

STATE OF SOUTH DAKOTA
Richard Kneip, Governor

DEPARTMENT OF NATURAL RESOURCE DEVELOPMENT
Vern W. Butler, Secretary

GEOLOGICAL SURVEY
Duncan J. McGregor, State Geologist

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**MIOCENE CHANNELS IN THE CEDAR PASS AREA,
JACKSON COUNTY, SOUTH DAKOTA**

by

J. C. Harksen

Science Center
University of South Dakota
Vermillion, South Dakota
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ABSTRACT

Recent discoveries in southwestern South Dakota have shown that in at least two places there is an unconformable contact between the Oligocene Brule and Miocene Sharps Formations. In the Cedar Pass area a Miocene channel cutting down into Oligocene rock has deposited a channel sandstone which is similar to the *Protoceras* channel sandstone. Through definition *Protoceras* Channels are restricted to the upper part of the Brule Formation. The Miocene channel sandstone being lithically similar to and lying at the same level as the *Protoceras* channel sandstone creates an interesting problem in local stratigraphy and paleontology.

INTRODUCTION

Oligocene and Miocene are both time units based on the European section. Although these terms are basic to historical geology, Glaessner (1953), points out that the common boundary between these two time units is not in agreement even in Europe, the area where these two units were first recognized and named. In South Dakota the Oligocene-Miocene contact has been arbitrarily placed at the base of the Rockyford Ash Member of the Sharps Formation (fig. 1). It has been placed at this level as a matter of convenience and through historical precedent even though the actual time mark may be some distance higher or lower in the section.

The Rockyford Ash is a wide ranging and easily recognized bed in South Dakota that has been used as a marker in both the collection of vertebrate fossils and in stratigraphic studies. The base of this unit has been and will be used by the author and his associates as the base of the Miocene in South Dakota until such time as new and valid evidence is obtained that will shift the time boundary either up or down the section. In all cases, however, the base of the Rockyford Ash is the contact between the White River and Arikaree Groups.

In almost all instances the Rockyford Ash rests conformably upon the Poleslide (fig. 1). This means that there is no significant time break between the Oligocene and Miocene rocks of these regions but rather an unbroken record of deposition between these two epochs. The constant deposition has also preserved the only complete record of Mammalian evolution transecting the Oligocene-Miocene boundary known in the Great Plains. Up until this time only at one spot (marked as Godsell Ranch on fig. 2) was a post Rockyford channel known to cut down through the Rockyford Ash and form an unconformable contact between the Oligocene and Miocene rocks of southwestern South Dakota. The discovery of a Miocene channel which cuts through

the Rockyford Ash down into the Poleslide in the Cedar Pass area (fig. 2) forms the basis of this report.

HISTORICAL STATEMENT

Matthew (1907) placed the base of the "Rosebud beds" along Porcupine Creek (fig. 2) at "a heavy white stratum which appears to be identical with the stratum capping the White River formation on Sheep Mountain." As the White River was considered Oligocene and the Rosebud was considered Miocene this was the historical precedent for drawing the boundary between the Oligocene and Miocene at the base of the Rockyford Ash. Most people who worked with and wrote of the White River Oligocene seemed to avoid consideration of the upper beds and thereby the upper contact. However, Harksen and Macdonald (1969) give additional historical perspective on the Oligocene-Miocene boundary in South Dakota and their table 1 shows the development of the stratigraphic nomenclature of the White River Badlands.

Osborn followed Matthew's work closely as did most other workers of this and later periods. Osborn (1907, 1909) graphically portrays "Lower Miocene (Rosebud) resting on Brule (Oligocene) near Porcupine Butte, South Dakota." It should be here noted that the term "Rosebud" was used by Matthew (1907), Osborn (1907, 1909), Bump (1956), and almost all authors prior to 1960 to delimit a different sequence of strata than it delimits today. While previously the name "Rosebud" was given to all of the strata between the Brule and the Ogallala, currently "Rosebud" is used in the restricted manner shown in figure 1. The history of the "Rosebud" terminology is documented by Macdonald and Harksen (1968).

Matthew's work was also followed quite closely by Wanless (1923, p. 260) who in writing about the White River Badlands of South Dakota said "Miocene deposition in this area is initiated by the white ash layer at the base of the Rosebud formation." It is to be here noted that half a century after its publication Wanless' treatise is still the basic work on the White River Badlands.

