

## Burrow-like Features of the Arikaree Formation, Southeastern Montana

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### Introduction

Burrow-like features are common in outcrops of the Arikaree Formation in the southern Ekalaka Hills, Carter County, southeastern Montana. It crops out over the high plains of South Dakota, Wyoming, Montana, and Nebraska. The Arikaree Formation is primarily Miocene, although basal parts may be latest Oligocene in age (see Roy, 1993). I carried out detailed studies on burrow-like features in two lithologies: a buff channel sandstone, which directly underlies the Arikaree Formation, and a greenish sandstone of the Arikaree Formation. It is not clear whether the buff channel sandstone is Paleocene or Miocene (and thus Arikaree) because of lack of fossil evidence.

The purpose of my project was to identify and analyze burrow-like features in the Arikaree Formation. Some structures may be interpreted as biological features, whereas others are probably inorganic in origin. The probable burrows may be divided into two types on the basis of overall shape: *Skolithos*-like and *Thalassinoides*-like.

### Methods

Srabani Roy and I measured five stratigraphic sections in the southern Ekalaka Hills. I documented the burrow like features with photographs and sketches, and I recorded their stratigraphic occurrence. The stratigraphic sections were located in the following areas:

- 1) SW1/4 sec. 21 T. 1 N., R. 58 E. (green sandstone)
- 2) SW1/4 sec. 34 T. 1 N., R. 58 E. (buff channel sandstone)
- 3) SW1/4 sec. 10 T. 1 N., R. 58 E. (green sandstone)
- 4) SW1/4 sec. 09 T. 1 N., R. 58 E. (green sandstone)
- 5) NE1/4 sec. 34 T. 1 N., R. 58 E. (buff channel sandstone)

I collected twenty-two rock specimens for further analysis. The rock specimens were cut and thin sections were prepared; I studied the thin sections to look for internal structures, and grain-size variation within the rock specimen (Figure 1).

### Discussion

All of the burrow-like features (BLFs) were cemented with calcite, and therefore were prominent features in outcrop. I divided the BLFs into two types: probable burrows and inorganic structures. The burrows comprised two major morphologies: *Skolithos*-like and *Thalassinoides*-like. The inorganic BLFs may have formed through diagenesis, and were also divided into two categories: sand pipes and other diagenetically altered structures.

The *Skolithos*-like burrows resemble the common ichnogenus *Skolithos* (see Ekdale and others, 1984). These burrows range from 0.3 to 4 cm in diameter, and 1 to 8 cm in length (Figure 2). The burrows are slender and resemble a soda-straw structure (Figure 3).

The *Thalassinoides*-like burrows ranged from 0.3 to 3 cm in diameter, and 5 to 56 cm in length (Figure 2). These burrows resemble the common ichnogenus *Thalassinoides* because they branch in a Y-shape from the main burrow (Ekdale and others, 1984) (Figure 4). The angle of the branching in the *Thalassinoides*-like burrows was not consistent. Cementation has caused the filling in of material around the branches of the rock specimens, therefore the angle of the branching could not be seen. The cutting of some bulbous structures revealed burrows that divided into two branches. The *Thalassinoides*-like burrows differ from *Ophiomorpha* in one aspect; *Thalassinoides*-like burrows are lacking the corn cob surficial features of *Ophiomorpha*.

Most *Skolithos* specimens have been found in shallow-marine facies; this is not the case with the Arikaree burrows. The Arikaree Formation has been interpreted to be a terrestrial sandstone, partly fluvial and partly lacustrine in origin. To support this hypothesis, sedimentary structures such as hummocky cross-stratification and a reactivation surface were identified within the Arikaree (Roy, 1993). These structures

typically occur in marine facies, but can also be interpreted as lake features. On the basis of thin-section analysis, Roy (1993) concluded that the Arikaree is a lake-deposited sandstone.

Some of the *Thalassinoides*-like "burrows" may be sand pipes or other structures resulting from diagenesis. Sand pipes are known to form when water escapes along preferential zones in the saturated sediment. The pipe is defined by chemicals precipitating from the escaping water. The product of this process would be more resistant to erosion than the surrounding rocks.

Some BLFs may be a result of other types of diagenetic alteration. The features are extremely abundant and concentrated, which leads me to believe they may be a feature of diagenesis. As ground waters flowed through the Arikaree Formation some of the layers were more permeable resulting in cementation in consistent patterns. Therefore, these layers are more resistant to erosion and are recognizable in the outcrop.

### Conclusions

The Arikaree Formation in the Ekalaka Hills of southeastern Montana contains burrow-like features ranging from true burrows to diagenetic structures. The probable burrows have many of the characteristics of burrows documented in major publications. *Skolithos*-like burrows are identical in shape and size to structures commonly referred to *Skolithos*. *Thalassinoides*-like burrows have been analyzed in thin section, and the structures and grain-size distributions are representative of those of a trace fossil (Figure 2). The diagenetic structures occur primarily in the buff channel sandstone; many may be sand pipes or other diagenetic structures.

