Trip A-7
Paleontology and Stratigraphy of the middle Helderberg Group at Rickard Hill Road, Schoharie, New York

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Introduction

Although the Helderberg Group (Upper Silurian and Lower Devonian) has been the subject of study for over 150 years, there are still many questions unanswered, particularly in the areas of regional stratigraphy, sedimentology, paleontology, and paleoecology. Rickard's (1962) stratigraphic synthesis has been the foundation for all modern studies of these rocks. The lower units of the Helderberg Group (Manlius, Coeymans, Kalkberg and New Scotland formations) have served as the "textbook" example of deposition in shallow, epicontinental seas since Laporte (1969). However, even these well-studied units still hold surprises (see Ebert and Matteson, this volume and Ebert and Matteson, 2003). Middle and upper parts of the Helderberg Group have been less well studied (Ebert, 1987). In general, the lower formations may be regarded as recording stepwise, rather than continuous transgression (Ebert and Matteson, 2003). A similar interpretation probably holds for the upper units (Becraft, Alsen and Port Ewen) as well (Ebert, 1987). However, the interval between these transgressive sequences is poorly understood in comparison. It is these middle units which will be examined on this field trip.

Stratigraphy of the Rickard Hill Road Outcrops

The upper portions of the Kalkberg Formation (Lower Devonian) are clearly exposed in the road cuts on Rickard Hill Road, near Schoharie, New York. Kalkberg strata comprise alternations of generally fossiliferous, decimeter-scale, muddy limestones (micrites, wackestones and packstones) and poorly fossiliferous, dark, calcareous shales. In general, the Kalkberg is coarser and more fossiliferous in the uppermost few meters. The Kalkberg Formation is abruptly overlain by the Becraft Formation.

The Kalkberg-Becraft contact is most easily seen on the more weathered northern side of the road (Fig. 1). Here, the contact stands out by the change in relative resistance to weathering and erosion of the two units (Becraft is more resistant.) and by the presence of a thin (1-3 cm)

reentrant that marks the contact. This reentrant is formed by the relatively rapid weathering of a K-bentonite or altered volcanic ash, which is reported for the first time in this paper. Other K-bentonites have been well-documented in the lower Helderberg Group (Rickard, 1962; Smith, Berkheiser and Way; Ebert, Applebaum and Finlayson, 1992; Milunich and Ebert, 1993; Tucker, et. al., 1998). Overlying this K-bentonite, the lowest bed of the Becraft Formation contains rare intraclasts of Kalkberg lithology, including exhumed fossils with adhered matrix. These features suggest that the interval that separates the lower from the upper transgressive sequence is, at least in part, disconformable. Further study of this contact is still in progress.

The Becraft Formation (Lower Devonian) is made up entirely of thick beds of coarse, fossiliferous limestone (grainstones). On many weathered joint surfaces, very well-developed cross-stratification is apparent.

