

Correlation Problems with the Cambrian and Ordovician Systems in Illinois with Neighboring Wisconsin and Missouri

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Abstract:

The Cambrian and Ordovician rocks throughout the Midwest have been classified by many workers over the years. Most of the states surrounding Illinois developed their classification system in the 1960s or 1970s. Since then a wealth of new information has arrived, and there are many units that need modification or redefinition.

Purpose:

The need for stratigraphic reclassification is of great importance. As resources become harder to find we need to achieve a more accurate picture of the rocks from which we take our resources. This includes stone, soil, oil, minerals and, perhaps most importantly, water. Currently the Maquoketa Group (see Figure 1) is the only set of units addressed here that are actively being redefined. Older units need to be reexamined in order to understand the rocks in on which we depend so much.

Introduction:

Little has been done in the past 30 years to correlate and classify the Cambrian and Ordovician rocks throughout the Midwest. Wisconsin, Illinois, and to a lesser extent Missouri have all developed their own classification system over the years. This is a preliminary report that sets the stage to address these shortcomings. Since the establishment of Willman's excellent 1975 Illinois State Geological Survey publication "Handbook of Illinois Stratigraphy," a wealth of new information has come about. Quarries have deepened, tunnels have been dilled in the bedrock under Chicago, the North American Stratigraphic Code has been updated, and mapping by the state survey has increased. This publication addresses but does not resolve present correlation issues.

Precambrian:

The Precambrian rocks in Illinois are mentioned here because they form the basement rock in which all of our sedimentary rocks are deposited. Only a handful of wells have ever penetrated the Precambrian rocks. Most wells that have are in northern Illinois (where the sedimentary rocks are at their thinnest). None have been drilled in Eastern Illinois. We don't know much about the Precambrian, since Precambrian rocks outcrop nowhere in Illinois. From the limited data that we have the rocks appear to be all igneous granites and rhyolites. No metamorphic rocks have yet been discovered.

Cambrian:

Mount Simon Formation:

The sedimentary rocks directly overlying the Precambrian in Illinois are all Cambrian in age. These rocks are at the surface in North-central Illinois only, around the area of Rochelle. The basal Formation that covers almost all of the Precambrian are the sands and conglomerates of the *Mount Simon Formation*. Since the *Mount Simon* does not occur at the surface everything we know about it in Illinois is from subsurface data. Willman defined seven members within the *Mount Simon*. These members are based on relative amounts of gravel. It is possible that the lowest member, the *Crane Member*, is actually equivalent to basal conglomerates in Wisconsin that are assigned to the Oronto Group and may actually be Precambrian in age. The two members above the *Crane* are the *Keyon* and *Lovell Members* (see Figure 1). These may be equivalent to the Middle Cambrian Bayfield Group in Wisconsin. More information on these basal Members is needed to assign an exact age. Since their exact regional extent and conformable boundaries is not known, they are included in the *Mount Simon*.

The *Mount Simon* is very important to the residents of Illinois. It serves as a major aquifer for community water wells. It is also a potential source for carbon dioxide storage and gravel source.

Eau Claire / Bonnetterre Formations:

While researching Figure 1, it was realized that the *Lombard Member* (Buschbach 1964) of the *Eau Claire Formation* actually grades southward into the *Bonnetterre Formation* of Missouri and Tennessee. For the purpose of this report, the *Lombard* is renamed the *Lombard Tongue* and assigned to the carbonates of the *Bonnetterre Formation*. This renaming is more consistent with the North American Stratigraphic Code. Also the overlying and underlying *Proviso* and *Elmhurst* are renamed as Tongues of the *Eau Claire Formation* (see Figure 1 and 2). As you go from north to south the *Eau Claire Formation* gives way to the *Bonnetterre Formation*.

Wonewoc Formation:

Traditionally the *Ironton* and *Galesville* have been Formations in Illinois and rest above the *Eau Claire Formation*. However, in the subsurface they are often not separated and referred to as the *Ironton-Galesville* (hyphenated names should be avoided) or worse, lumped into one or the other. Since they are a major source of water a standard has to be developed. It is suggested that the *Ironton* and *Galesville* be reduced to Members and that the Wisconsin *Wonewoc Formation* be extended through Illinois. The *Ironton* and *Galesville* do not change significantly from Wisconsin to Illinois. There is no need for two sets of nomenclature. Since the contact between the two is gradational, Wisconsin's nomenclature should be adopted in Illinois.

