DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

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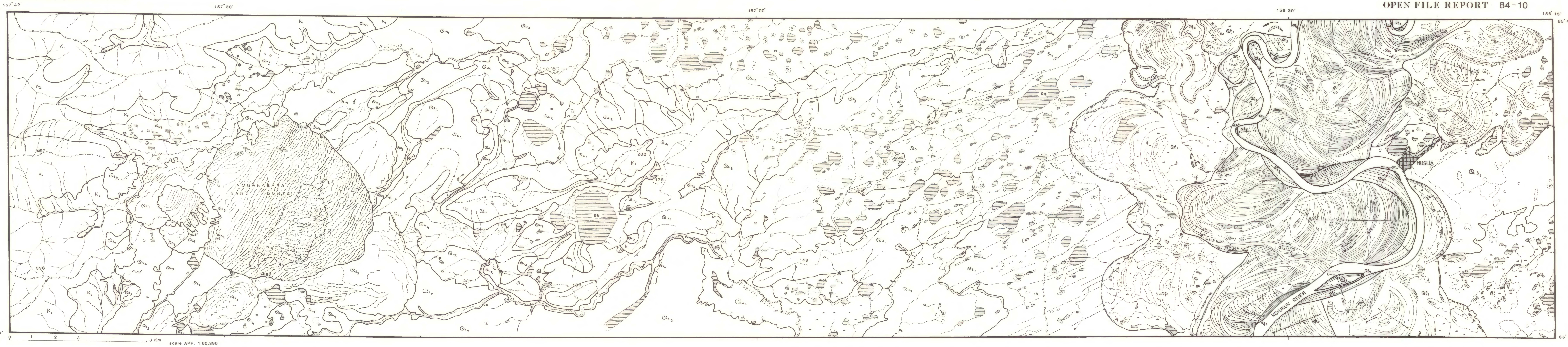
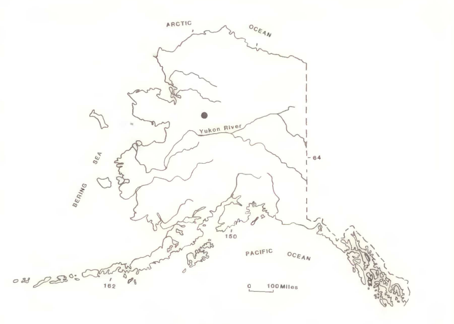


DESCRIPTION OF MAP UNITS

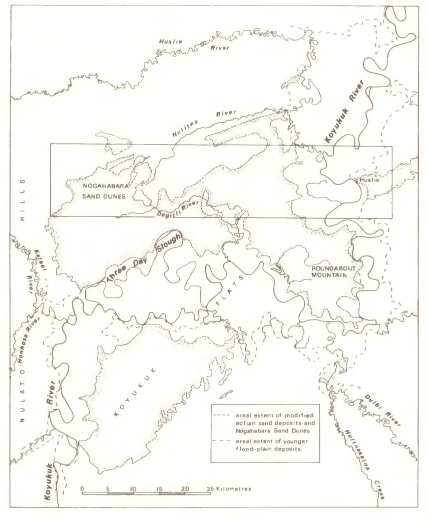
LANDFORMS	GEOMORPHOLOGY	
EOLIAN SAND DEPOSITS	Qs_5	ACTIVE DUNES
	Qs_4	YOUNGER STABILIZED DUNES
	Qs_3	OLDER STABILIZED DUNES
	Qs_2	RELATIVELY FLAT LOWLANDS PARTLY SAND COVERED
	Qs_1	UNDULATING UPLANDS AND LOWLANDS, PARTLY SAND COVERED WITH LONGITUDINAL DUNES
FLUVIAL DEPOSITS	Qf_4	MODERN RIVER BARS
	Qf_3	YOUNGEST POINT BAR SYSTEM
	Qf_2	YOUNGER POINT BAR SYSTEM
	Qf_1	OLDER POINT BAR SYSTEM
UNDIFFERENTIATED SURFICIAL DEPOSITS	Qu_4	VALLEYS
	Qu_3	UNDULATING LOWLANDS
	Qu_2	SLOPES OF TRANSPORT
	Qu_1	UNDULATING UPLANDS
BEDROCK	K_2	FOOTSLOPES
	K_1	BEDROCK

