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# THE GENEVA (MIDDLE DEVONIAN) DOLOMITE IN ILLINOIS

by  
Howard R. Schwalb


DIVISION OF THE  
ILLINOIS STATE GEOLOGICAL SURVEY  
JOHN C. FRYE, *Chief* URBANA

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## ABSTRACT

The Geneva dolomite extends from its type outcrop in Indiana westward into south-central Illinois. In tracing the correlation of Indiana and Illinois Devonian outcrop sequences, the Geneva's brown color and organic content make it an important marker bed. Therefore, its areal distribution, thickness, lithologic characteristics, and relation to surrounding sediments in Illinois were determined and are shown by cross-section diagrams and isopach maps. Samples and electric logs from about 100 wells in seventeen counties were studied.

The Geneva is a dark-brown porous sucrose dolomite occurring at the base of the Middle Devonian sequence in the south-central Indiana outcrop belt. In Illinois it does not crop out but occurs in subsurface in a belt extending westward across the south-central part of the state (fig. 1). As it is easily distinguished by its color and organic content, it is an important marker bed in a thick sequence of Silurian and Devonian dolomites that are difficult to differentiate. Much of the Devonian oil production in Illinois and Indiana is from the Geneva dolomite. The present study is an attempt to find how far the Geneva can be traced within Illinois for the purpose of correlating the outcrop sequence of southern Indiana with that of southwestern Illinois - a major stratigraphic problem. The report is based upon microscopic examination of drill samples and core chips and upon electric logs.

The help of Illinois Geological Survey colleagues D. H. Swann and H. B. Willman, who offered assistance and encouragement in this study, and W. F. Meents, who supplied information and cores, is gratefully acknowledged.

Middle Devonian formations are exposed in southwestern Illinois. In descending order, these are Lingle limestone, Grand Tower limestone, Dutch Creek sandstone, and Clear Creek chert. Beneath these formations are the Backbone limestone and Bailey limestone of Early Devonian age. In the subsurface to the north and east of the outcrop area, the Clear Creek and much of the Grand Tower formations grade to dolomite. Farther north the Clear Creek and the Lower Devonian formations are absent, and dolomite equivalent to the Grand Tower rests on Silurian dolomite. The Geneva formation is correlated with the lower part of the Middle Devonian dolomite and therefore with the lower part of the Grand Tower limestone of southwestern Illinois.

The Geneva dolomite in subsurface in Illinois, as in its type outcrops in Indiana, is brown to very dark brown. The color generally darkens toward the

