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nel of Greyling Creek,[4] which was formerly a tributary of Hawk Creek. Since the piracy, it has lowered its channel, cut channels through the old fan formed by Hawk Creek (Fig. 1-R), and formed its own fan.

Further evidence that some pre-Hawk Creek drainage formerly drained the area is found in the remnants of the two older terraces to the north of Hawk Butte. This drainage joined the Sagavanirktok River just south of the southern end of the Northern Section of Franklin Bluffs. Piracy, in a manner similar to that previously described, took place at the north end of Hawk Butte. This piracy cut off the area drained by Hawk and Greyling creeks from the larger system, just as the most recent piracy has separated the Hawk Creek drainage area from that drained by Greyling creek. The Sagavanirktok River, in its eastward migration, has removed much of the evidence of the older and larger drainage system that existed in the low area between the two sections of the bluffs. Continued similar migration of the river will some day remove Hawk Butte and the terrace remnants to the east of it. Thus will be destroyed the evidence which today so graphically portrays the sequence of events that resulted in the piracy.

ACKNOWLEDGEMENTS

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The Structure and Stratigraphy of the Skvor-Hartl Area, Southeast Linn County, Iowa

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Abstract. An area in southeast Linn County, Iowa is discussed in which a number of geological units from the Coralville limestone (Devonian) through the Silurian are exposed in a very small area.

A map is included which shows the outcrop pattern and axis of the major structural feature, a sharp narrow northeast-southwest trending syncline. Smaller folds, and at least one fault are indicated.

The study was based on exposures and a number of scores.

[4] The tributary of Hawk Creek is here named Greyling Creek.

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The Skvor-Hartl area is located in sections 9 and 16 T. 82 N., R. 6 W. in Linn County, Iowa and affords an unusual opportunity to study a number of stratigraphic units in a very small area.

It is possible to study in outcrop stratigraphic units from the Coralville member of the Cedar Valley (Devonian) to the Silurian, which in this area consists of Anamosa, LeClaire, and Hopkinton (?). It is rather interesting to note that contacts between most if not all the stratigraphic units can also be studied in this area.

The interpretations of the stratigraphy and structure were based on a number of cores, as well as exposures. All information was tied in by a stadia survey.

Stratigraphy

The stratigraphic units have been arranged in ascending order. However, since the LeClaire and Anamosa are considered as lateral facies, the Anamosa has been described first alphabetically.

Silurian

The Silurian rocks are represented by Undifferentiated Niagaran Series (Hopkinton?), Anamosa, and LeClaire.

Undifferentiated Silurian (*Hopkinton*?). There are at least two cores which penetrate the Silurian and show a different lithology than that described below. This unit consists of a dolomite, very light gray weathering to yellow-brown, fine-grained, very porous and cindery appearing but locally dense and hard, massive, somewhat brecciated with highly inclined fracture planes. The only fossils are some molds of crinoid stems. No thickness can be given for this unit.

Anamosa. The Anamosa is not present in large amounts in the area, but when it occurs, it is a dolomite, yellow-brown, fine-grained, soft to medium-hard, sparsely fossiliferous, laminated, of undetermined thickness. There may be some exposures of this unit in the area, but it is often difficult to distinguish between weathered Coggon and Anamosa, and the authors have not seen anything they would definitely call Anamosa.

LeClaire. The LeClaire is a dolomite, light gray to pinkish brown, weathering to reddish-brown, fine- to medium-grained, vuggy, very hard, with locally soft marly zones, abundantly fossiliferous, containing mostly small brachiopods and gastropods, generally massive with steeply dipping beds. Thickness of the unit is not known.

Silurian – Devonian

The Bertram dolomite is quite well represented in several cores, but can be seen in exposure only in the floor of Hartl Quarry.

The Bertram is a dolomite, very light gray to medium bluish gray, fine-grained to sublithographic with an earthy texture, porous and soft to dense and hard; massive, abundant clear quartz sand, with some very distinctive (locally abundant) rounded black chert grains; brecciated, with many vertical green clay and calcite fracture fillings. Probably the most distinguishing feature of this unit is the brecciation, in which the breccia fragments appear to be the same material as the matrix. The complete thickness is unknown, however a thickness of fifty-seven feet is known from the cores.

While this paper is not an attempt to solve the problem of the age, and/or stratigraphic relation of the Bertam there are certain features brought out during the study which may shed some light on a possible solution.

(1) The unit is a breccia, or at least is highly fractured, indicating a relationship to some sort of disturbance, tectonic or otherwise.
(2) Outcrops of this unit are in a line generally trending northeast-southwest parallel to the major structures of the area.
(3) Cores indicate there is some sort of lateral change from Bertram lithology to the Silurian types.
(4) Coring shows that the Wapsipinicon lies on Bertram, LeClaire, Anamosa, or undifferentiated Silurian which would indicate that if the Bertram were related to a structural feature it would have been formed Pre-Wapsipinicon post Silurian (or during late Silurian).

