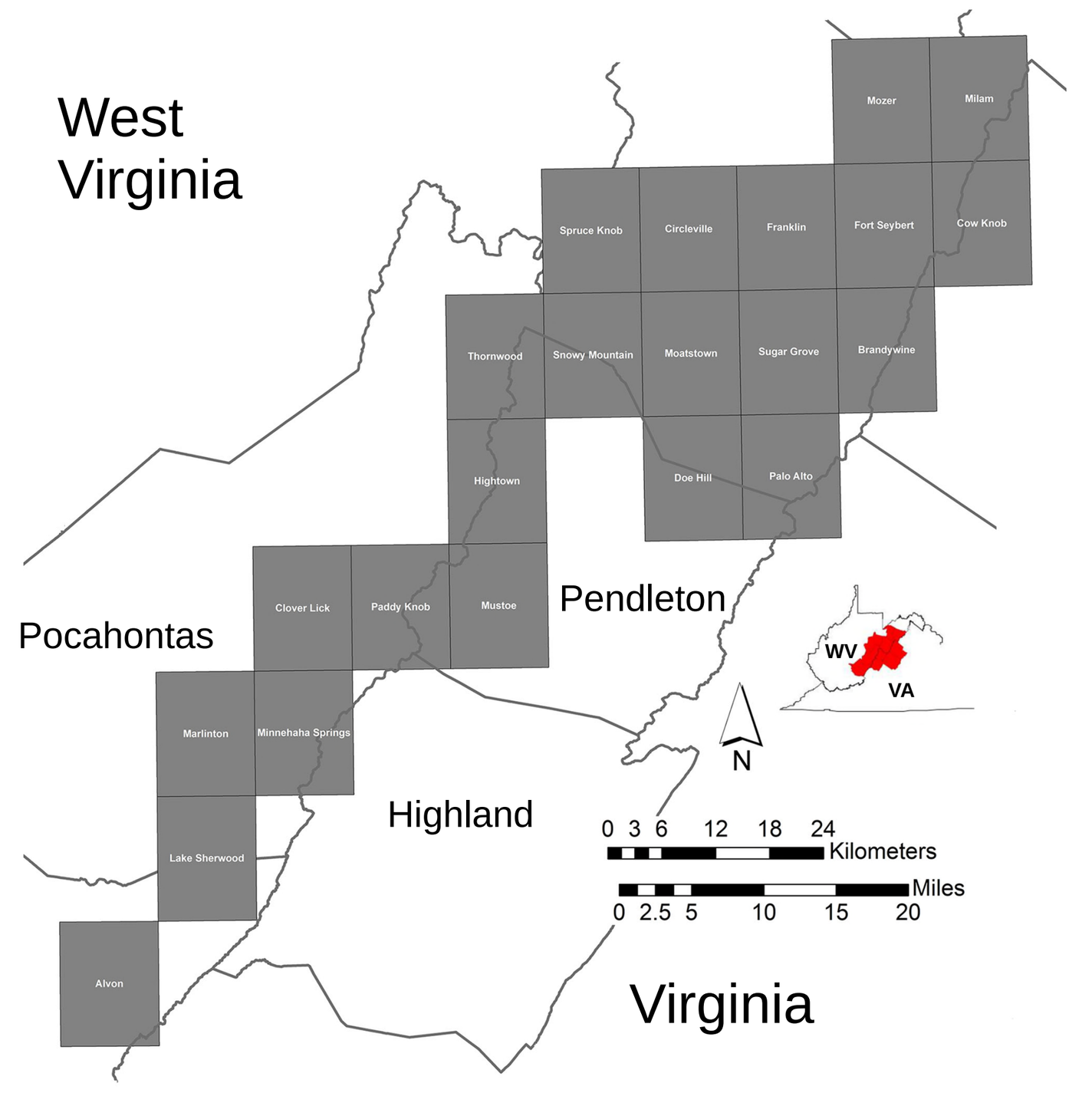
USING FOSSILS TO AID IN BEDROCK MAPPING: EXAMPLES FROM WEST VIRGINIA

MCDOWELL, Ronald R.[1] (mcdowell@geosrv.wvnet.edu), HUNT, Paula J.[1], BURNS, Mary Sue[2] and MCCLURE, Goldie[2]
[1]West Virginia Geological and Economic Survey, 1 Mont Chateau Road, Morgantown, WV 26508, [2]Pocahontas County High School, Dunmore, WV 24934