Tunnel City Group:

Overlying the *Wonewoc Formation* is the *Franconia Formation* (labeled *Lone Rock Formation* in Figure 1). Since the term "Franconia" is also used as a biostratigraphic time unit in the Midwest (Ostrom 1967), it should be dropped as a Formation to avoid confusion. The *Lone Rock Formation* of the Tunnel City Group in Wisconsin is equivalent to what Buschbach defined as the *Franconia Formation* in 1964. As a result, the Tunnel City Group and *Lone Rock Formation* should be extended into Illinois. The *Davis Member* (base of the Formation) is included here as a Tongue. The *Derby-Dorun Member* of the *Franconia Formation* appears to grade southward into the *Potosi Formation*. Hence the *Derby-Dorun* is removed from the *Franconia*, and becomes a carbonate tongue of the *Potosi Formation* (see Figure 1). It is also recommended that the *Derby-Dorun's* name be changed at some point to avoid hyphenating it.

The upper Tongue of the *Lone Rock Formation* (see Figure 1) was originally the *Momence Member* of the *Eminence Formation*. However, there is evidence that the *Momence* actually grades into the *Lone Rock*. Since both are sandstones, it is more appropriate to assign the *Momence* to the *Lone Rock*. The *Momence* is somewhat patchy and discontinuous. This is probably due to the fact it is rarely more than 15 feet thick. An unconformity probably does not exist above or below. More data is needed before the exact position of the *Momence* can be determined.

As you go from north to south the Tunnel City Group gives way to the *Potosi Formation* in a similar way as the older *Eau Claire* and *Bonnetterre Formations*.

Potosi and Eminence Formations:

The *Potosi* appears to grade into the Tunnel City Group but is not part of it. It retains its definition as defined by Willman in 1975 with the inclusion of the *Derby-Dorun Tongue*. The overlying *Eminence Formation* also retains its original definition minus the *Momence*. The *Eminence Formation* grades laterally northward into the *Black Earth Member* of the *Saint Lawrence Formation*. The two do not appear to be the same unit. The *Black Earth* of Wisconsin is a far less pure, fossil-rich dolostone than the *Eminence Formation*. The *Black Earth* appears to be a shoal deposit as whereas the *Eminence* is a carbonate shelf deposit.

Jordan Formation and Gunter Member:

The *Jordan Formation* is the upper-most Cambrian Formation in Wisconsin and Northwestern Illinois. No unconformity exists above or below. It consists of two Members in Wisconsin but is so thin in Illinois that it is not differentiated. It is a clean sandstone and resembles the Ordovician *Saint Peter Formation* in parts of Wisconsin where it is a moderate aquifer.

The *Gunter Member* is included within the overlying Ordovician *Arsenal Member* of the *Oneota Formation* and is roughly at the same stratigraphic position as the *Jordan Formation*. Willman in 1975 stated that the *Gunter* has sharp contacts above and below, and these contacts maybe unconformities. Sharp contacts do not necessarily indicate unconformities. Since the above and below units are carbonates and the *Gunter* is an impure sandstone, the possibility of unconformities must be entertained. The *Gunter* is used in Illinois as a minor aquifer. It is important to derive its exact position. If there are unconformities present that means the *Gunter* could be either Cambrian or Ordovician in age. Unfortunately the *Gunter* is not very fossiliferous, and more research is needed to determine its age. For now, it is included as defined by Willman in 1975.

Ordovician:

Oneota Formation:

The *Oneota Formation* is the oldest known Ordovician unit in the area. It is present in Wisconsin and is divided into two Members that differ from the two Members in Illinois, although they maybe equivalent. Since the Sub-Tippecanoe I Unconformity has separated the Wisconsin and Illinois Members, they will not be redefined here (see Figure 1).

Shakopee Formation:

The *Shakopee* in Wisconsin is a formation that includes the *New Richmond Sandstone* as a Member. In Illinois the *New Richmond* has traditionally been a Formation. The *New Richmond* in Illinois is thicker than in Wisconsin and is lithologically unique. However, it does seem to intertongue or gradate into the *Shakopee* to the south, and the upper contact is sometimes gradational. The nomenclature for the *Shakopee* in Wisconsin should be extended through Illinois. This includes the extension of the *Willow River Member* into Illinois. The *New Richmond* is a moderate aquifer in Illinois and crops out along the Sandwich Fault Zone in North-central Illinois.

