Stratigraphic Lexicon for Michigan

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Bulletin 8

Lansing, Michigan, 2001

Geological Survey Division

and the

Michigan Basin Geological Society

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On the Internet @ HTTP://WWW.DEQ.STATE.MI.US/GSD

Printed by Authority of Act 451, PA 1994 as amended
Total number of copies printed 1,000
Total cost: $2,500.00
Cost per copy: $2.50

DEDICATION

The authors gratefully dedicate this volume to the memories of Helen M. Martin and Muriel Tara Straight. This volume would not have been possible without their monumental reference work Bulletin 50, An Index of Michigan Geology published by the Michigan Geological Survey in 1956. All geologists who have worked and toiled with Michigan's stratigraphy recognize the outstanding work they bequeathed to their colleagues. They have provided us a legacy that still stands today.

Helen M. Martin

Helen Melville Martin

Muriel Tara Straight

Muriel Tara Straight

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INTRODUCTION

Acknowledgments

This volume is the result of the efforts and interest of a great many people, all of whom were volunteers. Some of them were members of the project founding committee (Table 1). Others assisted that committee in compiling stratigraphic units for the text; still others performed the tedious, but necessary review of the first rough draft of the document (Table 2). We have listed all of those below, some of whom assisted in those tasks and more. We hope that we have not omitted anyone whose name should appear.

To all of those men and women we owe our thanks, many times over, for without that assistance this tome would not have been written. In addition, we are very grateful to the Michigan Basin Geological Society for sponsoring this project, and to the Michigan Geological Survey for publishing it and the newly revised stratigraphic chart which accompanies it. The authors alone are responsible for any of the errors that are present.

Project History

The last comprehensive compilation of stratigraphic terms published for the Michigan Basin was by Martin and Straight (1956). A short supplement to their bibliography was produced by Kirkby (1961) which was then followed by the influential Stratigraphic Succession in Michigan, Chart 1, published by the Michigan Geological Survey (1964). Essentially, the extensive drilling for hydrocarbons in the basin over the coming years utilized the terminology provided on Chart 1. Subsequently, Lilienthal (1978) published a significant stratigraphic cross-sectional study of the basin's stratigraphy that has proven to be most useful. Both formal and informal new terminology was also introduced during this period, some of which appears on the American Association of Petroleum Geologists COSUNA chart (Shaver and others, 1985). Because of the time span that had elapsed, a group of geologists formed a committee in 1990 (Table 1) whose main purpose was to compile the stratigraphic terms most commonly in use, as well as to provide an update to the previously published work. We stress that is was not the intent of the committee to bring the existing terminology up to the standards demanded by the North American Stratigraphic Code (1983). As desirable as that was (and is), it was clearly recognized that task lay beyond the scope of the committee. It was, however, the intent of the committee to produce a work that would be the first step towards eventually achieving that result when used by stratigraphic scholars during the twenty-first century.

Don Bailey	Tim Mannes
Scott Bellinger	Murray Matson
Mike Bricker	Mark Nida
Paul Catacosinos	Bob Reynolds
Rob Chapman	Bill Strickler
John Esch	Dave Westjohn
George Gallup	Steve Wilson
Bill Harrison	Mark Wollensak
Katherine Manger	

Table 1. The list of those who served on the Stratigraphic Nomenclature Project Committee.

Bruce Arndt	Kevin Kincare
Diane Baclawski	Glenn Larsen
Mark Baranoski	Lance Lindwall
Patrick Brennan	Jim McDonald
Mike Bricker	Jimmy Myles
Terry Carter	Greg Nadon
Aureal Cross	Dan Pfeiffer
Bob Dott	Ron Riley
Ron Elowski	James Skipper
John Esch	Eric Taylor
Bill Everham	Ray Vugrinovich
Nancy Hasenmueler	Larry Wickstrom
Dennis Hull	Steve Wilson
Brian Keith	

Table 2. The list of volunteers who reviewed the Lexicon text, the new columnar column or both.

This volume is not a complete compilation of all terms that have been used in the Michigan Basin. Future workers requiring that information should use this volume along with Martin and Straight (1956), Kirkby (1961), Lilienthal (1978) and Wilmarth (1938) and all other stratigraphic correlation charts subsequently available. The

new chart that accompanies this Lexicon was produced using information from Compton (1962), Ostrom (1967) and Swanson (1985).

The color for the chart was based on the AAPG color standard for lithologic units and modified to provide the best presentation.

Structure of the Lexicon

The Lexicon has been designed to aid both present and future workers with an interest in Michigan stratigraphy. Entries that are in **bold face** in the Stratigraphy section indicate inclusion on the new stratigraphic chart, Stratigraphic Nomenclature for Michigan, that accompanies this work. The many Archean and mid-Proterozoic age rocks of the western Northern Peninsula are not included in the Lexicon; an excellent reference for the geology of those units, however, may be found in Reed (1991).

There are two types of stratigraphic entries. Those providing the most information include the unit's Name and Age, Related terms, Lithology (giving both thickness in feet and metric units and its distribution), Type locality (including Author and Date), Additional references (those deemed most significant and/or most recent) and Remarks (other information thought to be useful). The other type of entry also provides the Unit Name and Age, but is followed only by Remarks.

In choosing unit names for inclusion on the new chart, the authors were guided by the Michigan Geological Survey, Chart 1 (1964) because of its familiarity to Michigan geologists. Updating, however, required not only the revision of familiar terms but also the addition of new terms, some as replacements. A number of stratigraphic terms currently used in the basin are informal in nature. They are also in violation of the stratigraphic code.

One such example is the Silurian Salina Group which makes use of the terms A-1 Salt or Anhydrite, A-2 Carbonate and so forth, with many variations. These informal terms are imbedded in the literature. The authors chose the path of pragmatism and suggest that the terms should be standardized; e.g., the Salina A-1 Evaporite as a general term for the salt or anhydrite, trusting that further discussion will indicate the type of evaporite to which it refers. In addition, we advocate the use of newer terms that have been formally proposed such as the Ruff and Cain Formations. These formations replace the informal Salina A-0 Carbonate and the Salina A-1 Carbonate respectively. We further advocate that in time, all such informal terms be evaluated and replaced by formal terms, where necessary, following the procedures prescribed in the stratigraphic code. The structure of the Lexicon has thus been designed to provide the necessary information towards furthering this end in the coming years.

The terminology developed in the Michigan Basin, in common with many other basins, has an involved and somewhat ancient history. Many of the terms in use here were introduced into the basin from elsewhere at a time when no stratigraphic code existed. Furthermore, different terms have been used to describe the same unit, and the same term has been used to describe different units. While some of this has been corrected over time, there are still many units requiring attention. It is our intention that, sometime in the future, the stratigraphic terms in use by geologists will be properly defined and clarified.

As an additional aid, the Lexicon provides a listing of all formations by their age. The Index by Period should prove useful to stratigraphers. This index, coupled with the Related terms and Remarks portions of the entries, should provide a powerful tool for information searching and retrieval.

STRATIGRAPHIC PROBLEMS

Nature of the Problems

As indicated in the introduction above, the stratigraphic terminology currently in place for Michigan has evolved historically from workers who introduced both formal and informal terms for surface units from regions adjacent to Michigan. Some of these terms were subsequently applied to subsurface rocks. This, it should be pointed out, is similar to procedures followed in other cratonic basins elsewhere. With the birth of modern oil and gas exploration in the basin in the nineteen twenties, a need was developed for new stratigraphic terms to describe subsurface rock units being encountered in the Michigan Basin. Almost immediately, informal naming of units became the norm, a practice that continues to the present day. As a practical solution it served the purposes of subsurface petroleum geologists; but its informal nature brought it into inevitable conflict with the stratigraphic codes that were subsequently developed to formalize terminology.

That development was no mere academic whim but was essential as subsurface information from different basins swelled. The codes have introduced clarity and structure to stratigraphy, and have helped enormously in the correlation of subsurface and surface units. Informal nomenclature certainly has its place in stratigraphy, but is not a substitute for formal terminology.

In Michigan, as elsewhere, some units have been given different names have been subsequently shown to be the same rock units. Others were given the same names, although they might later be found to be different units. The practice of mixing time-stratigraphic terms with rock-stratigraphic terms is particularly vexing and has compounded the problems. In addition, the cores required for evaluating many of these problem units are either incomplete, or do not exist.

Over time, some formations have been studied and re-defined, but many problems remain to be resolved. In the discussions following, only a few of the stratigraphic problems currently existing are mentioned. Where possible, suggestions are offered that may help clarify and possibly correct the situation after proper re-valuation has been made. The focus below is on Cambrian through Jurassic age rocks.

Cambrian

The Cambrian surface units present in the Northern Peninsula have been studied and formally described by Hamblin (1956). A problem exists with the term Munising. Hamblin clearly defined the Munising as a formation in the Northern Peninsula. It however has been used (informally) in the Southern Peninsula as a Group term by Briggs (1968) and subsequently by Catacosinos (1973, with further modifications) and also Catacosinos and Daniels (1991b). It should be determined if the Munising as a group term should be extended into the Southern Peninsula or if a different name would be more appropriate.

In the subsurface of the Southern Peninsula there are different facies or lithologies present and the names used are those common in the upper mid-west. The problem is that some time-stratigraphic terms (or variations of the same) are in use such as Trempealeau, Franconia, Dresbach, and these units are used as rock-stratigraphic terms. They should be re-defined and appropriately named as required by the North American Stratigraphic Code (1983). That may be easier said than done as there is a dearth of Cambrian core available to stratigraphers for the purpose. Re-evaluating the Trempealeau Formation should lead to clarification of its stratigraphic relations with the overlying Ordovician Prairie du Chien Group, and the necessary elimination of the acronym T-PDC.

Ordovician

The Foster Formation named by Fisher and Barratt (1985) is equivalent, at least in part, to the Prairie du Chien Group of Bain (1906). Correlation analysis should be undertaken to determine if Foster terminology should prevail, or if existing Prairie du Chien formation and member terms are more suitable to describe this very thick unit in the Michigan Basin.

A problem also exists between the Au Train Formation of Hamblin (1958) and the Prairie du Chien in the Northern Peninsula of Michigan. A detailed analysis should be carried out to determine which term is more applicable and useful.

In the opinion of the authors, the St. Peter Sandstone named by Owen (1847) and the Bruggers Sandstone (Fisher and Barratt, 1985) are equivalent units. The Bruggers of the Michigan Basin is undoubtedly a thicker, more complete section, but the St. Peter Sandstone has priority and is of wider use in the literature. We therefore suggest St. Peter as the preferred usage. The readers are referred to Smith and others (1993, 1996) and to Barnes and others (1996), recent works on the Prairie du Chien Group and the St. Peter Sandstone, respectively; and Nadon and others (1991, 2000) also on the St. Peter Sandstone.

Correlation studies of the surface Richmond Group to its subsurface equivalents are also necessary. There is some question as to the age of the units involved and that may affect the correlations. Also, facies changes appear to be present between the surface and subsurface units. Clearly, re-evaluation of this part of the section would be fruitful.

Silurian

The most glaring problem unit is the Salina Group. Informal surface unit terminology was initially brought into the Northern Peninsula by Landes (1945b). It has subsequently evolved in the subsurface of the south with many variations.

These units should be carefully evaluated and renamed formally following the examples of the Cain Formation of Gill (1979, Salina A-0 Carbonate) and the Ruff formation of Budros and Briggs (1977) for the Salina A-1 Carbonate.

Other terms that require re-evaluation are the Guelph, Guelph-Lockport and the Lockport dolomites. The Guelph and Lockport are Ontario and New York surface units that form the Niagara Group. They are not distinguished in the subsurface of Michigan and are sometimes called Guelph-Lockport. Their relationships to the surface Engadine Group of the Northern Peninsula as well as to the informally named subsurface Brown, White and Gray Niagara units are fairly well known, but a thorough review of all terms with an eye to the Stratigraphic Code is warranted.

Surface Silurian units such as the Burnt Bluff and Manistique Groups that are normally not differentiated in the subsurface may well be. Detailed correlation studies of these units should prove worthwhile. An initial attempt at subdividing these groups using surface nomenclature can be found in Harrison (1985).

Devonian

The major unit requiring attention is the subsurface Traverse Group, consisting of the Bell Shale and Traverse Limestone (top). To comply with the code and if the Traverse Group as a term is to be retained, then the Traverse Limestone (an informal term) must be re-named. It is likely that detailed correlation studies of the surface formations of the Traverse Group and the subsurface Traverse Limestone will solve this problem handily. Stratigraphic relationships between the Ellsworth Shale in the westernmost portion of the basin and the various members of the Antrim Shale are still unclear.

The Dundee Formation has been formally subdivided into Rogers City and Dundee in outcrop, but is undifferentiated in the subsurface. Informal but widely used terms such as Reed City Dolomite or Anhydrite should be evaluated for possible incorporation into formal subdivisions in the subsurface.

A significant sequence-bounding unconformity (Tippecanoe-Kaskaskia) occurs in the Lower Devonian. The position and magnitude of missing section needs to be determined. The relationships of the Garden Island, Bois Blanc and Sylvania Formations are also muddled and in need of further work.

Mississippian

The Michigan Formation contains a large number of informal terms derived from oil field usage. In particular there is a somewhat bewildering inclusion of sandstone units named the Stray, Stray-Stray and Stray-Stray-Stray that are in need of attention.

Stratigraphic names for other Mississippian sandstones also continue to be a source of confusion. There are typically two blanket sandstones that stratigraphers consider to form the Marshall Sandstone, but in some areas of the basin, the formation consists of either one or three blanket sandstones. The confusion in stratigraphic nomenclature seems to be related to naming elongate, laterally discontinuous sands that interfinger with shales and evaporates of the Michigan Formation. Hard (1938) shows as many as three of these sandstones (so-called Michigan Stray, Stray-Stray, and Stray-Stray-Stray) on detailed fence diagrams; and recent analysis of extensive geophysical log data by Westjohn and Weaver (1998) entirely supports the early work of Hard (1938).

Although the Mississippian sands were deposited in two quite different sedimentary environments (isolated, bar-type or shoestring sands versus continuous blanket sands), both types contained natural gas. The principal naming problem is that gas-bearing sandstones were typically called Michigan Stray sandstone, even though minor north to northwest trending closures in blanket sandstones that form the upper part of the Marshall Sandstone also contained natural gas.

Pennsylvanian

Pennsylvanian rock units in the basin form a very complex intercalated sequence of sandstone, siltstone, and shale, with substantially lesser amounts of coal and limestone. Wanless and Shideler (1975) divided the Pennsylvanian package into a lower dominantly sandstone/siltstone sequence, and intermediate sequence consisting most of shale (lesser sandstone/siltstone-the coal bearing facies), and an upper sequence of mostly sandstone. Vugrinovich (1984) used an extensive suite of geophysical logs to map Pennsylvanian stratigraphic units in the Six-Lakes gas storage field and proposed several new names, while

attempts by others, for example Westjohn and Weaver (1998) concluded that in general lithologic units within the Pennsylvanian sequence have only local continuity. These authors, Vugrinovich (1984) and Westjohn and Weaver (1998) studied different areas of the basin (Six-Lakes and surrounding area, versus the former coal 'basins'-Parma, Williamston, and Standish areas), so there may be several sub-basins during Pennsylvanian sedimentation. The stratigraphy of the Pennsylvanian sequence deserves a focused study. Most stratigraphers suggest the Parma Sandstone forms the base of the Pennsylvanian sequence, but recent work (Westjohn and Weaver, 1998) indicates the Parma is a blanket sandstone much like the Marshall Sandstone, and in many areas of the basin the Parma seems to interfinger with the Bayport Limestone. The Parma has minor lenses of dolomite and limestone, and has marine cement (dolomite), and may be predominantly marine in origin as opposed to the typical depositional environment of the Pennsylvania, fluvial-deltaic. Vugrinovich (1984) proposed the possibility of the Parma forming the upper part of the Mississippian, so the stratigraphic position of the Parma Sandstone needs to be reconsidered.

Jurassic

A minor problem exists concerning the Jurassic Red Beds which were reported by Cross (1998) to be of Middle Jurassic age. He included the Ionia Sandstone (now Jurassic) and renamed the entire sequence the Ionia Formation. Since the term Ionia is preoccupied, another more suitable term is presently being sought. The authors have elected to use the term Ionia Formation in the Lexicon since once the name is formally changed in the literature it will be a simple matter to correct the Lexicon in any future revision or update.

Renewed interest in formally renaming the Jurassic Red Beds has led to speculation that formations thought to be in some way correlated (the Woodville, Eaton, and Ionia sandstones) are in fact in very different stratigraphic positions. For example, it has been shown that the Woodville Sandstone is near the base of the Pennsylvanian section at Jackson, Michigan (Westjohn and Weaver, 1994). These local outcrop names are obscure and probably are of little use in describing the Basin's stratigraphy.

Closing Remarks

If an attempt is to be made by stratigraphers to try and bring the Michigan stratigraphic terminology up to code in the future, then additional geologic projects are necessary. First, new detailed surface maps of Michigan should be produced, particularly of the Northern Peninsula. This would permit verification of type sections; if these are not available in Michigan, perhaps typical sections could be established that would be relevant to the Michigan section, but still meet code requirements. This work, if undertaken, could also be part of a larger project; one that includes existing seismic, magnetic and gravity maps coupled to accurate stratigraphic cross-sections, all published together in a volume. Remote sensing data, wireline logs and geochemical information could also be included, enhancing the value of the volume.

In the future, as the surface formations are re-evaluated and perhaps re-defined, they can be projected into the subsurface. This project will help clarify the stratigraphy of the Southern Peninsula. By the end of the next century a very sharp, clear model of the surface and subsurface geology of the Michigan Basin could well exist. Approached bit by bit over a period of time, such a project would be viable, and as it would provide an accurate model of the State's geology, would also be invaluable in documenting it's natural resources.