Bump treated the Rockyford Ash differently in two successive papers. In his paper entitled "The White River Badlands of South Dakota," Bump (1951) included the Rockyford as the very top unit of the Brule Formation. However, in a later paper, Bump (1956) does not include it in the Brule but refers to it as the Basal Arikaree white ash, the stratigraphic position it has occupied ever since.

As mentioned at the beginning of this paper until a few years ago the Rockyford Ash was considered

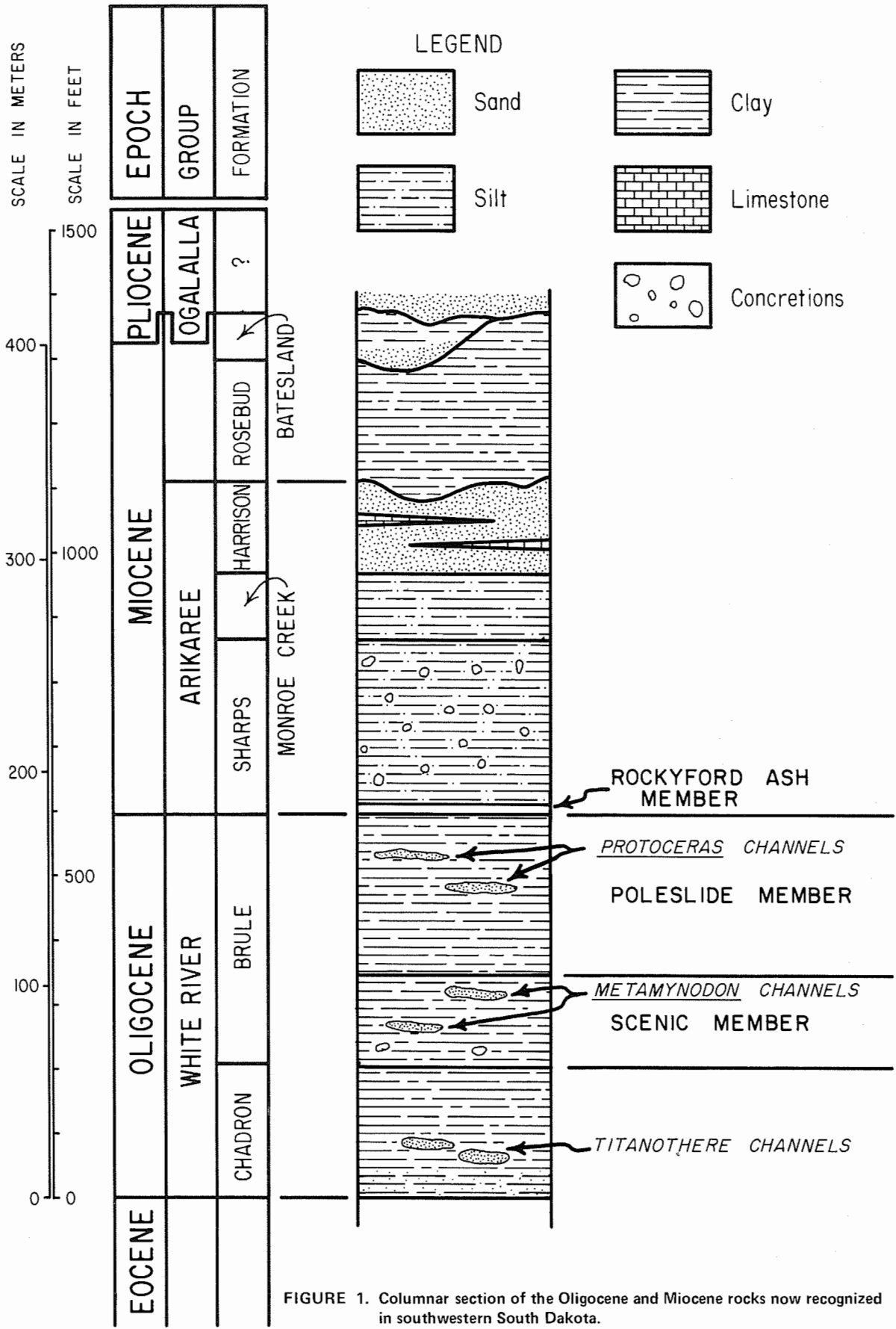


FIGURE 1. Columnar section of the Oligocene and Miocene rocks now recognized in southwestern South Dakota.

