

# EXPLANATION

Recent	Qd	Dune sand		QUATERNARY	
	Medium- to fine-grained sand and silt; calcareous, drab-colored. Grains smooth and rounded; poorly cemented in places.				
	Qb	Sand bar			
	Low mound of well-sorted medium-to fine-grained unconsolidated sand; rudely stratified and nearly horizontally bedded. Contains lenses and thin layers of silt and fine gravel as coarse as 1/4 inch. Clay content low. (See sample analysis S-4 on facing page.)				
	Qgc	Deposits in Pleistocene drainage courses and shallow basins (undifferentiated)			
Silt and sand predominate in most places, but marl, clay, and gravel also present. Boundaries of deposits are based on topographic outlines of valleys of Pleistocene drainage courses and shallow basins. Material is unconsolidated except for caliche zone near surface in places. Deposits include minor amounts of slope wash and alluvium.					
Pleistocene	Qk	Kame			
	Miscellaneous kames, undifferentiated as to origin; knobs, low mounds, and irregular - shaped hills of unconsolidated glacial outwash. Silt and sand most abundant, but clay, gravel, and boulders also present. Coarse sand and gravel poorly sorted and rudely stratified. Fine sand and silt sorted in steeply dipping to horizontal lenses and discontinuous layers; cross-bedding common. Deposits locally contain till. Most common rock types present; granite and limestone abundant; platy shale, ironstone nodules, and zones of lignite fragments common; caliche zone near top and locally at depth. (See analyses of samples from kames, on facing page.)				
	Qbk	Boulder kame			
	Elongate mound 5 to 17 feet high composed predominantly of cobbles and boulders of all common rock types. Stratification very poor.				
	Qkt	Kame terrace			
Mixed gravel, cobbles, and boulders deposited on the slopes of melt-water channels. Material well stratified in places.					
Paleocene	Qe	Esker			
	Long, narrow, sinuous ridge composed essentially of interbedded sand, gravel, and silt; lithologically similar to kames but less clay and silt present. Sorting poor. Stratification good to absent; bedding horizontal to near 45 degrees. Boulders as large as 1/2 cu. yd. in size present. Glacial till (pebbly clay) present locally. (See sample analysis S-2 on facing page.)				
	Qgm	Ground moraine			
	Glacial till; chiefly unstratified calcareous, plastic clay containing scattered stones of all common types and in sizes from pebbles to boulders. Locally contains lenses and irregular masses of unconsolidated silt, sand, and gravel. Color buff (oxidized) at and near surface; gray to blue-gray at depth. Caliche zone near surface common. Ground moraine covered in places by thin mantle of fine sand and silt, particularly adjacent to meltwater channels. Cobbles and boulders scattered over surface. Sand-size gypsum crystals abundant near surface.				
	Qm	Max moraine Late Wisconsin (?)			
Similar to ground moraine, but surface consists of abundant knobs, irregular ridges, ripples, and undrained depressions; boulders abundant.					
Tertiary	Tfu	Fort Union formation			
	Interstratified beds of clay, silt, fine sandstone, and lignite; silt and clay predominate. The clay (silty to fatty) and silt (clayey to sandy) are compacted to soft clay shale and soft silty shale in places. Some cementation by calcium carbonate in most beds. Sandstone is mostly buff or yellowish buff; silts, buff or gray; clays, gray (blue-gray when wet). Some uniform silts have a distinctive "salt-and-pepper" appearance. Clays mostly plastic. Also contains lenses and irregular masses of hard limy siltstone, thin layers and nodules of ironstone, fossil plants and fossilized wood. Stratification excellent, but beds not continuous over wide areas. Locally beds dip as much as 3 1/2 degrees.				

### RELIABILITY OF MAP UNIT BOUNDARIES

(All boundaries except Ft. Union formation based on combined interpretation of topography and lithology.)