STRATIGRAPHY

Stratigraphic names and ages in **bold print** are found on the chart "*Stratigraphic Nomenclature for Michigan*" that accompanies this volume.

I (numeric)

I Carbonate, Late Silurian
Remarks: Sharma (1966), see Salina A-0 Carbonate.

II Carbonate, Late Silurian
Remarks: Sharma (1966), see Salina A-1 Carbonate.

I Salt and Anhydrite, Late Silurian
Remarks: Sharma (1966), see Salina A-1 Evaporite.

II Salt and Anhydrite, Late Silurian
Remarks: Sharma (1966), see Salina A-2 Evaporite.

III Salt, Late Silurian
Remarks: Sharma (1966), see Salina B Unit.

IV Salt, Late Silurian
Remarks: Sharma (1966), see Salina D Unit.

IV Shale and Carbonate, Late Silurian
Remarks: Sharma (1966), see Salina C Unit.

V Salt, Late Silurian
Remarks: Sharma (1966), see Salina F Unit.

V Shale and Carbonate, Late Silurian
Remarks: Sharma (1966), see Salina E Unit.

A

A-0 Carbonate, Late Silurian
Remarks: Informal term, Evans (1950), Gill (1977), see Salina A-0 Carbonate.

A-1 Anhydrite, Late Silurian
Remarks: Informal term, see Salina A-1 Evaporite.

A-1 Carbonate, Late Silurian
Remarks: Informal term, Evans (1950), MGS (1964), Gill (1977), see Salina A-1 Carbonate.

A-1 Dolomite, Late Silurian
Remarks: Informal term, see Salina A-1 Carbonate.

A-1 Evaporite, Late Silurian
Remarks: Informal term, Evans (1950), MGS (1964), Gill (1977), see Salina A-1 Evaporite.

A-1 Limestone, Late Silurian
Remarks: Informal term, see Salina A-1 Carbonate.

A-1 Salt, Late Silurian
Remarks: Informal term, see Salina A-1 Evaporite.

A-1 Sylvinite, Late Silurian
Remarks: A mixture of halite and sylvite, see Elowski (1980), Sonnenfeld and Al-Aasm (1991) and Salina A-1 Evaporite.

A-2 Anhydrite, Late Silurian
Remarks: Informal term, see Salina A-2 Evaporite.

A-2 Carbonate, Late Silurian
Remarks: Informal term, Evans (1950), MGS (1964), Gill (1977), see Salina A-2 Carbonate.

A-2 Dolomite, Late Silurian
Remarks: Informal term, see Salina A-2 Carbonate.

A-2 Evaporite, Late Silurian
Remarks: Informal term, Evans (1950), MGS (1964), Gill (1973), see Salina A-2 Evaporite.

A-2 Limestone, Late Silurian
Remarks: Informal term, see Salina A-2 Carbonate.

A-2 Salt, Late Silurian
Remarks: Informal term, see Salina A-2 Evaporite.

ALPENA LIMESTONE, Middle Devonian

Remarks: Formal term, Grabau (1902), surface unit, see Traverse Group, Charlevoix Stage. Two members, (top) Four Mile Dam Member and Newton Creek Member.

Amherstburg Dolomite, Middle Devonian
Remarks: Sherzer and Grabau (1909), see Amherstburg Formation.

AMHERSTBURG FORMATION, Middle Devonian

Related terms: Amherstburg Dolomite, Black Lime, Monroe Group.

Lithology: Dolomite, limestone and sandstone, 325 feet (99.1 meters) maximum: Michigan Basin and western Ontario, eastward to Erie County, Ohio.

Type locality: Named for rocks dredged from bottom of eastern channel of Detroit River opposite Amherstburg, Ontario: Sherzer and Grabau (1909).

Additional references: Gardner (1974), Lilienthal (1978).

Remarks: Middle formation of the Detroit River Group, contains two members: Meldrum Member below, Filer Sandstone Member above. The two members are not differentiated everywhere in the basin. The Filer Sandstone Member is present only in the west central portion of the basin, whereas the Meldrum Member is found primarily in the central basin.

ANDERDON LIMESTONE, Middle Devonian

Remarks: Sherzer and Grabau (1908), see Detroit River Dolomite, Detroit River Group, Lucas Formation and Monroe Group. A surface term, it may be a limestone facies of the Lucas Formation, see Schuchert (1943).

Antrim Formation, Late Devonian
Remarks: Informal term, Dellapenna (1991), see Antrim Shale, Dark Antrim.

ANTRIM SHALE, Late Devonian

Related terms: Antrim Formation, Dark Antrim (Lower Antrim), Ellsworth Shale, Huron Group, Huron Shale, Kettle Point Formation, Light Antrim (Upper Antrim), Middle Antrim (Ellsworth Formation), St. Clair Shale, Squaw Bay Limestone, Traverse Formation, Upper Member.

Lithology: Black to brown shale, middle portion gray to greenish gray, 60-650 feet (18-198.2 meters): Southern Peninsula of Michigan, NE Indiana, NW Ohio.

Type locality: Shore of Grand Traverse Bay about half mile south of the pier off Norwood, Antrim County, Michigan: Lane (1902).

Additional references: Bailey and others (1991), Ells (1979), Dellapenna (1991), Harrell and others (1991), Martin and Straight (1956), Matthews (1993), Newcombe (1933).

Remarks: Gutschick and Sandberg (1991a,b) have proposed a revised type locality in the Paxton Quarry, Alpena Co., Michigan. They have four members: Upper Member (unnamed, top), Lachine Member, Paxton Member, and Norwood Member (base), formal term. In western Michigan the Upper Member grades upward into the Ellsworth Shale. An extensive gas zone in the northern part of the Northern Peninsula of Michigan.

Armada Formation, Late Silurian
Remarks: Felber (1964), see Salina A-2 Carbonate and Salina B unit, informal term.

Arnheim Shale, Late Ordovician
Remarks: Also Limestone, surface unit, and part of Richmond Group in states south of Michigan. Term currently not used in Michigan, see Martin and Straight (1956).

AuGres Limestone, Late Mississippian
Remarks: Douglas (1841), obsolete, equivalent to Bayport Limestone. See Point Au Gres Limestone, see Martin and Straight (1956), and Wilmarth (1938).

Augusta Limestone (also Group, Stage), Late Mississippian
Remarks: Keyes (1893), obsolete, see Martin and Straight (1956), Wilmarth (1938).

AU TRAIN FORMATION, Early Ordovician

Related terms: Prairie du Chien Group, Hermansville Limestone.

Lithology: Sandy dolomite (top) to dolomitic sandstone, distinctly glauconitic, in part, 125-300 feet (38-91.5 meters) plus: Northern Peninsula, Michigan.

Type locality: Au Train Falls, Alger County, Michigan: Hamblin (1958).

Additional references: Catacosinos (1973), Catacosinos and Daniels (1991b), Dott (1991), Haddox and Dott (1990).

Remarks: Formal surface term, equivalent in part to the Prairie du Chien Group.

B

B, Late Silurian
Remarks: Evans (1950), see Salina B Unit.

B Evaporite, Late Silurian
Remarks: MGS (1964) see Salina B Unit.

B Salt, Late Silurian
Remarks: Gill (1973), see Salina B Unit.

B Unit, Late Silurian
Remarks: Gill (1973), see Salina B Unit.

Babbitt Sandstone, Mississippian
Remarks: Lane (1900), obsolete, see Martin and Straight (1956).

Basal Beds, Middle Ordovician
Remarks: A Canadian term, Manitoulin Island area in Ontario. See Sanford (1978).

BASAL CONGLOMERATE, Late Cambrian

Related terms: Chapel Rock Member, Miner's Castle Member, Munising Group.

Lithology: Conglomerate, 2-15 feet (less than 1-4.5 meters): Northern Peninsula of Michigan.

Type locality: Grand Island, Michigan: Hamblin (1958).

Additional references: Catacosinos (1973), Catacosinos and Daniels (1991b), Haddox and Dott (1990).

Remarks: Formal term, unnamed basal member of the Munising Formation.

Bass Islands Dolomite, Late Silurian
Remarks: Lane and others (1909), renamed Bass Island dolomite by Smith (1914), Island and Islands interchangeable, see Martin and Straight (1956), see Bass Islands Group.

Bass Islands Formation, Late Silurian
Remarks: Gill (1973), see Bass Islands Group.

BASS ISLANDS GROUP, Late Silurian

Related terms: Tymochtee Shale, Greenfield dolomite, Salina "H" Unit (St. Ignace Dolomite), Bass Islands Dolomite, Bass Islands Formation.

Lithology: Dolomites, with minor anhydrites, halite beds in central basin, 300-600 feet (91-183 meters) but may be only about 150 feet (45.7 meters) or so: Southeastern Michigan, Northern Ohio, Western Ontario.

Type locality: Exposures on the Bass Islands in western Lake Erie: Lane and others (1909).

Additional references: Felber (1964), Haynes and Parkins (1992), MGS (1964).

Remarks: Formal surface term, Group consists of Raisin River Dolomite and Put-In-Bay Dolomite (base includes the St. Ignace), usually neither are delineated in the subsurface. Modern re-study is needed. May be totally eroded by sub-Kaskaskia unconformity at the southern margin of the basin.

BAY de NOC Member, Late Ordovician

Remarks: Hussey (1926), sometimes called the Bay de Noc Shaley Limestone. It is the lower member of the Stonington Formation of the Richmond Group. Though referred to by Dorr and Eschman (1970, Fig. V-2), it is obscure.

Bayport Formation, Late Mississippian
Remarks: See Bayport Limestone.

BAYPORT LIMESTONE, Late Mississippian

Related terms: AuGres Limestone, Bayport Formation, Echinochoncus Zone, Eo-Carboniferous Limestone, Grand Rapids Limestone (Group, Series), Maxville Limestone, Point Au Gres Limestone, Upper Grand Rapids Group.

Lithology: Limestone, sandstone interbedded, generally less than 100 feet (30 meters), up to 200 feet (61 meters): Southern Peninsula, Michigan.

Type locality: Bayport Quarry, Huron County, Michigan: Lane (1899).

Additional references: Ciner (1988), Cohee (1979) Harrell and others (1991), Martin and Straight (1956), Wilmarth (1938).

Remarks: Formal term.

BEDFORD SHALE, Late Devonian

Related terms: Berea Sandstone, Ellsworth Shale.

Lithology: Gray shale, up to 200 feet (61 meters): Eastern Michigan.

Type locality: Bedford, Cuyahoga County, Ohio: Newberry (1870).

Additional references: Ells (1979), Gutschick and Sandberg (1991a,b), Harrell and others (1991), Pepper and others (1954).

Remarks: Formal term, is generally considered the basal portion of the Berea/Bedford deltaic complex that extends southward through Ontario into Ohio. In NW Ohio, the upper part of the "Bedford Shale" makes the geophysical log signature that has traditionally been correlated to the Berea Sandstone, see Berea Sandstone. It is a lateral facies, in part, of the western Ellsworth Shale, see Gutschick and Sandberg (1991a); however it was not considered a time equivalent either by Ells (1979) or Mathews (1993).

BELL SHALE, Middle Devonian

Related terms: Traverse Group, Traverse Limestone.

Lithology: Gray shale, 80 feet (24.4 meters) maximum: Southern Peninsula, Michigan.

Type locality: Bell, Presque Isle County, Michigan: Grabau (1902).

Additional references: Lilienthal (1978).

Remarks: Formal term, basal formation of Traverse Group. It is equivalent to the Silica Shale in NW Ohio. Both a surface and subsurface unit.

Berea Grit, Late Devonian
Remarks: Also Shale, Lane (1895), see Martin and Straight (1956), Wilmarth (1938), see Berea Sandstone, both terms obsolete.

BEREA SANDSTONE, Late Devonian

Related terms: Bedford Shale, Berea Grit, Ellsworth Shale.

Lithology: Fine-grained sandstone, some siltstone and shale, about 50 feet ranging upward to 100 feet (15.2-30.5 meters): Eastern and central Michigan Basin.

Type locality: Berea, Cuyahoga Co., Ohio: Newberry (1870).

Additional references: Ells (1979), Gutschick and Sandberg (1991a,b), Harrell and others (1991), Matthews (1993).

Remarks: Formal term. It is the sandstone component of the Berea/Bedford deltaic complex that extends southward from Ontario into Ohio, oil and gas producer. It may be absent in western and SE Michigan and NW Ohio, see Bedford Shale. Lateral facies of the western Ellsworth Shale. In a couple of fields in western Michigan, a "Berea" member of the Ellsworth Shale has produced hydrocarbons; it is doubtful that this is the Berea Sandstone of eastern Michigan.

Big Anhydrite, Middle Devonian
Remarks: informal oil field term, see Lucas Formation and Gardner (1974).

BIG HILL FORMATION, Late Ordovician

Remarks: Originally named Big Hill Beds, also Limestone. Named by Hussey (1926). A Northern Peninsula surface unit overlying the Ogontz Member of the Stonington Formation. It is equivalent to the Queenston Shale of the Richmond Group of Michigan. It is obscure. See Liberty (1978).

Big Salt, Middle Silurian
Remarks: Informal term, see Salina B Unit.

Big Salt, Middle Devonian
Remarks: Informal oil field term, see Lucas Formation and Gardner (1974).

BILL'S CREEK SHALE, Middle to Late Ordovician

Remarks: Originally Bill's Creek Beds, Hussey (1926). A Northern Peninsula surface term, it is equivalent in part to the upper part of the Collingwood Shale and the lower part of the Utica Shale of the Richmond Group. It is obscure. See Liberty (1978).

Black Lime, Middle Devonian
Remarks: Informal term and useful structural marker, see Amherstburg Formation.

BLACK RIVER FORMATION, Middle Ordovician

Related terms: Black River Limestone, Black River Group, Black River Shale, Bony Falls Formation, Extra Section, Gull River Formation, Sneaky Peak, Sneaky Peek, Sneaky Pete, Van Wert Zone.

Lithology: Limestone, 150-500 feet (45-152.5 meters): New York, Pennsylvania, NE Indiana, Northern and NW Ohio, SW Ontario.

Type locality: Cliffs on Black River, New York: Vanuxem (1842).

Additional references: Budai and Wilson (1991), Catacosinos and others (1991).

Remarks: Preferred designation in the Michigan Basin. Major oil and gas producer.

Black River Group, Middle Ordovician
Remarks: Vanuxem (1842), see Martin and Straight (1956) and Wilmarth (1938), see Black River Formation.

Black River Limestone, Middle Ordovician
Remarks: See Black River Formation.

Black River Shale, Middle Ordovician
Remarks: An informal term for a thin shale unit near the top of the Black River Formation. A useful marker bed for correlation.

Blue Mountain Formation, Middle Ordovician
Remarks: An Ontario, Canada term, see Liberty (1978).

BOIS BLANC FORMATION, Middle Devonian

Related terms: Garden Island Formation.

Lithology: Limestones and dolomite, cherty, 360 feet (109.8 meters) maximum: Michigan, Northern Ohio, Ontario, Canada.

Type locality: Bois Blanc Island, Straits of Mackinac, Michigan: Ehlers (1945).

Additional references: Dow (1962), Ells (1958), Gardner (1974), Martin and Straight (1956).

Remarks: Formal term. Gardner (1974) considers it a facies of the Garden Island Formation.

Bony Falls Formation, Middle Ordovician
Remarks: Named by Hussey, (1952), it appears to be the surface equivalent of the Black River Formation. Obscure, should be re-studied.

Brazil Shale, Middle Ordovician
Remarks: Misnomer for Brazos Shale, should be dropped.

Brazos Shale, Middle Ordovician
Remarks: See Foster Formation and Prairie du Chien Group. This black shale unit is found at the top of the Prairie du Chien Group (or Foster Formation) in the central portion of the Michigan Basin, see Catacosinos and Daniels (1991b). Author unknown, this field term is preoccupied by a series and a member in Texas. It should be formally renamed or dropped.

Brown Dolomite, Late Mississippian
Remarks: Informal term, see Clare Dolomite, Michigan Formation, see Swanson (1955).

Brown Lime, Late Mississippian
Remarks: Informal term, see Clare Dolomite, Michigan Formation, see Swanson (1955).

Brown Niagara, Middle Silurian

Remarks: MGS (1964), informal oil field term in wide usage, top of Niagara Group. See Guelph Dolomite, Lower Restricted Marine, Niagara Group, Pinnacle Reef, Silurian Reef, see Catacosinos and others (1991), Friedman and Kopaska-Merkel (1991. Equivalent to the upper Engadine Dolomite and to the Guelph Dolomite. Pinnacle and barrier reef complexes grew on the slope, shelves, platforms and banks of the basin originating from the Brown Niagara. Also present in interreef facies, see Porcher (1985).

Bruggers Sandstone, Middle Ordovician

Related terms: St. Peter Sandstone, Jordan Sandstone, Knox Sandstone, Massive Sand, New Richmond Sandstone, Prairie du Chien Sandstone.

Lithology: Sandstone, over 1100 feet (335.5 meters): Southern Peninsula of Michigan.

Type locality: Jem Bruggers 3-7 well, Missaukee CO., Mi., Sec 7, T24N, R6W: Fisher and Barratt (1985).

Additional references: Barnes and others (1996), Catacosinos and Daniels (1991a,b), Harrison (1987).

Remarks: Formal subsurface term, produces gas and oil, equivalent to the St. Peter Sandstone. See Stratigraphic Problems Section in the lexicon.