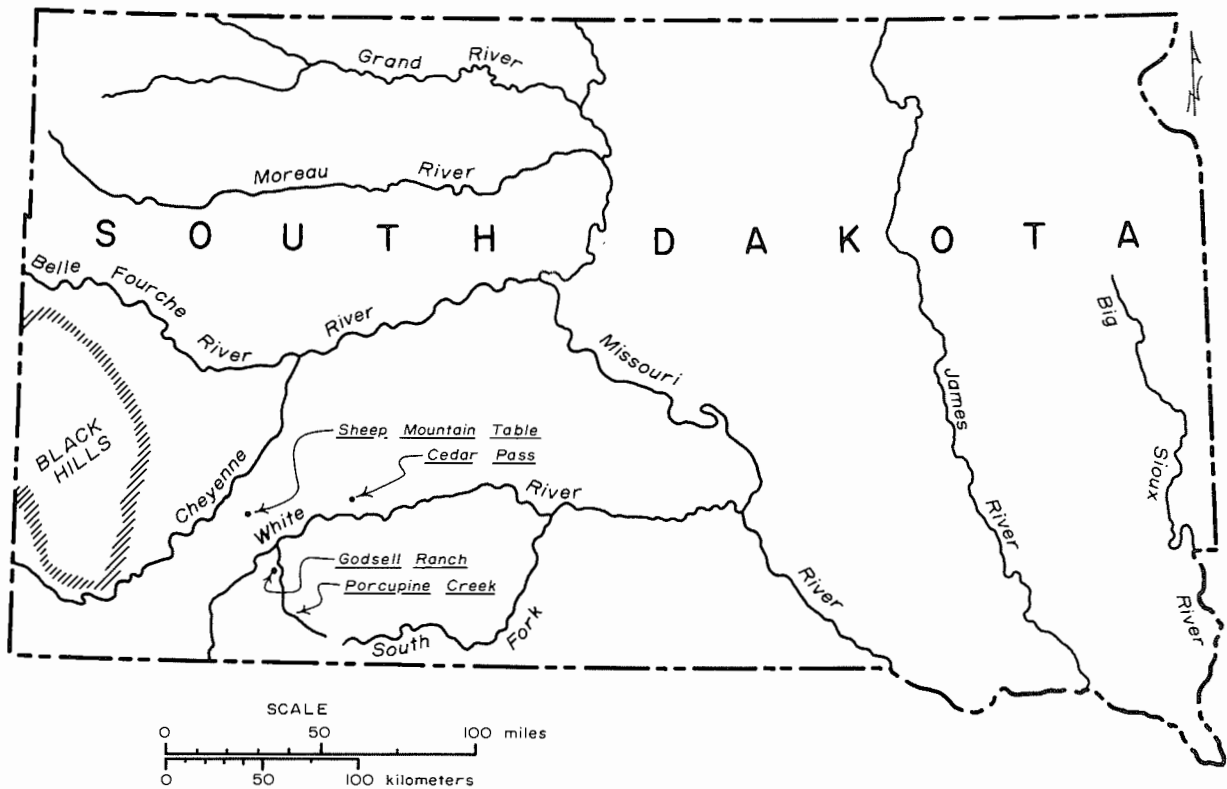


FIGURE 2. Index map of South Dakota showing the location of several areas mentioned in this report.

the basal part of the Rosebud Formation (fig. 1). This was formally changed by the naming of the Sharps Formation (Harksen, Macdonald, and Sevon, 1961) and by the naming of the Rockyford Ash Member of the Sharps Formation (Nicknish and Macdonald, 1962).

It had long been recognized that an unconformity of major proportions existed between the Brule and Gering Formations in Nebraska and Wyoming. It was therefore a pleasant surprise when it was learned that in southwestern South Dakota there was a series of beds which represented all the time that was missing between the Brule and Gering of Nebraska. In addition beds equal in age, but dissimilar in lithology to the Gering, were also represented in the South Dakota section.

The Sharps Formation (Harksen, Macdonald, and Sevon, 1961) was named because in southwestern South Dakota the unit between the Monroe Creek Formation (Hatcher, 1902) and the Brule Formation (Darton, 1899) was lithically dissimilar to the Gering Formation (Darton, 1899), the unit occupying the similar stratigraphic position in Nebraska. Figure 3 shows the contact between the Sharps and Brule

Formations at the type section for the lower half of the Sharps Formation in Shannon County, South Dakota.