### SHARPLY DEFINED GEOLOGIC CONTACT

(Conspicuous topographic change or marked lithologic gradation)

### GRADATIONAL GEOLOGIC CONTACT

### INFERRED AND GRADATIONAL GEOLOGIC CONTACT (Generalized in places)

	INTERMITTENT LAKE		UNDRAINED DEPRESSION
	INTERMITTENT STREAM		DAM AND RESERVOIR
	POORLY DRAINED AREA INTERMITTENTLY MARSHY		SAND AND GRAVEL PIT
S-2	SAMPLE SITE (Number refers to analysis of sample--see facing page)	S-4	SAMPLE SITE IN SAND AND GRAVEL PIT
ROADS		LIGNITE STRIP MINE BOUNDARY	
	Hard surface		BENCH MARK
	Graded and gravelled		TOPOGRAPHIC CONTROL
	Graveled		BUILDINGS
	Trail		
	State Highway		
	INTERNATIONAL BOUNDARY COMMISSION MONUMENT		

(2)

### DEPTH RELATIONS FROM SURFACE

(Number of item below refers to number in diamond on map)

1. 2 ft. pebbly clay over at least 7 ft. sand.
2. 18 ft. sand over at least 6 ft. gravel.
3. 14 ft. sand and gravel over 31 ft. clay over Ft. Union formation.
4. Top Ft. Union formation less than 145 ft. from surface.
5. Top Ft. Union formation more than 455 ft. from surface.
6. Top Ft. Union formation more than 342 ft. from surface.
7. Top Ft. Union formation less than 30 ft. from surface.
8. 25 ft. pebbly clay over 26 ft. sand and gravel over Ft. Union fm.
9. Top Ft. Union formation less than 47 ft. from surface.
10. At least 9 ft. sand and silt.
11. At least 14 ft. sand.
12. At least 14 ft. sand.
13. Top Ft. Union formation less than 110 ft. from surface.
14. At least 10 ft. sand.
15. 2 ft. clay over 15 ft. pebbly clay over 3 ft. sand over pebbly clay.
16. 4 ft. silt over 18 ft. pebbly clay over sand.
17. At least 15 ft. sand and gravel.
18. At least 24 ft. silt and sand.
19. At least 13 ft. pebbly clay.
20. 4 ft. silt over at least 20 ft. pebbly clay.
21. At least 17 ft. sand and gravel.
22. 35 ft. pebbly clay over Ft. Union formation.
23. 17 ft. pebbly clay over Ft. Union formation.
24. Top Ft. Union formation less than 130 ft. from surface.
25. At least 9 ft. sand.
26. 19 ft. silt over at least 4 ft. pebbly clay.
27. 6 ft. pebbly clay over Ft. Union formation.
28. 6 ft. pebbly clay over Ft. Union formation.
29. 3 ft. clay over 16 ft. sand.
30. 15 ft. sand and silt over more than 15 ft. clay.
31. 6 ft. pebbly clay over 3 ft. sand over at least 14 ft. pebbly clay.
32. 19 ft. pebbly clay over at least 4 ft. silt.
33. 8 ft. silt over at least 24 ft. pebbly clay.
34. 33 ft. pebbly clay over 5 ft. sand over pebbly clay.
35. At least 25 ft. silt.
36. 26 ft. silt over at least 9 ft. silt and gravel.
37. Less than 15 ft. silt and gravel over Ft. Union formation.
38. At least 23 ft. sand and gravel.
39. 51 ft. pebbly clay over at least 19 ft. sand and gravel.
40. 12 ft. sand over at least 60 ft. pebbly clay.
41. 5 ft. sand over 20 ft. sand and gravel over at least 45 ft. pebbly clay.
42. 16 ft. pebbly clay over 9 ft. gravel over at least 25 ft. silt.
43. 12 ft. sand and gravel over pebbly clay.
44. 3 ft. sand and gravel over pebbly clay.
45. Top Ft. Union formation less than 15 ft. from surface.