Burnt Bluff Dolomite, Middle Silurian

Remarks: Informal term, see Burnt Bluff Group.

Burnt Bluff Formation, Middle Silurian

Remarks: Ehlers (1921), see Burnt Bluff Group, see Newcombe (1933) and Wilmarth (1938).

BURNT BLUFF GROUP, Middle Silurian

Related terms: Burnt Bluff Dolomite, Burnt Bluff Formation, Burnt Bluff Limestone, Clinton formation (sometimes Group), Fiborn Limestone.

Lithology: Mostly limestone (subsurface) and dolomite (surface), over 350 feet (106.7 meters): Michigan.

Type locality: Burnt Bluff hill, east shore of Big Bay de Noc, Garden Peninsula, Delta County, Michigan: Ehlers (1921).

Additional references: Catacosinos and others (1991), Ehlers and Kesling (1957), Harrison (1985), Martin and Straight (1956), Wilmarth (1938).

Remarks: Formal term, formations are Hendricks Formation (top), Byron Formation, Lime Island Formation (base), generally undivided in the subsurface. Not present in the southern half of the Michigan Basin. A minor gas zone. Requires modern re-study.

Burnt Bluff Limestone, Middle Silurian

Remarks: Informal term, see Burnt Bluff Group.

BUSH BAY FORMATION, Middle Silurian

Remarks: Johnson and others (1979), top member of the Engadine Group. See Johnson and Sorensen (1981).

BYRON FORMATION, Middle Silurian

Related terms: Originally Byron Beds, see Burnt Bluff Group.

Lithology: Limestone and dolomite, 110-140 feet (33.5-42.7 meters): Wisconsin, Michigan.

Type locality: Byron Township, Wisconsin: Chamberlin (1877).

Additional references: Harrison (1985), Newcombe (1933), Sanford (1978), Wilmarth (1938).

Remarks: Surface term, middle formation of Burnt Bluff Group.

C

C, Late Silurian

Remarks: Evans (1950), see Salina C Unit, informal unit.

C Shale, Late Silurian

Remarks: Gill (1973), see Salina C Unit, informal unit.

C Unit, Late Silurian

Remarks: MGS (1964) see Salina C Unit, informal unit.

CABOT HEAD SHALE, Early Silurian

Related terms: Cataract Group, Manitoulin Dolomite.

Lithology: Green and red shale, some thin limestone interbeds, 80 feet (24.4 meters) maximum: Michigan, Ohio, Ontario, Canada.

Type locality: Cabots Head on the Bruce Peninsula, Ontario, Canada: Grabau (1913).

Additional references: Catacosinos and others (1991), Lilienthal (1978), Martin and Straight (1956), Shaver and others (1986), Wilmarth (1938).

Remarks: Formal term, top formation of Cataract Group.

CAIN FORMATION, Late Silurian

Remarks: Gill (1979), see Salina A-0 Carbonate. Basal member of the Salina Group.

Cap Dolomite, Middle Ordovician

Remarks: An informal oil field term for a bed at the top of the Trenton Formation in southern Michigan, see Budai and Wilson (1991), Keith (1985).

Casco Formation, Middle Silurian
Remarks: Felber (1964), informal term, see Salina A-1 Evaporite, Salina A-0 Carbonate, Niagara Group.

Cataract Formation, Early Silurian
Remarks: Schuchert (1913), see Cataract Group; see Shaver and others (1986).

CATARACT GROUP, Early Silurian

Related terms: Cabot Head Shale, Manitoulin Dolomite.

Lithology: Green and red shale, dolomite, limestone, under 130 feet (39.6 meters): Western New York, NE to NW Ohio, Michigan, Ontario.

Type locality: Cataract, Ontario, Canada: Schuchert (1913).

Additional references: Catacosinos and others (1991), Martin and Straight (1956), Wilmarth (1938).

Remarks: Formal term, two formations, Cabot Head Shale (top), Manitoulin Dolomite (also Limestone and Formation). Part of the Medina Group, New York.

CHANDLER FALLS MEMBER, Middle Ordovician

Remarks: A Northern Peninsula surface term, named by Hussey (1952), lower member of surface Trenton in Michigan, see also Liberty (1978).

CHAPEL ROCK MEMBER, Late Cambrian

Related terms: Basal Conglomerate, Miner's Castle Member, Munising Group.

Lithology: Sandstone, 40-60 feet (12-18.3 meters): Northern Peninsula of Mi.

Type locality: Chapel Rock, eastern end of the Pictured Rocks cliffs: Hamblin (1958).

Additional references: Catacosinos (1973), Catacosinos and Daniels (1991b), Haddox and Dott (1990).

Remarks: Formal surface term, middle member of Munising Formation.

Charlevoix Stage, Middle Devonian
Remarks: Pohl (1930), Alpena Limestone equivalent, see Traverse Group. Should be dropped.

Charlton Black Shale Member, Late Devonian
Remarks: Dellapenna (1991), Informal term, same interval as the Norwood Member of the Antrim Shale, see Gutschick and Sandberg (1991a,b).

Chester Black Shale Member, Late Devonian
Remarks: Dellapenna (1991), Informal term, same interval as Unit 1A of Ells (1979) and the Lachine Member of the Antrim Shale, see Gutschick and Sandberg (1991a,b).

Cincinnatian Series, Late Ordovician
Remarks: Though of fairly wide usage in the Michigan Basin, it is a formal time term, named by Meek and Worthen (1865), and should be replaced by the Richmond Group when rock units are required. See Catacosinos and others (1991), Lilienthal (1978), Nurmi (1972) and the discussion in Wilmarth (1925, p. 85-86). See CS-Units 1 through 5, Units One through Six, and Utica Shale.

Clare Dolomite, Late Mississippian
Remarks: Swanson, (1955), informal oil field term. First recognized by B. F. Hake (see Hard, 1938) for a dolomite horizon in the Michigan Formation. Apparently identical to the Brown Lime or Brown Dolomite, it extends over 17 Michigan counties, between T1N to T25N and R3E to R15W. Thickness is 13-16 feet (3.9-4.8 meters), the term Clare was first suggested by C. Addison (see Swanson, p. 4, 1955).

Clinton Formation, Middle Silurian
Remarks: Also Group. A problem unit. A shaley carbonate in the southern part of the state, it is a facies of the Burnt Bluff Group and often misidentified for the Manistique Group in Central Michigan, Harrison, 1985. See also Catacosinos and others (1991). Also known as the Clinton Group in other states and as such it is a clastic unit. Requires modern stratigraphic analysis.

Coal Measures, Early Pennsylvanian
Remarks: Obsolete, see Martin and Straight (1956). Outdated name for the Saginaw Formation, see Jackson Coal Group and Jackson Coal Measures.

Coldwater Lime, Early Mississippian
Remarks: Informal term, Hale (1941), see Coldwater Shale.

Coldwater Limestone, Early Mississippian
Remarks: Riggs (1938) see Coldwater Shale.

Coldwater Redrock, Early Mississippian
Remarks: Riggs (1938), informal term. Lowest unit of the Coldwater Shale, it is a term used for upper oxidized and often fossiliferous Coldwater at or near the contact with the Sunbury and Ellsworth Shales. See Ells (1979), Hale (1941), Harrell and others (1991), see Coldwater Shale.

COLDWATER SHALE, Early Mississippian

Related terms: Coldwater limestone, Coldwater Redrock, Forestville Shale, Kidney Iron Formation, Rock Fall Series, Waverly Group, Weir Sandstone.

Lithology: Gray, blue-gray, and red fossiliferous shales, locally limestone and dolomite in the west and siltstone and sandstone in the east, 500-800 feet (152.5-244 meters) west, 1100 feet (335.5 meters) east: Southern Peninsula, Michigan into Ohio and Indiana.

Type locality: Coldwater River near Coldwater, Branch County, Michigan: Lane (1893).

Additional references: Cohee (1951), Harrell and others (1991), Lilienthal (1978), Matthews (1993), Vugrinovich (1988).

Remarks: Hale (1941) listed the informal terms Speckled Dolomite and Coldwater Lime for horizons approximately 200-300 feet (61-91.5 meters) above the base of the formation. The terms Weir "Sand" and Richmondville Sandstone were applied to gas bearing sand stringers.

Collingwood Formation, Middle Ordovician
Remarks: Raymond (1912), see Collingwood Shale.

COLLINGWOOD SHALE, Middle Ordovician

Related terms: Bill's Creek Shale, Collingwood Formation.

Lithology: Limestone and shale, about 20-60 feet (6-18.3 meters): Central Michigan Basin subsurface and sporadically on the surface from Manitoulin Island, Ontario, to Lake Ontario, Canada.

Type locality: Manitoulin Island, Ontario: Raymond (1912), as Formation.

Additional references: Hiatt and Nordeng (1985), Johnson and others (1992), Winder (1961).

Remarks Formal term, unconformably overlies the Trenton Formation, may be part of the Utica Shale.

COPPER HARBOR CONGLOMERATE, Middle Proterozoic Eon

Related terms: Freda Sandstone, Nonesuch Shale, Oronto Group.

Lithology: Conglomerate and sandstone, 4400 feet (1342 meters) plus: Northern Peninsula of Mi. and adjoining Wisconsin.

Type locality: Copper Harbor, Michigan: Lane and Seaman (1907).

Additional references: Catacosinos and Daniels (1991b), Daniels (1982), Daniels and Elmore (1988).

Remarks: Formal surface term, basal formation of Oronto Group.

Copper Ridge Dolomite, Late Cambrian
Remarks: An Ohio term, correlates to a portion of the Knox Dolomite. See Janssens (1973), Foster Formation, Trempealeau Formation.

CORDELL FORMATION, Middle Silurian

Remarks: Also Dolomite. See Harrison (1985) and Sanford (1978), top formation of Manistique Group. See Cordell Member. It should be formally changed to formation status.

Cordell Member, Middle Silurian
Remarks: Also Formation: Newcombe (1933) but see Harrison (1985), Martin and Straight (1956). Top of Manistique Group. Its designation should be changed formally to Formation. Formal surface term.

Cottrellville Formation, Middle Silurian
Remarks: Informal term, Felber (1964), see Salina A-1 Carbonate and Salina A-2 Evaporite.

Crappo Creek Grey Shale Member, Late Devonian
Remarks: Dellapenna (1991), informal term, same interval as the Paxton Member of the Antrim Shale, see Gutschick and Sandberg (1991a,b).

CS-Units 1 through 5, Late Ordovician
Remarks: Lilienthal (1978), informal Cincinnatian Series units, see Richmond Group and Units One through Six, see Nurmi (1972).

D

D, Late Silurian
Remarks: Informal term, Evans (1950), see Salina D Unit.

D Salt, Late Silurian
Remarks: Informal term, Gill (1973, 1977), see Salina D Unit.

D Unit, Late Silurian
Remarks: Informal term, MGS (1964), see Salina D Unit.

Dark Antrim, Late Devonian
Remarks: Widely used oilfield term, see Antrim Shale, Lower Antrim, see Dellapenna (1991).

Detroit River Dolomite, Middle Devonian
Remarks: Lane and others (1909), see Anderdon Limestone, Detroit River Group, Flat Rock Dolomite and Martin (1956) and Wilmarth (1938).

DETROIT RIVER GROUP, Middle Devonian

Related terms: Anderdon Limestone, Detroit River Dolomite, Monroe Group.

Lithology: Dolomite, limestone, sandstone and evaporites, about 1450 feet (442 meters): Michigan, NW Ohio but only east to western Erie County, Ohio, southern Ontario, Canada.

Type Locality: Originally for rocks from the Detroit River channel, Michigan: Lane and others (1909).

Additional references Catacosinos and others (1991), Gardner (1974), Wilmarth (1938).

Remarks: Formal term. Consists of Sylvania Sandstone (base), Amherstburg Formation, Lucas Formation (top). Oil and gas producer.

Dresbach Sandstone, Late Cambrian

Remarks: Used extensively in older literature, it was informally incorporated into the Galesville Sandstone by Catacosinos (1973). Formal time term named by Winchell (l886) but should be abandoned as a lithostratigraphic term.

Dundas Formation, Late Ordovician

Remarks: An Ontario, Canada term, see Liberty (1978).

Dundee Formation, Middle Devonian

Remarks: A synonym for Dundee Limestone.

DUNDEE LIMESTONE, Middle Devonian

Related terms: Dundee Formation, Reed City Anhydrite, Reed City Dolomite (or Zone), Reed City Member, Rogers City Limestone, Rogers City Member.

Lithology: Limestone, locally dolomitized, less than 100 to more than 400 feet (30.5-122 meters): Southern Peninsula of Mi., NW Ohio.

Type locality: Dundee, Monroe County, Michigan: Lane (1893).

Additional references: Catacosinos and others (1991), Gardner (1974), Lilienthal (1978), Wilmarth (1938).

Remarks: Formal term, see the discussion in Catacosinos and others (1991) and Gardner (1974) regarding Reed City-Rogers City relationships. A prolific producer of oil and gas.

E

E, Late Silurian

Remarks: Informal term, Evans (1950), see Salina E Unit.

E Unit, Late Silurian

Remarks: Informal term, MGS (1964), Gill (1973, see Salina E Unit, Kintigh Zone.

Eaton Sandstone, Late Pennsylvanian

Related terms: Grand River Group, Grand River Formation, Ionia Formation, Ionia Sandstone, Red Beds, Woodville Sandstone.

Lithology: coarse grained, brown weathered sandstone, conglomeratic at base, 50 feet (15.2 meters), type locality only: Southern Peninsula of Mi.

Type locality: Bluffs along the Grand River, near Grand Ledge, Eaton County, Michigan: Kelly (1936).

Additional references: Martin and Straight (1956), Wilmarth (1938).

Remarks: Stratigraphic status uncertain, Kelly (1936) points out that the stratigraphic relations of the Woodville, Ionia and Eaton Sandstones cannot be determined. It occupies channels cut into shale, sandstone and limestones of the Saginaw Formation.

EAU CLAIRE FORMATION, Late Cambrian

Related terms: Munising Group.

Lithology: Shale, some siltstone and dolomite, generally 100- 200 feet (30.5-61 meters): Great Lakes and upper Midwest.

Type locality: Eau Claire, Wisconsin: Ulrich in Walcott (1914).

Additional references: Catacosinos and Daniels (1991b), Wilmarth (1938).

Remarks: Originally Eau Claire Sandstone. Formal term, informally used as the basal formation of Munising Group in the Southern Peninsula of Michigan. Group usage requires re-evaluation.

Echinochoncus Zone. Late Mississippian

Remarks: Pringle (1937), fossiliferous zone in Bayport Limestone, see Martin and Straight (1956).

Ellsworth Formation, Late Devonian

Remarks: Informal term, Dellapenna (1991), see Ellsworth Shale, Middle Antrim.

ELLSWORTH SHALE, Late Devonian

Related terms: Antrim Shale, Bedford Shale, Berea Sandstone, Ellsworth Formation, Middle Antrim.

Lithology: gray-green banded shale, 50-800 feet (15.2-244 meters): Central western Michigan.

Type locality: Heinz No. 5 well, Muskegon, Michigan: Newcombe (1932).

Additional references: Bishop (1940), Dellapenna (1991), Ells (1979), Fisher (1980), Gutschick and Sandberg (1991a,b), Harrell and others (1991), Martin and Straight (1956), Wilmarth (1938).

Remarks: Formal term, grades downward into Antrim Shale in western part of the basin, and is a lateral facies of the Berea/Bedford deltaic sequence, Gutschick and Sandberg (1991a), but see also Bedford shale, see Ells (1979) and Mathews (1993). A minor gas producer in western Michigan.

Elltrim, Late Devonian

Remarks: Informal term, Unit 3 of Ells (1979). The "Light Antrim" of old drillers logs in western Michigan, but not the same as the "Light Antrim" of central Michigan which overlies the Ellsworth Shale. Should either be formally named, or abandoned.

Engadine Dolomite, Middle Silurian
Related terms: Engadine Group, Guelph Dolomite, Guelph-Lockport, Lockport Dolomite.

Lithology: Dolomite, bluish, very massive, hard, very crystalline, 54-95 feet (16.4-28.9 meters): Michigan.

Type locality: Engadine, Mackinac County, Michigan: Smith (1916).

Additional references: Johnson and Sorensen (1981), Johnson and others (1979), Evans (1950), Gill (1979), Landes (1945b).

Remarks: Formal surface term, see Niagara Group, equivalent to Brown Niagara, Lockport and Guelph Dolomites.

ENGADINE GROUP, Middle Silurian

Remarks: Surface term, see Johnson and others (1979), see Engadine Dolomite. Three units, (top) the Bush Bay Formation, Rapson Creek Formation, and Rockview Formation (base).

Eo-Carboniferous Limestone, Late Mississippian
Remarks: Lane (1900), obsolete term for Bayport Limestone. See Martin and Straight (1956).

Escanaba Limestone, Middle Ordovician
Remarks: Lane (1909), a surface term. A euphemism for the Trenton of Michigan and not needed. See Trenton Formation, Martin and Straight (1956), Wilmarth (1938).

Extra Section, Middle Ordovician
Remarks: An informal oil field term for an extra section of limestone found below the standard geophysical log signature used as the base of the Black River Formation. Present in Eastern Michigan as cited in Catacosinos (1974). Its relationship, if any, to the Sneaky Peak porosity zone is not known at this time.

F

F, Late Silurian
Remarks: Informal term, Evans (1950), see Salina F Unit.

F Evaporite, Late Silurian
Remarks: Informal term, MGS (1964), see Salina F Unit.

F Salt, Late Silurian
Remarks: Informal term, Gill (1973), see Salina F Unit.

F Unit, Late Silurian
Remarks: Informal term, Landes (1945), see Salina F Unit.

