

Genesis and Morphology of Mima Mounds and Associated Soils at Kalsow Prairie, Iowa

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ABSTRACT

The objectives of this study were to identify the genesis of Kalsow Prairie Mima mounds and to compare on-mound and off-mound soil properties. Kalsow Prairie is a 60 ha uncultivated prairie remnant in north-central Iowa. A 4 ha zone near the center of Kalsow Prairie containing 59 mounds was selected for detailed field study. Field methods included mapping the spatial distribution of mounds, measuring mound geometry, and sampling and describing soil profiles associated with both on-mound and off-mound landscape positions. The average height and diameter of the mounds was 0.23 m and 3.7 m, respectively. Twenty-nine of the mounds showed ongoing pocket gopher (*Geomys bursarius*) burrowing. This, in conjunction with the formation of 40 new mounds since 1969, indicates pocket gopher burrowing is the mode of Mima mound genesis at Kalsow Prairie. Borrowing has resulted in significant differences between on-mound and off-mound soil morphology. The average mollic epipedon thickness for on-mound and adjacent off-mound soils was 115 cm and 78 cm, respectively.

INTRODUCTION

The term "Mima mound" refers to a miniature hill that is located within a cluster of like hills. The height of mounds varies from a few centimeters to more than 2 m. Likewise their diameters are highly variable – ranging from around only one meter to more than 10 m (Sletten et al., 1994). They were originally identified more than a century ago in a number of areas – e.g., California, Washington, Texas, Louisiana, Colorado, Arkansas, and Iowa (Washburn, 1988; Aten, 1981). Since then, many have been destroyed by cultivation and construction activities; however, areas of Mima mounds are still present in a number of localized undisturbed sites throughout the central and western USA. Hypothesized modes of origin include gopher burrowing, selective erosion around a clump of vegetation, and ground heaving either induced by periglacial or seismic activity.

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MATERIALS AND METHODS

This study was conducted in a four hectare site located near the center of Kalsow Prairie, which is a 64 ha preserve owned and managed by the State of Iowa. It has never been cultivated. The legal description of Kalsow Prairie is the NE1/4, Sec. 36, T90N, R32W. The major soils within the study area are till-derived Mollisols; i.e., Clarion (fine-loamy, mixed, mesic Typic Hapludoll), Nicollet (fine-loamy, mixed, mesic Aquic Hapludoll), and Webster (fine-loamy, mixed, mesic Typic Endoaquoll). Fieldwork consisted of: (a) topographically surveying the site, (b) identifying the exact location, size, and surface features of each mound, and (c) collecting fifteen 7.5 cm diameter soil cores to a depth ≥ 105 cm using a hydraulic probe. These 15 cores came from on or adjacent to four mounds, which had been selected at random. The cores were used in making complete pedological descriptions, after which samples from selected horizons were analyzed for bulk density, pH, total nitrogen, and total carbon. All field work was completed during the summer of 1996.

Table 1: Summary of selected Pedological Features.

Location	n	A horizon Thickness (cm)	Depth of Structure (cm)	Depth to Effervescence (cm)
Mound Top	4	101 \pm 29	121 \pm 46	22 \pm 41
Mound Side	5	90 \pm 19	120 \pm 22	77 \pm 51
Off Mound	6	75 \pm 16	106 \pm 15	63 \pm 39

Table 2: Summary of Diagnostic Horizons and Pedon Classifications

Location	Mollic Epipedon (cm)	Cambic Thickness (cm)	Typical Classification (USDA-SCS, 1994)
Mound Top	115 \pm 21	17 \pm 19	Haplic Vermudoll
Mound Side	96 \pm 15	27 \pm 15	Haplic Vermudoll
Off Mound	78 \pm 21	41 \pm 24	Cumulic Hapludoll

RESULTS – MOUND CHARACTERISTICS

- (1) Fifty-nine mounds are present in the 4 ha study area. Their mean height and diameter are 0.23 m and 3.7 m, respectively.
- (2) Mounds are clustered with 45 of the 59 being in a 2 ha area of the study area. Fourteen of these are located within a 0.2 ha area.
- (3) Two general mound shapes exist – round (37) and oblong (22).
- (4) Twenty-nine of the mounds showed ongoing pocket gopher (*Geomys bursarius*) burrowing as indicated by fresh surface additions of strong fine and medium granular soil structure.
- (5) Gophers have constructed 40 new mounds over the past 30 years. Brotherson (1969) studied the same area and identified only 19 mounds.
- (6) Mound construction appears to be limited to within the Nicollet (Aquic Hapludoll) map unit.