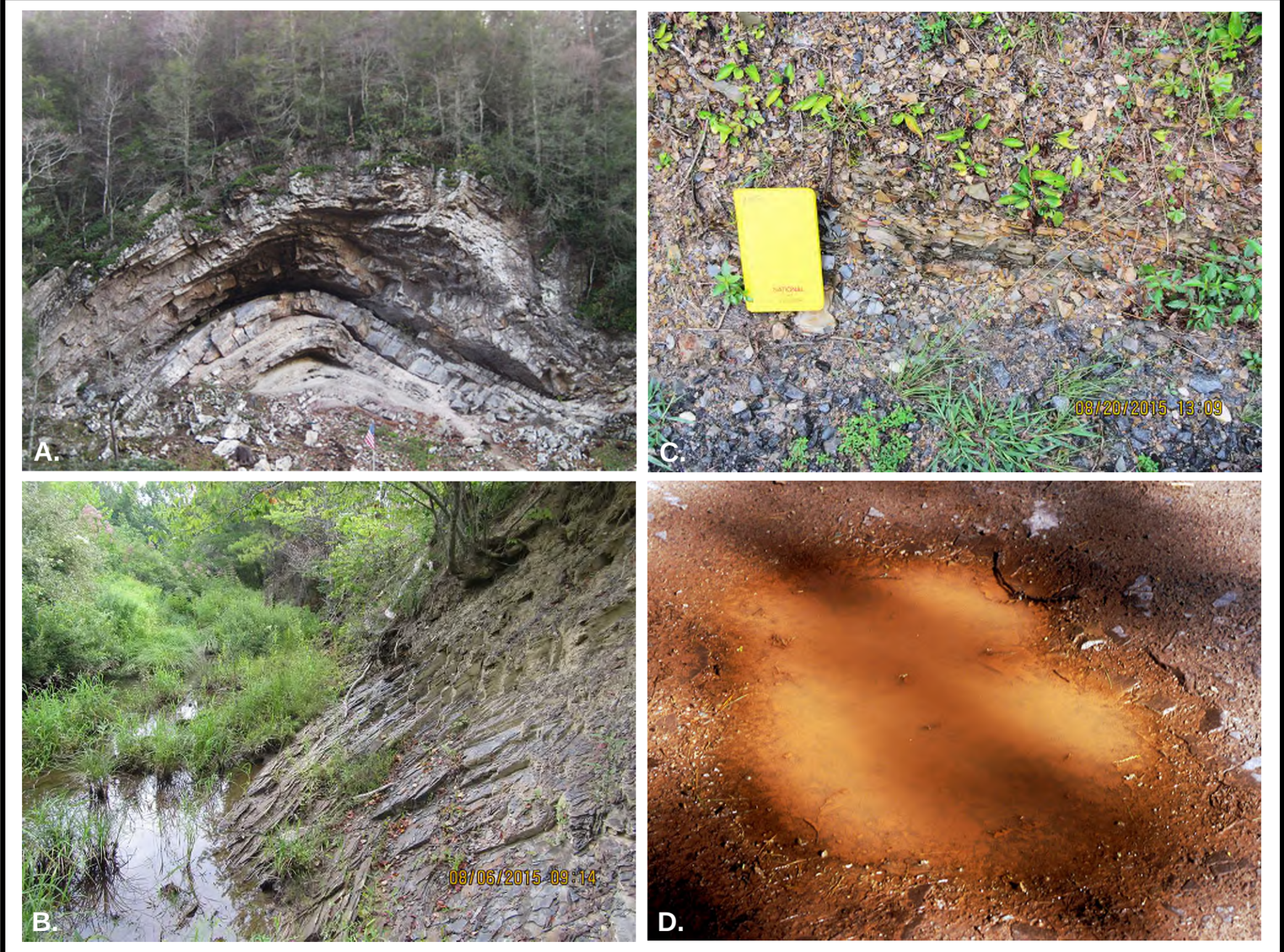
ABSTRACT

Bedrock mappers in eastern West Virginia contend with outcrops that are typically small, discontinuous, and poorly exposed. Add intense structural deformation, sedimentary facies changes, and superficially similar lithologies, and the field geologist is left grasping for any and every possible clue to help differentiate and identify stratigraphic units. In the 1800s and early 1900s, geologists mapping in the state used fossils primarily to identify the time period to which each rock unit belonged. Unfortunately, early workers did not distinguish index from facies fossils, confounding the time information implied by the former with the depositional/sedimentological information inferred from the latter.