The Sharps Formation in the type area consists of 350 feet of massive pink clayey silt that contains multitudinous quantities of randomly spaced, four inch to six inch, calcareous concretions (Harksen, 1965). The Gering as described by Darton (1899) consists of "... Laminated, massive, and cross-bedded, light gray, mainly coarse sands and soft sandstone...". The lithologies, the basis for the concept of formations as such, can hardly be confused.

STRATIGRAPHIC RELATIONSHIPS IN THE CEDAR PASS AREA

During the summers of 1969 and 1970 some investigations were made of a "*Protoceras* channel" in the Cedar Pass area to determine its possibilities as a field trip stop. Close observation showed that this channel was not a *Protoceras* channel (which through definition is restricted to the upper part of the Brule Formation) but rather a channel of Miocene age which had cut down into the Brule Formation. While



FIGURE 3. The contact between the Sharps and Brule Formations at the type section for the lower part of the Sharps Formation. The Rockyford Ash is indicated at point "R." Note the difference in light value and weathering between the Brule and the Sharps Formations.

channeling in the Cedar Pass area had been reported by Parris and Green (1969) none of these channels had been known to cut down through the Rockyford Ash. This then becomes the second site in South Dakota where Arikarean channels are known to cut down through the Rockyford Ash and deposit Sharps Formation unconformably on the Brule Formation.

The Cedar Pass area is not an area of layercake geology. In the upper part of the section there are many subtle Miocene channels which cut only Miocene rock. These channels are mentioned by Parris and Green (1969) but because they were primarily interested in vertebrate fossils they merely mentioned the complexities of the section. The repeated cycles of cut and fill in the Miocene section were either missed or ignored by the earlier workers. Parris and Green also do a valuable service in presenting a list of mammals they collected above the Rockyford Ash and in pointing out the fossiliferous nature of the channel deposits.

Scattered across southwestern South Dakota are erosional remnants that are now the only remains of a

bed of white volcanic ash that was once continuous throughout the area. The white ash layer is one of the most persistent and interesting elements in the White River area (Wanless, 1923). This bed, named the Rockyford Ash Member (Nicknisch and Macdonald, 1962), is made up of a very white massive volcanic ash layer having a remarkably constant thickness of 25 feet (Bump, 1951). At the type section the Rockyford Ash is 30 feet thick (Nicknisch and Macdonald, 1962) while at Cedar Pass it is 22 feet thick (Wanless, 1923). Figure 4 shows a photograph of the Rockyford Ash at Cedar Pass (see fig. 2 for the location of Cedar Pass).

Prior to this investigation, and only in one area, has there been reported an unconformity between the Sharps Formation and the Brule Formation. This unconformity was reported as a Miocene (Sharps) channel which cut down through an undetermined thickness of Sharps Formation and into the Brule Formation. This unconformity was reported by Macdonald (1963 and 1970) who collected a vertebrate fauna from the basal conglomerate of this channel in sec. 13, T. 40 N., R. 44 W., Shannon

