

Statewide Geologic Maps of Indiana¹

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Abstract

The first geologic map to cover the territory that now is the State of Indiana was at a very small scale, about an inch to 100 miles. This map shows the state as a single geologic unit: Secondary, or, in present terminology, late Paleozoic. Mapping through the subsequent 150 years has, of course, been of increasing detail, so that, in the current set of Regional Geologic Maps, eight sheets cover the state (and parts of adjacent states) on a scale of one-quarter inch to the mile. On these maps, 18 separate bedrock units (all Paleozoic in age) and 23 different units of unconsolidated materials (mostly Pleistocene in age) are recognized.

In future statewide mapping, further refinements in detail and changes in classification and nomenclature are likely; it seems, however, that limitations of size and scale virtually preclude printing statewide maps of significantly greater complexity.

In August 1972, the Indiana Geological Survey displayed, at the International Geological Congress in Montreal, a series of Regional Geologic Maps that covers the state at a scale of 1:250,000 and that shows both bedrock geology and unconsolidated deposits. We wish here to describe the most significant milestones in the 150 years of geologic mapping in Indiana that form a background for this most recent statewide mapping.

Indiana geology was first depicted in published form early in the 19th century by regional maps that covered all or most of the present United States. One of the first of these, in 1809, was a map by William Maclure (18) that showed all of Indiana as "Secondary" rocks. Several later versions of this map were printed. The most widely known (19) appeared in the *Transactions of the American Philosophical Society* in 1818. It was copied by many compilers, who, unlike Maclure, did no original work.

The first geologic map of Indiana alone was made in 1838 by David Dale Owen (23), but was never published. Owen's report (24), in describing this map, lists map units called the Coal formation, Sub-carboniferous limestone, Knob-freestone, Black bituminous shale, Coral limestone, Magnesian limestones, and Blue limestone. These units are approximate equivalents of the present Pennsylvanian System, upper Valmeyeran-plus Chesterian Series, Kinderhookian-plus-lower Valmeyeran Series, New Albany Shale, Devonian limestones, Silurian System, and the exposed part of the Ordovician System.

In 1843, James Hall's "Geological map of the middle and western states" (7) included Indiana and showed approximately the same number of units, but with a somewhat different scheme of classification that followed closely Hall's New York usage. Hall was present when Owen, in 1843, delivered a paper "On the geology of the western

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states" (25), and his mapping of the Midwest has on occasion been termed an uncredited copy of Owen's work, but it differs in significant details. For example, it showed a clear conception of the Michigan Basin.

Lyell's "Travels in North America," published in 1845, includes an excellent geologic map of the United States and Canada (17) which lists Owen among "the principal authorities." Lyell was quite familiar with Owen's work, and in 1842 he read a paper of Owen's to the Geological Society of London. In 1846, these two men, well acquainted through correspondence, met when Lyell visited Owen in New Harmony.

Owen's paper "On the geology of the western states of North America," which included a "Geological chart of the Ohio Valley" (26), finally was published in 1846. It was among a group of "postponed papers" and was issued "in order satisfactorily to establish the claim of Doctor Owen to be considered the original discoverer of many important points in the geology of the north-western states of North America." The units shown for Indiana are essentially those of the unpublished 1838 Owen map (23). Owen showed the upper boundary of the present Ordovician System, presumably before the beginning of the Sedgwick-Murchison controversy, and 40 years before the naming of the Ordovician.

In the 1850's, compilations showing the geology of the entire United States began to appear. Edward Hitchcock, in 1853, published "A geological map of the United States and Canada" (8) that showed, for Indiana, the Coal Measures, Carboniferous Limestone, Old Red Sandstone, Upper Silurian System, and Lower Silurian. The distribution of these units roughly followed Owen's mapping. Hitchcock's map was crude, however, especially by comparison with the two that follow.

In 1855, Jules Marcou issued his "Carte géologique des Etats-Unis et des Provinces Anglaises de l'Amerique du Nord" (21), which was the first mapping of Indiana printed in color, although most of those mentioned earlier had been hand-colored. The bedrock units, under French names, are essentially Owen's. Marcou showed, by a dashed line, the "Limite méridionale du terrain erratique du nord," the first recognition of a glacial boundary.

Also in 1855, H. D. Rogers compiled a "Geological map of the United States and British North America" (28). The six mapped units were Paleozoic systems, under a set of names peculiar to Rogers' work. He too used Owen's contacts in the Ohio Valley area; Owen was specifically mentioned in the long list of references. Rogers' map was undoubtedly the finest of its period, both cartographically and geologically. It compares favorably with maps that are 30 to 40 years younger.

