structural mapping, they are only moderately manifested on the aeromagnetic maps of Ohio (Hildenbrand and Kucks 1984).

This study maps the eastern half of the Suffield fault zone by detailed magnetic investigation and examines the Paleozoic stratigraphic sequence for indications of recurrent movement during deposition.

MAGNETIC INVESTIGATIONS

Traverses were made across the region of the Suffield fault, as defined by Gray (1982), with a portable E. G. & G. Geometrics Memory-Mag Proton Precession magnetometer. Stations were located every 30 m (100 ft) along north-south lines, supplemented by reconnaissance stations, where required for coverage. Data were reduced for diurnal variation. An area of 64.7 km² (25 mi²) was covered with 325 stations (MacWilliams 1985).

In Ohio the Paleozoic strata are generally magnetically transparent. A few red bed units may have significant magnetic susceptibility but, because of the small area studied, any facies changes are considered negligible. Therefore, associated magnetic variations will be minimal and their contribution to the total magnetic field, both vertically and laterally, will be negligible. Any magnetic anomalies are, therefore, ascribed to Precambrian igneous basement properties. Again, because of the small area, corrections for datum and the geomagnetic reference field are not critical. For this study only the total magnetic field intensity was mapped.

A map of the total magnetic field at a 10-gamma contour interval (Fig. 2) shows patterns that are interpreted as the result of displacement in the basement. The Suffield fault mapped by Gray (1982) is located astride a steep magnetic gradient which is a common magnetic signature of faults. South of the fault the trend of magnetic contours is WNW-ESE and generalized maximum values are about 56,380 gammas. On the upthrown block, north of the fault, the trend of magnetic contours is N-S, with a second trend E-W, and generalized maximum values are about 56,430 gammas. These values
Position of the fault on top of basement from the magnetic map is best defined in the eastern part of the area where it occurs about 300 m (1,000 ft) south of the trace of the fault on the Onondaga as mapped by Gray (1982). Elevation difference between the Onondaga (Gray 1982) and generalized basement (Summerson 1962) is about 1,950 m (6,500 ft) indicating a fault dipping south more than 80°. Displacement sense of the fault is uncertain. Typically, subvertical faults are associated with lateral motion. Geometry of the Akron-Suffield-Smithtownship faults suggests that they originated as en echelon synthetic faults produced by right-lateral wrenching. Inferred displacement, from anomaly offsets on the map of Popenoe et al. (1964), is arguably a minimum of 21 km (13 mi). This displacement would have occurred early in the development of the fault. Subsequent movements of the fault, however, may involve normal faulting of small displacement rather than wrench tectonics.

**RECURRENT FAULTING**

Where first recognized in Pennsylvania, the Transylvania fault zone has a history of reactivation during the Ordovician, Permo-Pennsylvanian, and Jurassic (Root and Hoskins 1977, Root 1985). In the study area, it is impossible to recognize post-Permo-Pennsylvanian faulting because the youngest bedrock in the area is Lower Pennsylvanian. From regional relations it is clear that much of the displacement shown on the Silurian and younger horizons (Gray 1982) occurred during terminal Paleozoic Alleghenian deformation. However, small displacement increments may be attributable to syndepositional movement. Abundant oil and gas well data are available that may be used to determine recurrent fault activity from formational thickness variations restricted to an area where the fault is now recognized. Geophysical logs start at the top of the Berea, the first potential producing unit, and terminate at the base of the Medina, the deepest producer. Hence, information is available for all the Silurian and Devonian, and Lower Mississippian strata.

Isopach maps were prepared for seven key driller's units, spanning this time interval. These units are shown from oldest to youngest in Figure 3. The isopach map of the Lower Silurian Clinton/Medina sequence (Fig. 3a) shows a NE-SW thickening, probably an offshore bar, extending without interruption across the site of the Suffield fault. The isopach of the Middle Silurian Packer Shell, shows narrow zones of thickness variation extending across the fault (Fig. 3b). The Middle Silurian Casing Shell is a thin unit (4.5-6.0 m) showing a distribution similar to the Packer Shell and is not illustrated. The overlying Middle Silurian Rochester Shale shows a subtle northwest thinning and contours trend uniformly across the fault (Fig. 3c). The very thick Upper Devonian Ohio Shale, which is mapped here to include shales from below the Berea to the top of the Onondaga, shows constant westward thinning, with contours passing uniformly across the site of the Suffield fault (Fig. 3e). The Lower Mississippian, second Berea sandstone, defines a N-S trending thin area passing across the fault site (Fig. 3f). In aggregate, these units demonstrate that their distribution was not noticeably influenced by syndepositional movement of the Suffield fault. Therefore, during much

![Figure 2. Total magnetic intensity map of Limaville area (designated by "L"). Contour interval 10 gammas. Solid line is position of Suffield fault at level of the Onondaga, mapped by Gray (1982). Dotted line is position of fault on top of basement as inferred from magnetic values.](image-url)
Evidence of syndepositional activity on the Suffield fault has an extended deformational history throughout the Paleozoic. Both geologic and geophysical data must be used for full understanding of such features.

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LITERATURE CITED