JEFFERSON COUNTY

Bedrock Geology of Jefferson County, Wisconsin

MAP 511–SUPPLEMENT • 2024

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Introduction

This map describes the distribution of bedrock, or solid rock, that underlies Jefferson County and is mostly buried beneath unconsolidated surficial material. Surficial material was deposited by glacial processes during the last ice age (Ives and Rawling, 2022). These unconsolidated Quaternary deposits overlie topography carved into the bedrock surface by preglacial fluvial systems and subsequent glacial scour (fig. 1). Generally, depth to bedrock is 20–100 ft (6–30 m). Locally, however, bedrock crops out at land surface, or is buried beneath more than 300 ft (91 m) of unconsolidated material within bedrock valleys.

Jefferson County straddles the eastern edge of the Wisconsin Arch, a structural high underlain by Precambrian bedrock that was subaerially exposed periodically during deposition of Paleozoic units. Precambrian bedrock units include the Waterloo quartzite, a Paleoproterozoic to Mesoproterozoic quartzite with lesser schist (**XYw**), and cross-cutting Mesoproterozoic intrusions related either to the Green Island Plutonic belt of the ca. 1400 Ma. Eastern Granite Rhyolite province (Holm and others, 2007) or to the ca. 1100 Ma Midcontinent Rift (**Yfm**). The crystalline bedrock is nonconformably overlain by Paleozoic siliciclastics and carbonates that dip 3 to 5 degrees eastward into the Michigan basin. In northwestern Jefferson County, the Waterloo quartzite (**XYw**) is exposed as isolated, low-relief ridges along the western limb of the Waterloo syncline (fig. 2 or the map). The syncline axis is located to the north, in Dodge County, and so it is not shown on the map. Overlying Cambrian through Ordovician sandstones and dolomites were deposited 510–430 Ma ago as shoreline through offshore deposits in an epeiric sea (e.g., Sloss, 1963; Smith and others, 1993; Choi and others, 1999; Runkel and others, 2007). This map identifies many previously unrecognized, low-amplitude (10–50 ft; 3–5 m) folds in the Paleozoic units. Folds are recognized by undulations in the base Sinnipee bedrock surface (fig. 2), similar to the approach described in Stewart (2021).

Chronologic subdivisions of Paleozoic units are from Gradstein and others (2020). The position of the Cambrian–Ordovician boundary and subdivision of the Cambrian into Middle and Late Cambrian units (Epoch 3 and Furongian; **Ꞓe, Ꞓtc, Ꞓt**) are based on Runkel and others (2007). Subdivision of the Ordovician units (**Opc, Oa, Osp, Osg**) are after Choi and others (1999) and Witzke and others (2010).

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Methods

Interpretation of bedrock geology is based on information from 13,461 water well driller's well construction reports (WCRs), three drill cores, eight suites of geophysical logs, 86 geologic logs of water well cuttings, 34 geochemical profiles of drill core or well cuttings measured by a portable X-ray fluorescence (pXRF) instrument, soils data from the U.S. Department of Agriculture, observation of land surface topography, and observation of bedrock exposed in quarries and sparse outcrops. Locations of wells, geophysical logs, and cores are available in dataset 1. Bedrock unit contacts are drawn on the buried bedrock surface.

The bedrock surface was interpreted from bedrock elevation recorded in WCRs through a combination of computer interpolation and hand modification of 25-ft contours. A 10-m resolution raster surface was generated from the bedrock elevation contours (dataset 2). Figure 1 shows the interpreted elevation of the bedrock surface. This surface is included in the base of the map plate, where it is shown in shaded relief with bedrock elevation contour lines.

Paleozoic bedrock contacts were interpreted by generalizing Paleozoic unit thicknesses relative to the base Platteville Formation (**Osp** on map, Sinnipee Group). The base Platteville elevation surface (fig. 2) was hand contoured from elevations recorded in well data, and the surface was intersected with the bedrock elevation surface to generate a base Platteville contact. Other Paleozoic bedrock contacts, except the base Ancell Group, were interpreted by estimating a generalized thickness of each unit based on stratigraphic correlation of well data and assuming each surface has the same morphology as the base Platteville Formation. Stratigraphic correlation