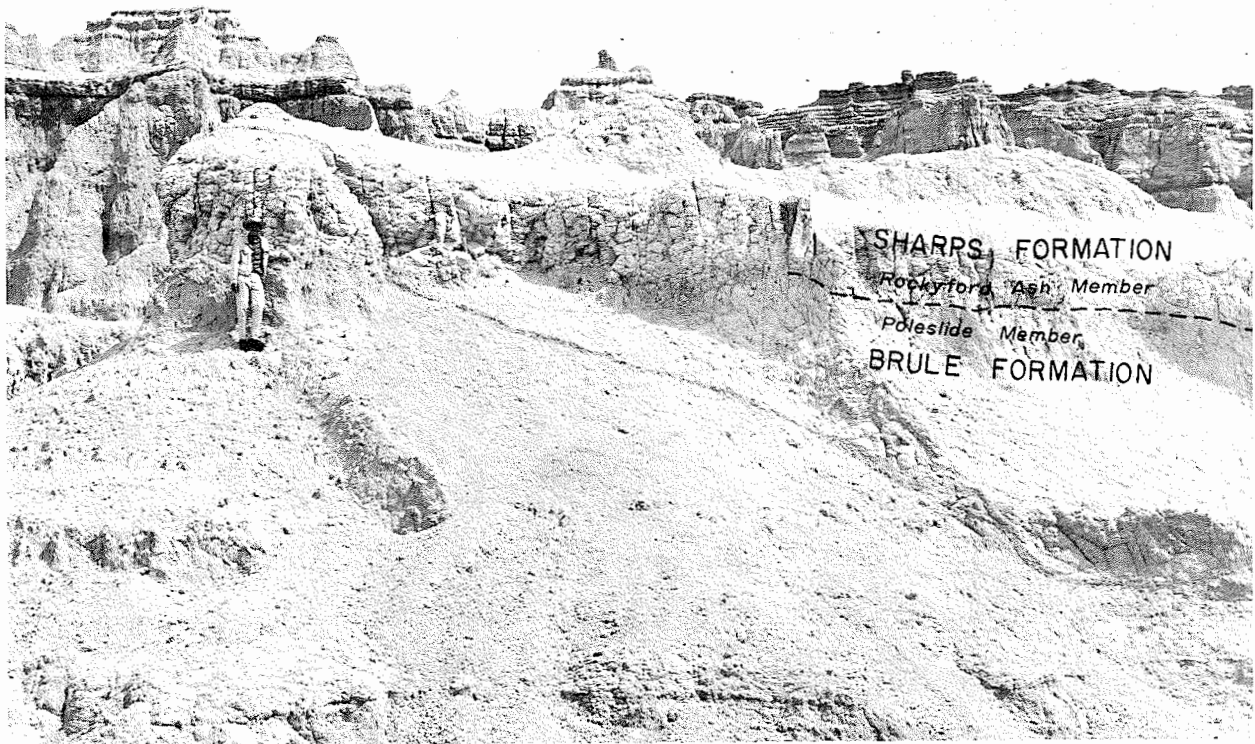


FIGURE 4. Photograph of the Rockyford Ash Member of the Sharps Formation along with underlying and overlying units in the Cedar Pass area of Jackson County, South Dakota.

County. This site is referred to as the Godsell Ranch Channel faunule by Macdonald (1963) and is labeled "Godsell Ranch" on figure 2. A photograph of this channel as it appears in section 13 is presented as figure 5.

The Miocene channel shown in figure 5 is fossiliferous as is documented by the faunal list for site SDSM V5413 as given by Macdonald (1970). The channel at this site is quite restrictive and is sandwiched between the Brule and late Pleistocene deposits. However, across the canyon to the west, in section 14, this same channel can be observed cutting down through the Rockyford Ash, thus lending additional information concerning the age of this channel. Parris and Green (1969) give a Sharps age to the channel.

In the area just to the north of Cedar Pass there are located scattered remnants of an eastwardly trending Miocene stream channel. These few scattered remnants mark the channel of an early Miocene stream that cut down through an unknown thickness of post Rockyford Sharps, 22 feet of Rockyford Ash,

and 45 feet of the Poleslide Member of the Brule Formation. Figure 6 is a columnar section which graphically portrays the downcutting and filling by this stream channel.

A photograph of the "pseudo-*Protoceras* channel" of the Cedar Pass area is presented as figure 7. For comparison a photograph of a typical *Protoceras* Channel from the south side of Sheep Mountain Table (fig. 2) is presented as figure 8. Both channels are composed of consolidated green sandstone that is resistant to erosion and litter the slopes with a jumble of giant boulders.

A basal conglomerate is not present at all places along the base of the unconformity. Along the flanks of the channel deposits there is no basal conglomerate and the contact is much harder to spot. Figure 9 shows the unconformable contact at one site where the basal conglomerate is missing and the mode of deposition of both the Oligocene and Miocene rocks is approximately the same.

