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The Major Pre-Mississippian Unconformity in Rock Canyon, Central Wasatch Range, Utah

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Cambrian and Devonian section and possible location of the pre-Mississippian unconformity in Rock Canyon, Utah; figure 2 from article. Photograph by Bart J. Kowallis.

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ABSTRACT

In central Utah, the major pre-Mississippian unconformity is fairly well understood at most of the localities where it is recognized. However, the unconformity is more enigmatic in Rock Canyon of the central Wasatch Range. At this locality, dolomitization of most pre-Mississippian rocks obscures stratigraphic identification of Devonian and older units. The absence of any identifiable angular relationship further complicates resolution. Because of this, both identification of the stratigraphic level of the unconformity and, consequently, its magnitude remain controversial. Large-size dolomite samples taken in Rock Canyon at closely spaced intervals for the 3.6-m directly below definite Upper Devonian rocks yield microfossils, including conodonts, in the uppermost 1.6-m of that interval that indicate no unconformity exists between the Cambrian Maxfield Limestone and the Upper Devonian-Lower Mississippian Fitchville Dolomite at the horizon previously identified as unconformable. Rather, an unknown thickness of dolomitized Upper Devonian Pinyon Peak Formation and probable older rock (possibly Bluebell Dolomite and Victoria Formation) occurs between the top of definite Maxfield and base of the Fitchville. The identification of the unconformity horizon remains unknown. Our preliminary work outlines a promising procedure for future understanding of the magnitude and stratigraphic level of the unconformity.

THE PROBLEM

Earliest documentation of the widespread Upper Devonian unconformity in central and eastern Utah included the conclusion that in Rock Canyon (figure 1), upper Middle Cambrian dolomite beds are overlain by Lower Mississippian carbonates (Baker, 1947; Rigby, 1959). However, additional work on the Mississippian section in this part of Utah demonstrated that the lower part of the carbonates assigned to the Mississippian contained Late Devonian conodonts (Beach, 1961), and the rocks earlier interpreted to be Lower Mississippian were differentiated into the Fitchville Formation of Late Devonian-Early Mississippian age and the overlying Gardison Formation of younger Mississippian age (Morris and Lovering, 1961). Since this early work, the major pre-Mississippian unconformity in Rock Canyon has been interpreted to occur between the base of the

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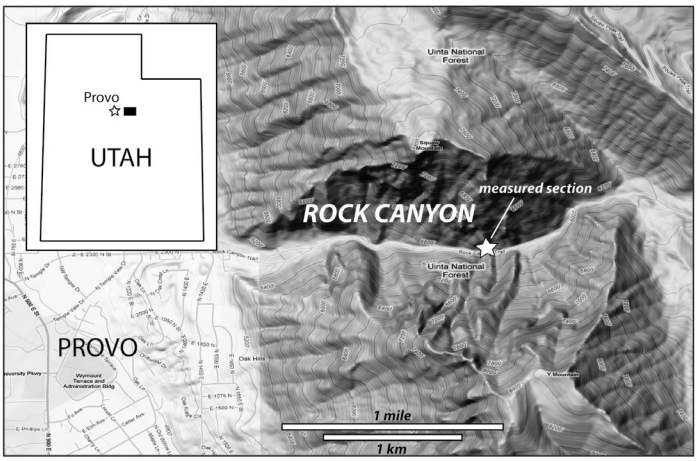

Figure 1. *Location of section studied in Rock Canyon, adjacent to Provo.*

Devonian-Mississippian Fitchville Formation, marked by a sandstone unit, and what was assumed to be the underlying late Middle Cambrian Maxfield Limestone (Sandberg and Gutschick, 1979; Derenthal and others, 2008; Hintze and Kowallis, 2009), an unconformity perhaps representing almost 150 my. A similar unconformable relationship exists at other localities in central and eastern Utah, but the Fitchville rests on Paleozoic strata of different ages in some of these areas (Rigby, 1959).

In several areas of central Utah, the Fitchville Formation consists of several hundred meters of carbonate with the base of the formation marked by a 30- to 50-cm-thick bed of sandstone and sandy dolomite. In the Fitchville type area of the East Tintic Mountains, the basal sandstone is referred to as the "sand grain marker bed" (Morris and Lovering, 1961, p. 82). A similar stratigraphy is recognized in Rock Canyon.

In Rock Canyon, all of the dolomites below the sand grain marker bed of the Fitchville Formation have previously been assigned to the Cambrian Maxfield Limestone. The Maxfield is widespread in central Utah, but it is not as easily understood in the Wasatch Range where exact stratigraphic interpretations are difficult because the limestone beds of the Maxfield and overlying formations have been dolomitized. In addition, there are few diagnostic fossils in any part of the Maxfield, especially in the Wasatch Range.