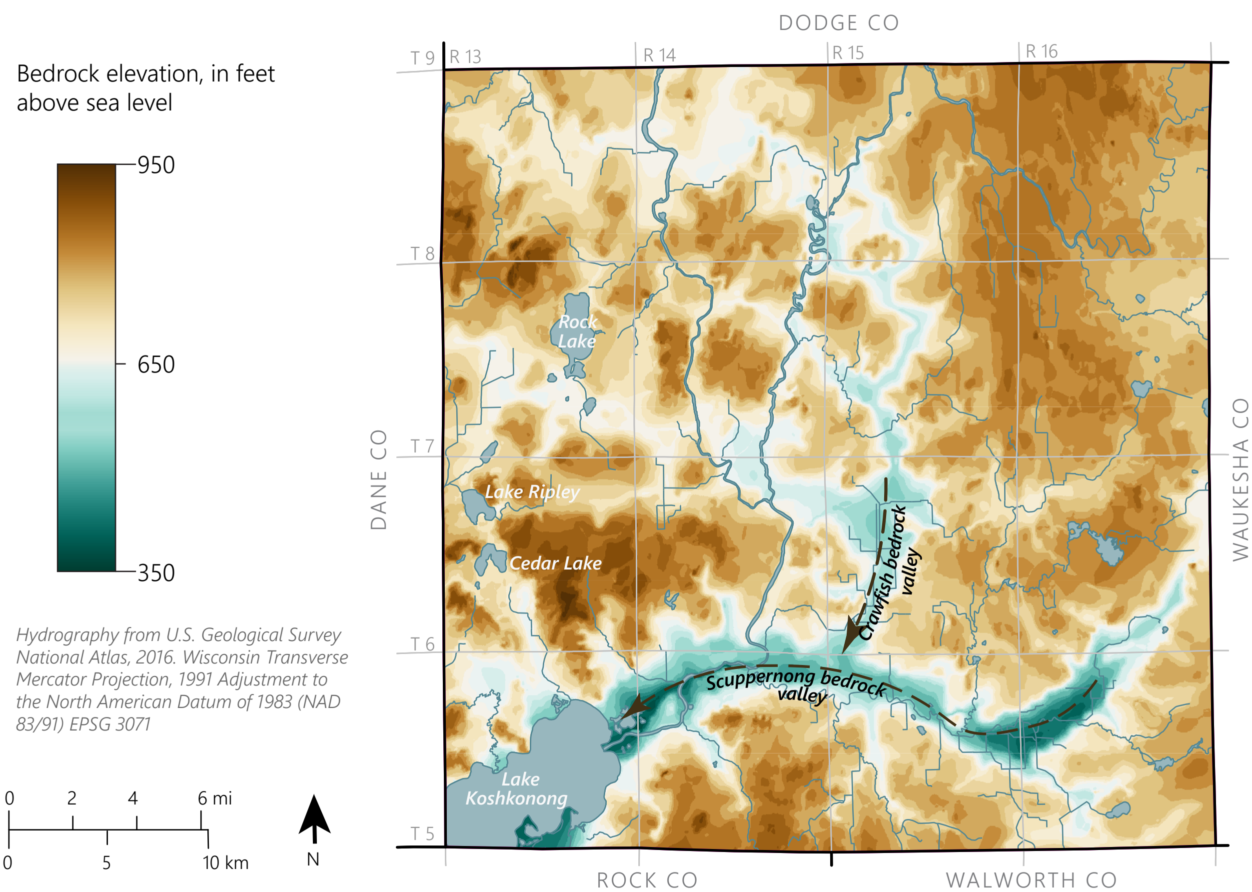

Figure 1. Elevation of the buried bedrock surface, in feet above sea level. Elevation data are binned in 25-ft intervals. Modern lakes and rivers are shown in blue. The locations of bedrock valleys are shown by the dashed brown lines, with arrows indicating downstream direction. Bedrock valley names from Ives and Rawling (2022).

was based on gamma ray geophysical logs tied to elemental abundances of potassium (K) from pXRF logs measured from drill cores and cuttings (fig. 3). Elemental abundances of calcium (Ca) and silicon (Si) are proxies for carbonate or siliciclastic (sandstone) bedrock lithologies and further support stratigraphic correlation. The average unit thicknesses estimated from stratigraphic correlation were added or subtracted from the base Platteville surface, and the resulting surface was intersected with the bedrock surface to create contacts. For example, the base Galena contact (**Osg** on map) was interpreted by adding 70 feet to the base Platteville surface and intersecting the result with the base bedrock surface. The base Ancell surface (**Oa** on map) is erosive and so does not share the same morphology as the base Platteville. The base Ancell was therefore interpreted by observing changes in slope of the bedrock elevation surface and the top bedrock lithology recorded in wells near the base Platteville Formation contact.

In northwest Jefferson County, Paleozoic units are characterized by a greater abundance of sandstone close to paleotopographic highs of the Waterloo syncline (fig. 2). This facies variability makes stratigraphic correlation of WCRs difficult, with greater uncertainty in the extent of the mapped bedrock units in the northwest corner of the map.