RESULTS – SOIL PROFILE CHARACTERISTICS

- (1) Thickness of A horizons and mollic epipedons are greatest on mounds and thinnest off mounds (Tables 1 & 2).
- (2) Gopher burrowing has largely destroyed the cambic B horizon (Table 2).
- (3) Average total nitrogen content of the upper 50 cm was between 0.23 and 0.32% for all 15 profiles. Its distribution was more irregular with depth in the on mound profiles than in the off mound profiles.
- (4) Mound construction results in shallower depths to effervescence as gophers incorporate calcareous till within the sola (Table 1).
- (5) The soils in the study area have thicker epipedons than most soils on comparable landscapes in north-central Iowa for two reasons: (a) they have never been cultivated, and (b) mound building.

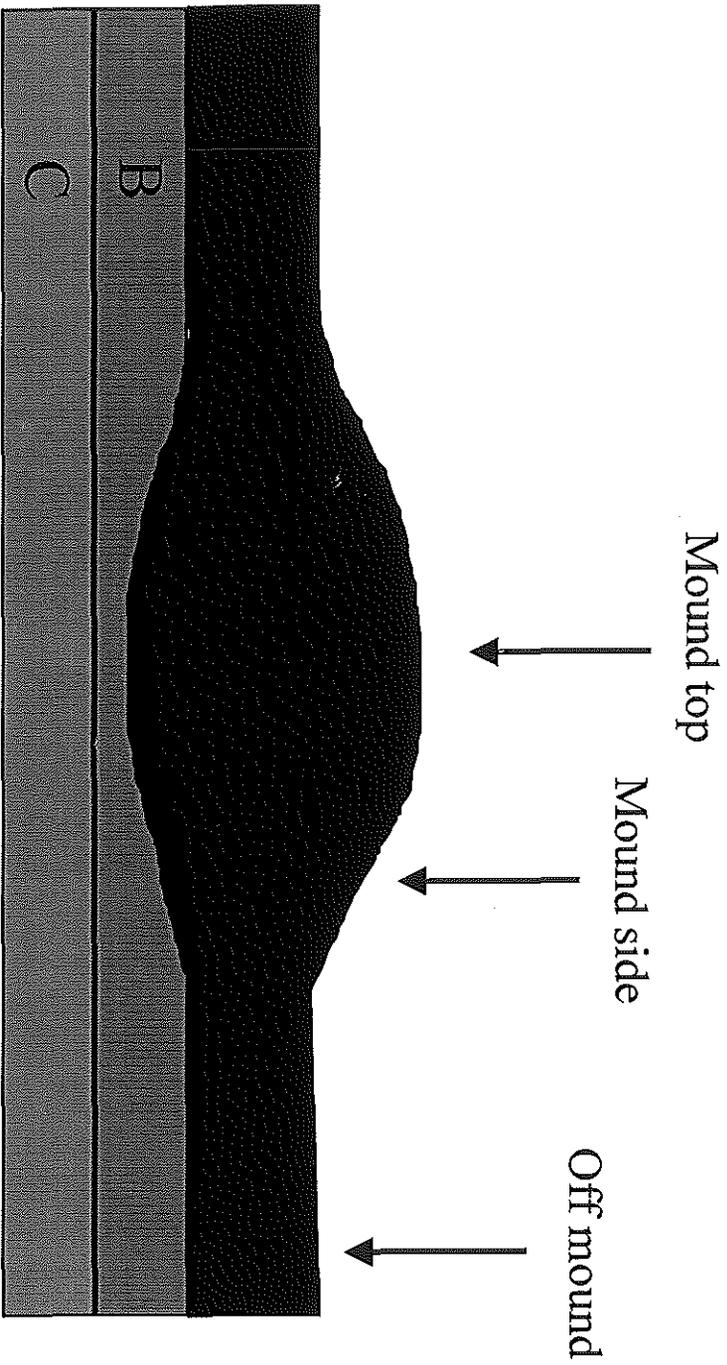
CONCLUSION

Mima mound construction is an ongoing phenomenon in Kalsow Prairie, Iowa. The mode of construction is burrowing by pocket gophers (*Geomys bursarius*). Pedologically, this burrowing has resulted in soils with unusually thick mollic epipedons and incorporation of calcareous till nearly throughout the sola. Simultaneously, this burrowing has destroyed much of the naturally occurring cambic B horizons.