As a consequence of these observations, we have questioned whether the stratigraphic level of the major pre-Mississippian unconformity in Rock Canyon has been accurately determined. We have considered the possibility that the dolomite beds traditionally assigned to the upper part of the Maxfield Limestone and below the Fitchville might be older Devonian, Silurian, or even Ordovician in age because strata of all of these ages underlie the Upper Devonian unconformity at different localities elsewhere in central Utah (Rigby, 1959). This appears reasonable because rocks of these Early Paleozoic ages are much thicker only a few kilometers west of the Wasatch due to a general eastward thinning onto the shelf and because this locality was on the south flank of a west-trending crustal arch that affected Paleozoic deposition (Morris and Lovering, 1961). During the early Paleozoic, the area of the present Wasatch Range was the eastern margin of the same depositional basin. At least some of the dolomite beds assigned to the upper part of the Cambrian Maxfield Limestone in Rock Canyon could be older Devonian and possibly as old as Ordovician (figure 2).

In order to address this problem, we decided to use the same method that was successfully used in resolving a similar problem involving the Cambrian-Ordovician unconformity in southern Wisconsin. There, the dolomites and dolomitic sandstones of the Cambrian-Ordovician interval are conformable and contain few megafossils, but large size samples treated with formic acid yielded definitive conodonts and other microfossils that were adequate for a high level of stratigraphic resolution (Parsons and Clark, 1999). Therefore, in order to

Figure 2. *Photograph of Rock Canyon section showing contact of Fitchville and Pinyon Peak, formerly considered to be the pre-Mississippian unconformity. Precise age of lower strata unknown.*

better understand the nature of the unconformity in Rock Canyon, we sampled the dolomites immediately below the base of the Fitchville clastic unit at 10- to 40-cm increments over an interval of 3.6 meters. A total of 96, two to four kg samples were processed for conodonts and other phosphatic or siliceous fossils.

RESULTS OF LAB WORK

The conodont terminology used here is the same as that documented in the conodont Treatise on Invertebrate Paleontology (Clark and others, 1981). For purposes of description, the 3.6-m section has been divided into six units as shown on figure 3.

Unit 1 – The 30-cm interval of dolomite immediately beneath the Upper Devonian clastic unit of the Fitchville Formation yielded 23 conodonts, all fragmentary, in 12 samples, including: *Polylophodonta* ?, P*olygnathus sp. aff. costatus, Polygnathus* fragments, various probable conodont fragments including *P. semicostatus, Icriodus Pa*, two fragments of basal part of coniform elements of *Icriodus*, one partial and one complete Pa element (*spathognathodid*) of *Ozarkodina sp.*, one unidentified ramiform, and unidentified fragments. A single shark dermal denticle and a broken sponge spicule were also recovered.

Unit 2 – The next lower 75-cm interval (16 samples) yielded fragments of probable ramiform specimens and a fragmentary piece of an *Icriodus* Pa element plus a broken sponge spicule.

Unit 3 – The next 30-cm interval below (14 samples) yielded a single fragment of the Pa element of *Icriodus* and several unidentifiable fragments.

Unit 4 – The next lower 30-cm interval (16 samples) yielded possible conodont fragments plus the partial internal mold of a gastropod.

Unit 5 – The next lower 60-cm interval (9 samples) yielded no conodonts or fragments, but at the base of the interval several specimens of *Tasmanites*, a phosphatic green algae with an extremely long stratigraphic range in the Paleozoic.

Unit 6 – The lower 135-cm interval of the sampled interval (29 samples) yielded part of an internal mold of a gastropod, plus a single possible fragment of a coniform conodont.