FERRON POINT FORMATION, Middle Devonian

Remarks: Formal surface unit, Warthin and Cooper (1935) see Traverse Group.

FIBORN LIMESTONE MEMBER, Middle Silurian

Remarks: Formal surface term, Smith (1916). Member of Hendricks Formation. See Burnt Bluff Group, Hendricks Dolomite. See Martin and Straight (1956), Newcombe (1933), Wilmarth (1938), Sanford (1978).

Filer Sandstone, Middle Devonian
Remarks: Top member of the Amherstburg Formation, see Gardner (1974) and Lilienthal (1978), informal term. Localized in the northwestern part of the basin, especially Manistee and Mason Counties.

Flat Rock Dolomite Member, Middle Devonian
Remarks: Sherzer and Grabau (1909), see Detroit River Dolomite and Wilmarth (1938).

Flat Rock Point Sandstone, Early Mississippian
Remarks: Lane (1900), geographic name for Marshall Sandstone in Huron County. Should be abandoned.

Forestville Shale, Early Mississippian
Remarks: Gordon (1900), outcrop name for Coldwater Shale in Sanilac County. Should be abandoned.

FOSTER FORMATION. Early to Middle Ordovician

Related terms: Brazos Shale, Copper Ridge Dolomite, Knox Dolomite, Lower Knox Carbonate, Prairie du Chien Group, T-PDC, Umlor Formation.

Lithology: Shale and dolomite, over 1570 feet (478 meters): Southern Peninsula of Mi.

Type locality: Brazos St. Foster-1 well, Ogemaw County, Michigan, Sec 28, T24N, R2E: Fisher and Barratt (1985).

Additional references: Catacosinos and Daniels (1991b).

Remarks: Formal term, produces oil and gas. Upper portion of the Prairie du Chien Group in the central Michigan Basin. Correlates to a portion of the Knox Dolomite of Ohio, see Janssens (1973), and in part to the Shakopee Dolomite of Wisconsin and Minnesota. There is approximately 1200 feet of core in this well, covering nearly the complete section. The core is stored at the University of Michigan Subsurface Laboratory.

FOUR MILE DAM MEMBER, Middle Devonian

Remarks: Formal surface term, Cooper and Warthin (1941) see Traverse Group, and Martin and Straight (1956). Top member of Alpena Limestone.

FRANCONIA FORMATION, Late Cambrian

Related terms: Franconia Sandstone, Munising Group, Kerbel Formation.

Lithology: Dolomite, sandstone and shale, 100-200 feet (30.5-61 meters): Minnesota, Illinois.

Type locality: Franconia, Minnesota: Berkey (1897).

Additional references: Catacosinos and Daniels (1991b).

Remarks: Informally defined as a shale, dolomite and minor feldspathic and glauconitic sandstone unit by Catacosinos (1973) as the top formation of the Munising Group in the Southern Peninsula of Michigan, to replace the term Franconia Sandstone. A time term, It should be formally defined and renamed as a rock term. Correlates in part to the Kerbel Formation of Ohio, see Janssens (1973).

Franconia Sandstone, Late Cambrian
Remarks: Used extensively in older literature, it was redefined and renamed informally as a formation by Catacosinos (1973). The sandstone portion has been incorporated into the underlying Galesville Sandstone. It is a formal time term, named by Berkey (1897), and should be abandoned as a lithostratigraphic term.

FREDA SANDSTONE, Middle Proterozoic Eon

Related terms: Copper Harbor Conglomerate, Jacobsville Sandstone, Nonesuch Shale, Oronto Group, pre-Mt. Simon Clastics.

Lithology: Sandstone, siltstone and shale, 14,000 feet (4270 meters): Michigan, Wisconsin.

Type locality: Freda, Michigan: Lane and Seaman (1907).

Additional references: Catacosinos and Daniels (1991b), Daniels (1982), Daniels and Elmore (1988).

Remarks: Formal surface term, Northern Peninsula of Michigan, top member of Oronto Group. Possibly present in Southern Peninsula subsurface.

Freer Sandstone, Middle Devonian
Remarks: Informal term, see Lucas Formation, Richfield Member and Gardner (1974).

G

G, Late Silurian
Remarks: Informal term, Evans (1950) and Sharma (1966), see Salina G Unit.

G Shale, Late Silurian
Remarks: Informal term, see Salina G Unit.

G Unit, Late Silurian
Remarks: Informal term, Gill (1973), see Salina G Unit.

GALESVILLE SANDSTONE, Late Cambrian

Related terms: Dresbach Sandstone, Franconia Sandstone, Munising Group.

Lithology: Sandstone, 100-200 feet (30.5-61 meters): Wisconsin, NE Indiana, NW Ohio.

Type locality: Galesville, Wisconsin: Trowbridge and Atwater (1934).

Additional references: Catacosinos and Daniels (1991b).

Remarks: Formal term, replaces Dresbach and Franconia Sandstones in Mi., see Catacosinos (1973). Type section revised by Emrich (1966), Middle formation of the Munising Group. It is equivalent in part to the Kerbel Formation of Ohio, see Janssens (1973).

Galt Limestone, Middle Silurian
Remarks: Hall (1852), renamed as Guelph Formation by Logan (1863), see Guelph Dolomite, Wilmarth 1938.

GARDEN ISLAND FORMATION. Early Devonian

Related terms: Bois Blanc Formation.

Lithology: Dolomitic sandstone and dolomite, and cherty dolomite, 3-20 feet (about 1-6.1 meters): Michigan.

Type locality: Westernmost point of Garden Island, some 5 miles north of Beaver Island in northern Lake Michigan: Ehlers (1945).

Additional references: Catacosinos and others (1991), Ells (1958), Gardner 1974).

Remarks: Formal surface term. Gardner (1974) considers it a facies of the Bois Blanc Formation.

GENSHAW MEMBER, Middle Devonian

Remarks: Warthin and Cooper (1935), surface term, see Traverse Group. Basal member of the Long Lake Limestone.

GLACIAL DRIFT, Quaternary

Remarks: Rominger (1873), as Drift. It is essentially Pleistocene Epoch sediment that covers the surface of almost all of the Southern Peninsula of Michigan. It varies in thickness from 0 to over 1000 feet (0-305 meters). A general term for a complex unit, see Dorr and Eschman (1970), Westjohn and others (1994) and the discussion in Martin and Straight (1956). It is an important source of sand and gravel deposits and also groundwater.

GLENWOOD FORMATION, Middle Ordovician

Related terms: Glenwood Shale, Goodwell Unit, Wells Creek Formation, Zone of Unconformity.

Lithology: Shale, dolomite, with sandstone and limestone, 5 to over 100 feet (1.5-30.5 meters): NE Iowa, western Illinois, southern Minnesota, Wisconsin.

Type locality: Glenwood Township, Winneshiek County, Iowa: Calvin (1906).

Additional references: Barnes and others (1996), Catacosinos and Daniels (1991b), Harrison and Barnes (1988).

Remarks: Formal term, gas and oil producer, see Goodwell unit and Zone of Unconformity. It is equivalent to the Wells Creek Formation in Ohio, see Janssens (1973).

Glenwood Shale, Middle Ordovician
Remarks: Calvin (1906), see Glenwood Formation, see Wilmarth (1938).

Goodwell Unit, Middle Ordovician
Remarks: Named by Wheeler (1987) for a unit of the Glenwood Formation in a Goodwell Field well, Newaygo County, Mi. See Glenwood Formation and Zone of Unconformity. Though used by some (e.g., Brady and DeHaas, 1988a), it is an informal oil field term and should be formally defined or abandoned.

Grand Lake Limestone Member, Middle Devonian
Remarks: Pohl (1930), a synonym for the Rockport Quarry Limestone. See Martin and Straight (1956), Wilmarth (1938). Not adequately described.

Grand Rapids Group, Late Mississippian
Remarks: Lane (1893), outdated term for the Bayport Limestone, Grand Rapid Series, and Michigan Formation. See Martin and Straight (1956) and Wilmarth (1938), should be dropped.

Grand Rapids Limestone, Late Mississippian
Remarks: Lane (1899), outdated term for Bayport Limestone. Should be dropped.

Grand Rapids Series, Late Mississippian
Remarks: Lane (1893), outdated term for Grand Rapids Group. See Bayport Limestone, Michigan Formation, see Martin and Straight (1956) and Wilmarth (1938).

GRAND RIVER FORMATION, Late Pennsylvanian

Related terms: Eaton Sandstone, Grand River Group, Ionia Formation, Ionia Sandstone, Red Beds, Woodville Sandstone.

Lithology: Coarse-grained sandstone, locally red mudstone, carbonate and coal, generally 50 to 100 feet (15-30.5 meters), maximum 275 feet (83.8 meters) in Mecosta County: Saginaw Bay to Jackson County, and Midland west to Newaygo County, Michigan.

Type locality: Outcrops near Grand Ledge, Michigan, along the Grand River: Kelly (1936), as Group.

Additional references: Wanless and Shideler (1975).

Remarks: Published literature on the Grand River Formation indicates that there is no clear lithologic break between the Saginaw and Grand River Formations. Kelly (1936) suggests a conglomerate marking the base of the Grand River. Mapping by WestJohn and Weaver (1994) indicates that a clear break within the Pennsylvanian sequence is problematic. The Ionia Sandstone has been temporarily redefined by Cross (1998) as the Middle Jurassic Ionia Formation (see the Stratigraphic Problems section of this lexicon).

Grand River Group, Late Pennsylvanian
Remarks: Kelly (1936), see Grand River Formation, Red Beds, see Martin and Straight (1956) and Wilmarth (1938).

Granite Wash, Precambrian
Remarks: Found at top of Precambrian granite in some wells in Michigan, see Catacosinos (1973, 1981), informal term. Wide usage in upper Midwest and elsewhere by many authors.

Gravel Point Limestone, Middle Devonian
Remarks: Pohl (1930), see Gravel Point Stage and Traverse Limestone.

Gravel Point Stage, Middle Devonian
Remarks: Pohl (1930), but see Charlevoix Stage in Martin and Straight (1956) and Wilmarth (1938). See also Gravel Point Limestone, Traverse Limestone, and Newcombe (1933).

Gray Niagara, Middle Silurian
Remarks: Informal term, see, Niagara Group, upper part of Lockport Dolomite, Friedman and Kopaska-Merkel (1991).

Greenfield Dolomite, Late Silurian

Remarks: Orton (1871), see Prosser (1903, p. 539) for comments on coinage of the term. See Martin and Straight (1956), Wilmarth (1938), see Bass Islands Group. An Ohio outcrop term.

GROOS QUARRY MEMBER, Middle Ordovician

Remarks: A Northern Peninsula term, named by Hussey (1952), upper part of surface Trenton in Michigan, see also Liberty (1978).

GUELPH DOLOMITE, Middle Silurian

Related terms: Also Limestone. Engadine Dolomite, Galt Limestone, Guelph-Lockport, Niagaran Reef, Pinnacle Reef.

Lithology: Massive, buff weathered, light gray, saccharoidal dolomite on outcrop, 120-270 feet (36.6-82.3 meters): Michigan Basin subsurface, Ontario, New York.

Type locality: Guelph Ontario, Canada: Logan (1863), see remarks.

Additional references: Friedman and Kopaska-Merkel (1991), Gill (1977), Johnson and others (1992), Martin and Straight (1956), Wilmarth (1938), Winder (1961).

Remarks: Originally named Galt Limestone by Hall (1852) and renamed Guelph Formation by Logan (1863). An Ontario surface term used in Michigan as the upper formation of the Niagara Group. In the subsurface the Guelph Dolomite and Lockport Dolomite are not distinguishable. It is equivalent to the Brown Niagara and, in the subsurface the reefs of Lambton, Huron and Bruce are part of the Guelph. Though Guelph is the preferred usage in the Michigan Basin, further study is required to determine if the Guelph should be incorporated into the Lockport Dolomite. See also Engadine Dolomite.

Guelph-Lockport, Middle Silurian
Remarks: Williams (1919), a term used for part of the Niagara Group, see Engadine Dolomite, Guelph Dolomite, Lockport Dolomite, see Evans (1950), Gill (1977), Johnson and others (1992), Wilmarth (1938), Winder (1961).

Gull River Formation, Middle Ordovician
Remarks: A Manitoulin Island, Ontario, Canada term. Equivalent in part to the lower Black River Formation, see Liberty (1978).

H

H Unit, Late Silurian
Remarks: See Salina H Unit, see Bass Islands Group. In Northern Peninsula of Michigan called St. Ignace Dolomite, see Ehlers (1945).

Hamilton Group, Middle Devonian
Remarks: Vanuxem (1840), used in southwestern Ontario, see Johnson and others (1992), Martin and Straight (1956), Uyeno and others (1982), Wilmarth (1938), Winder (1961). See Traverse Formation, possibly Late Devonian age.

Hardwood Point Sandstone, Early Mississippian
Remarks: Lane (1900), geographic term for Lower Marshall Sandstone outcrop along Lake Huron, eastern Huron County, Michigan. See Marshall Sandstone, Martin and Straight (1956).

Hat Point Sandstone, Early Mississippian
Remarks: Lane (1900), outcrop and geographic name for Napoleon Sandstone, Huron County, Michigan. See Martin and Straight (1956).

HENDRICKS FORMATION, Middle Silurian

Remarks: Harrison (1985). Top member of the Burnt Bluff Group, see also

Hendricks Member, Fiborn Limestone. See Newcombe (1933), Sanford (1978).

Hendricks Member, Middle Silurian
Remarks: Formal surface term, Smith (1916), see Burnt Bluff Group, Hendricks Formation, Fiborn Limestone.

Hermansville Limestone, Early Ordovician
Remarks: Also Formation, Lower Magnesian: Van Hise and Bayley (1900). See Berquist (1937), Thwaites (1934). Replaced by the Au Train Formation of Hamblin (1958).

Horner Member, Middle Devonian
Remarks: Top member of the Lucas Formation, see Gardner (1974).

Huron Gritstones, Early Mississippian
Remarks: Winchell (1861), outcrop name for the Marshall Sandstone near Grindstone City, Huron County, Michigan. Obsolete, should be dropped.

Huron Group, Late Devonian
Remarks: Winchell (1861), obsolete term, see Antrim Shale.

Huron Shale, Late Devonian
Remarks: Newberry (1870), obsolete term in Michigan, see Antrim Shale.

I

IONIA FORMATION, Middle Jurassic

Remarks: Cross (1998) who has reassigned the age from Early Jurassic to Middle Jurassic. See Ionia Sandstone, Eaton Sandstone, Jurassic Red Beds, Permo-Carboniferous Red Beds, Red Beds, Woodville Sandstone, see Kelly (1936). This is a temporary name, as it does not conform to the Stratigraphic Code. See the Stratigraphic Problems section of this lexicon.

Ionia Sandstone, Middle Jurassic
Remarks: Winchell (1871). The age was reassigned from Late Pennsylvanian to the Middle Jurassic and tentatively assigned as the basal sandstone of the Ionia Formation by Cross (1998, see the Stratigraphic Problems section of this lexicon). See Eaton Sandstone, Jurassic Red Beds, Red Beds, Woodville Sandstone. See Lane and Seaman (1909), Newcombe (1931).

Iutzi Member, Middle Devonian
Remarks: Middle member of the Lucas Formation, see Gardner (1974).

J

Jackson Coal Group, Early Pennsylvanian
Remarks: Lane (1893), obsolete. See Saginaw Formation; See Coal Measures, Jackson Formation, Jackson Coal Measures.

Jackson Coal Measures, Early Pennsylvanian
Remarks: Lane (1899), obsolete. See Saginaw Formation; See Coal Measures, Jackson Coal Group.

Jackson Formation, Early Pennsylvanian
Remarks: Lane (1893), obsolete. See Saginaw Formation; See Jackson Coal Group and Jackson Coal Measures.

JACOBSVILLE SANDSTONE, Middle Proterozoic Eon

Related terms: Freda Sandstone, Pre-Mt. Simon Clastics.

Lithology: Conglomerate and sandstone, ranging from 15 feet to at least 1,800 feet (4.6-549 meters, plus): Northern Peninsula of Michigan, possibly Lower Peninsula subsurface.

Type locality: Jacobsville, Michigan: Lane and Seaman (1907).

Additional references: Catacosinos (1981), Catacosinos and Daniels (1991b), Hamblin (1958) and Kalliokoski (1982, 1988).

Remarks: Formal surface term.

Jordan River Formation, Middle and Late Devonian
Remarks: Kesling and others (1974), equivalent to the Squaw Bay Limestone, see Gutschick and Sandberg (1991a,b).

Jordan Sandstone, Late Cambrian
Remarks: Winchell (1872). Used improperly as a synonym for the St. Peter and Bruggers sandstones, see Catacosinos (1973) and Catacosinos and Daniels (1991b). Formal term but apparently not needed in Michigan Basin.

Jurassic Red Beds, Middle Jurassic
Remarks: Redefined as the Ionia Formation and reassigned a Middle Jurassic age by Cross (1998). See the Stratigraphic Problems section of this lexicon, see Red Beds. Rocks formerly called and dated as Permo-Carboniferous may in part refer to some Pennsylvanian rocks, but most are probably Middle Jurassic in age.

K

Kerbel Formation, Late Cambrian
Remarks: An Ohio unit, see Janssens (1973). It is equivalent in part to the Franconia Formation and Galesville Sandstone.

Kettle Point Formation, Late Devonian
Remarks: Logan (1863), an Ontario, Canada term, see Johnson and others (1992), Uyeno and others (1982), Winder (1961) see Antrim Shale.

Kidney Iron Formation, Early Mississippian
Remarks: Hubbard (1840), for nodular iron ore in upper Coldwater Shale.