The first published geologic map of Indiana alone (29) appeared in 1865 and was one of a series compiled by Nelson Saylor for various middle-western states. The units, under different names, were approximately those of Owen, and the map could have been compiled

from any two or three earlier ones. It showed glacial materials, called "Post-Tertiary and Modern Diluvium and Alluvium" in the northern quarter of the state. The hand-colored map was crude, however, and Sayler, a geologic unknown, apparently must be considered a "commercial" compiler.

In 1880, John Collett (2) prepared the first geologic map of the entire state that was published by the State. This was a page-size map that was reprinted with little change in three successive annual reports. Only five geologic units were shown. On the later maps, the Silurian-Devonian boundary across northern Indiana was scratched off, and the words "Drift surface" were added in the northernmost part of the state.

The first colored geologic map of Indiana published by the State was John Collett's 1883 map (3) in the 13th annual report of the Indiana Department of Geology and Natural History. Printed at a scale of 9 miles to the inch, it was a distinct improvement on any earlier effort, as it subdivided the Pennsylvanian System into three units and showed closer accord with topography than its predecessors. It was lithographed in color that did not fit the black boundary lines in places, the discrepancies being not a matter of register, but correction of the color plates without correction of the boundaries on the base. In the 14th annual report, for 1884, a similar map (4), marked "Revised and corrected," adjusted these differences and added accuracy and detail to the present Ordovician-Silurian boundary at places in southeastern Indiana.

The 11th report of the United States Geological Survey, in 1890, contained a small geologic map of Indiana by A. J. Phinney (27), designed as a geologic base on which to locate gas and oil fields. Phinney said that the map was "essentially the same" as Collett's (3, 4), but the differences are significant and include subdivision of the Devonian rocks beneath the New Albany Shale into two units, and subdivision of the present Silurian System into three units.

The 17th annual report of the Indiana Department of Geology and Natural Resources (for 1891) carried a map under Gorby's name entitled "Geological map of Indiana showing location of stone quarries and natural gas and oil areas" (5). The geology was significantly altered from Collett's version, and in general it was less accurate. Mineral resource locations were shown by overprint. The 18th annual report (for 1893) included a virtually identical map (6). Both these maps recognized, by omitting the color for bedrock units, the deeply drift-covered area of northern Indiana.

A small-scale map of Indiana was prepared in 1886 by J. C. Branner (1), apparently in conformity with a classification and coloring scheme devised by an International Geological Congress. No doubt Branner's map was intended as a part of some larger compilation—which map, however, we have not yet located. An enigmatic letter in French accompanied the Branner map, explaining the difficulties in applying the international scheme to Indiana geology. This rare and elusive item remains somewhat of a mystery.

In 1894, a map of the United States by W. J. McGee (22) gave simple but good coverage in Indiana and showed the extent of Pleistocene materials by overprint. Subsequent excellent geologic maps of the entire United States are numerous and will not be tabulated here.

Hopkins' "Geological map of Indiana" (9) in the 28th annual report (for 1903) of the Indiana Department of Geology and Natural Resources was a milestone in Indiana mapping. It showed more units than any previous effort and showed them more accurately. Subsurface information was not extensive in most localities, and therefore the detail and accuracy were much better in southern Indiana than in the region of Wisconsinan drift. Northernmost Indiana was left blank for lack of information.

Another large wall map of Indiana geology was issued in 1932, under W. N. Logan (16). It further subdivided the Pennsylvanian System, omitted the Chesterian Series as a map unit, and added the outer glacial boundary. It also carried bedrock patterns to the northern limits of the state. Neither cartographically nor geologically, however, did this map mark a significant advance over Hopkins' map of 1903 (9).

The Indiana Geological Survey Atlas Map No. 9, of 1956 (10), was at 1:1,000,000 scale but managed to show more detail than the earlier maps at 1:250,000 scale. Advancements included subdivision of the Chesterian Series into three units and separate mapping of the upper Valmeyeran rocks. This is the currently definitive one-sheet map of bedrock geology in Indiana.