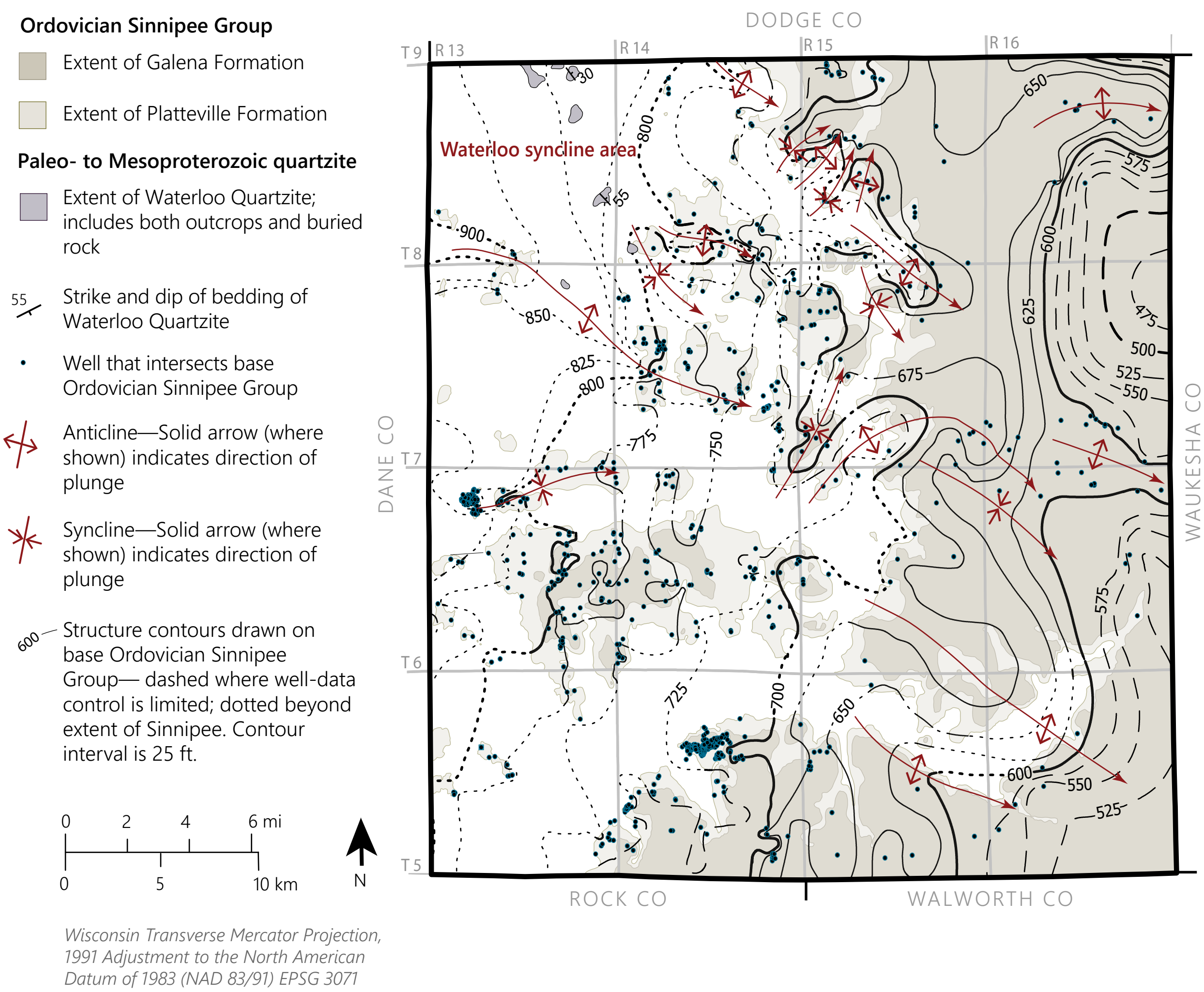

Figure 2. Structure-contour map of the base of the Ordovician Sinnipee Group. Contours were drawn by hand from the elevation of the base of the Sinnipee Group as recorded in well construction reports, geophysical logs, and drill core.