For the purposes of "modern-day" mapping, we concentrate primarily on facies fossils and treat their presence (or absence) as an indicator of a particular set of environmental conditions during the deposition of individual stratigraphic units. In general, no time constraints are inferred – our purpose is to use the fossil content as an adjunct lithologic property to help us differentiate and identify rock units. To this end, we have had success mapping Paleozoic siliciclastic and carbonate rock units using both body fossils and ichnofossils. The presence or absence of individual fossils or assemblages of fossils can be equally important, as can the numbers and diversity of fossils. For example, the shales and minor sandstones of the Devonian Brallier Formation are typically devoid of body fossils but contain a unique, easily recognizable trace fossil; similar strata of the overlying Devonian Foreknobs Formation are typically highly fossiliferous and contain a diverse and prolific assemblage of trace fossils; similar strata of overlying Devonian Hampshire Formation are typically barren except for rare plant fossils. Treating fossil content as a critical component of lithology when mapping is a technique applicable to sedimentary rocks ranging in age from latest Proterozoic through Cenozoic.



Location of STATEMAP quadrangle mapping efforts 1997-2015.



Outcrop exposures in the study area range from spectacular (A) to obscure (B) to minuscule (C) to nonexistent (D). Obscure to non-existent exposure is the norm.

INTRODUCTION

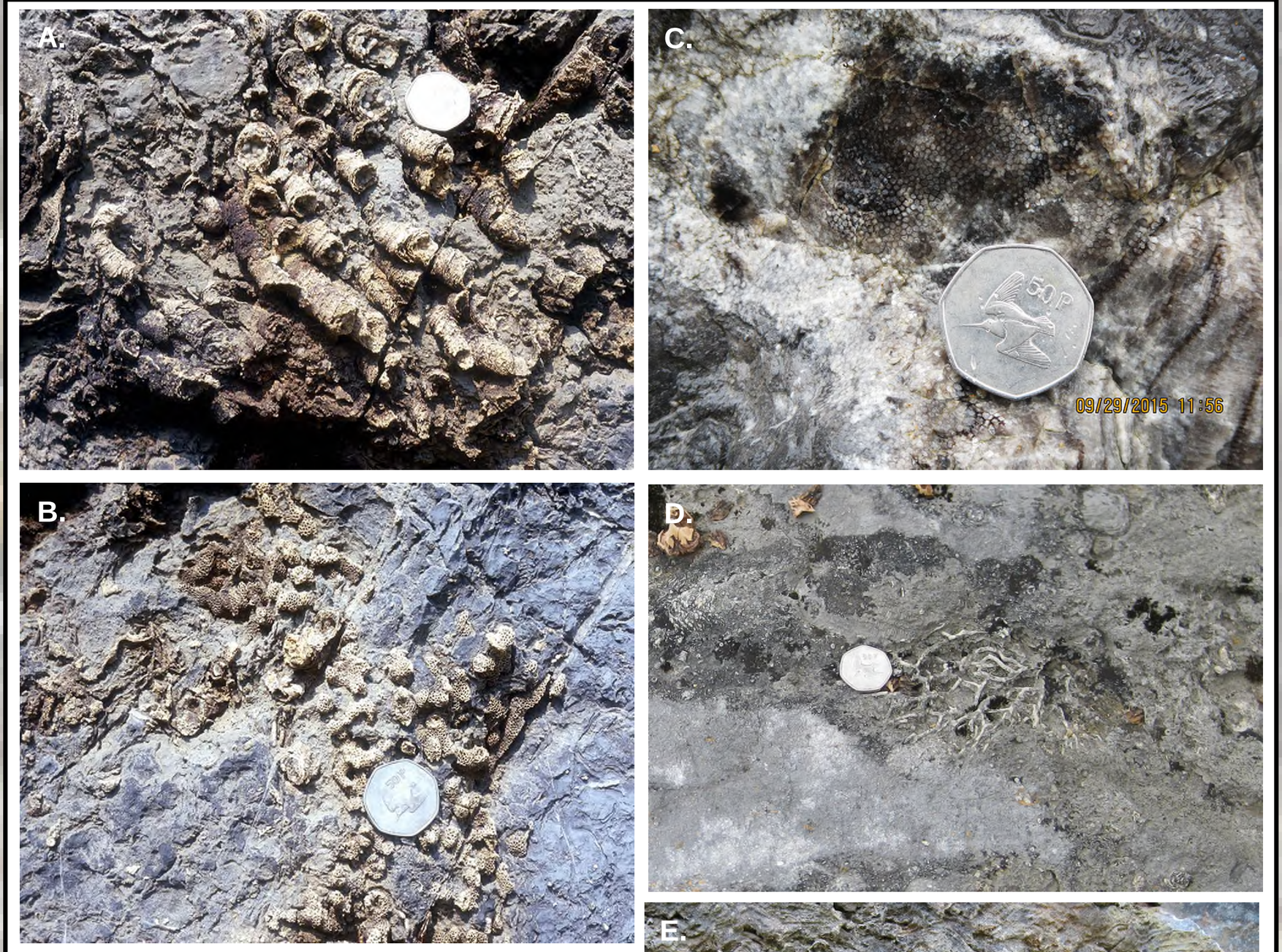
Rather than using fossils to constrain geologic age or environmental conditions, we use them as an additional lithologic component of the rocks being mapped to give us more criteria to help differentiate rock units. Further, we don't dwell on the taxinomic aspect of the fossils as many of our mapping geologists have had minimal training in paleontology, especially new student interns. We concentrate on "extended" lithologic descriptions using observed fossil characteristics - "fossiliferous" just won't do. The type, variety, abundance, mode of preservation of fossil material become as important as grain size, color, and bedding style in telling stratigraphic units apart. The main body of this poster illustrates some of the fossil material we have found characteristic of key stratigraphic units in our study area.