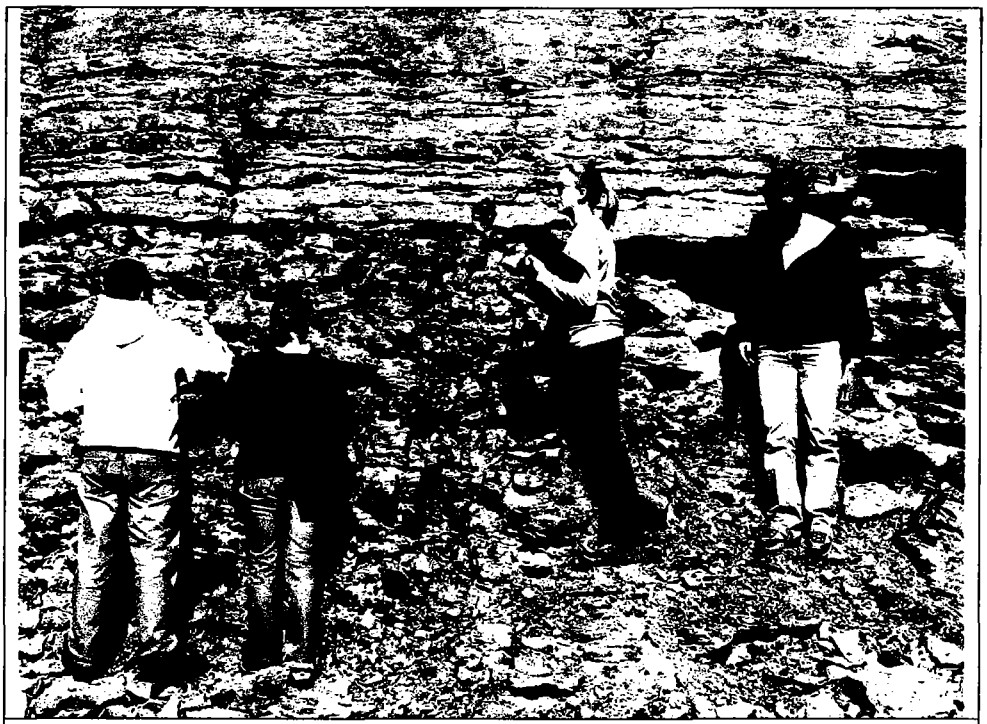

Fig. 1 The disconformable contact between the Kalkberg (below) and Becraft (above) formations on Rickard Hill Road. The prominent reentrant at the contact is a K-bentonite (altered volcanic ash). Four future earth science teachers (SUNY Oneonta students) provide scale.

Paleoenvironments

Lithologic and paleontologic aspects of the Kalkberg Formation suggest that this unit was deposited on an open marine shelf with nearly ideal conditions for benthic fauna (See also the general interpretations in Isachsen, et. al., 1991, p. 109; and Linsley, 1994). In general, the sea floor was below fair-weather wave base, but shallow enough that the waters were well oxygenated and contained abundant suspended food for the filter-feeding organisms. The

lithologies and sedimentary structures present (rare ripples and cross lamination) indicate that this shelf was periodically affected by storms, which winnowed the bottom and created shell pavements. Ordinarily, the sea floor was blanketed with soft mud as evidenced by the "snowshoe" strategies adopted by much of the fauna.

In contrast, the Becraft Formation was deposited in significantly shallower water, well-above storm and fair-weather wave base. Tidal currents (Ebert, 1987) and waves winnowed finer sediments from the sea floor and produced well-sorted sands and gravels comprised of skeletal material. Sedimentary structures (trough cross stratification and upper stage planar stratification) indicate shallow, energetic conditions. Net accumulation of sediment was probably relatively low as indicated by the well-sorted and abraded nature of the skeletal debris. In the lower parts of the formation, abundant holdfasts of the enigmatic crinoid *Aspidocrinus scutelliformis* (another "snowshoe" adaptation) may have been reworked and concentrated from muddier environments.

Paleontology and Paleoecology

The Kalkberg and New Scotland formations, comprising the upper part of the lower Helderberg Group and the middle part/transition to upper Helderberg, are the most fossiliferous units in the group. Rickard (1962) reported that these formations have yielded over 300 species. Linsley (1994) indicates that there are at least 65 species of brachiopods alone. The fauna is dominated by epifaunal suspension feeders such as brachiopods, bryozoans, echinoderms, sponges, tabulate corals and pelecypods. Most of the community exhibits "snow shoe" types of adaptation to soft substrate. This is best displayed by the broad, flat valves of the strophomenid brachiopods, which are extremely common. Colonial bryozoans, tabulate corals, and solitary crinoids generally availed themselves of localized hard substrates for attachment, such as brachiopod valves or winnowed shell pavements. Motile benthos includes trilobites and gastropods, which probably functioned as scavengers on the Kalkberg sea floor.