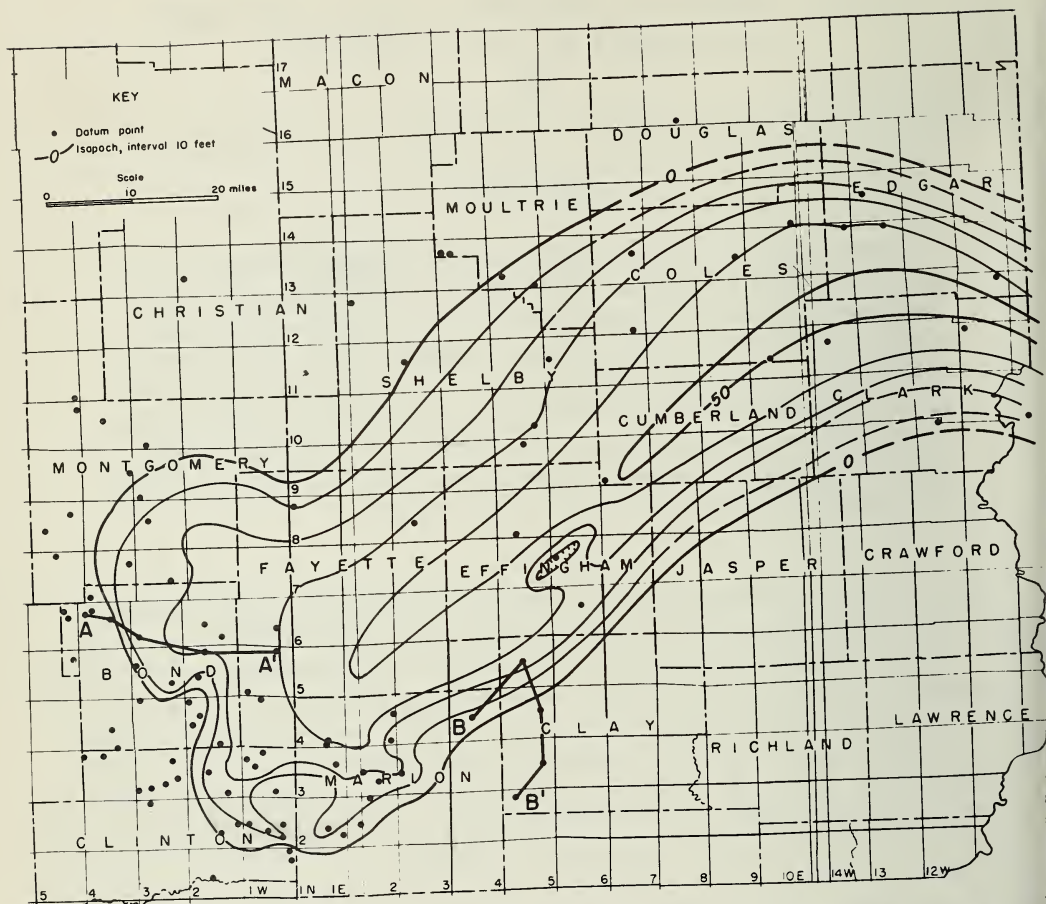


Fig. 1. - Isopach map showing occurrence of Geneva dolomite in south-central Illinois.

bottom of the formation, though in some areas, as noted by Bieberman (1949), the reverse is true. The color of the Geneva is caused by a minute quantity of disseminated organic material. When the dolomite is dissolved in dilute hydrochloric acid, the brown organic residue accumulates on the surface of the acid. This test distinguishes the Geneva from other Devonian and Silurian dolomite in Illinois. Differential thermal analyses of the dolomite show an exothermic peak between 400 and 500° C.,\* which probably is caused by oxidation of the organic material. Where lighter-colored dolomites lie above the Geneva and are locally oil-stained, they are difficult to distinguish from the Geneva except by residues. The distinctive flaky organic residue of the Geneva is easily recognized, even in the presence of a film of oil.

The texture of the Geneva dolomite is granular or sucrose, and the bulk of the rock is composed of uniform dolomite rhombohedrons. Analyses of cores from various areas suggest that the Geneva porosity ranges between 10 and 20 percent, averaging about 17 percent. This is the general porosity range suggested.

\*Analysis by Herbert D. Glass, Illinois State Geological Survey.

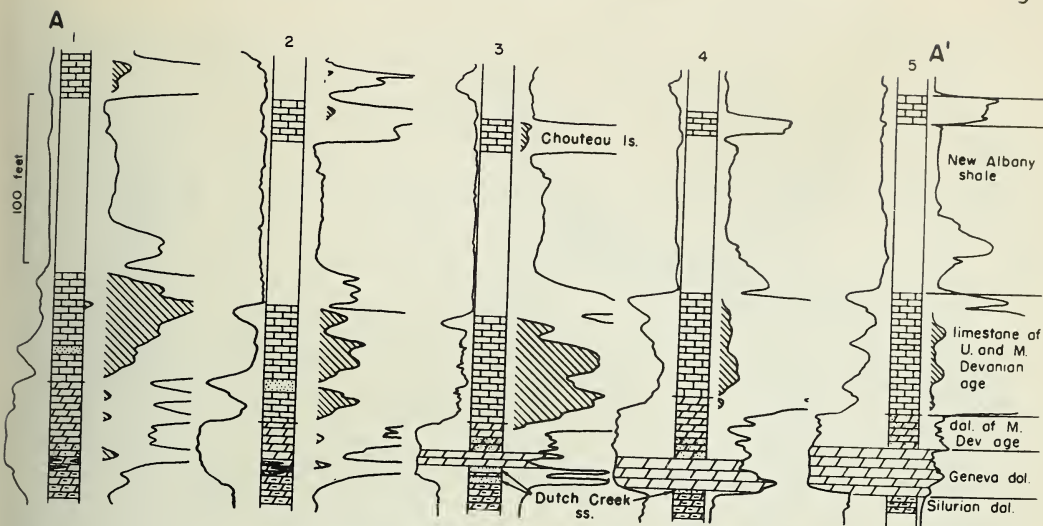


Fig. 2. - Electric log and lithologic cross section showing Geneva dolomite in five wells.

gested also by resistivity data. The intergranular porosity is quite high. In addition, many samples of the dolomite are vesicular. The cavities are lined with larger dolomite rhombohedrons and here and there contain small quartz crystals. The grain size is very fine to fine. The Geneva dolomite commonly is slightly coarser than the overlying lighter-colored dolomites. Bedding is not obvious in the sample or core sections examined, but stylolite partings are not uncommon.

In some localities the Geneva is arenaceous; the sand is rounded and frosted and generally is dispersed in the matrix as floating grains. The sand tends to be bimodal; it is mostly in the fine-sand range, but many samples contain a few coarse grains and very few medium grains. Chert very rarely is found in the Geneva, but where present it is light brown to tan, opaque, and has a waxy luster. Most of the Geneva dolomite is of high purity and the trace of organic material is the only insoluble residue.