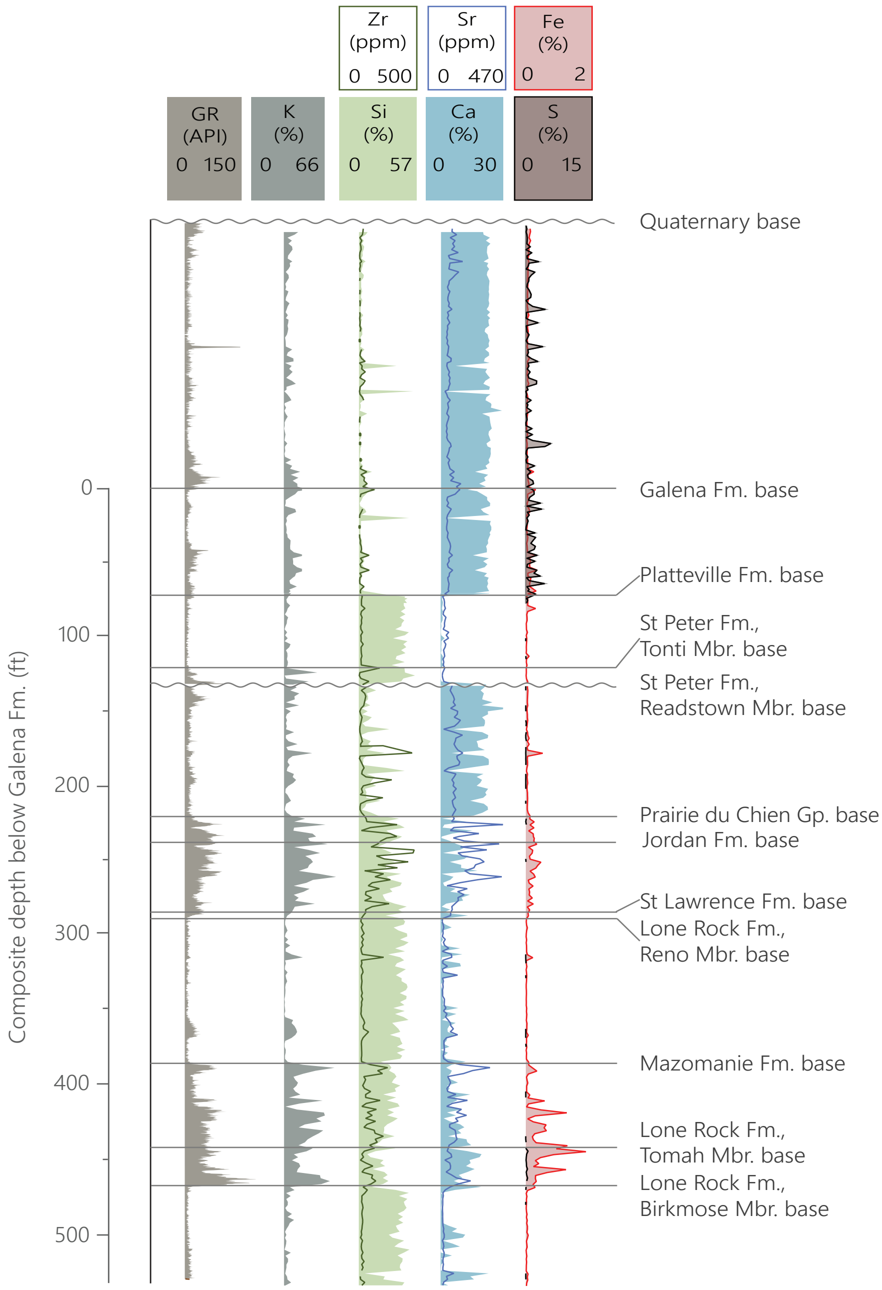

Figure 3. Generalized chemostratigraphic column for Paleozoic strata in Jefferson County. The vertical axis shows composite depth (in ft) relative to the base of the Galena Formation. Elemental concentrations and a gamma ray curve are illustrated on horizontal axes; units of measurement as well as the minimum and maximum of each axis are labeled at the top. Chemostratigraphic profiles are compiled from pXRF logs of wells 28001135 and 28000856. Gamma ray (GR) profile is compiled from wells 28001080 and 28001135. Abbreviations: API- American Petroleum Institute; K- potassium; Zr- zirconium; Si- silicon; Sr- strontium; Ca- calcium; Fe- iron; S- sulfur; ppm- parts per million; Fm.- Formation; Mbr.- Member; Gp.- Group.

Supplemental material

The following materials are available for download at https://doi.org/10.54915/xeeb5653:

Map: Geologic map
A map (.pdf format) of the bedrock geology of Jefferson County.

Dataset 1: GIS data
A geodatabase (.gdb) including bedrock elevation contours, map unit contacts, and other geologic data.

Dataset 2: Bedrock elevation raster
A 10 m resolution raster surface (.gdb) generated from the bedrock elevation contours.

Dataset 3: Geochemical data
Geochemical data (.xls) measured by pXRF and gamma ray data used to create generalized stratigraphic column.

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