DEVONO-MISSISSIPPIAN - PRICE FORMATION

Large brachiopods - *Schuchertella* sp. (A) and other body fossils (B) are common in marine sandstones of the Price. Two unusual and, as yet unidentified, feeding trace fossils (C, D) are also diagnostic.

SILURIAN - WILLS CREEK FORMATION

Gastropods like *Hormotoma* sp. (A), rare brachiopods, occasional "leperditid" ostracodes, and small, isolated algal stromatolites (B) represent the sparse fossil content of the Wills Creek.



SILURO-DEVONIAN - KEYSER LIMESTONE OF THE HELDERBERG GROUP

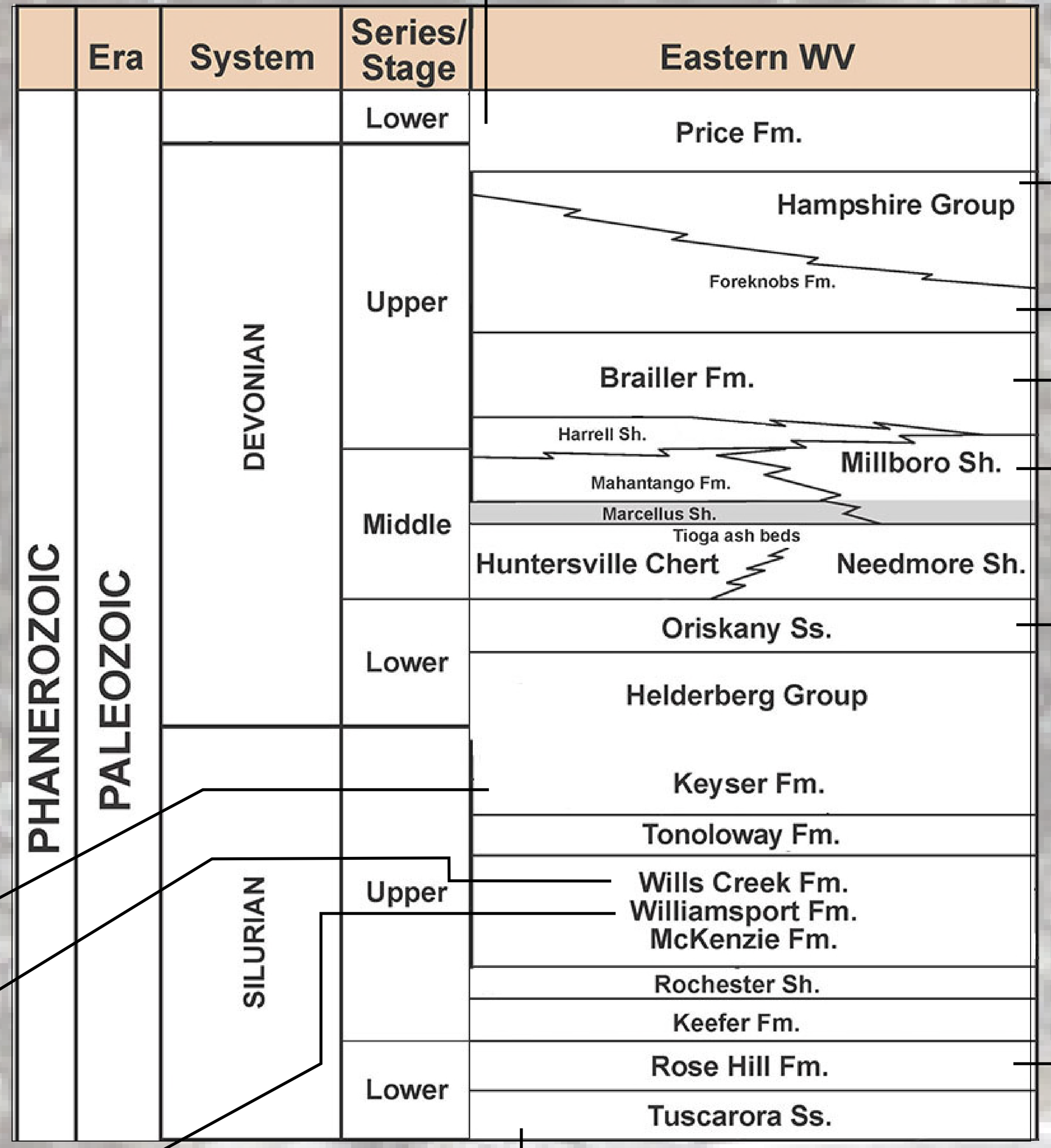
The lowermost member of the Helderberg, the Keyser Limestone, is characterized by body fossils of organisms capable of building bioherms. Colonial rugose (A) and tabulate corals (B, C), ramose bryozoans (D), and stromatoporoids (E) may occur singly or as *in-situ* growth assemblages of varying size and faunal composition.

SILURIAN - WILLIAMSPORT SANDSTONE

The Williamsport is devoid of body fossils but bottoms and occasionally tops of beds are marked by trace fossils. *Arthrophycus* sp. (A) and various horizontal feeding traces (B) are found in sandstones superjacent to shale interbeds. Entranceways to U-tubes like *Arenicolites* sp. (C) are found in the tops of sandstone layers.