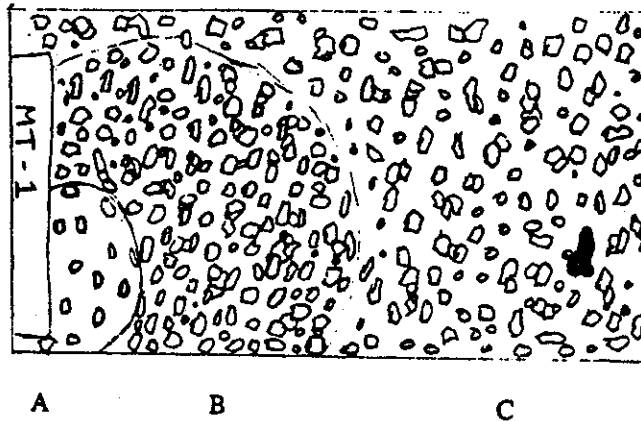


FIGURE 1. Thin section of a burrow found in the buff channel sandstone. Note the concentric appearance. A) Inner portion of the burrow, which is entirely matrix supported. B) Middle portion of the burrow, which is both matrix and grain supported, but the grains are more closely packed than in A or C. C) Outer portion of the burrow is both matrix and grain supported.

GREEN SANDSTONE

<u>BURROW TYPE</u>	<u>GRAIN SIZE</u>	<u>DIAMETER</u>	<u>LENGTH</u>	<u>CEMENTATION</u>
<i>Skolithos</i> -like	fine	0.3 to 2 cm	1 to 5.5 cm	yes and no
<i>Thalassinoides</i> -like	very fine to medium	0.75 to 3 cm	6 to 19 cm	yes and no

BUFF CHANNEL SANDSTONE

<u>BURROW TYPE</u>	<u>GRAIN SIZE</u>	<u>DIAMETER</u>	<u>LENGTH</u>	<u>CEMENTATION</u>
<i>Skolithos</i> -like	fine to medium	0.3 to 4 cm	1.5 to 8 cm	yes
<i>Thalassinoides</i> -like	fine to medium	0.3 to 3 cm	5 to 56 cm	yes

FIGURE 2. Variation in grain size and shape of the burrows in the green sandstone and the buff channel sandstone.