KILLIANS MEMBER, Middle Devonian

Remarks: Warthin and Cooper (1935), formal surface term, see Traverse Group. Top member of Long Lake Limestone.

Kintigh Zone, Late Silurian
Remarks: Also E Unit, oil field term, see Burns (1962), Lilienthal (1978), see Salina E Unit.

Knox Dolomite, Early Ordovician
Remarks: Ohio term, see Janssens (1973), see Copper Ridge Dolomite, Foster Formation.

Knox Sandstone, Late Cambrian
Remarks: Safford (1869). It is essentially a synonym for the Jordan Sandstone and, improperly used in Michigan for the St. Peter and Bruggers Sandstone. See Catacosinos and Daniels (1991b). It is an Ohio term now incorrectly used as an oil field term in Michigan.

L

LACHINE MEMBER, Late Devonian

Related terms: Antrim Shale, Chester Black Shale, Unit 1A, Upper Black Shale.

Lithology: Black shale, interbeds of greenish-gray shale, 60-80 feet (18.3-24.4 meters): Michigan Basin.

Type locality: Paxton Quarry, 10 miles west of Alpena, Alpena County, Mi.: Gutschick and Sandberg (1991a).

Additional references: Dellapenna (1991), Ells (1979), Gutschick and Sandberg (1991b).

Remarks: Formal surface term, member of Antrim Shale.

Lake Superior Group, Late Cambrian
Remarks: Winchell (1871), see Lake Superior Sandstone, Houghton (1840), Wilmarth (1938). It has been abandoned by the USGS and is obsolete.

Lake Superior Sandstone, Late Cambrian

Remarks: Formal term, Houghton (1840). For nomenclatural history, see Hamblin (1958). See Lake Superior Group and Munising Formation. See Berquist (1937), Martin and Straight (1956), Thwaites (1934) and Wilmarth (1938). Term appears to be obsolete and should be abandoned.

Lapeer Formation, Late Silurian
Remarks: Informal term, Felber (1964), see Marine City Formation, Ode Formation, Salina E Unit, Salina F Unit.

Light Antrim, Late Devonian
Remarks: Informal term, described by Ells (1979), see Antrim Shale, Elltrim, Upper Antrim.

Lighthouse Conglomerate, Early Mississippian
Remarks: Lane (1900), Local term for a conglomerate bed in the Marshall Sandstone of Huron County, Michigan. It should be dropped.

Lighthouse Point Series, Early Mississippian
Remarks: Lane (1900), obsolete term for Marshall Sandstone, should be dropped.

LIME ISLAND FORMATION, Middle Silurian
Remarks: Also Dolomite, surface term, Ehlers and Kesling (1957), base of Burnt Bluff Group. See Catacosinos and others (1991), Harrison (1985), Sanford (1978).

Lingula Shales, Early Pennsylvanian
Remarks: Kelly (1936), see Martin and Straight (1956). Shale lenses or lentils are present in the Saginaw Formation.

LOCKPORT DOLOMITE, Middle Silurian

Remarks: Hall (1839), who referred to it as Lockport Limestone, see Wilmarth (1938), see Guelph Dolomite, Guelph-Lockport, Niagara Group. Two members, the Gray Niagara (top) and White Niagara, it is the lower formation of the Niagara Group, see Friedman and Kopaska-Merkel (1991). Further study is required to see if it should incorporate the Guelph Dolomite. It is equivalent to the lower portion of the surface Engadine Dolomite in the Northern Peninsula of Michigan.

Lodi Formation, Late Cambrian
Remarks: See Trempealeau Formation and Catacosinos (1973). It is a formal term, named by Thwaites (1923), but is not needed in the Michigan Basin.

LONG LAKE LIMESTONE, Middle Devonian

Remarks: See Warthin and Cooper (1943) see Long Lake Series, Traverse Group. Two Members, (top) Killians Member and Genshaw Member.

Long Lake Series, Middle Devonian
Remarks: Grabau (1902), see Long Lake Limestone, Traverse Limestone.

Lorraine Group, Late Ordovician
Remarks: Emmons (1842), it is an obscure term and not needed. Should be dropped.

Lower Antrim, Late Devonian
Remarks: Dellapenna (1991), see Antrim Shale, Dark Antrim.

Lower Black, Late Devonian
Remarks: Also Lower Black Antrim, oil field term, see Norwood Member.

Lower Grand Rapids Formation, Late Mississippian
Remarks: Lane (1900), see Michigan Formation.

Lower Knox Carbonate, Early to Middle Ordovician
Remarks: Oil field term, see Foster Formation.

Lower Magnesian, Early Ordovician
Remarks: See Hermansville Limestone and Hamblin (1958). It is an informal, obscure term, abandoned by the USGS.

Lower Marshall Sandstone, Early Mississippian
Remarks: Lane (1900), see Hardwood Point Sandstone, Marshall Sandstone, Point aux Barques Sandstone, Port Austin Sandstone.

Lower Restricted Marine, Middle Silurian
Remarks: Oil field term for the interval on gamma ray logs between the high gamma ray spike near the top of the Brown Niagara and the high gamma ray spike at the top of the Gray Niagara. See Brown Niagara.

Lower Saginaw Formation, Early Pennsylvanian
Remarks: Kelly (1936), see Saginaw Formation.

LUCAS FORMATION, Middle Devonian

Related terms: Anderdon Limestone, Big Anhydrite, Big Salt, Freer Sandstone, Massive Anhydrite, Massive Salt, Monroe Group, Richfield Member (or Zone), Sour Zone, also known as Lucas Dolomite.

Lithology: Dolomite and evaporites, 20 plus-1000 feet (6.1-305 meters): Michigan and western Ontario.

Type locality: Lucas County, Ohio: Prosser (1903).

Additional references: Catacosinos and others (1991), Gardner (1974), Lilienthal (1978), Schuchert (1943), Wilmarth (1938).

Remarks: Formal term, top formation of the Detroit River Group. Contains three members, (base) the Richfield Member (which contains the Freer Sandstone), Iutzi Member and Horner Member (top), see Gardner (1974). Oil and Gas producer.

M

MACKINAC BRECCIA, Late Silurian to Middle Devonian

Related Terms: None, but see Mackinac Limestone.

Lithology: Indurated breccia masses, variable thickness: northern Southern Peninsula and southern Northern Peninsula of Michigan, both in the surface and subsurface.

Type locality: Mackinac Straits area of Michigan: Landes (1945a).

Additional references: Lilienthal (1978), Martin and Straight (1956), MGS Chart 1 (1964).

Remarks: Consists of rock masses derived from the Salina Group through the Detroit River Group, see Lilienthal (1978) for discussion.

Mackinac Limestone, Middle Devonian
Remarks: Houghton (1840) but see also Wilmarth (1938), possibly related to Mackinac Breccia.

Manistique Formation, Middle Silurian
Remarks: Ehlers (1921). Two members named by Newcombe (1933), (top) Cordell Member, Schoolcraft member. It is usually undivided in the subsurface. See Clinton Formation, Manistique Group, Manistique Series, see Harrison (1985), Martin and Straight (1956), Wilmarth (1938).

MANISTIQUE GROUP, Middle Silurian

Related terms: Clinton Formation, Cordell Formation, Manistique Formation, Manistique Series, Schoolcraft Formation.

Lithology: Limestone (subsurface), dolomite (surface), less than 50 to more than 200 feet (15.2-61 meters): Michigan Basin.

Type locality: Manistique, Garden Peninsula, Northern Peninsula, Michigan: Author not known but see Harrison (1985).

Additional references: Catacosinos and others (1991), Newcombe (1933) and see Martin and Straight (1956).

Remarks: Two members, (top) the Cordell Formation, and (bottom) the Schoolcraft Formation. Harrison (1985) shows the Manistique as a Group, and the Cordell as a Formation and the Schoolcraft as both Dolomite and Formation. Undifferentiated in the subsurface The Group requires modern re-study and analysis.

Manistique Series, Middle Silurian
Remarks: Smith (1916), see Manistique Formation, Manistique Group, see Martin and Straight (1956), Wilmarth (1938).

MANITOULIN DOLOMITE, Early Silurian

Related terms: Cabot Head Shale, Cataract Group, Manitoulin Limestone and Formation.

Lithology: Dolomite in outcrop, limestone in subsurface, 11 to over 50 feet (3.3-15.2 meters): Great Lakes portions of Ontario, Canada, NW to NE Ohio, Michigan Basin.

Type locality: Manitoulin Island, Ontario: Bigsby (1824).

Additional references: Catacosinos and others (1991), Lilienthal (1978), Martin and Straight (1956), Wilmarth (1938).

Remarks: Formal term, basal formation of Cataract Group.

Manitoulin Formation, Early Silurian
Remarks: Sanford (1978), see Cataract Group, Manitoulin Dolomite.

Manitoulin Limestone, Early Silurian
Remarks: Also Formation, Bigsby (1824), see Cataract Group, see also Catacosinos and others (1991) and Wilmarth (1938).

Marine City Formation, Late Silurian
Remarks: Felber (1964), informal term, see Ode Formation, Lapeer Formation, Salina C, D, F and G Units.

Marshall Dolomite, Early Mississippian
Remarks: Informal term, see Marshall Sandstone.

Marshall Formation, Early Mississippian
Remarks: Outdated term, see Marshall Sandstone, Napoleon Sandstone.

MARSHALL SANDSTONE, Early Mississippian

Related terms: Flat Rock Point Sandstone, Hardwood Point Sandstone, Huron Gritstones, Lighthouse Conglomerate, Lighthouse Point Series, Lower Marshall Sandstone, Marshall Dolomite, Marshall Formation, Marshall Group, Napoleon Sandstone, Osage Group, Richmondville Sandstone, Rock Fall Series, Upper Marshall Sandstone.

Lithology: Red, tan and green sandstone, siltstone, micaceous sandstone, locally shale and carbonate, 200-250 feet (61-76.2 meters) if both upper and lower Marshall Sandstone are included: Southern Peninsula of Michigan.

Type locality: Marshall, Calhoun County, Michigan: Winchell (1861).

Additional references: Harrell and others (1991), Martin and Straight (1956), Westjohn and Weaver (1998), Wilmarth (1938).

Remarks: The term Napoleon Sandstone is rarely used as the term upper Marshall Sandstone is more common. These nomenclatural differences should be resolved. It is a source of groundwater in Michigan.

Massive Anhydrite, Middle Devonian
Remarks: Informal oil field term, see Lucas Formation and Gardner (1974).

Massive Salt, Middle Devonian
Remarks: Informal oil field term, see Lucas Formation and Gardner (1974).

Massive Sand, Middle Ordovician
Remarks: A synonym for the St. Peter and Bruggers Sandstones, see Catacosinos and Daniels (1991b). It is an informal oil field term and should be abandoned. It produces oil and gas.

Maxville Limestone, Late Mississippian
Remarks: Andrews (1870), see Martin and Straight (1956), see Bayport Limestone.

Meaford Formation, Late Ordovician
Remarks: An Ontario, Canada term, see Liberty (1978).

Meldrum Member, Middle Devonian
Remarks: Basal member of the Amherstburg Formation, see Gardner (1974).

Meramec Group, Late Mississippian
Remarks: (Meramecian) North American Series, Upper Mississippian in Michigan for Grand Rapids Group (outdated), or combined Michigan Formation and Bayport Limestone. Should be dropped.

MICHIGAN FORMATION, Late Mississippian

Related terms: Brown Dolomite, Brown Lime, Clare Dolomite, Grand Rapids Series, Lower Grand Rapids Formation, Michigan Salt Group, Michigan Stray Dolomite, Michigan Stray Sandstone, Michigan Stray-Stray Sandstone, Michigan Stray-Stray-Stray Sandstone, National City Gypsum, Stray Dolomite, Stray Sandstone, Stray-Stray-Sandstone, Stray-Stray-Stray Sandstone, Triple Gyp.

Lithology: Shale, limestone, dolomite, anhydrite, gypsum, sandstone, 300-350 feet (91.5-106.7 meters): Southern Peninsula of Mi.

Type locality: Section 3, T6N, R12W, north side of Grand River, near Grand Rapids, Michigan: Taylor (1839).

Additional references: Ball and others (1941), Briggs, (1970), Cohee and others (1951), Eddy (1936), Hard (1938), Harrell and others (1991), Lilienthal (1978), Martin and Straight (1956), Moser (1963), Newcombe (1928,1933), Swanson (1955), Wilmarth (1938).

Remarks: The many informal stratigraphic terms given in Related terms above are very obscure, and most are drillers terms that evolved when the Michigan "stray" was a target for natural gas exploration and for gas storage. Cohee and others (1951), credit the term "triple gyp" to R. H. Wolcott who read an unpublished paper at a 1948 meeting of the Michigan Geological Society (see Moser, 1963 also).

Michigan Salt Group, Late Mississippian
Remarks: Winchell (1861), outdated term for Michigan Formation.

Michigan Stray, Late Mississippian
Remarks: Driller's term, see Michigan Formation, Michigan Stray Sandstone, Stray Sandstone, see Eddy (1936).

Michigan Stray Dolomite, Late Mississippian
Remarks: Drillers term, see Michigan Formation, Stray Dolomite.

Michigan Stray Sandstone, Late Mississippian
Remarks: Drillers term, see Michigan Formation, Stray, Stray Sandstone, see Ball and others (1941), Hard (1938).

Michigan Stray-Stray, Late Mississippian
Remarks: Hard (1938), Ball and others (1941), drillers term, see Michigan Formation, Stray-Stray Sandstone.

Michigan Stray-Stray-Stray, Late Mississippian
Remarks: Hard (1938), Ball and Others (1941), drillers term, see Michigan Formation, Stray-Stray-Stray Sandstone.

Middle Antrim, Late Devonian
Remarks: Dellapenna (1991), informal term, see Antrim Shale, Ellsworth Formation, Ellsworth Shale.

Middle Gray Antrim, Late Devonian
Remarks: Informal term used to describe the gray shale interval separating the two black shale producing interval in Otsego Field, Otsego County, Michigan, see Paxton Member.

Middle Gray Shale, Late Devonian
Remarks: Drillers term, see Paxton Member.

Middle Run Formation, Precambrian?
Remarks: A western Ohio unit, see Shrake and others (1990, 1991), see pre-Mt. Simon Clastics.

MINER'S CASTLE MEMBER, Late Cambrian

Related terms: Basal Conglomerate, Chapel Rock Member, Munising Group.

Lithology: Sandstone, 140 feet (42.7 meters): Northern Peninsula, Michigan.

Type locality: Miner's Castle in the Pictured Rocks cliffs, Michigan: Hamblin (1958).

Additional references: Catacosinos (1973), Catacosinos and Daniels (1991b), Haddox and Dott (1990).

Remarks: Formal surface term, top member of Munising Formation.

Monroe Group, Middle Devonian

Remarks: Lane (1893), also Series and Formation. An obsolete term, the upper Monroe was equivalent in part to the Detroit River Group. See Amherstburg Formation, Anderdon Limestone, Lucas Formation, Sylvania Sandstone, see Carman (1927), Grabau and Sherzer (1910), Martin and Straight (1956) and Wilmarth (1938).

MOUNT SIMON SANDSTONE, Late Cambrian

Related terms: Also Mt. Simon Sandstone, Munising Group.

Lithology: Sandstone, 1500 feet plus (457.5 meters): Upper Midwest.

Type locality: Mt. Simon, near Eau Claire, Wisconsin: in Walcott (1914).

Additional references: Briggs (1968), Catacosinos and Daniels (1991b).

Remarks: Formal term, see also Catacosinos (1973).

MUNISING FORMATION, Late Cambrian

Related terms: Munising Group.

Lithology: Sandstone and conglomerate, about 200-250 feet (61-76 meters): Northern Peninsula of Michigan.

Type locality: Munising, Michigan: Lane and Seaman (1907).

Additional references: Catacosinos (1973) and Catacosinos and Daniels (1991b), Hamblin (1958), Thwaites (1934). See Berquist (1937) and Lake Superior Sandstone.

Remarks: Formal surface term. Members consist of Basal Conglomerate, Chapel Rock and (top) Miner's Castle. The correlation of all the members in the Formation to those in the Group needs clarification.

MUNISING GROUP, Late Cambrian

Related terms: Mount Simon Sandstone, Munising Formation.

Lithology: Sandstone, shale and dolomite, over 600 feet (183 meters): Southern Peninsula of Michigan.

Type locality: Not known: See Briggs (1968).

Additional references: Catacosinos and Daniels (1991b), Shaver and others (1986).

Remarks: See Munising Formation. Extended into Indiana by Droste and Patton (1985), also see Cohee (1945b). Modified by Catacosinos (1973) in the Southern Peninsula, the Group consists of Eau Claire Formation, Galesville Sandstone and (top) Franconia Formation. Briggs (1968) included the Mount Simon Sandstone in his use of the Group. An informal term that needs evaluation, possibly formal proposal. The correlation of all the members of the Group to those in the Formation needs clarification.

N

Napoleon Sandstone, Early Mississippian

Related Terms: Hat Point Sandstone, Marshall Formation.

Lithology: red, green, gray, and buff sandstone, and micaceous sandstone, 50-100 feet 15.2-30.5 meters), locally absent: Northern Peninsula of Michigan.

Type locality: Napoleon, Jackson County, Michigan: Taylor (1839).

Additional references: Martin and Straight (1956), Rieck and Winters (1979), Wilmarth (1938).

Remarks: Thomas (1931) attempted to introduce a third sandstone to the Marshall Sandstone that he termed the Upper Marshall Sandstone, placing it above the Napoleon Sandstone. This term was not adopted, but the terms Napoleon Sandstone and Upper Marshall Sandstone continue to be used interchangeably. Its relationship to the Marshall Sandstone needs clarification.