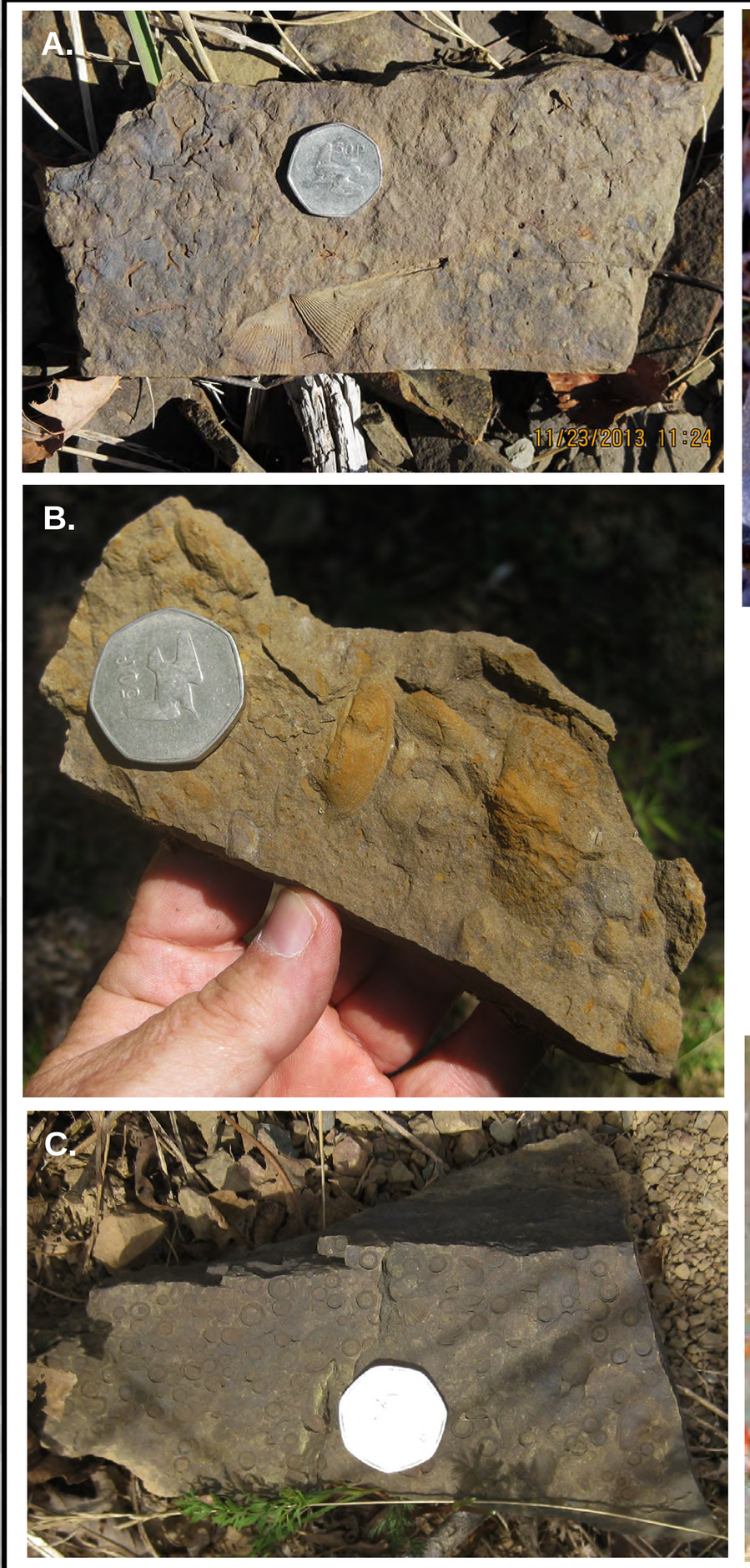
DEVONIAN - HAMPSHIRE FORMATION

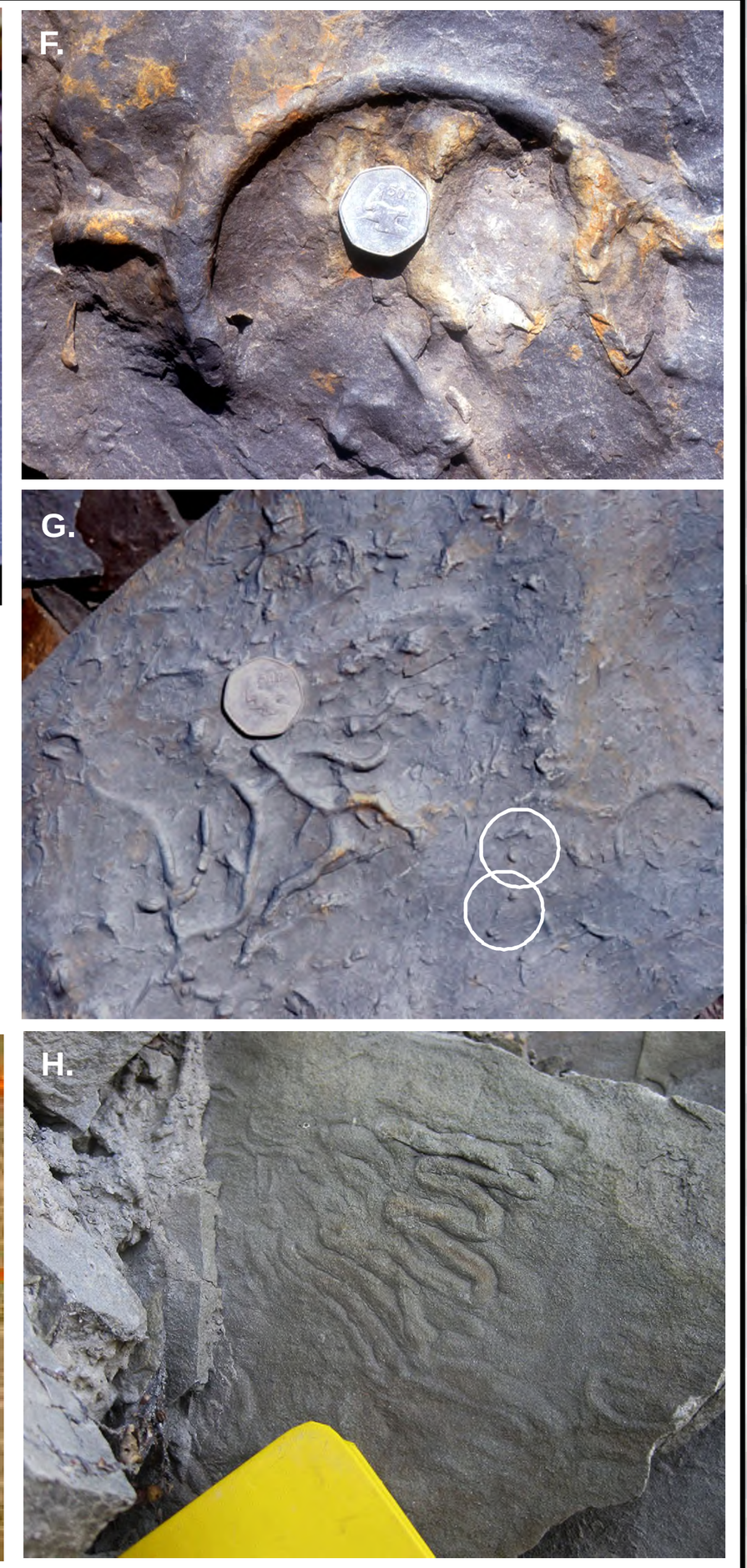
Fossils of any sort are a rarity in the Hampshire. Plant fossil *Archaeopteris* sp. (A) and probable insect larval trace fossil *Treptichnus*? sp. (B) are shown. These two specimens represent the sum total of recognizable fossil material observed in nearly twenty years of mapping the Hampshire in eastern West Virginia.



SILURIAN - TUSCARORA SANDSTONE

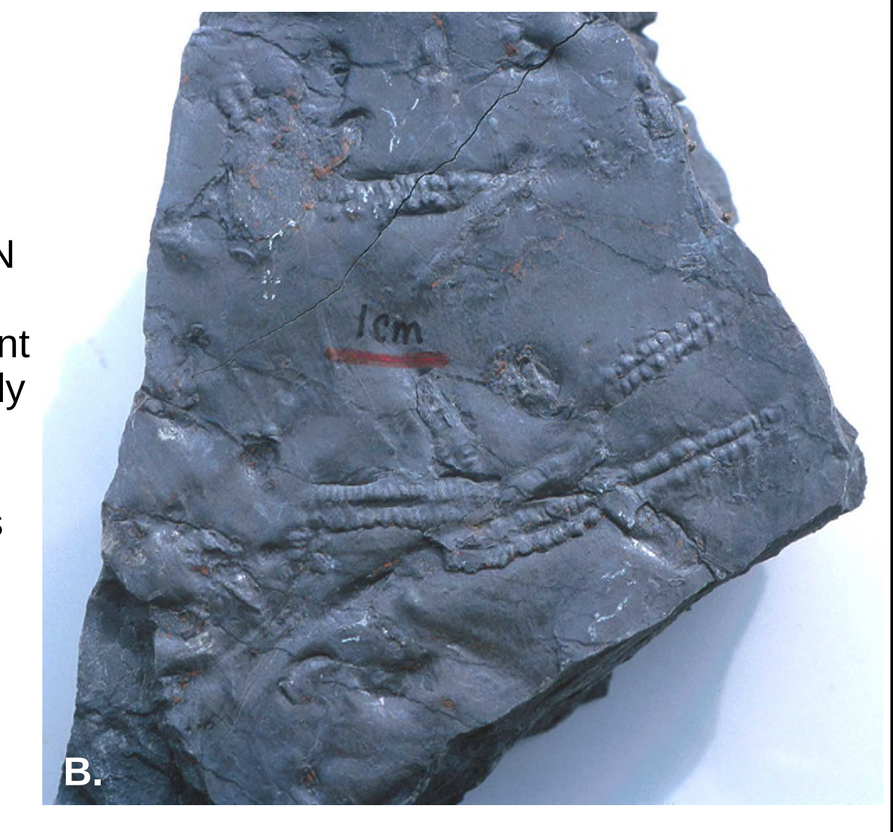
Trace fossil *Arthrophycus alleghaniensis* (A, B) is found on the bottoms of sandstone beds especially where shaly interbeds are present. Layers with the trace fossil *Arenicolites* sp. (misidentified as *Skolithos* sp.) are also common (C).