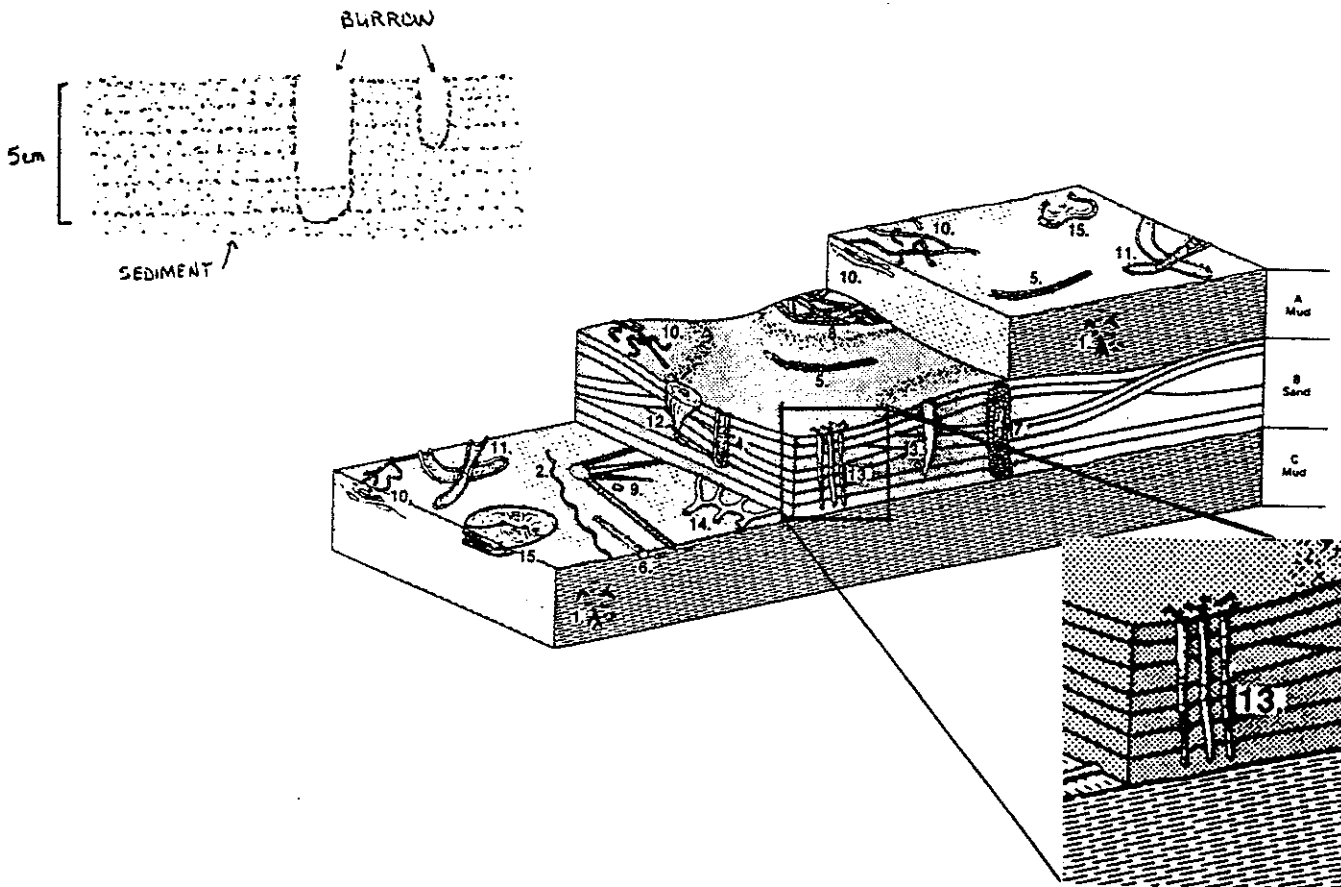


FIGURE 3. Comparison of *Skolithos*-like burrows from the Anikaree Formation with representative *Skolithos* (#13) (from Ekdale and others, 1984, fig. 15-8).

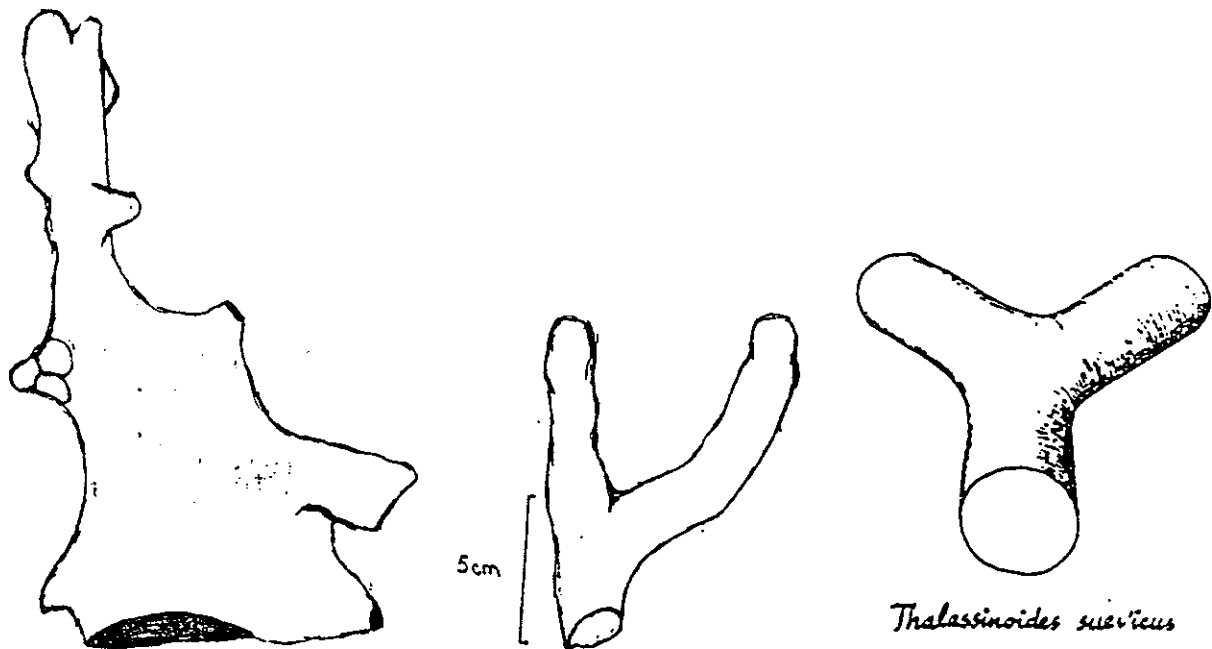


FIGURE 4. Comparison of *Thalassinoides*-like burrows from the Arikaree Formation with representative *Thalassinoides* (from Ekdale and others, 1984, fig. 6-2).

#### References

- Ekdale, A. A., Bromley, R.G., and Pemberton, S.G., 1984, *Ichnology: trace fossils in sedimentology and stratigraphy*: Society of Economic Paleontologists and Mineralogists Short Course Notes 15, 317 p.
- Roy, S., 1993, Depositional history of the Arikaree Formation in the Ekalaka Hills, Carter County, Montana: Sixth Keck research symposium in geology (abstracts), this volume.