The Becraft fauna is markedly more abundant than that of the Kalkberg, but it is considerably less diverse. Disarticulated echinoderm debris predominates, with abundant brachiopods, lesser numbers of bryozoans, and rare stromatoporoids and cephalopods. Again, the fauna is dominated by suspension feeders; however, the Becraft fauna exhibits distinctly different adaptations to the environment. Most of the brachiopods are thick-shelled and relatively equidimensional – a "roly-poly" or "weeble" type of adaptation to a firm, but frequently mobile substrate. This habit is exemplified by several species of uncinulids. It is most easily seen on the characteristic gypidulid, *Gypidula pseudogaleata*, which also possesses an unusual thickening in the umbonal region as a means of remaining upright. Rare, large (up to 6 cm diameter) gastropods (crushed), fragments of trilobites, and conches of orthocone cephalopods are also present. In general, the Becraft community indicates a shallow, well-agitated shoal environment. Sediments were reworked frequently and net rates of deposition were generally low.

In addition to the unusual holdfast of *Aspidocrinus scutelliformis*, which is present in the lower part of the formation, the Becraft at Rickard Hill Road also displays *in situ*, root-like holdfasts of a crinoid, which may be assignable to the genus *Clonocrinus*. These holdfasts are

best seen in the uppermost 1-2 meters of the formation and are particularly well displayed on the exposed bedding plane at the top of the outcrop on the north side of the road. Many of these root-like masses exhibit a preferred orientation, which may reflect an attempt by the crinoids to anchor themselves against a prevailing (probably tidal) current.

Fossil Collecting and Teaching Activities

The abundance and diversity of fossils available at Rickard Hill are such that large collections may be acquired in a short time. Individual fossils, freed from the matrix by weathering, may simply be picked up from the talus at the foot of the outcrop. For some species, it may be possible to collect enough individuals for classroom sets (i.e., 12 samples for a class of 24). Slabs of the Kalkberg Formation are also easily collected from the float. These commonly display a variety of fossils on a single bedding plane. Such samples may be particularly useful because they illustrate the concept of assemblage diversity, as well as ecological interactions. For example, bryozoans may be found encrusting on valves of brachiopods.

Although it may be possible to collect individual fossils from the Becraft, it is difficult owing to the relative resistance of the formation. Therefore, slab samples, commonly with abundant brachiopods on bedding planes, are a better bet. However, the thick-bedded nature of the Becraft generally means fairly large samples.

Crinoidal debris predominates in the Becraft. Because echinoderm plates break with cleavage, fresh surfaces of Becraft samples appear sparkly. Such surfaces may be somewhat misleading for inexperienced students, who may think that the rock has a crystalline rather than bioclastic texture.

Once fossils have been collected, how can they be used in the classroom? Activities using fossils address two of the specific understandings in Standard 4 (Science), Key Idea 1 in the Regents Earth Science Core Curriculum:

1.2i The pattern of evolution of life-forms on Earth is at least partially preserved in the rock record.	
	◆ Fossil evidence indicates that a wide variety of life-forms has existed in the past and that most of these forms have become extinct.
1.2j Geologic history can be reconstructed by observing sequences of rock types and fossils to correlate bedrock at various locations.	
	◆ The characteristics of rocks indicate the processes by which they formed and the environments in which these processes took place. ◆ Fossils preserved in rocks provide information about past environmental conditions.

Activities addressing Understanding 1.2i might include –

- ◆ Having students recognize the different species in an assemblage
- ◆ Measuring the dimensions of a large number of a single species to identify variations within a population
- ◆ Comparing diversity of two different assemblages
- ◆ Making comparisons between the fossils (extinct) and modern examples of the same types of organism.

Activities related to Understanding 1.2j could include -

- ◆ Having students make inferences regarding environmental conditions based on the ecological needs of the fossils in an assemblage. Comparisons may be made with the ecological requirements of living representatives of the same groups.
- ◆ Environmental information may also be gleaned from the way the fossils are preserved. For example, if fossils are preserved in life positions, this suggests little physical reworking in the environment by waves and currents, therefore relatively quiet, and possibly deep conditions (e.g., some examples from the Kalkberg Formation). Conversely, if fossils are disarticulated and abraded, the environment was likely turbulent and shallow (Becraft Formation).