The source of the channel fill sediment is

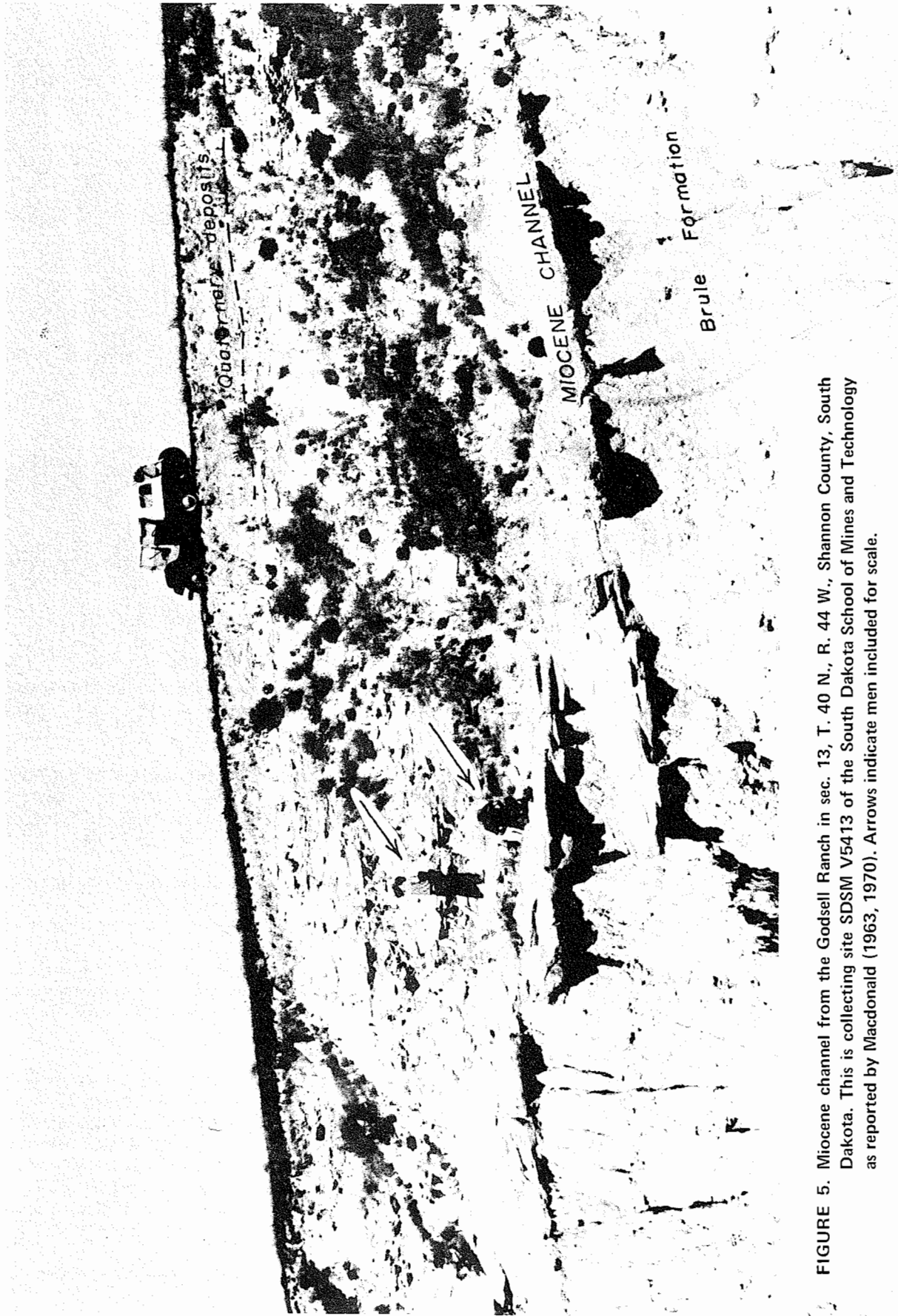


FIGURE 5. Miocene channel from the Godsell Ranch in sec. 13, T. 40 N., R. 44 W., Shannon County, South Dakota. This is collecting site SDSM V5413 of the South Dakota School of Mines and Technology as reported by Macdonald (1963, 1970). Arrows indicate men included for scale.