We turn now from mapping of bedrock to glacial geology. Toward the end of the 19th century, T. C. Chamberlain developed a concept of classification of glacial deposits in which multiple glaciation is a fundamental factor. As glacial studies progressed, greater detail in the recognition of moraines was paralleled by a more accurate representation of the outermost glacial boundary through the work of G. F. Wright, and in 1897 these studies were summarized on a map, "The Pleistocene deposits of Ohio and Indiana," by Leverett (12). Although generally accurate in its geologic representation, and cartographically good, this map omitted glacial lake areas in southern Indiana, and a vast area of extinct lake was erroneously shown in northwestern Indiana.

As is traditional in the mapping of glacial deposits, the classification was a hybrid of topography, materials, and age. Further work by Leverett in Illinois (13) and Ohio (14) and adjacent parts of Indiana further refined his understanding of the stratigraphic and morphologic succession, and led to a study in which the Pleistocene of Indiana was mapped and discussed with a detail and accuracy that was unsurpassed for many years. On a scale of 1:1,000,000, this map (15) showed no fewer than 17 distinct subdivisions of the Pleistocene deposits.

The first effort of the State in this field was a small black-and-white map by Malott (20). For the most part, however, this was compiled from

Leverett's earlier mapping and it offered nothing new. Wayne's 1958 map, "Glacial geology of Indiana" (30), was somewhat refined in detail over earlier mapping and is today considered the definitive single-sheet map of glacial deposits in Indiana, but mainly it was a generally crisper cartography that set it apart from earlier mapping. A page-size map on which true stratigraphic nomenclature was first applied to Indiana's Pleistocene deposits was presented in a later publication by Wayne (31).

In 1958, the Indiana Geological Survey launched a mapping effort, cooperatively with other State Geological Surveys, that resulted in the eight sheets covering Indiana and parts of adjacent states, at a scale of 1:250,000 or one-quarter inch to the mile, in their Regional Geologic Map Series of 1° by 2° quadrangles. These maps, which were published from 1961 to 1972, showed bedrock in gray patterns and unconsolidated materials in color on the same sheet as a composite. For the latter seven of the sheets, versions are available that show bedrock and unconsolidated materials separately. As a by-product of the series, a page-size colored "Map of Indiana showing bedrock geology" was issued in 1970 (11).

Although the completion of this series marks another milestone in the history of geologic mapping in Indiana, it is not, of course, an end. Significant changes in classification, particularly among the Pleistocene deposits, are likely in future years, and refinement in detail, especially where dependent on subsurface control, is to be expected. The eight regional geologic sheets joined, however, make a genuinely wall-size map, and it is apparent that the combination of scale and size practically preclude printing of a statewide map done with significantly greater complexity. For the future, more detailed mapping on larger scales and of smaller areas, a logical development from the Regional Geologic Maps, appears to offer promise.

List of the Regional Geologic Maps

- (unnumbered) Geologic map of the Indianapolis 1° by 2° Quadrangle, Indiana and Illinois, showing bedrock and unconsolidated deposits. By C. E. WIER and H. H. GRAY, 1961.
- No. 2. Geologic map of the 1° by 2° Danville Quadrangle, Indiana and Illinois, showing bedrock and unconsolidated deposits. By W. J. WAYNE, G. H. JOHNSON, and S. J. KELLER, 1966.
- No. 3. Geologic map of the 1° by 2° Vincennes Quadrangle and parts of adjoining quadrangles, Indiana and Illinois, showing bedrock and unconsolidated deposits. By H. H. GRAY, W. J. WAYNE, and C. E. WIER, 1970.
- No. 4. Geologic map of the 1° by 2° Chicago Quadrangle, Indiana, Illinois, and Michigan, showing bedrock and unconsolidated deposits. By A. F. SCHNEIDER and S. J. KELLER, 1970.
- No. 5. Geologic map of the 1° by 2° Muncie Quadrangle, Indiana and Ohio, showing bedrock and unconsolidated deposits. By A. M. BURGER, J. L. FORSYTH, R. S. NICOLL, and W. J. WAYNE, 1971.
- No. 6. Geologic map of the 1° by 2° Louisville Quadrangle, Indiana, showing bedrock and unconsolidated deposits. By H. H. GRAY, 1972.

- No. 7. Geologic map of the 1° by 2° Cincinnati Quadrangle, Indiana and Ohio, showing bedrock and unconsolidated deposits. By H. H. GRAY, J. L. FORSYTH, A. F. SCHNEIDER, and A. M. GOODING, 1972.
- No. 8. Geologic map of the 1° by 2° Fort Wayne Quadrangle, Indiana, Michigan, and Ohio, showing bedrock and unconsolidated deposits. By G. H. JOHNSON and S. J. KELLER, 1972.

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