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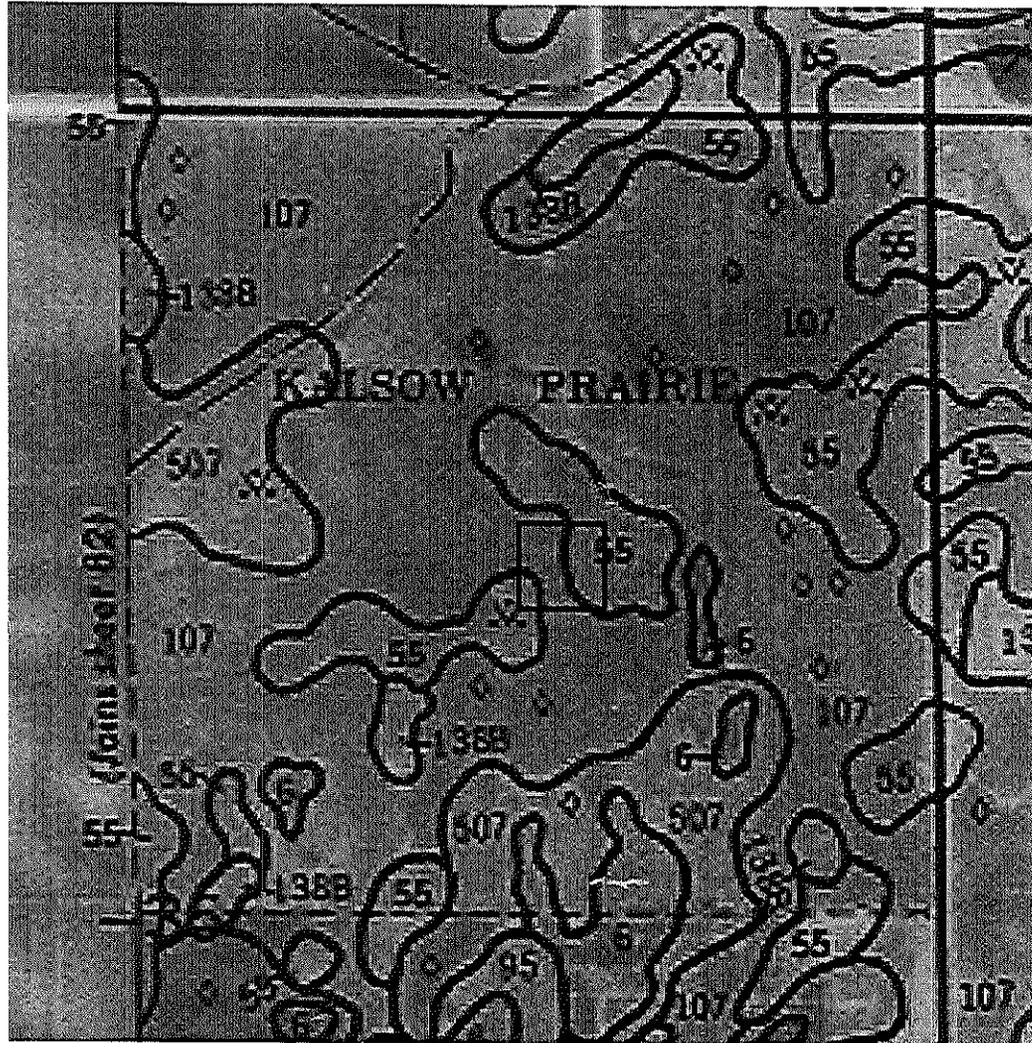
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Idealized Kalsow Prairie Mima Mound



Not to scale

Location of mounds studied



- 6 Okoboji - Cumulic Endoaquol
- 55 Nicollet - Aquic Hapludoll
- 107 Webster - Typic Endoaquol
- 138B Clarion - Typic Hapludoll
- 507 Canisteo - Typic Endoaquol

✓◇ Better drained soil

◇ Depressions

□ 4 ha intensive study are