It must be pointed out that although the Coggon-Bertram contact has been penetrated in a number of places, the bottom contact has never been identified with certainty either in core or outcrop to the writer's knowledge, although it has been found in well cuttings by the Iowa Geological Survey. In one instance it is possible that a core in this area showed LeClaire over Bertram, but this would not definitely relate the age of the Bertram to the Silurian, as there are a number of ways (i.e. slump, cave filling, etc.) in which locally the Bertram could be beneath older units.

Middle Devonian

The Devonian of this area consists of the Wapsipinicon formation and the Cedar Valley formation, which are described in ascending order.

Wapsipinicon Formation

Coggon member. The lowermost member of this formation is the Coggon, which is represented by up to twenty-five feet of dolomite, brown to gray, fine- to medium-grained, crystalline to earthy dolomite, very vuggy in some areas. Bands of smooth brown chert nodules are associated with the dolomite.

The Coggon may rest on the Bertram, LeClaire, Anamosa, or undifferentiated Silurian. The upper contact is drawn at the change to a light brown very fine-grained, very hard limestone or dolomite of the Otis.

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This unit outcrops on both sides of the Silurian in the southern one-quarter of the map where it can be identified by the brown chert. The entire thickness, however, can be observed in the Hartl Quarry at the north end of the area.

Otis member. The next member is the Otis which is here represented by about twenty feet of limestone and/or dolomite. The stone is from light to dark brown, fine-grained to sublithographic, dense, hard and brittle, with a rather consistent soft zone of about seven feet in the middle, abundant small smooth shelled brachiopods in some zones. Locally brecciated, and arenaceous.

The best exposure of the Otis is at Hartl Quarry, although it may be possible to find some exposed in the bluffs along the south side of the Cedar River.

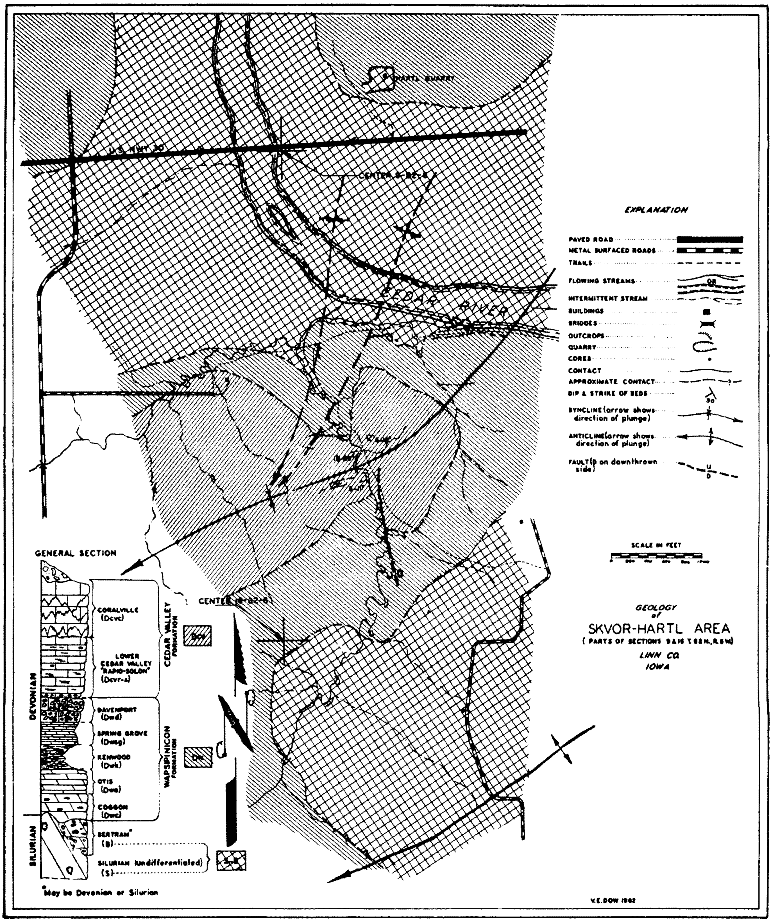

Figure 1. The Skvor-Hartl Area.

The upper contact of this unit is marked at the change to a shale or very argillaceous limestone of the Kenwood.

Kenwood member. The Kenwood lies on the Otis, and shows the most variable lithology of any unit in the formation, but has the most consistent thickness, about twenty-one feet.

There are numerous outcrops of Kenwood in the bluffs south of the river, and the entire thickness can be observed in a number of places. This member consists of shale, limestone, dolomite, and all gradations in between, blue to yellow-brown, fine-grained, sandy, with abundant black chert sand grains which gives a "salt and pepper" appearance. There are a number of breccias, none of which are traceable laterally for any great distance. The limestones and dolomites are in lenses which alternate and/or grade into shale. Gray, fine-grained chert masses are locally common. The base of this unit is nearly always a shale or an extremely argillaceous limestone.