DEVONIAN - FOREKNOBS FORMATION

Marine sandstones, siltstones, and shales in the Foreknobs are characterized by diverse and numerous assemblages of both body fossils (A-C) and trace fossils (D-H).



DEVONIAN - BRALLIER FORMATION

Body fossils are practically non-existent and trace fossils are restricted primarily to a single species, *Pteridichnites biseriatus* (A, B). Occurring sparsely throughout the unit, this trace appears most abundantly near the base of the Brallier.

DEVONIAN - MILLBORO SHALE

The Millboro is characterized by rare intervals of diminutive body fossils suggesting inhospitable living conditions. Tiny *Styliolina* sp. (A) and miniature adult brachiopods and cephalopods (B) are typical.

DEVONIAN - ORISKANY SANDSTONE

Original shell material is rarely found in the Oriskany. Typically, fossil voids consisting of external molds of crinoids columnals (A, B) or inarticulate brachiopods form lag layers. Simple vertical cal trace fossils in the form of u-tubes are the most common ichnofossils.

SILURIAN - ROSE HILL FORMATION

A numerous and diverse assemblage of trace fossils (A - D) is found on both the tops and bottoms of the ferruginous sandstone beds, especially when interbedded with shale. Trilobite traces like *Rusophycus* sp. (B) are easily recognizable. Body fossils, primarily "zygobolbid" ostracods (E), are restricted to the shales but are generally few and far between.

DISCUSSION

The structural geology of eastern West Virginia is complex and facies changes, both subtle and dramatic, make mapping of the Lower to Middle Paleozoic section a challenge. The lack of continuous exposure, thick vegetation cover, and difficulty finding good, local reference sections for many stratigraphic units, all add to the challenge.

Early in the process of bedrock mapping as part of the STATEMAP program, we found it useful to treat fossil content and expression as lithologic components of individual stratigraphic units giving us an expanded set of characteristics to help differentiate formations. Because many of our mapping geologists are not paleontological specialists and, indeed, many of our mapping interns have not yet had training in paleontology, we concentrate on observation and description of fossil material instead of identification or interpretation. Notebook sketches and digital images taken in the field can all be used as readily accessible reference materials even when a paleontological "expert" is not with the mapping geologist. Simplistic descriptions of body fossils or trace fossils aid in their recognition - for example, having a geological intern keep an eye out for "zygobolbid" ostracodes requires entirely too much expertise but looking for "small, kidney bean-shaped fossils with a fold like a fortune cookie" works perfectly. Likewise, counting the numbers and different types of fossils in a unit can be easily accomplished - the naming and interpretation of the fossils can come later.

Our ultimate goal is to establish a suite of characteristics for each rock unit that can be used (in whole or in part) to identify and differentiate individual units. The suite of characteristics must be "portable" in that it can be taken from map area to map area. The only real constraints on the mapping geologist using this technique are the necessity for persistence in the search for fossils, an eye for detail, and some skill in "pattern recognition." The end result is a series of 22, completed bedrock maps of the West Virginia-Virginia border region in structurally and sedimentologically complex Paleozoic strata.

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