Other Geologic Features of Interest

On the top of the outcrop on the north side of the road, excellent examples of glacial striations and polish may be observed. An interesting aspect of these striations is that they comprise two sets which are oriented at nearly 90° to each other (Fig. 2).

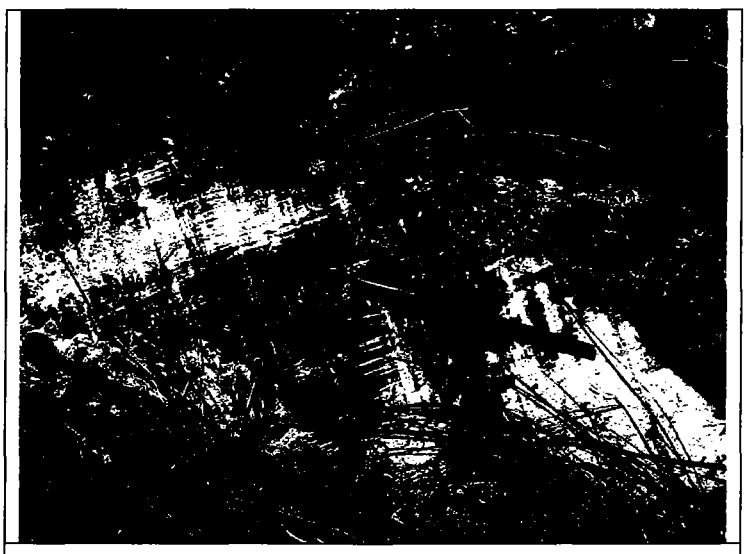

Fig. 2 Two sets of glacial striations at nearly 90° on the top of the road cut on Rickard Hill Road. Pen provides scale.

The northern outcrop overlooks the large, active quarry in Schoharie. Visits to the Rickard Hill road cuts may be interrupted on occasion by blasting within the quarry. At these times, employees of the quarry will ask visitors to leave the outcrop.

Conclusion

Collections of fossils for classroom use are acquired fairly easily at Rickard Hill Road. Samples from the Kalkberg and Becraft formations may be used to design a variety of activities in which students utilize multiple science process skills to explore a snapshot of the history of life on Earth. The abundance and diversity of fossils, along with a variety of other geologic features, make the outcrops on Rickard Hill Road well suited for class field trips also. Ample parking is available on wide shoulders and there is a safe distance between the face of the exposure and the road.

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Directions to Rickard Hill Road Outcrops

Because this trip comprises a single stop, directions to the outcrop are provided in lieu of a road log. Directions are given from the closest exit on Interstate 88.

◆ Take Exit 23 for Schoharie and Central Bridge, Rts. 7, 30 and 30A.

◆ At the end of the ramp, turn onto Rt. 30A south toward Schoharie.

◆ When Rt. 30A and 30 split, stay on Rt. 30 to the village of Schoharie.

◆ In Schoharie, you will pass a school on the left, which is set back slightly from the road and uphill. Immediately after the school, there is a blinking traffic light.

◆ Turn left at the light.

◆ Almost immediately after turning off Rt. 30 the road will split. The road on the right goes uphill and there is a sign that indicates that this is Rickard Hill Road (Schoharie County Rt. 1a).

◆ After a few tenths of a mile, you will encounter outcrops on both sides of the road. These are exposures of the Coeymans Formation. The upper surfaces of these outcrops display clear glacial striations and are overlain by glacial sediments.

◆ Continue uphill to the very large outcrops on both sides of road. There is ample parking on both sides of the road. Description of the outcrops is in the narrative for this field trip.

If time permits, we may also visit the site of the Cave House Museum of Mining and Geology, a geoscience education facility which is currently under development. This facility will comprise parts of the Howe Cave Quarry, the old Lester Howe Hotel and the original entrance to

Howe Caverns. Strata of the lower Helderberg Group, various cave and karst features, a thrust fault, as well as spectacular fields of ripple marks and glacial striations are some of the features that will be available for study and exhibition. See Ebert and Matteson (this volume) for directions to the site and for contact information regarding the Cave House Museum.