Everton Formation:

The *Everton Formation* unconformably overlies the *Shakopee* and exists in Illinois only as a small tongue in the Southwest corner of the State. It has known unconformities above and below and is somewhat patchy. It thickens rapidly into Missouri where it serves as an aquitard.

Ancell Group:

The Ancell Group lies above the Sub-Tippecanoe I Unconformity. The Sub-Tippecanoe I is an erosional unconformity. As a result, the Ancell Group lies on rocks as old as Upper Cambrian and as young as the *Everton*. The main body of the Ancell Group is the *Saint Peter Formation*, which is a clean, white, well-sorted quartz sandstone, some of the cleanest in the world. The *Saint Peter* has a basal conglomerate known as the *Readstown Member* in Wisconsin and is called the *Kress Member* in Illinois. However, the name *Readstown* trumps *Kress* for two reasons. No neighboring States use the term *Kress* the *Readstown's* type section is an actual outcrop and not a boring (Ostrom 1967). The *Tonti* and *Starved Rock Members* serve as a major aquifer and source of sand for glass in Illinois (especially in Ottawa and Oglesby areas). The *Starved Rock Member* is a clean sandstone that separates the sandy and shaley *Glenwood Formation* to the north from the carbonate *Joachim Formation* to the south.

Sinnipee Megagroup:

The Sinnipee Group is referred to as a Megagroup in Illinois and overlies the Ancell Group. The term Sinnipee is extended from Wisconsin to replace the term Ottawa Limestone Megagroup based on the reasons defined by Ostrom in 1967. The Sinnipee consist of three Groups in the area: the basal Platteville Group, the middle Decorha Group, and the upper Galena Group, all of which are undivided in this report due to the complex relationships and multiple variations in nomenclature, although the Formations within are legitimate units. The Sinnipee is extensively used for an aquifer (and sometimes confused with the Silurian dolostones) and is the only unit which contains many layers of bentonite. In Illinois the top of the Galena does appear to be unconformable with the above Maquoketa. Whether or not it represents a small period of non-deposition or an erosional surface has been debated for decades.

Maquoketa Group:

The Maquoketa Group overlies the Galena Group and *Kimmswick Formation*. It is the uppermost Ordovician unit, and understanding it is key. It is the most significant aquitard in Northern Illinois, and the basal shales have the potential to be used as oil shale or topsoil replacement. The upper green shales are illite clay and can potentially be used as quality back fill. The upper *Neda Formation* has been mined extensively in Wisconsin for iron ore.

The Maquoketa is treated as a Group in Missouri and Illinois but as a Formation in Wisconsin and Iowa. Its Group status is justified. This publication introduces a new Formation present in Northern Illinois. In Northern Illinois a long and wide dolostone extending from near Wisconsin to Central Illinois trending NNE by SSW exists below the *Fort Atkinson Formation*. This unit is hereby named the *Virgil Formation* and is lithologically distinct from the *Scales Formation* in which it intertongues. It consists mostly of coarse crystalline, olive, colored dolostones, similar but not connected to the *Fort Atkinson*. Fossils are rare but larger than typical for the Maquoketa. Cephalopods up to three feet have been pulled from it at Elmer Larson Quarry near Sycamore, IL. The *Virgil* is named for the town of Virgil near the type section, which is Elmer-Larson Quarry.

Above the Maquoketa lies the Silurian dolostones. A major erosional unconformity separates the Ordovician from the Silurian in Wisconsin, Indiana, Illinois, Missouri, and Iowa. The Sub-Tippecanoe II Unconformity (top of Maquoketa) serves as the datum line for Figure 2.

Conclusions:

As resources become more scarce and new technologies increase our demand for our limited resources, we need to understand Stratigraphy at a detail previously unconsidered just a generation ago. After all, everything we use other than the air we breath is either grown or mined. If it's mined it comes from the rocks. Now more than ever we need to understand how the rocks beneath our feet relate to one another.

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Figures:

Figure 1: Generic Time Transgressive Rock Chart of Cambrian Through Ordovician Deposits in Illinois (page 2) adapted from: Workman, Bell (1948), Grohskoph (1955), Freeman, Dott, Murray (1954), Ostrom (1970), Baumann (2007)

Figure 2: Dominant Lithological Symbols of Cambrian Through Ordovician Deposits in Illinois (page 3) based on: *Handbook of Illinois Stratigraphy*, H.B. Willman, 1975, ISGS Bulletin 95

Photos:



Photo taken by Steven Baumann, Elmer Larson Quarry, 8-19-2007.