SYMBOLS

- Contact between geomorphic/landform units, plotted from aerial photographs
- Drainage divide[5]
- Stream channel
- Dune crests
- Area with linear arrangement of blowouts
- Stabilized longitudinal dunes
- Thaw lake, including coalescing lakes in floodplain channel scrolls
- Drained thaw lake basins
- Abandoned channel
- Point bar system with arrow pointing in direction of build up
- Polygonal ground cracks
- Swamp
- Terrace scarp, hachures point downslope
- Infered fault scarp, teeth on downthrown side
- Village with roads
- •285 Elevation in meters above sea level



Location of Study Area



Areal extent of younger flood plain deposits and modified eolian sand deposits as mapped by Patton (1966)

INTRODUCTION

The Nogahabara Sand Dunes and part of the Koyukuk Lowland are located in the Kateel River (1:250,000) quadrangle between the northeastern spurs of the Nulato Hills and the Koyukuk River near the village of Huslia. The Nogahabara Sand Dunes lie approximately 45 km west from the village of Huslia in the northwest and northeast corners of the Kateel River C-3 and C-4 (1:63,360) quadrangles. The dunes lie within an area of about 3200 km^2 of dunes in the lower Koyukuk Valley (Péwé, 1975, p. 36), in the zone of discontinuous permafrost and the area has a mean annual temperature of approximately -6°C. Geologic maps of the area, scale 1:250,000, (Cass, 1957; Patton, 1966) show three eolian units and two flood-plain units. Some of the surficial geologic units in the map of the Yukon-Koyukuk Lowland (Weber and Péwé, 1970) are useful guides to photointerpretation in our study area, even though it is 10 km to the north.

This map (scale 1:60,390) is based solely on the interpretation of thirteen false-color infrared and seven black and white aerial photographs (4). Four major map units, bedrock, undifferentiated surficial deposits, eolian and fluvial, form the basis for our map. Both eolian and fluvial landforms have been listed in order of relative age. Dunes and sand sheets are recognized, on the airphotos, by: 1) color differences, 2) topography and geomorphic form, 3) presence or absence of drainage patterns, 4) distribution of thaw lakes, and 5) relative topographic position. Fluvial landforms, point bars and abandoned channels, are separated on the basis of: 1) color differences, 2) meander development, 3) degree of modification by thermokarst activity, 4) presence or absence of ox-bow lakes or abandoned channels, and 5) cross-cutting relationships. Undifferentiated surficial deposits are separated on the basis of: 1) color differences, 2) degree of modification by thermokarst activity, and 3) geomorphological criteria like relative height and slope angles. Landforms in which the deposits are undifferentiated were mapped and described without consideration of age. Bedrock was recognized on the airphotos by: 1) color differences and 2) topographic expression.