National City Gypsum, Late Mississippian

Remarks: Moser (1963), see Michigan Formation.

New Richmond Sandstone, Early Ordovician

Remarks: Wooster (1878), it is the middle formation of the Prairie du Chien Group. Misused as a synonym for the Bruggers Sandstone and St. Peter Sandstone. Formal term, but not needed in the Michigan Basin.

NEWTON CREEK MEMBER, Middle Devonian

Remarks: Cooper and Warthin (1941), surface term, see Traverse Group and Martin and Straight (1956). Basal member of Alpena Limestone.

Niagara Formation, Middle Silurian

Remarks: See Catacosinos and others (1991), see Niagara Group.

NIAGARA GROUP, Middle Silurian

Related Terms: Casco Formation, Guelph, Guelph-Lockport, Lockport Dolomite, Niagara Formation, Niagaran Reef, Pinnacle Reef.

Lithology: Generally an argillaceous, micritic, fossiliferous limestone or dolomite with some sucrosic textured zones: Underlies entire Southern Peninsula of Michigan Basin, half of the Northern Peninsula, and most of southern Ontario.

Type locality: New York State: Hall (1842).

Additional references: Friedman and Kopaska-Merkel (1991), Lilienthal (1978), Mesolella and others (1974), Shaver (1991).

Remarks: In the Southern Peninsula the Niagaran carbonate is divided into three oil Industry formation names based on color, texture and E-log response called the (top) Brown Niagara, Gray Niagara and the White Niagara (base). In the Northern Peninsula it corresponds to the Engadine Dolomite. A major oil and gas producer.

Niagaran Reef, Middle Silurian
Remarks: Reef development within the Brown Niagara, oil industry term, see also Guelph Dolomite, Niagara Group, Pinnacle Reef.

Nonesuch Formation, Middle Proterozoic Eon
Remarks: See Nonesuch Shale

NONESUCH SHALE, Middle Proterozoic Eon

Related terms: Copper Harbor Conglomerate, Freda Sandstone, Nonesuch Formation, Oronto Group.

Lithology: Shale, siltstone and sandstone, up to 500 feet (152.5 meters): Northern Peninsula of Mi. and NE Wisconsin.

Type locality: Nonesuch Mine, Gogebic County, Michigan: Irving (1883).

Additional references: Catacosinos and Daniels (1991b), Daniels (1982), Daniels and Elmore (1988), Elmore and others (1988).

Remarks: Formal surface term, middle formation of Oronto Group.

NORWAY POINT MEMBER, Middle Devonian

Remarks: Warthin and Cooper (1935), surface term, see Traverse Group, basal member of the Thunder Bay Limestone.

NORWOOD MEMBER, Late Devonian

Related terms: Antrim Shale, Charlton Black Shale Member, Unit 1C, Lower Black.

Lithology: Black, greenish gray shale, and limestone, less than 20-80 feet (6-24.4 meters): Michigan Basin area.

Type locality: (Presumed) one mile north of the village of Norwood, Michigan: See Gutschick and Sandberg (1991a).

Additional references: Dellapenna (1991), Ells (1979), Gutschick and Sandberg (1991b).

Remarks: Formal surface term, basal member of Antrim Shale.

O

Ode Formation, Middle Silurian
Remarks: Felber (1954), see Lapeer Formation, Marine City Formation, Salina F Unit, Salina G Unit.

OGONTZ MEMBER, Late Ordovician

Remarks: Hussey (1926). Upper member of the Stonington Formation. It is an obscure surface term.

Oneota Dolomite, Early Ordovician
Remarks: McGee (1891), it is the basal formation of the Prairie du Chien Group. Formal term, but not used in the Michigan Basin.

ORONTO GROUP, Middle Proterozoic Eon

Related terms: None.

Lithology: Sandstone, shale, conglomerate and siltstone, about 20,000 feet (6100 meters): Northcentral Wisconsin to Northern Peninsula of Michigan.

Type locality: Oronto Bay, Iron County, Wisconsin: Thwaites (1912).

Additional references: Catacosinos and Daniels (1991b), Daniels (1982), Daniels and Elmore (1988).

Remarks: Formal surface term, Group consists of (base) Copper Harbor Conglomerate, Nonesuch Formation and (top) Freda Sandstone.

Osage Group, Early Mississippian
Remarks: Williams (1891), (Osagean) N. American Series, it is a synonym in Michigan for the Marshall Sandstone.

P

PARMA SANDSTONE, Late Mississippian to Early Pennsylvanian

Related terms: Saginaw Formation.

Lithology: White to yellowish quartzose sandstone with occasional plant remains, 0-220 feet (0-67.1 meters): Much of the Southern Peninsula of Michigan.

Type locality: Parma, Jackson County, Michigan: Winchell (1861).

Additional references: Allen (1917), Kelly (1936), Lane (1902), Newcombe (1928), Wanless and Shideler (1975).

Remarks: The new geologic map by the MGS (1987) does not show the Parma, while current work by the USGS shows the Parma as a stratigraphically continuous unit over most of the basin. Vugrinovich (1984) and Westjohn and Weaver (1998) both place the Parma in the Late Mississippian. Type locality may be now considered as the outcrop on US Interstate-94, just west of US 127 near Jackson, Michigan.

PARTRIDGE POINT MEMBER, Middle Devonian

Remarks: Originally Formation, Warthin and Cooper (1935). Surface term, top member of the Thunder Bay Limestone, see Traverse Group.

PAXTON MEMBER, Late Devonian

Related terms: Antrim Shale, Crapo Creek Gray Shale Member, Middle Gray Antrim, Middle Gray Shale, Unit 1B.

Lithology: Light gray argillaceous limestone and greenish gray calcareous shale, 0-60 feet (0-18.3 meters): Michigan Basin area.

Type locality: Paxton Quarry, about 10 miles west of Alpena, Alpena County, Michigan: Gutschick and Sandberg (1991a).

Additional references: Dellapenna (1991), Ells (1979), Gutschick and Sandberg (1991b).

Remarks: Formal surface unit, member of Antrim Shale.

Permo-Carboniferous Red Beds, Pennsylvanian to Permian
Remarks: Newcombe (1931), age assignment incorrect, some may be related to Pennsylvanian rocks, but most are probably Middle Jurassic in age. See Ionia Formation, Red Beds. Term should be dropped.

Peters Formation, Late Silurian
Remarks: Felber (1964), see Salina C Unit.

Petoskey Limestone, Middle Devonian
Remarks: Grabau (1901), see Traverse Limestone.

Pinnacle Reef, Middle Silurian
Remarks: Oil field term for Reef growth within the Brown Niagara, see also Guelph Dolomite, Niagara Group, Niagaran Reef, see Gill (1979).

Point aux Barques Sandstone, Early Mississippian
Remarks: Winchell (1871). Part of Lower Marshall Sandstone, see Martin and Straight (1956), Wilmarth (1938).

Point aux Gres Limestone, Late Mississippian
Remarks: Douglas (1841), same as AuGres Limestone, equivalent to Bayport Limestone, see Lane (1900), Martin and Straight (1956), Wilmarth (1938). Obsolete term.

POINTE aux CHENES FORMATION, Late Silurian

Remarks: Ehlers (1945). Surface equivalent to the Salina Group, see Martin and Straight (1956).

Port Austin Sandstone, Early Mississippian
Remarks: Lane (1899). Part of Lower Marshall Sandstone, see Martin and Straight (1956), Wilmarth (1938).

POTTER FARM MEMBER, Middle Devonian

Remarks: Surface term, Warthin and Cooper, (1935), see Traverse Group, middle member of Thunder Bay Limestone.

PDC Sand, Middle Ordovician
Remarks: See Prairie du Chien Sandstone. An oil field term that should be dropped.

PRAIRIE du CHIEN GROUP, Early Ordovician

Related terms: Au Train Formation, Brazos Shale, Foster Formation, Jordan Sandstone, Knox Dolomite, New Richmond Sandstone, Oneota Dolomite, St. Lawrence (upper portion), Shakopee Dolomite, T-PDC (PDC portion), Umlor Formation.

Lithology: Dolomite, sandstone and some shale, 300 to over 2500 feet (91.5 to 762.meters) in central basin (including the Foster Formation): Illinois, Wisconsin, southern Minnesota, Iowa.

Type locality: Vicinity of Prairie du Chien, Wisconsin: Bain (1906).

Additional references: Catacosinos and Daniels (1991b), Smith and others (1993, 1996).

Remarks: Formal term, see also Cohee (1945, chart 9) and Fisher and Barratt (1985), produces gas and oil. If the Foster Formation is included, it may also be Middle Ordovician in age. It correlates to a portion of the Knox Dolomite of Janssen (1973). In Illinois, the group consists of the Oneota Dolomite, New Richmond Sandstone and (top) Shakopee Dolomite, terms not presently used in the Michigan Basin.

Prairie du Chien Sandstone, Middle Ordovician

Remarks: A synonym for the St. Peter and Bruggers sandstones, see Catacosinos and Daniels (1991b). Author unknown, it is an informal oil field term, also called PDC sand, both terms should be abandoned.

PRE-MT. SIMON CLASTICS, Middle Proterozoic Eon

Related terms: Freda Sandstone, Jacobsville Sandstone, Middle Run Formation.

Lithology: Sandstone, siltstone and shale, over 800-5000 feet (244-1525 meters): Beaver Island, Michigan, the northern Southern Peninsula subsurface rift zone, and Western Ohio.

Type locality: None: Author unknown: Up to 5000 feet (1525 meters) tentatively assigned to the Freda Sandstone in the McClure Oil, Sparks and others #1-8 well, Gratiot County, and over 800 feet (244 meters) tentatively assigned to the Jacobsville Sandstone in the McClure Oil, Beaver Island #1 well, Charlevoix County. Both wells were drilled into the Southern Peninsula rift zone of Michigan.

Additional references: Catacosinos (1973), Catacosinos (1981), Catacosinos and Daniels (1991b), Shrake and others (1990, 1991).

Remarks: An informal term, pre-Mt. Simon clastics are widespread in the upper Midwest. They appear to be related to rift zone tectonic regimes. See Dickas (1986), Drahovzal and others (1992), Wickstrom and others (1992). Both the Jacobsville Sandstone and the Freda Sandstone have been informally called pre-Mt. Simon clastics in Michigan.

PRECAMBRIAN CRYSTALLINE BASEMENT COMPLEX, Archean to Middle Proterozoic Eons

Remarks: Composed of igneous, metamorphic and sedimentary rocks, see Hinze and Merritt (1969), Hinze and others (1975), Lidiak (1996), Medaris (1983), Reed (1991), van der Pluijm and Catacosinos (1996), Wold and Hinze (1982).

PUT-IN-BAY DOLOMITE, Late Silurian

Remarks: Sherzer and Grabau (1909), basal formation of Bass Islands Group, see Martin and Straight (1956), Wilmarth (1938). An Ohio outcrop term.

Puttygut Formation, Middle Silurian

Remarks: Felber (1964), see Salina A-0 Carbonate, Salina A-1 Carbonate, Salina A-1 Evaporite.

Q

QUEENSTON SHALE, Late Ordovician

Related terms: Big Hill Formation, Richmond Group, Utica Shale.

Lithology: Shale and some dolomite, about 230-930 feet (70.1-283.6 meters): Western New York, Ontario, Michigan.

Type locality: Niagara River at Queenston, Ontario, Canada: Grabau (1908).

Additional references: Martin and Straight (1956), Johnson and others (1992), Wilmarth (1938), Winder (1961).

Remarks: Formal term, top of Richmond Group in Michigan.

R

Rabbit Ears Anhydrite, Late Silurian

Remarks: Oil field term, near reef indicator, see Ruff Formation, Salina A-1 Carbonate, Gill (1977).

RAISIN RIVER DOLOMITE, Late Silurian

Remarks: Sherzer and Grabau (1909), top formation of the Bass Islands Group, see Martin and Straight (1956), Wilmarth (1938). Ohio outcrop term.

RAPSON CREEK FORMATION, Middle Silurian

Remarks: See Johnson and others (1979). Middle Member of the Engadine Group.

Red Beds, Middle Jurassic

Related terms: Eaton Sandstone, Grand River Formation, Grand River Group, Ionia Formation, Ionia Sandstone, Jurassic Red Beds, Permo-Carboniferous Red Beds, Woodville Sandstone.

Lithology: Shale, mudstone, sandstone (generally variegated red-purple-light tan), gypsum, and locally green shales and limestone, generally 50-200 feet (15.2-61 meters): Central Michigan Basin, from northeast Kent County to southwest Roscommon County, and from Gratiot to Osceola Counties, and intervening areas. It is not exposed at the surface; glacial deposits overlie it.

Type Locality: See Winchell (1861): See Lane and Seaman (1909) and remarks below.

Additional references: Cross (1998), Kelly (1936), Shaffer (1968), Smith (1917), Westjohn and others (1994).

Remarks: The first reference to "red beds" Lane and Seaman (1909), was for sediments that had been described by Winchell (1861) (see Woodville Sandstone), and Lane and Seaman (1909, see Ionia Sandstone). Newcombe (1931) suggested the term Red Beds and that they were Permo-Carboniferous in age. The "red beds" as described by Newcombe actually included red sandstones of Pennsylvanian and Jurassic age. The term Ionia Sandstone coined by Lane and Seaman (1909) is for a type locality. These rock units tentatively correlated to Woodville by Kelly (1936) are Middle Jurassic in age and are temporarily called the Ionia Formation by Cross (1998, see the Stratigraphic Problems section of this lexicon). An earlier unpublished report (Mesozoic spores from the "red beds" of Michigan) presented by A. T. Cross in 1964 to the Michigan Basin Geological Society and a dissertation by Shaffer (1969) both establish a Jurassic age for "red beds". The palynological evidence was later shown in a figure published by Dorr and Eschman (1970, p.442-443). The "red beds" near Jackson named Woodville Sandstone by Winchell (1861) are of Pennsylvanian age.

Reed City Anhydrite, Middle Devonian
Remarks: Informal term, see Landes (1951), see Gardner 1974), see Dundee Limestone.

Reed City Dolomite, Middle Devonian
Remarks: Also Zone. Informal term, see Dundee Limestone and Gardner (1974), Landes (1951).

Reed City Member, Middle Devonian
Remarks: Also called Reed City Dolomite or Zone. Informal term, see Landes (1951), see Gardner (1974), see Dundee Limestone, has produced oil.

Richfield Member, Middle Devonian
Remarks: Also known as Richfield Zone. Consists of interbedded carbonates and anhydrite with a maximum thickness of 200 feet (61 meters). It contains sandstone lentils variously called the Richfield Sandstone and Freer Sandstone, and is the lowest member of the Lucas Formation; see Landes (1951), Gardner (1974), Martin and Straight (1956).

Richfield Sandstone, Middle Devonian
Remarks: Informal term, see Richfield Member and Gardner (1974).

Richfield Zone, Middle Devonian
Remarks: Hautau (1952), see Richfield Member.

RICHMOND GROUP, Late Ordovician

Related terms: Cincinnatian Series, CS-Units 1 through 5, Units Two through Six.

Lithology: Shale and limestone interbedded, over 900 feet (274.5 meters): Indiana, SW Ohio, Kentucky, Illinois, Missouri.

Type locality: Richmond, Indiana: Winchell and Ulrich (1897).

Additional references: Catacosinos and others (1991), but as the Cincinnatian Series, Lilienthal (1978), Nurmi (1972).

Remarks: Formal term, should replace Cincinnatian Series. Group in subsurface consists of Utica Shale and (top) Queenston Shale. See also Big Hill Formation, Bill's Creek Shale, Stonington Formation.

Richmondville Sandstone, Early Mississippian
Remarks: Lane (1895), see Marshall Sandstone.

Rock Falls Series, Early Mississippian
Remarks: Lane (1900), see Coldwater Shale, Marshall Sandstone, see Wilmarth (1938).

Rockport Limestone, Middle Devonian
Remarks: Smith (1916), renamed Rockport Quarry Limestone.

ROCKPORT QUARRY LIMESTONE, Middle Devonian

Remarks: Cooper and Warthin (1941), previously named Rockport Limestone. See Martin and Straight (1956), Grand Lake Limestone Member, and Traverse Group.

ROCKVIEW FORMATION, Middle Silurian

Remarks: See Johnson and others (1979). Basal member of Engadine Group.

ROGERS CITY LIMESTONE, Middle Devonian

Remarks: Ehlers and Radabaugh (1938), see Gardner (1974), Martin and Straight (1956), see Dundee Limestone, Rogers City Member.

Rogers City Member, Middle Devonian
Remarks: See Gardner (1974), see Dundee Limestone, Rogers City Limestone.

RUFF FORMATION, Late Silurian

Remarks: Budros and Briggs (1977) see Rabbit Ears Anhydrite, Salina A-1 Carbonate, Salina Group.

S

SAGINAW FORMATION, Early Pennsylvanian

Related terms: Coal Measures, Jackson Coal Measures, Jackson Coal Group, Jackson Formation, Lingula Shales, Parma Sandstone, Verne Limestone.

Lithology: Shale (black, gray, and green), sandstone, coarse to fine, siltstone, very thinly laminated siltstone and shale, coal, locally limestone, limy shale and limy siltstone, 30-563 feet (9.1-171.7 meters). Maximum thickness is in Midland County including Parma Sandstone, see Wanless and Shideler (1975): Roscommon County to Jackson County (north to south) and Newaygo County to Bay County (west to east).

Type locality: Grand Ledge, Eaton County, Michigan: Lane (1900).

Additional references: Cooper (1905), Kelly (1936), Wanless and Shideler (1975).