Photo shows the typical lithology of the new *Virgil Formation* from a quarried block.



Photo taken by Steven Baumann, Elmer Larson Quarry, 8-19-2007.

Photo shows the purple iron staining in the typically pale green *Brainard Formation*. The ledge on top of the gully is a thin layer of Silurian dolostone. The gully is approximately six feet deep.

FIGURE 1: Generic Time Transgressive Rock Chart of Cambrian Through Ordovician Deposits in Illinois

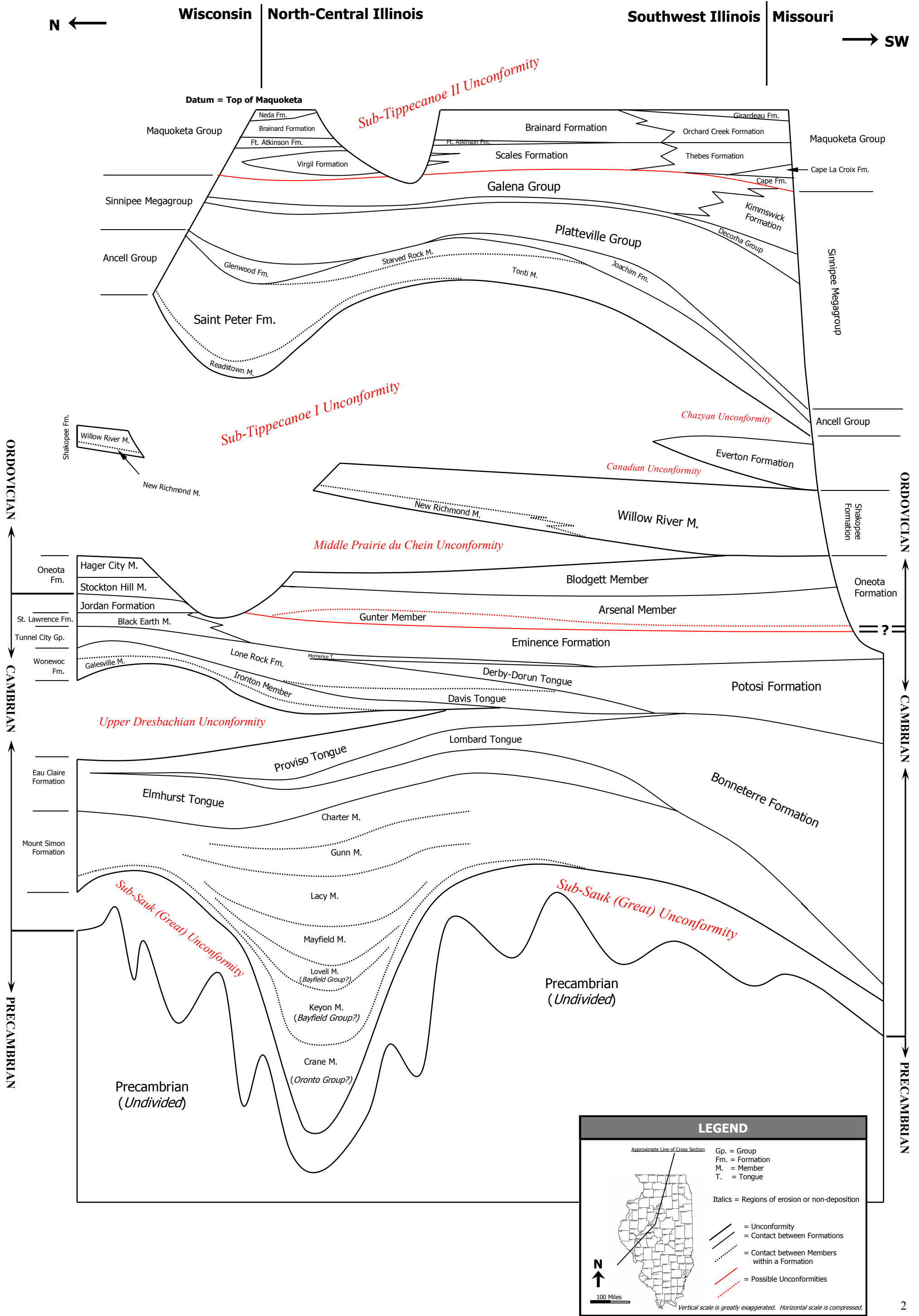


FIGURE 2: Dominant Lithological Symbols of Cambrian through Ordovician Deposits in Illinois