EOLIAN SAND DEPOSITS

Based on topographic expression five eolian sand units have been recognized; active dunes (Qs_5), younger stabilized dunes (Qs_4), older stabilized dunes (Qs_3), relatively flat lowlands partly covered with sand (Qs_2), and undulating uplands and lowlands partly covered with sand and longitudinal dunes. (Qs_1). The largest active dune field forms a circular body of sand having a diameter of approximately 7 km. The edge of the field is sharply defined all around by a distinct escarpment. Lying at an elevation of 100 to 170 meters above sea level the active dune fields cover an area of 44.5 km^2. This units (Qs_5) consists of actively drifting sand, free of vegetation, which appears white to light-blue on the photographs. Dunes with relatively low height and even spacing are clearly visible on the photographs and appear to be transverse or barchanoid in form. The low dune height is probably influenced by shallow sediment thickness as seen from the many areas of deflation located in the central part of the dune field. Deflation areas, red in color on the photographs, have a linear arrangement of W-E to WNW-SSE. This direction slightly deviates from the inferred transport direction of the dunes. We have estimated the dune height, trough to crest, to be generally less than 10 meters with crest line spacing being 50 to 200 meters. Dune forms are surprisingly uniform in spacing, height and crest line orientation. Most dune crests can be followed for a few kilometers. Crest lines are parallel in orientation NNE-SSW. There is a slight deviation of the orientation along the edge of the dune field. Evidence of present-day surficial drainage and thaw lakes is absent in the active dune field. However, former drainage lines are still visible. Cass (1957) described the dune field as consisting of quartz sand, coarse grained on the western edge decreasing in grain size towards the eastern edge. Results of a mechanical analyses of a sand sample collected from the Nogahabara Sand Dunes was reported by Weber and Pewe (1970). The midpoint on the cumulative frequency curve lies at 2.75 phi, fine sand. Mechanical analysis of sand samples from another active dune field (The Great Kobuk Sand Dunes) show a slightly coarser sand with the midpoint on the cumulative frequency curve ranging from 1.75 phi, medium sand, to 3.0 phi, fine sand (Galloway and Koster, n.d.). We do not agree with Patton (1966) and Cass (1957) that the active dunes are moving northeastward and eastward or southeastward. The major transport direction appears to be to the west and northwest with a possible secondary (summer) direction to the east.

Younger stabilized dunes (Qs_4) lie to the west of the active dune field. This unit appears white to green-grey on the photographs, suggesting that stabilization is still incomplete. Dune crests are clearly visible and are approximately parallel to the crest lines in the active dune field. Dunes have climbed up the eastern lower slopes of the Nulato Hills. As in the Nogahabara Sand Dunes no thaw lakes are present.

A third eolian sand unit (Qs_3) consists of dunes stabilized by sparse vegetation (color reddish-grey). Based on topographic position these dunes appear to be older than the dunes previously described. These rosette-like dunes lie just east and south of the largest active dune field. They form circular to elliptical bodies and on the airphotos appear medium to dark grey in color. Trends of the dunes, transverse in form, vary strongly in orientation. Development of the dunes may have occurred under periglacial conditions. Paleowind direction before stabilization was variable originating from the southeast, east and northeast. The presence of several thaw lakes and lack of a white tone on the photographs suggest the dunes have been stable for some time. Similar rosette-like dune fields have been identified along the Koyukuk River southeast of Nogahabara, and in various other Alaskan stabilized dune fields; Shaw Creek Sand Dunes, Tetlin Sand Dunes, and Kantishna Sand Dunes. Altogether the dune fields (Qs_5, Qs_4, Qs_3) cover an area of more than 80 km^2.

Large areas, having a relief of less than 15 m, surrounding the dune fields and in the area south of the Dagitli River have a partial cover of eolian sand (Qs_2). These areas are dark green to reddish green in colors on the photographs. The eolian sand appears to be relatively thin and discontinuous. Formation of this sand cover might be related to an early phase of dune-building, however in this unit no dune forms have been recognized. These areas are conspicuous for their absence of thaw lakes.

The largest eolian map unit (Qs_1) mantles the Koyukuk Flats just west and east of the flood-plain. Patton (1966) called this area modified eolian sand deposits. "Dunes much modified and locally dissected by stream erosion but some longitudinal and parabolic forms recognizable in aerial photographs. Deposits have strong NE-SW trend. Heavier accumulations on northeast-facing slopes and orientation of parabolic dunes convex toward the southwest suggests deposition by prevailing northeast winds." Apart from an inconspicuous, probably discontinuous eolian sand cover, longitudinal dunes are readily recognizable on the photographs. The longitudinal dunes have been indicated on the map only schematically and have a strong NE-SW trend indicating former transport directions to the southwest. This unit probably rests on the older (high) terrace deposits as described for the Yukon-Koyukuk Lowland by Weber and Péwé (1970). The large number of thaw lakes, drained thaw lakes and the terrace scarp of unit Qf_1 cutting into the dune forms suggest a long period of stabilization. Thaw lakes lie at an elevation of approximately 80 meters and vary in area from 0.1 to 3.5 km^2. Dune forms are strongly modified by thaw lakes and dissected by stream erosion.