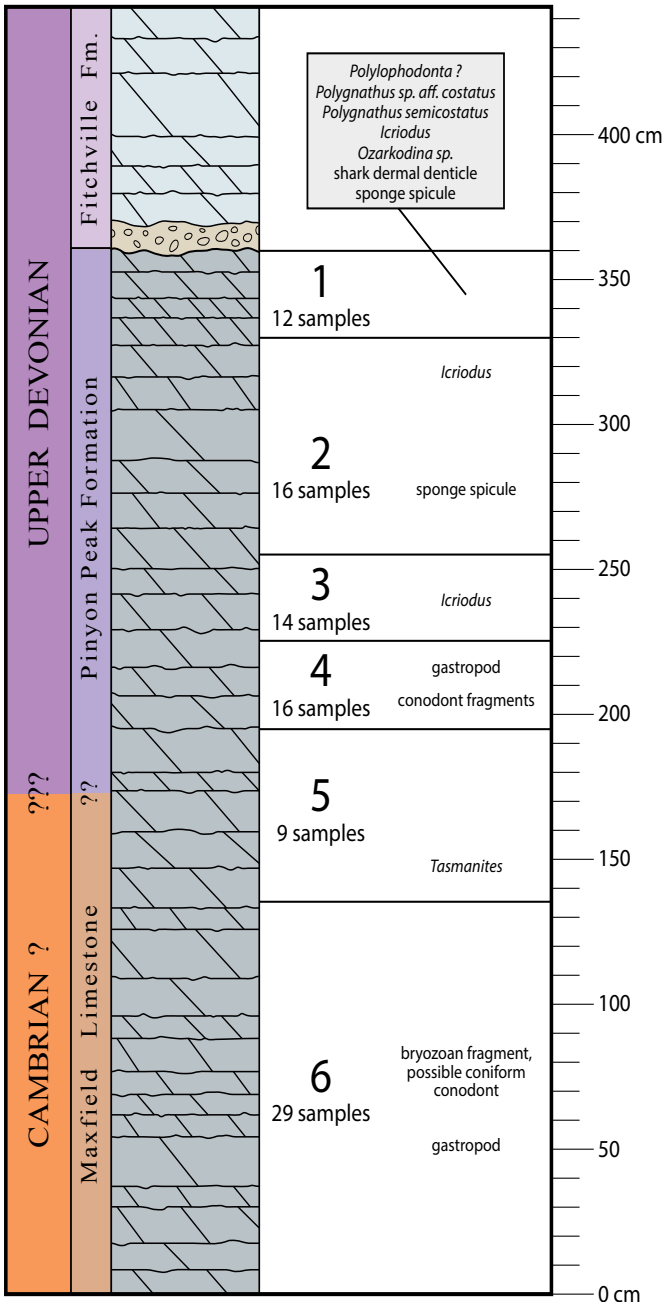

Figure 3. *Details of stratigraphic section with fossils and numbered sequences of samples referred to in text.*

INTERPRETATIONS

The uppermost 1.3-m of what has been assigned to the Cambrian Maxfield Limestone yielded 25 poorly preserved Devonian conodont fragments (CAI 5+), a single sponge spicule, and one shark dermal denticle (figure 3). In addition, a number of unidentifiable fragments, possible pieces of conodonts, occur in this up-

permost interval as well as in the next 30-cm lower unit (4) in the section that also yielded a single gastropod mold. Together, the conodont fragments suggest that at least the uppermost 1.6-m interval of the rocks (units 1 to 4) assigned to the Cambrian Maxfield Limestone in Rock Canyon are Late Devonian in age and are more realistically considered to be part of a dolomitized Pinyon Peak Formation. The conodonts of the upper part of the Pinyon Peak are the same age and are representative of the same fauna as that described from the overlying basal Fitchville Formation (Sandberg and Gutschick, 1979), a condition that has been noted in other parts of north-central Utah (Gosney, 1982). While the conodont faunas are separated by a clastic layer that marks the base of the Fitchville Formation, both faunas (i.e., that from the upper part of the dolomite beds previously assigned to the Cambrian Maxfield and that from the dolomites and limestone beds of the overlying Fitchville), represent a Late Devonian (probably *Expansa*) interval, slightly older than the youngest Late Devonian conodont zone recognized. Whether there exist additional beds of the Pinyon Peak Limestone or other rocks younger than the Cambrian Maxfield (i.e., the Bluebell Dolomite and Victoria Formation) below our lowest sampled interval was not determined. However, approximately 60-cm lower, the phosphatic green algae *Tasmanites* occurs along with another partial internal mold of a gastropod. *Tasmanites* has been reported from strata ranging through rocks of the entire Phanerozoic Era. A possible bryozoan fragment occurs just above the 3-m base of our sampled section. Although this tiny fragment is not definitive, most likely it is not Cambrian.

SUMMARY

The poorly preserved conodont fauna of the 1.6-m interval underlying the basal Fitchville Formation clastic unit in Rock Canyon firmly identifies the interval as Late Devonian (figure 3). Clearly, the clastic unit of the basal Fitchville does not mark the unconformity as previously assumed. The Devonian dolomite beds of what have previously been assigned to the Cambrian Maxfield Limestone are not distinctive from the beds of definite Maxfield found lower in the Rock Canyon section. Thus, position of the major pre-Mississippian unconformity is somewhere below the 1.6-m interval of conodont-bearing dolomite beds (below the basal clastic unit of the Fitchville). The dolomite lithologies as well as the absence of an angular relationship in the underlying strata are problems that will continue to trouble those attempting to identify the location and age of the unconformity.

Clearly, the major pre-Mississippian unconformity in Utah is not well understood. Additional field work is needed in Rock Canyon and elsewhere in central and eastern Utah in order to retrieve large size samples taken at closely spaced stratigraphic intervals below the established Devonian strata. Microfuana from such samples will be the most helpful tool for understanding the location and magnitude of Utah's major pre-Mississippian unconformity.

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