The Geneva appears unfossiliferous. However, many of the vesicular cavities seem to be very crude molds of fossils or fossil debris. Scolecodonts are moderately abundant. Foraminifera are extremely rare in the sparse insoluble residues. Chitinozoa occur in some Indiana samples but have not been noted in Illinois samples.

The type locality of the formation (Collett, 1882) is at Geneva in southeastern Shelby County, Ind., near the northern end of the Devonian outcrop belt of south-central Indiana about 95 miles north of Louisville, Ky. At the type locality, the Geneva unconformably overlies the Silurian, but its relations to the Jeffersonville formation, which overlies it a little farther south, are obscure (Dawson, 1941, p. 21-29; Sutton and Sutton, 1937, p. 326-328). The Geneva outcrop extends southward beneath the Jeffersonville to a point about 25 miles northeast of Louisville. The Geneva is not present south of this point, and the Jeffersonville formation lies directly on the Silurian at the outcrop. In subsurface, the Geneva occurs in an arcuate belt which curves northwest from the outcrop to



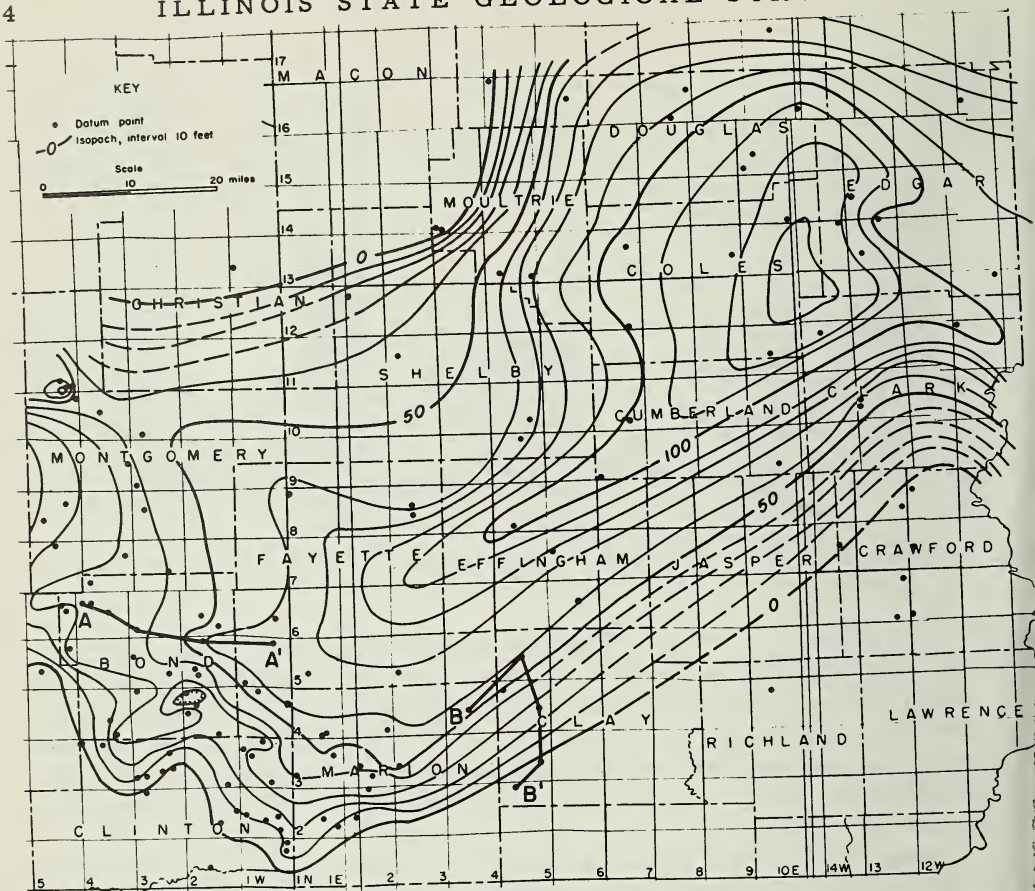


Fig. 3. - Isopach map showing thickness of post-Dutch Creek Devonian dolomites.

west-central Indiana (Bieberman, 1949). It enters Illinois in Clark and Edgar counties (fig. 1), bends to the southwest, and extends as far as Montgomery, Bond, and Clinton counties. The maximum observed thickness of the Geneva in Illinois is 50 feet.

A rather persistent sandstone zone is at the base of the Geneva dolomite and is included with the dolomite on the thickness map. The sandstone varies from less than an inch to several feet thick. The sand differs in its uniform size, angularity, and lack of frosting from the floating sand grains in the Geneva. It is uniformly fine, subrounded to angular, white to brown, and much is quartzitic. In some well cuttings the sandstone is intermixed with the base of the Geneva dolomite. In one drill core this sandstone was found two feet above the base of the Geneva dolomite. The sandstone extends beyond the limits of the Geneva to the west and south and appears to be equivalent to the Dutch Creek sandstone of the southwestern Illinois outcrop area.