The upper contact is marked by the appearance of a brown saccharoidal dolomite of the Spring Grove.

Spring Grove member. The Spring Grove is represented by about nineteen feet of medium to dark brown dolomite, fine-grained, saccharoidal, very porous with some large marl-filled cavities, soft, very thin bedded with some distortion and breciation.

The best exposure of this member is about six hundred and fifty feet south of the center of section 9 T. 82 N., R. 6 W., where about three or four feet can be seen. Small amounts of this stone occur on the sides of the ridges south of the river in some spots, and in the bed of the main creek which flows through the area.

The upper contact in this area is known only from cores, where there is a very slight gradation to the brown lithographic Davenport limestone above.

Davenport member. The Davenport member is a brown, sublithographic to lithographic brecciated limestone with a yellowish-brown argillaceous, arenaceous matrix. Where weathered, the matrix is soft and crumbly. Average thickness is about nineteen feet.

The Davenport is exposed at two locations in the north central part of the area; one east of the creek, and one on the west side. Both of these exposures are significant for the Cedar Valley-Davenport contact can be observed in each.

The upper contact is seen in cores as well as in outcrop and the break is made at the first appearance of breccia fragments of lower Cedar Valley limestone.

Cedar Valley Formation

Lower Cedar Valley (Rapid-Solon). No core has penetrated the entire thickness of this unit, but the top and bottom can be observed in cores and exposures and a thickness of about fifty feet has been determined.

The upper portion of this unit consists of blue-gray, medium- to coarse-grained limestone, very fossiliferous, thick bedded, very argillaceous in spots, with some small masses of soft white crinoidal chert.

The lower part is a light brown, fine- to medium-grained, very fossiliferous, slabby limestone; the lower two to three feet of which is brecciated, and contains considerable quartz sand and dark chert grains.

The Lower Cedar Valley is exposed on the west side of the creek near the center of the area as well as the two exposures mentioned earlier in the section on the Davenport member.

The upper contact of this unit has been drawn about four feet below a prominent black shaly brachiopod bed of the Coralville limestone.

Coralville member. The Coralville member is a light brown to light gray, fine-grained to lithographic limestone; upper and lower *Idiostroma* zones are present as well as abundant corals and brachiopods; massive, stylolitic, with some thin green clay shale partings.

There is about fifty feet of Coralville present.

In exposure this unit is greatly disturbed with dips of up to 20° observed.

STRUCTURE

The main structures in this area are a narrow northeast-southwest trending syncline plunging southwest about one hundred feet to the mile, and a broader, more gently plunging parallel anticline.

The beds of the syncline show dips of up to 30°. However, these become much gentler outside the narrow central portion of the fold. The flanks of the anticline dip only about 8-10°.

There are at least three structural features associated with the syncline. In the center of the map there is a north-south trending normal fault, with the east side displaced downward about twenty-five feet.

Branching outward from the main downfold are two small plunging folds which diverge northward. The flanks show a dip of 10-15°.

Investigations outside the area of this report have shown that the sharp downfold disappears just to the west of the mapped area, and the normal gentle southwesterly dip of the strata is once again observed.

Conclusion

Faults and folds are not unusual in Iowa geology, but the folds are generally not as steep as those observed in this area, and the rocks are almost always covered with drift and not readily studied.

Ground Patterns as Keys to Photointerpretation of Arctic Terrain

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Abstract. Data based on field observations made during the summers of 1955-61 substantiate the belief that angle of slope is the most significant factor in determining the type of ground pattern which regionally or locally features arctic terrain.

The factors of influence in any arctic terrain ground pattern are texture of regolith, type and thickness of vegetation mat, amount of surface and subsurface water, thickness of active layer, and angle of slope of the ground surface.

The angle of slope and texture of regolith determine surface and subsurface drainage to a large extent, and thus control the water loss from the area. The amount of water in the ground, in turn, plays a large role in determining the type and amount of vegetation that can grow in the area and, hence, the thickness of the vegetation mat. The vegetation mat, in turn, pretty well determines the thickness of the active layer. It is most thick (deep) where the mat is very thin, or absent.

It was determined that equidimensional ground patterns, circular frost scars, hummocks, ice-wedge polygons, and sorted stone nets develop on slopes of less than two degrees. With increase in slope to four degrees, these patterns become elongated, but not aligned nor continuous, i.e.—not stripes. Further increase in slope to six degrees is featured by such linear features as stripes (both sorted and non-sorted), and by development of steps. Steps become much more pronounced on steeper slopes, and solifluction lobes characterize slopes in excess of eight degrees.

Some changes in slope are very common and very local, so that a regional pattern peculiar to a slope of two to four degrees will be modified by a pattern of the locally developed steeper slope.

Once one knows the significance of the different types of ground patterns, he can do an excellent job of determining terrain conditions of an unknown area from good air photos of that area.

Introduction

Anyone who has flown over Arctic Coastal plain terrain, or

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