Remarks: Wanless and Shideler (1975) is the only known significant work on the Pennsylvanian rocks since Kelly (1936). They include the Parma Sandstone in the Saginaw Formation, and consider the Verne Limestone member the top, although they recognize a depositional sequence break indicated by the marine assemblages characteristic of the Verne type deposits.

St. Clair Shale, Late Devonian

Remarks: Lane (1893), see Antrim Shale. Obsolete term.

ST. IGNACE DOLOMITE, Late Silurian

Remarks: Ehlers (1945), see Bass Islands Group, equivalent to Salina H unit, see Martin and Straight (1956).

St. Lawrence Formation, Late Cambrian

Remarks: See Trempealeau Formation and Prairie du Chien Group, also Catacosinos (1973), Catacosinos and Daniels (1991b). Named by A. Winchell (1874). Formal term, but not needed in Michigan Basin.

St. Louis Formation, Mississippian

Remarks: Also Limestone, Engelmann (1847), see Martin and Straight (1956) and discussion of relationship to Meramec Group in Wilmarth (1938).

ST. PETER SANDSTONE, Middle Ordovician

Related terms: Bruggers Sandstone, Jordan Sandstone, Knox Sandstone, New Richmond Sandstone, Massive Sand, Prairie du Chien Sandstone.

Lithology: Sandstone, over 1200 feet (366 meters): Central Michigan Basin subsurface, midwestern United States.

Type locality: St. Peter River (now Minnesota River), southern Minnesota: Owen (1847).

Additional references: Barnes and others (1988, 1992, 1996), Dapples (1955), Catacosinos and Daniels (1991b), Harrison (1987), Mai and Dott (1985), Mazzullo and Ehrlich (1981), Nadon and others (1991, 2000), Smith and Dott (1993), Smith and others (1996).

Remarks: Formal term, produces gas and oil in the central Michigan Basin.

Salina A-0 Carbonate, Late Silurian

Related terms: I Carbonate, A-0 Carbonate, Cain Formation, Casco Formation, Puttygut Formation.

Lithology: Composed of dolomites which are micro-laminated mudstones and planar Stromatolites, 5-10 feet (1.5-3 meters): Almost entire Michigan Basin.

Type section: Southeastern Michigan: Originally Landes (1945b), complex nomenclatural history, see for example the discussions in Gill (1977) and Lilienthal (1978).

Additional references: Alling and Briggs (1961), Dana (1863), Friedman and Kopaska-Merkel (1991) Gill (1973), Evans (1950), Felber (1964), MGS (1964), Sharma (1966), Shaver (1991).

Remarks: First carbonate deposition in the Salina Group sequences with an unconformity at the base separating it from the Niagaran. The Salina A-0 Carbonate formed in a shallow-water marine carbonate mudstone - planar stromatolite depositional environment. It is equivalent to the Cain Formation.

Salina A-1 Carbonate, Late Silurian

Related terms: II Carbonate, A-1 Carbonate, A-1 Sylvinite, Cottrellville Formation, Puttygut Formation, Rabbit Ears Anhydrite, Ruff Formation, Unit A.

Lithology: Composed of dark to light colored limestones and dolomites (micritic) planer stromatolites and lenses of poorly developed nodular anhydrites with occasional stringers of salt, 50-125 feet (15.2-38.1 meters): Almost entire Michigan Basin.

Type locality: Southeastern Michigan: Originally Landes (1945b), a complex nomenclatural history, see for example the discussions in Gill (1977) and Lilienthal (1978).

Additional references: Alling and Briggs (1961), Budros and Briggs (1977), Dana (1863), Evans (1950), Felber (1964), Friedman and Kopaska-Merkel (1991), MGS (1964), Sharma (1966), Shaver (1991).

Remarks: Formed by deposition of carbonate muds and oolites to form micrites and oomicrites between two evaporite sequences within a subsiding basin. It is equivalent to the Ruff Formation. It may contain the Rabbit Ears Anhydrite, a near-reef indicator.

SALINA A-1 EVAPORITE, Late Silurian

Related terms: I Salt and Anhydrite, A-1 Anhydrite, A-1 Evaporite, A-1 Sylvinite, Casco Formation, Puttygut Formation, Salina Group, Unit A.

Lithology: In the center of the basin, the unit is predominantly a clean, massive halite; it becomes mixed with sylvite (forming the Salina A-1 Sylvinite) thickening towards the northwest. Towards the unit's edges, the salt is bounded top and bottom by Salina A-1 Anhydrite; salt thickness in the central basin attains 475 feet (144.8 meters). Where the salt is missing, the Salina A-1 Anhydrite is 10-30 feet (3-9.1 meters): Michigan Basin.

Type locality: Southeastern Michigan: Originally Landes (1945b), complex nomenclatural history, see for example the discussions in Gill (1977) and Lilienthal (1978).

Additional references: Alling and Briggs (1961), Dana (1863), Elowski (1980, Evans (1950), Felber (1964), Gill (1973), MGS (1964), Sharma (1966), Shaver (1991), Sonnenfeld and Al-Aasm (1991).

Remarks: The Salina A-1 Evaporite covers much of the Michigan Basin as salt within roughly the outline of the Niagaran reef trend and the remainder of the basin as anhydrite. Origin is from precipitation of salts and anhydrite from hyper-saline seawater within a subsiding, evaporitic basin. Thins or disappears near or over reefs, a near reef indicator. Informal term, it should be formally named.

SALINA A-2 CARBONATE, Late Silurian

Related terms: A-2 Carbonate, A-2 Dolomite, A-2 Limestone, Salina Group, Unit A.

Lithology: Composed of dark to light colored limestones and dolomites, with lenses of poorly developed anhydrite and occasional stringers of salt. Generally less than 100-150 feet (30.5-45.7 meters), but thickens to as much as 275 feet (83.8 meters) near reefs: Present in most of the basin except in southwestern Michigan where it has been removed by erosion.

Type locality: Southeastern Michigan: Originally Landes (1945b): Complex nomenclatural history, see for example the discussions in Gill (1977) and Lilienthal (1978).

Additional references: Alling and Briggs (1961), Dana (1863), Shaver (1991).

Remarks: Formed by deposition of carbonate muds and oolites to form micrites and oomicrites within a subsiding basin, at the end of an evaporitic sequence. Informal term, it should be formally named.

SALINA A-2 EVAPORITE, Late Silurian

Related terms: II Salt and Anhydrite, A-2 Evaporite, A-2 Salt, Cottrellville Formation, Salina Group.

Lithology: Clean, massive halite in the center of the basin, grading laterally to anhydrite towards the edges of the basin. The salt is up to 475 feet (144.8 meters), the anhydrite is 10-30 feet (3-9.1 meters): Covers two thirds of the basin as salt, most of the remainder as anhydrite.

Type locality: Southeastern Michigan: Originally Landes (1945b), complex nomenclatural history, see for example the discussions in Gill (1977) and Lilienthal (1978).

Additional references: Alling and Briggs (1961), (Dana) 1863, Evans (1950), Gill (1973), Lilienthal (1978), MGS (1964), Sharma (1966), Shaver (1991), Sonnenfeld and Al-Aasm (1991).

Remarks: origin, deposition of salts and anhydrite from hyper-saline seawater within a subsiding evaporite basin, thins or disappears near or over reefs, a near reef indicator. Informal term, it should be formally named.

SALINA B UNIT, Late Silurian

Related terms. III Salt, Armada Formation, B, B Evaporite, B Salt, Big Salt, B Unit, Massive Salt, Salina Group, Unit B.

Lithology: Principally an evaporite (halite) formation, thinning to anhydrite on the margins, shale and dolomites only on the southern margin of the basin, up to 475 feet (144.8 meters) in the central basin: Cover about two thirds of the basin as salt, remainder is shale and dolomite beds.

Type locality: Southeastern Michigan: Originally Landes (1945b), complex nomenclatural history, see for example the discussions in Gill (1977) and Lilienthal (1978).

Additional references: Alling and Briggs (1961), Dana (1863), Evans (1950), Felber (1964), Gill (1973), MGS (1964), Sharma (1966), Sonnenfeld and Al-Aasm (1991).

Remarks: Primarily, deposition of halite within a subsiding evaporitic basin. Thins over reefs. Informal term, it should be formally named.

SALINA C UNIT, Late Silurian

Related terms: IV Shale and Carbonate, C, C Shale, C Unit, Marine City Formation, Peters Formation, Salina Group, Unit C.

Lithology: Consists of greenish-gray shale often containing anhydrite nodules, 60-120 feet (18.3-36.6 meters): Michigan to New York.

Type locality: Southeastern Michigan: Originally Landes (1945b), complex nomenclatural history, see for example the discussions in Gill (1977) and Lilienthal (1978).

Additional references: Alling and Briggs (1961), Dana (1863), Evans (1950), Felber (1964), Gill (1973), MGS (1964), Sharma (1966).

Remarks: Deposition in a shallow-water marine environment. Informal term, it should be formally named.

SALINA D UNIT, Late Silurian

Related terms: IV Salt, D, D Salt, D Unit, Marine City Formation, Peters Formation, Salina Group, Unit D.

Lithology: The Salina D Unit consists of clear to white halite split by a thin dark brown dolomite, averages 40 feet (12.2 meters): Limited to basin interior.

Type locality: Southeastern Michigan: Originally Landes (1945b), complex nomenclatural history, see for example the discussions in Gill (1977) and Lilienthal (1978).

Additional references: Alling and Briggs (1961) Dana (1863), Evans (1950), Felber (1964), Gill (1973), MGS (1964), Sharma (1966), Sonnenfeld and Al-Aasm (1991).

Remarks: Because of its gamma ray-neutron log characteristics, it is one of the most easily recognized Salina units in the basin. Informal term, it should be formally named.

SALINA E UNIT, Late Silurian

Related terms: V Carbonate and Shale, E Unit, Kintigh Zone, Lapeer Formation, Salina Group, Unit E.

Lithology: A series of gray, greenish - gray and red shales interbedded with thin Dolomites, 90-120 feet (24.4-36.6 meters): Covers most of the Southern Peninsula except the southwestern Corner.

Type locality: Southeastern Michigan: Originally, Landes (1945b), complex nomenclatural history, see for example the discussions in Gill (1977) and Lilienthal (1978).

Additional references: Alling and Briggs (1961), Dana (1863), Evans (1950), Felber (1964), Gill (1973), MGS (1964), Sharma (1966), Sonnenfeld and Al-Aasm (1991).

Remarks: The Kintigh Zone, a porous dolomite, has produced some oil. Informal term, it should be formally named.

SALINA F UNIT, Late Silurian

Related terms: V Salt, F Evaporite, F Salt, Lapeer Formation, Marine City Formation, Ode Formation, Salina Group, Unit F.

Lithology: A succession of pure and impure salt beds (halite), thin anhydrites, anhydritic shale beds, shaley dolomites and dolomites, up to 970 feet (295.8 meters): Central Michigan Basin, enclosed by the reef trend. Towards the margins, the salts thin by solution.

Type locality: Southeastern Michigan: Originally Landes (1945b), complex nomenclatural history, see for example the discussions in Gill (1977) and Lilienthal (1978).

Additional references: Alling and Briggs (1961), Dana (1863), Evans (1950), Felber (1964), Gill (1973), MGS (1964), Sharma (1966), Sonnenfeld and Al-Aasm (1991).

Remarks: Ells (1962, 1967) informally divided the F Evaporite into six convenient units based on gamma ray-neutron log characteristics. He called them F Salt 1- F Salt 6. Formed by precipitation of salt in an evaporitic sequence. The shallow-water marine shales and carbonates were deposited during hyper-saline evaporative conditions within a subsiding basin. Informal term, it should be formally named.

Salina Formation, Middle to Late Silurian
Remarks: Dana (1863), see Salina Group.

SALINA G UNIT, Late Silurian

Related terms: G, G Shale, G Unit, Marine City Formation, Ode Formation, Salina Group, Unit G.

Lithology: Gray shaley dolomite, ranges from 40-80 feet (12.2-24.4 meters): Present in most of the Southern Peninsula except the southwestern corner where it has been removed by erosion.

Type locality: Southeastern Michigan: Originally Landes (1945b), complex nomenclatural history, see for example the discussions in Gill (1977) and Lilienthal (1978).

Additional references: Alling and Briggs (1961), Dana (1863) Evans (1950), Felber (1964), Gill (1973), MGS (1964), Sharma (1966).

Remarks: The shale is highly radioactive. These shallow marine deposits formed within a subsiding basin at the end of an evaporitic cycle. Informal term, it should be formally named. Top member of Salina Group.

SALINA GROUP, Late Silurian

Remarks: Informally named by Hall (1894). Originally named as Formation by Dana (1863), for rocks in Onondaga and Cayuga Counties, New York. See Lilienthal (1978), Friedman and Kopaska-Merkel (1991), Sonnenfeld and Al-Aasm (1991), See Salina Formation. Subsurface members include, in stratigraphic order: Cain Formation (base), Salina A-1 Evaporite, Ruff Formation, Salina A-2 Evaporite, Salina A-2 Carbonate, Salina B Unit, Salina C Unit, Salina D Unit, Salina E Unit, Salina F Unit, Salina G Unit (top).

Salina H Unit, Late Silurian
Remarks: Landes (1945b), see Bass Islands Group. Equivalent to the St. Ignace Dolomite.

SCHOOLCRAFT FORMATION, Middle Silurian

Remarks: See Harrison (1985), also Sanford (1978). Basal formation of the Manistique Group, it should be formally raised to formation status. See Schoolcraft Member.

Schoolcraft Member, Middle Silurian
Remarks: Also Dolomite (surface) and Formation: Newcombe (1933). Lower member of the Manistique Group, its designation should be changed formally to Formation. See Harrison (1985), Newcombe (1933), but see Martin and Straight (1956). Formal surface term.

Shakopee Dolomite, Early Ordovician
Remarks: Named by Winchell (1874), formal term, it is the top formation of the Prairie du Chien Group. Normally not used in Michigan Basin.

Silica Shale, Middle Devonian
Remarks: Equivalent to the Bell Shale, it is an Ohio term.

Sneaky Peak, Middle Ordovician
Remarks: Presumably also Sneaky Peek and Sneaky Pete. An informal oil field term for a porosity zone near the base of the Black River Formation, cited in DeHaas and Jones (1988). Considered by some to be a proximity indicator of fault controlled dolomitization. See also Extra Section.

Sour Zone, Middle Devonian
Remarks: Informal oil field term, see Lucas Formation and Gardner (1974). An oil and gas zone.

Speckled Dolomite, Early Mississippian
Remarks: Informal term, see Hale (1941). Horizon found in the Coldwater Shale.

SQUAW BAY LIMESTONE, Middle to Late Devonian

Remarks: Surface term, Warthin and Cooper (1935, 1943). See Gutschick and Sandberg (1991), Jordan River Formation and Traverse Formation. It underlies the Antrim Shale and overlies the Thunder Bay Limestone.

STONINGTON FORMATION, Late Ordovician

Remarks: Originally Stonington Beds, Hussey (1926). Shown as a formation on Chart 1 (MGS, 1964). It is divided into the Ogontz (above) and Bay de Noc members. Equivalent to the upper part of the Utica Shale of the Richmond Group. See Liberty (1978). Obscure surface term.

Stray Dolomite, Late Mississippian
Remarks: Drillers term, see Michigan Formation, Michigan Stray Dolomite.

Stray Sandstone, Late Mississippian
Remarks: Drillers term, see Michigan Formation, Michigan Stray Sandstone.

Stray Stray Sandstone, Late Mississippian
Remarks: Drillers term, see Michigan Formation, Michigan Stray Stray Sandstone.

Stray Stray Stray Sandstone, Late Mississippian
Remarks: Drillers term, see Michigan Formation, Michigan Stray Stray Stray Sandstone.

SUNBURY SHALE, Early Mississippian

Related terms: None

Lithology: Organic rich black shale similar to the Antrim black shales, up to 100 feet (30.5 meters) in the region around Saginaw Bay. Present throughout the Michigan Basin except in the southwest.

Type locality: Sunbury, Delaware County, Ohio: Hicks (1878).

Additional references: Davis (1909), Gutschick and Sandberg (1991a,b), Harrell and others (1991), Matthews (1993).

Remarks: Formal term. A highly radioactive, organic rich shale.

SYLVANIA SANDSTONE, Middle Devonian

Related terms: Monroe Group (or Formation), Detroit River Group.

Lithology: Sandstone, 20 feet plus (6.1 meters): Northwestern Ohio, Michigan and western Ontario.

Type locality: Sylvania, Lucas County, Ohio: Orton (1888).

Additional references: Catacosinos and others (1991), Gardner (1974), Grabau and Sherzer (1910), Martin and Straight (1956), Wilmarth (1938).

Remarks: Formal term, basal formation of the Detroit River Group.

T

THUNDER BAY LIMESTONE, Middle Devonian

Remarks: Douglass (1840), surface term. See Traverse Group, Whisky Creek Formation, Gutschick and Sandberg (1991a), Martin and Straight (1956), Warthin and Cooper (1935, 1943) and Wilmarth (1938). Overlain by the Squaw Bay Limestone. Three members, (top) Partridge Point, Potter Farm and Norway Point (base).

T-PDC, Late Cambrian to Middle Ordovician

Remarks: An acronym for the Trempealeau Formation and the Prairie du Chien Group (including Foster Formation), see Catacosinos and Daniels (1991b), Catacosinos and others (1991), Smith and others (1993, 1996). An informal term, the stratigraphic relationships between the Trempealeau and the Prairie du Chien need modern study.

Traverse Formation, Late Devonian

Related terms: Antrim Shale, Hamilton Group, Squaw Bay Limestone, Traverse Group, Traverse Limestone.