Although the dunes have been stabilized by vegetation massive subsidence of a sand sheet to the east has occurred due to recent tectonic activity. "Associated with the Huslia earthquake of April 7, 1958, were several thousand sand flows up to one-quarter square mile in area. This material appears to have flowed upwards from old lake and stream beds currently covered by vegetated sand dunes. Local collapse of the sand dune layer accompanied the sand flowage" (Davis, 1958).

FLUVIAL DEPOSITS

As noted by Weber and Péwé (1970) and Péwé (1975) the Koyukuk River flood-plain is a classic example of a flood-plain developed by strongly meandering rivers under periglacial conditions. Our four fluvial units are basically equivalent to the units developed by Weber and Péwé (1970) and have been differentiated and arranged according to relative age. Point bars and abandoned channels are located in a large valley where the river is currently capable of building point bars by channel migration. Near Huslia present-day lateral erosion of the river bank still occurs.

Modern river bars, Unit Qf_4, appear bluish-white in color on the photos and are free of vegetation. The youngest point bar system (Qf_3) appears red on false color infrared photographs suggesting the presence of a dense and healthy vegetation. Point bars appear fresh showing little or no evidence of erosion by thermokarst activity. Drainage is not integrated and thaw lakes are absent.

Appearing bluish-grey to red in color the younger point bar system (Qf_2) consists of modified point bars and abandoned channels. This unit represents several generations of point bars suggesting a complex history. Just below Huslia the width of the meander belt is approximately 10 km with a radius of 2.5 km. Although drainage is not integrated, linear thaw lakes parallel to drainage trends are common in abandoned channels.

The older point bar system (Qf_1) consists of ox-bow lakes, thaw lakes with no preferred orientation, abandoned channels and remnants of point bars. Thermal erosion around the edges of thaw lakes, integration of drainage between thaw lakes, and the degree of modification of the point bars suggest this unit was abandoned a relatively long time ago. The absence of red colors on the photographs probably indicates trees such as willows, larch and birch are absent. Grey to purple colors suggest the development of a typical tundra mat consisting of peat moss and sedges (Weber and Péwé, 1970). This unit cuts into Qs_1 producing a well defined terrace scarp of 10 to 30 meters in height. The total width of the Koyukuk River flood-plain in this area is from 13 to 22 km.

UNDIFFERENTIATED SURFICIAL DEPOSITS

As previously mentioned, all other landforms, developed in deposits of unknown origin were mapped without consideration for their relative age. Unit Qu_4, (valleys) is found along tributaries and the Dagitli and Nulitna Rivers which are strongly meandering streams having a gradient of less than 1:300. Mainly reworked alluvium is present along these streams valleys. Presently the Nulitna and Dagitli Rivers and their tributaries are incapable of building point bars. Polygonal ground cracks thought to be an expression of ice-wedges in this unit are shown where recognized. Patterned ground elsewhere in the valleys is not visible on aerial photographs. Weber and Péwé (1970) have described large abundant ground-ice masses as horizontal and vertical sheets in the Koyukuk Lowland which lies south of our study area.

Undulating lowlands (Qu_3) are characterized by large numbers of thaw lakes and an intricated drainage pattern. Evidence of eolian morphology is completely absent. Surficial deposits probably consist of reworked terrace deposits and colluvium. South of Huslia is an area of undifferentiated surficial deposits (Qu_3), approximately 15 meters above river level, which might be equivalent to the younger (low) terrace deposits as mapped by Weber and Péwé (1970) for the central part of the Yukon-Koyukuk Lowland.