The Geneva dolomite thins toward the west, as shown in cross section A-A' (fig. 2). In well 2 of this cross section, traces of Geneva dolomite interfinger with light-colored dolomite like that overlying the Geneva farther east, and the Geneva can no longer be distinguished as a formation. However, the



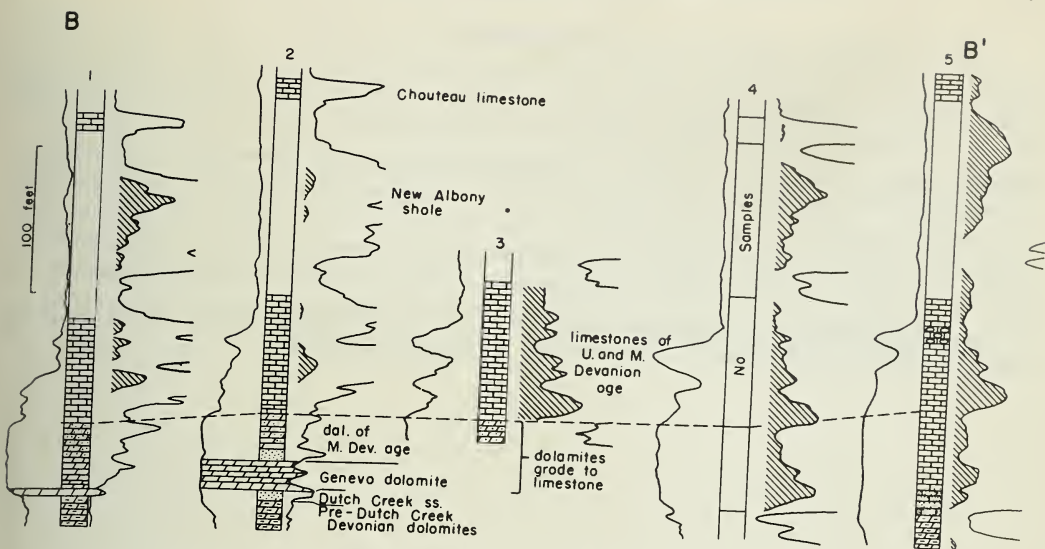


Fig. 4. - Electric log and lithologic cross section of five wells showing gradation of Geneva dolomite to limestone.

Dutch Creek sandstone is interbedded with the basal few feet of dolomite and extends into well 1 where the Geneva has graded completely into the light-colored dolomite. In the area around the western end of the cross section, the Dutch Creek sandstone is an oil-producing formation.

Above the Geneva is a variable sequence of dolomites. These upper dolomites are gray, yellow, or brown and lack the organic residue typical of the Geneva. They range from almost lithographic to finely granular, and in general are finer grained than the Geneva. Variable quantities of sand are found in the upper dolomites scattered as individual grains and in sandstone lenses. This sand is rounded, frosted, fine to coarse, and resembles, both in sorting and grain size, St. Peter sand or the floating grains in all but the basal part of the Geneva. As the Geneva dolomite thins, it grades laterally into the light-colored dolomite and becomes indistinguishable from it. The maximum thickness of the post-Dutch Creek Devonian dolomites, including the Geneva dolomite, is 130 feet (fig. 3); the thickest portions correspond to the areas of maximum thickness of the Geneva. The upper dolomites in Illinois cover and extend laterally beyond the limits of the Geneva. In a small area in southern Bond County, the strata overlying the Geneva are limestone rather than dolomite.

Cross section B-B' (fig. 4) shows the dolomite section above the Dutch Creek sandstone grading southward into the limestone. In well 3 only the top of the dolomite section was penetrated. In well 4 sample cuttings were not available for study, but the dolomite sequence is shown by the electric log, which also indicates by the increased resistivity the greatly decreased porosity of the dolomite. In the southernmost well the dolomite has graded completely to limestone correlated with the Grand Tower. Dutch Creek sandstone is present at the base of the section.

In two Illinois wells studied, in Cumberland and Bond counties, the basal portion of the Geneva has no trace of organic material and is pale yellow or buff. In both places the Dutch Creek sandstone identifies the base of the Grand Tower or Geneva equivalents, but in areas beyond the northern limits of the Geneva where the Dutch Creek is missing, the Devonian dolomite is difficult to distinguish from the underlying Silurian dolomite. Some of the features that are locally useful in identifying the Devonian dolomites in microscopic examination of well cuttings are: the presence of sand in the Devonian dolomites and its absence in the Silurian in this region; the occurrence of glauconite or chert in the Silurian dolomites, both rare in the Devonian; and the generally coarser texture and lighter color of the Silurian dolomites.

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