Lithology: Interbedded carbonates and gray and black shales with the shales progressively dominating the section upwards, up to 80 feet (24.4 meters): Present in the western and central portions of the basin. Thins to a featheredge in eastern Michigan.

Type locality: Southern Peninsula of Michigan: Winchell (1861).

Additional references: Dellapenna (1991), Ells (1979), Gardner (1974), Martin and Straight (1956), Warthin and Cooper (1943), Wilmarth (1938).

Remarks: It has been replaced in more modern usage by the surface term Squaw Bay Limestone. Once considered by some workers to be the upper part of the Traverse Group, it is transitional with and into the overlying Antrim Shale sequence, see also Gutschick and Sandberg (1991a,b). The terminology and age of the general term Traverse requires modern study and formal redefinition.

TRAVERSE GROUP, Middle Devonian

Remarks: Winchell (1871), as Little Traverse Group. Subdivided into following formations or members on outcrop. See Warthin and Cooper (1935,1943). From top to bottom;

- Thunder Bay Limestone
  - Partridge Point Member
  - Potter Farm Member
  - Norway Point Member
  - Alpena Limestone
  - Four Mile Dam Member
  - Newton Creek Member
  - Long Lake Limestone
  - Killians Member
  - Genshaw Member
- Ferron Point Formation
- Rockport Quarry Limestone
- Bell Shale

In the subsurface it consists of the Traverse Limestone, and Bell Shale (base), see Gardner (1974), Grabau (1902), Gutschick and Sandberg (1991a,b), Lilienthal (1978), Martin and Straight (1956), Wilmarth (1938), see Traverse Formation.

TRAVERSE LIMESTONE, Middle Devonian

Remarks: See Bell Shale, Charlevois Stage, Traverse Formation, Traverse Group. An informal subsurface term introduced into oil field studies before 1940. Modern re-evaluation is called for to establish its relationship to the Traverse Group.

TREMPEALEAU FORMATION, Late Cambrian

Related terms: Copper Ridge Dolomite, Lodi Formation, St. Lawrence Formation (lower part), T-PDC (T portion of the acronym).

Lithology: Dolomite, over 300 feet (91.5 meters): Southern Wisconsin, northern Illinois and Iowa, and southern Minnesota.

Type locality: Trempealeau Bluffs, Trempealeau County, Wisconsin: Thwaites (1923).

Additional references: Catacosinos and Daniels (1991b).

Remarks: Formal time term, it should be formally re-named as a rock unit.

TRENTON FORMATION, Middle Ordovician

Related terms: Cap Dolomite, Chandler Falls Member, Escanaba Limestone, Groos Quarry Member.

Lithology: Limestone, up to 550 feet (167.7 meters): New York, Pennsylvania, Northern Ohio, Western Virginia, Indiana, Ontario.

Type locality: Trenton Falls, Oneida Co., New York: Vanuxem (1838).

Additional references: Budai and Wilson (1991), Catacosinos and others (1991).

Remarks: Formal term, major oil and gas producer. The preferred terminology for the Michigan basin, it was originally named Trenton Limestone; the term Trenton Group is occasionally used also.

Triple Gyp, Late Mississippian
Remarks, Drillers term for three separate gypsum/anhydrite horizons commonly associated with Michigan Stray gas fields, see Michigan Formation.

Tymochtee Shale, Late Silurian
Remarks: Winchell (1873), as Tymochtee Slate. See Bass Islands Groups, see Martin and Straight (1956), Wilmarth (1938). Ohio outcrop term.

U

Umlor Formation, Early Ordovician
Remarks: Named by Brady and DeHaas (1988b), see Prairie du Chien Group, Foster Formation and Catacosinos and Daniels (1991b). Informal oil field term.

Unit 1A, Late Devonian
Remarks: Ells (1979), informal term, see Lachine Member of Antrim Shale.

Unit 1B, Late Devonian
Remarks: Ells (1979), informal term, see Paxton Member of Antrim Shale.

Unit 1C, Late Devonian
Remarks: Ells (1979), informal term, see Norwood Member of Antrim Shale.

Unit 3, Late Devonian
Remarks: Ells (1979), informal term, see Elltrim.

Units A-G, Middle to Late Silurian
Remarks: Landes (1945b), see appropriate Salina units.

Units One through Six, Late Ordovician
Remarks: Nurmi (1972), informal Cincinnatian Series units. Unit One is equivalent to the Utica Shale, see CS Units-1 through 5, Richmond Group, Utica Shale, see Lilienthal (1978).

Upper Antrim, Late Devonian
Remarks: Dellapenna (1991), see Antrim Shale, Light Antrim.

Upper Black Shale, Late Devonian
Remarks: Drillers term, see Chester Black Shale member and Lachine Member of the Antrim Shale, Unit 1A.

Upper Marshall Sandstone, Early Mississippian
Remarks: Thomas (1931), see Marshall Sandstone and Napoleon Sandstone.

Upper Member, Late Devonian
Related terms: Antrim Shale
Lithology: Black Shale, about 25 feet (7.6 meters): Michigan Basin area.
Type locality: Paxton Quarry, 10 miles west of Alpena, Alpena County, Michigan: Gutschick and Sandberg (1991a).
Additional references: Gutschick and Sandberg (1991b).
Remarks: Surface term, unnamed upper member of Antrim Shale.

UTICA SHALE, Late Ordovician

Related terms: Bill's Creek Shale, Collingwood Shale, Queenston Shale, Richmond Group, Stonington Formation, Unit One (of Units One through Six).

Lithology: Shale, 200-400 feet (61-122 meters): Mid-western United States.

Type locality: Utica, New York: Emmons (1842).

Additional references: Catacosinos and others (1991), Hiatt and Nordeng (1985), Nurmi (1972).

Remarks: Formal term, base of Richmond Group, see also Cincinnatian Series (Unit One is equivalent to the Utica Shale). See Lilienthal (1978), Nurmi (1972).

V

Van Wert Zone, Middle Ordovician
Remarks: An informal oil field term for a porosity zone in the lower Black River Formation. An oil and gas zone in the Stoney Point Field, Michigan.

Verne Limestone, Middle Pennsylvanian
Remarks: Kelly (1936), see Saginaw Formation, see Martin and Straight (1956), MGS (1964), Vugrinovich (1984), Wanless and Shideler (1975).

W

Wells Creek Formation, Middle Ordovician
Remarks: An Ohio term, see Janssens (1973). Correlates to the Glenwood Formation.

Whisky Creek Formation, Middle Devonian
Remarks: Kesling and others (1974), equivalent to the Thunder Bay Limestone, see Gutschick and Sandberg (1991a,b).

White Niagara, Middle Silurian
Remarks: Informal oil field term, see Niagara Group. Lower part of Lockport Dolomite, see Friedman and Kopaska-Merkel (1991).

Wier Sandstone, Early Mississippian

Remarks: Informal drillers term, used to describe gas producing beds in the Coldwater Shale at West Branch and Logan fields, Ogemaw County, Michigan, see Newman (1936), Martin and Straight (1956), Wilmarth (1938). The term "Wier Sand" may have been imported from the Appalachian Basin where a thin sand of Mississippian age occurs above the Sunbury Shale. See Pepper and others (1954, Fig. 22).

Woodville Sandstone, Late Pennsylvanian

Remarks: Winchell (1861), see Eaton Sandstone, Ionia Formation, Ionia Sandstone, Red Beds, see Martin and Straight (1956) and Wilmarth (1938). According to Newcombe (1933) it should be dropped.

X, Y

Z

Zone of Unconformity, Middle Ordovician

Remarks: Bricker and others (1983), see Glenwood Formation, Goodwell unit and Catacosinos and Daniels (1991b). It is an informal subsurface term.

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GSA	Geological Society of America
MBGS	Michigan Basin Geological Society
MGS	Michigan Geological Survey
USGS	United States Geological Survey

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X

Y

Z

INDEX BY PERIOD

Note: With the exception of the T-PDC acronym, all stratigraphic terms shown completely capitalized are part of the Stratigraphic Nomenclature for Michigan chart which accompanies this volume.

Wier Sandstone

Mississippian

Babbitt Sandstone

St. Louis Formation

Devonian, Late

Antrim Formation

ANTRIM SHALE

BEDFORD SHALE

Berea Grit (also Shale)

BEREA SANDSTONE

Charlton Black Shale Member

Chester Black Shale Member

Crappo Creek Grey Shale Member

Dark Antrim

Ellsworth Formation

ELLSWORTH SHALE

Elltrim

Huron Group

Huron Shale

Jordan River Formation (Middle to Late Devonian)

Kettle Point Formation

LACHINE MEMBER

Light Antrim

Lower Antrim

Lower Black (also Lower Black Antrim)

Middle Antrim

Middle Gray Antrim

Middle Gray Shale

NORWOOD MEMBER

PAXTON MEMBER

St. Clair Shale

SQUAW BAY LIMESTONE (Middle to Late Devonian)

Traverse Formation

Unit 1A

Unit 1B

Unit 1C

Unit 3

Upper Antrim

Upper Black Shale

Upper Member

Devonian, Middle

ALPENA LIMESTONE

Amherstburg Dolomite

AMHERSTBURG FORMATION

ANDERDON LIMESTONE

BELL SHALE

Big Anhydrite

Big Salt

Black Lime

BOIS BLANC FORMATION

Charlevoix Stage

Detroit River Dolomite

DETROIT RIVER GROUP

Dundee Formation

DUNDEE LIMESTONE

FERRON POINT FORMATION

Filer Sandstone

Flat Rock Dolomite Member

FOUR MILE DAM MEMBER

Freer Sandstone

GENSHAW MEMBER

Grand Lake Limestone Member

Gravel Point Limestone

Gravel Point Stage

Hamilton Group

Horner Member

Iutzi Member

Jordan River Formation (Middle to Late Devonian)

KILLIANS MEMBER

LONG LAKE LIMESTONE

Long Lake Series

LUCAS FORMATION

MACKINAC BRECCIA (Late Silurian to Middle Devonian)

Mackinac Limestone

Massive Anhydrite

Massive Salt

Meldrum Member

Monroe Group

NEWTON CREEK MEMBER

NORWAY POINT MEMBER

PARTRIDGE POINT MEMBER

Petoskey Limestone

POTTER FARM MEMBER

Reed City Anhydrite

Reed City Dolomite

Reed City Member

Richfield Member

Richfield Sandstone
Richfield Zone
Rockport Limestone

ROCKPORT QUARRY LIMESTONE

ROGERS CITY LIMESTONE

Rogers Member
Silica Shale
Sour Zone

SQUAW BAY LIMESTONE (Middle to Late Devonian)

SYLVANIA SANDSTONE

THUNDER BAY LIMESTONE

TRAVERSE GROUP

TRAVERSE LIMESTONE

Whisky Creek Formation

Devonian, Early

GARDEN ISLAND FORMATION

MACKINAC BRECCIA (Late Silurian to Middle Devonian)

Silurian, Late

I Carbonate
II Carbonate
I Salt and Anhydrite
II Salt and Anhydrite
III Salt
IV Salt
IV Shale and Carbonate
V Salt
V Shale and Carbonate
A-0 Carbonate
A-1 Anhydrite
A-1 Carbonate
A-1 Dolomite
A-1 Evaporite
A-1 Limestone
A-1 Salt
A-1 Sylvinite
A-2 Anhydrite
A-2 Carbonate
A-2 Dolomite
A-2 Evaporite
A-2 Limestone
A-2 Salt
Armada Formation
B
B Evaporite
B Salt
B Unit
Bass Islands Formation

BASS ISLANDS GROUP

C
C Shale
C Unit

CAIN FORMATION

D
D Salt
D Unit
E
E Unit
F
F Evaporite
F Salt
F Unit
G
G Unit
G Shale
Greenfield Dolomite
H Unit
Kintigh Zone
Lapeer Formation

MACKINAC BRECCIA (Late Silurian to Middle Devonian)

Marine City Formation
Peters Formation

POINTE aux CHENES FORMATION

PUT-IN BAY DOLOMITE

Rabbit Ears Anhydrite

RAISIN RIVER DOLOMITE

RUFF FORMATION

ST. IGNACE DOLOMITE

Salina A-0 Carbonate
SalinaA-1 Carbonate

SALINA A-1 EVAPORITE

SALINA A-2 CARBONATE

SALINA A-2 EVAPORITE

SALINA B UNIT

SALINA C UNIT

SALINA D UNIT

SALINA E UNIT

Salina Formation (Middle to Late Silurian)

SALINA F UNIT

SALINA G UNIT

SALINA GROUP

Salina H Unit

Tymochtee Shale

Units A-G (Middle to Late Silurian)

Silurian, Middle

Big Salt

Brown Niagara

Burnt Bluff Dolomite

Burnt Bluff Formation

BURNT BLUFF GROUP

Burnt Bluff Limestone

BUSH BAY FORMATION

BYRON FORMATION

Casco Formation

Clinton Formation

CORDELL FORMATION

Cordell Member

Cottrellville Formation

Engadine Dolomite

ENGADINE GROUP

FIBORN LIMESTONE MEMBER

Galt Limestone

Gray Niagara

GUELPH DOLOMITE

Guelph-Lockport

HENDRICKS FORMATION

Hendricks Member

LIME ISLAND FORMATION

LOCKPORT DOLOMITE

Lower Restricted Marine

Manistique Formation

MANISTIQUE GROUP

Manistique Series

Niagara Formation

NIAGARA GROUP

Niagaran Reef

Ode Formation

Pinnacle Reef

Puttygut Formation

RAPSON CREEK FORMATION

ROCKVIEW FORMATION

Salina Formation (Middle to Late Silurian)

SCHOOLCRAFT FORMATION

Schoolcraft Member Units A-G (Middle to Late Silurian)

White Niagara

Silurian, Early

CABOT HEAD SHALE

Cataract Formation

CATARACT GROUP

MANITOULIN DOLOMITE

Manitoulin Formation

Manitoulin Limestone

Ordovician, Late

Arnheim Shale

BAY de NOC MEMBER

BIG HILL FORMATION

BILL'S CREEK SHALE (Middle to Late Ordovician)

Cincinnatian Series

CS-Units 1 through 5

Dundas Formation

Lorraine Group

Meaford Formation

OGONTZ MEMBER

QUEENSTON SHALE

RICHMOND GROUP

STONINGTON FORMATION

Units One through Six

UTICA SHALE

Ordovician, Middle

Basal Beds

BILL'S CREEK SHALE (Middle to Late Ordovician)

BLACK RIVER FORMATION

Black River Group

Black River Limestone

Black River Shale

Blue Mountain Formation

Bony Falls Formation

Brazil Shale

Brazos Shale

Bruggers Sandstone

Cap Dolomite

CHANDLER FALLS MEMBER

Collingwood Formation

COLLINGWOOD SHALE

Escanaba Limestone
Extra Section

FOSTER FORMATION (Early to Middle Ordovician)

GLENWOOD FORMATION
Glenwood Shale
Goodwell Unit

GROOS QUARRY MEMBER
Gull River Formation
Lower Knox Carbonate (Early to Middle Ordovician)
Massive Sand
PDC Sand
Prairie du Chien Sandstone

ST. PETER SANDSTONE
Sneaky Peak
Sneaky Peek
Sneaky Pete
T-PDC (Late Cambrian to Middle Ordovician)

TRENTON FORMATION
Van Wert Zone
Wells Creek Formation
Zone of Unconformity

Ordovician, Lower

AU TRAIN FORMATION

FOSTER FORMATION (Early to Middle Ordovician)
Hermansville Limestone
Knox Dolomite
Lower Knox Carbonate (Early to Middle Ordovician)
Lower Magnesian
New Richmond Sandstone
Oneota Dolomite

PRAIRIE du CHIEN GROUP
Shakopee Dolomite
T-PDC (Late Cambrian to Middle Ordovician)
Umlor Formation

Cambrian Late

Basal Conglomerate

CHAPEL ROCK MEMBER
Copper Ridge Dolomite
Dresbach Sandstone

EAU CLAIRE FORMATION

FRANCONIA FORMATION
Franconia Sandstone

GALESVILLE SANDSTONE
Jordan Sandstone
Kerbel Formation
Knox Sandstone
Lake Superior Group
Lake Superior Sandstone
Lodi Formation

MINER'S CASTLE MEMBER

MOUNT SIMON SANDSTONE

MUNISING FORMATION

MUNISING GROUP
St. Lawrence Formation
T-PDC (Late Cambrian to Middle Ordovician)

TREMPEALEAU FORMATION

Precambrian

Granite Wash
Middle Run Formation (Precambrian?)

Proterozoic Eon, Middle

COPPER HARBOR CONGLOMERATE

FREDA SANDSTONE

JACOBSVILLE SANDSTONE
Nonesuch Formation

NONESUCH SHALE

ORONTO GROUP

PRE-MT. SIMON CLASTICS

PRECAMBRIAN CRYSTALLINE BASEMENT COMPLEX (Archean to Middle Proterozoic Eons)

Archean Eon

PRECAMBRIAN CRYSTALLINE BASEMENT COMPLEX (Archean to Middle Proterozoic Eons)

Figure 1: Stratigraphic Succession in Michigan: Chart 1,1964, Michigan Department of Environmental Quality, Geological Survey Division is seen on page 54

Figure 2: Stratigraphic Nomenclature for Michigan, 2000, Michigan Department of Environmental Quality, Geological Survey Division is seen on page 55

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Figure 1: Stratigraphic Succession in Michigan: Chart 1,1964, Michigan Department of Environmental Quality, Geological Survey Division

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Figure 2: Stratigraphic Nomenclature for Michigan, 2000, Michigan Department of Environmental Quality, Geological Survey Division

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