Relative height differences, slope angles, the frequent occurrences of gelifluction stripes and surface runoff features form the basis for the distinction of unit Qu_1 (various colors on the photographs), undulating uplands from unit Qu_2, slopes of transport (reddish-green color). Undulating uplands and slopes of transports vary in elevation from approximateiy 80 to 215 meters and have a surficial cover of colluvium. Unit Qu_2 consists of sediments which have been transported from the undulating uplands to the lowlands and valleys. Unit Qu_1 is probably partly underlain at very shallow depth by bedrock, consisting of volcanic rocks (Cass, 1957).

BEDROCK

The hilly region west of the Nogahabara Sand Dunes forms part of the Nulato Hills. With the exception of some crests, where a white-bluish color on the photographs indicates outcrops of bare rock, the base of unit K_1 is covered by forests (red in color). Footslopes, unit K_2, are less densely vegetated (grey-red colors) and covered by gelifluction stripes. These two units (K_1 and K_2) vary in height from approximately 170 to 500 meters above sea level and slope angles vary between 10 and 20 degrees. The prominent scarp visible along the northern side of the Dagitli River is probably of structural origin. According to Patton (1966) most of the andesitic volcanic rocks in this area are of earliest Cretaceous (Neocomian) age.

DISCUSSION

The Yukon-Koyukuk Lowland was not subjected to glaciation during the Quaternary, but was influenced by glacial activity to the north. The glacial periods provided conditions in the Koyukuk flood-plain and Upper Kuskokwin Region most favorable to the formation of dunes (Fernald, 1960). Aggradation of streams provided a large source of sediment. Sand moved by wind was derived from fluvial or glaciofluvial deposits.

Based on degree of dune modification, topographic position, and the presence or absence of thaw lakes we recognize at least three periods of eolian activity. Active dunes and younger stabilized dunes (units Qs_5 and Qs_4) represent the most recent period of eolian activity where the major eolian transport direction is westerly to northwesterly. Our second period, older stabilized dunes, rosette-like in form, (Qs_3) are stabilized by a sparse vegetation cover. Paleowinds for both periods appear to be variable originating from the southeast, east and northeast.

A sharp contrast, between clearly recognizable dune forms (Qs_5, Qs_4, Qs_3) and sand sheets (Qs_2, Qs_1) suggest a considerable time difference between the formation of parabolic, transverse, and rosette-shaped dunes and the sand sheets with longitudinal dunes. No inferred paleowind direction is given for unit Qs_2 because the eolian sand cover is relatively thin and discontinuous and has no clearly recognizable dune forms. Based on topographic position unit Qs_2 appear to be older than units Qs_5,Qs_4,Qs_3, yet younger than unit Qs_1.

For the Upper Kuskokwim Region, which lies approximately 325 km south-southeast of Huslia, Fernald (1960) has noted two periods of eolian activity based on the sharp degree of dune modification. Whether our periods of eolian activity are comparable to Fernald's (1960) remains to be seen. The position of the dune fields and the geomorphology of individual dunes indicate general easterly winds as the effective present and past dune-building winds. This is also the case for comparable dune fields in the Kobuk River Valley (Fernald, 1964), which lie approximately 150 km to the northwest of Huslia. We feel the clearly recognizable dune forms (units Qs_5, Qs_4 and Qs_3) are Holocene in age and the sand sheets (units Qs_2, Qs_1) are probably Late Wisconsin in age. The very conspicuous Nogahabara Sand Dunes merit further attention, as the exact nature of the dunes and the processes leading to their actively drifting character yet remain unknown.

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FOOTNOTES

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(4) Aerial photographs used for this study: false-color infrared - NASA JSC 386, July 78 Alaska CIR 60 roll 09, photographs 143 to 155; black and white - NASA JSC 386, June 78 Alaska BW 120 roll 08, photographs 079 to 085.

(5) divide (stream): The line of separation, or ridge, summit, or narrow tract of high ground, marking the boundary between two adajacent drainage basins or dividing the surface waters that flow naturally in one direction from those that flow in the opposite direction (Syn: drainage divide) (Gary and others, 1972).

Photo-interpretation Map of Surficial Deposits and Landforms of the Nogahabara Sand Dunes and part of the Koyukuk Lowland, Alaska

by

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