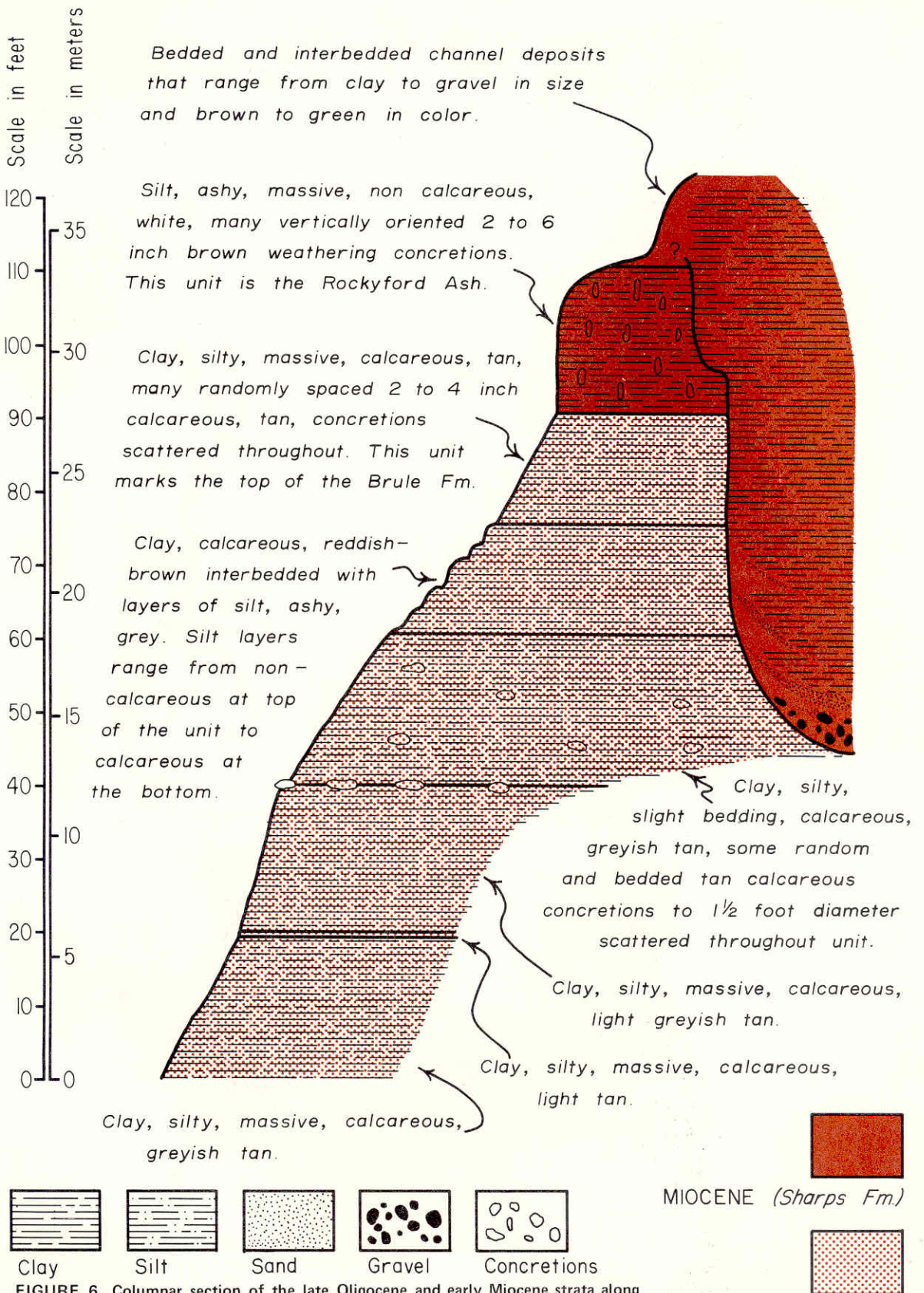


FIGURE 6. Columnar section of the late Oligocene and early Miocene strata along the line between the SE $\frac{1}{4}$ sec. 22 and the SW $\frac{1}{4}$ sec. 23, T. 3 S., R. 18 E., Jackson County, South Dakota. Note how the early Miocene channel has cut down at least 45 feet into the top of the Brule Formation.



FIGURE 7. *Pseudo-Protoceras* channel from the Cedar Pass area. This photograph was taken along the line between the SE $\frac{1}{4}$ sec. 22 and the SW $\frac{1}{4}$ sec. 23, T. 3 S., R. 18 E., Jackson County, South Dakota. Notice how the boulders of channel material are forming hoodoos up and down the slope.



FIGURE 8. *Protoceras* channel along the south side of Sheep Mountain Table in sec. 33, T. 43 N., R. 44 W., Shannon County, South Dakota.

threefold. Rock carried in by the stream from the Black Hills-Rocky Mountains is the least abundant but some pebbles of igneous rock are present in the coarser parts of the channel fill. Particles of cemented sedimentary rock locally derived from the units through which the stream cut form the major part of the coarser channel deposit while wind blown deposits of volcanic ash and dust, reworked by the stream, form the major part of the channel fill.

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a drawing of Sheep Mountain Table, was drawn by Donna Parks of Rapid City.

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FIGURE 9. The man included for scale is pointing at the unconformable contact between the Sharps and Brule Formations in the Cedar Pass area. This photograph was taken along the line between the SE¼ sec. 22 and the SW¼ sec. 23, T. 3 S., R. 18 E., Jackson County, South Dakota.

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