

CRITERIA FOR DIFFERENTIATING THE
TONGUE RIVER AND SENTINEL BUTTE
FORMATIONS (PALEOCENE), NORTH DAKOTA

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ABSTRACT

Weathered surfaces of the Tongue River Formation are more rounded and smoother than those of the overlying Sentinel Butte Formation. Small, relatively straight, steep-sided gulleys and small caves and tunnels are rare on exposures of the Tongue River and are absent on sandstone, but they are common on exposures of the Sentinel Butte, especially on sandstone.

Sandstone in the Tongue River Formation is much more friable than sandstone in the Sentinel Butte Formation. The Tongue River generally is easily excavated with a pick, but the Sentinel Butte is not.

Thick (a few tens of meters), tabular, laterally continuous sandstone beds are more common in the Sentinel Butte, and trough-shaped, laterally restricted sandstone beds are more common in the Tongue River.

Sedimentary-rock fragments are more abundant constituents of the sandstone of the Tongue River, and volcanic-rock fragments and metamorphic-rock fragments are more abundant constituents of the sandstone of the Sentinel Butte.

Zircon, tourmaline, and hornblende are the more common heavy minerals in sandstone of the Tongue River Formation, and kyanite and epidote are the more common heavy minerals in sandstone of the Sentinel Butte Formation. The zircon and tourmaline were probably derived from sedimentary rocks, and epidote and kyanite were probably derived from metamorphic rocks in the source areas.

Mica is the most abundant clay mineral in most Tongue River samples, although quartz is the most abundant mineral of the clay-size fraction of most of the samples. Montmorillonite is the most abundant mineral in the clay-size fraction of most Sentinel Butte samples, and it probably causes the color to be darker than the color of the Tongue River Formation. Calcite and dolomite are more abundant in most clay-size samples of the Tongue River than in clay-size samples of the Sentinel Butte.

Silicified wood is much more common in the Sentinel Butte than in the Tongue River. This probably resulted from the availability of soluble amorphous silica contained in volcanic-rock fragments.

INTRODUCTION

The Paleocene Tongue River and Sentinel Butte Formations either form the bedrock or occur at the surface over about 50 percent of North Dakota. Where the formations are well exposed, as in the badlands of the Little Missouri River, they can be easily differentiated. The most important difference between the two units is the color of weathered surface exposures (first pointed out by Leonard and Smith in 1909). The Tongue River Formation is yellow, buff or light gray, and the overlying Sentinel Butte Formation is darker gray or brown. In the Little Missouri River area the contact between the two formations is marked by a lignitic unit, the HT Bed, which ranges up to several meters thick. In many places the lignite is burned and the HT Bed is "scoria" (a local term for brick-red rock baked by the burning lignite). A sand bed at the base of the Sentinel Butte Formation also marks the contact. This bed ranges from a few meters to several tens of meters thick. Locally it may become so fine-grained as to lose its identity.

Where the contact is not visible it may be difficult to determine which formation is present. Although the color is probably the most obvious and easily used difference, it is largely a weathering phenomenon and is not always dependable. In the subsurface it has been difficult to distinguish these two formations, and outside the area of the Little Missouri River the contact may be difficult to recognize.

The purpose of this report is to describe characteristics that can be used to differentiate the Tongue River and Sentinel Butte Formations on the outcrop or in the subsurface. These characteristics were determined from surface sections in various parts of the badlands of the Little Missouri River and other areas in the western part of the Williston Basin where both formations are well exposed and can be identified with certainty.

CRITERIA FOR DIFFERENTIATING THE TONGUE RIVER AND SENTINEL BUTTE FORMATIONS

Criteria Useful for Surface Sections Only

Weathering and Topography

The Sentinel Butte forms steeper, more irregular slopes than the Tongue River, probably because it is better cemented (figs. 1 through 4). Sandstone in the Tongue River weathers into more rounded, smoother surfaces (fig. 2). Rather straight gulleys with very steep sides are common on the Sentinel Butte, but are rare on the Tongue River, especially on sandstone (compare figs. 1 through 4). The steep-sided gulleys on the Sentinel Butte commonly are associated with small caves and tunnels, apparently formed during runoff of surface water (fig. 3). Caves or tunnels are rare on exposures of the Tongue River.

Modern drying cracks are common on the surfaces of sandstone in Sentinel Butte, but are almost completely lacking on surfaces of sandstone in the Tongue River (compare figs. 2 and 4). This may be due to the higher content of montmorillonite in the Sentinel Butte; montmorillonite swells when it absorbs water, so cracks could easily form during drying.

Criteria Useful for Surface or Subsurface Sections

Friability of Sandstone

The sandstone of the Tongue River Formations is much more friable than the sandstone of the Sentinel Butte Formation except where it is cemented as concretions. The sandstone of the Tongue River is easily excavated with a pick and completely disintegrates. The sandstone of the Sentinel Butte is much more difficult to excavate with a pick. It does not disintegrate when struck but breaks into pieces, each of which remains consolidated. The difference in friability between the two formations may be of limited usefulness in subsurface sections.

Geometry of Sandstone Beds

Detailed stratigraphic cross sections have been prepared through the Tongue River Formation near Medora (Jacob, 1973) and the Sentinel Butte Formation in and near the North Unit of Theodore Roosevelt National Memorial Park (Cherven, 1973; Johnson, 1973). These cross sections show that both tabular and trough-shaped sand beds, ranging from several meters to several tens of meters thick, occur in these formations. The tabular sand beds have flat bases and flat tops, and the trough-shaped sand beds have bases that are concave upward and tops that are flat. In map view the tabular sand beds are elongate and as much as a few kilometers wide. The trough-shaped sand beds are also elongate, but they are only as much as a few hundred meters wide.

Most of the sand beds of the Tongue River are trough shaped. Tabular sand beds are present but they are rare; most of them are 2 to 3 meters thick or less, and they are thinner than most of the tabular sand beds of the Sentinel Butte. In the Sentinel Butte Formation tabular sand beds are more common. The tabular sand beds are interpreted to have been deposited by high-sinuosity streams and the trough-shaped sand beds are interpreted to have been deposited by low-sinuosity streams (Cherven, 1973; Jacob, 1973; Johnson, 1973).



Figure 1. Sandstone bed in the Sentinel Butte Formation about 6 miles west of Fryburg, Billings County. Surface slopes are steeper than in the Tongue River Formation, and the surface is more irregular. Straight gulleys with very steep sides are almost never present in the Tongue River Formation. Dark colored talus slopes are well cemented purple, dark brown, and maroon concretions that have rarely been observed in the Tongue River Formation.



Figure 2. Sandstone bed in the Tongue River Formation near Medora. Surfaces are smoother and more rounded than in the Sentinel Butte Formation. Canvas bag is about 0.3 m across.

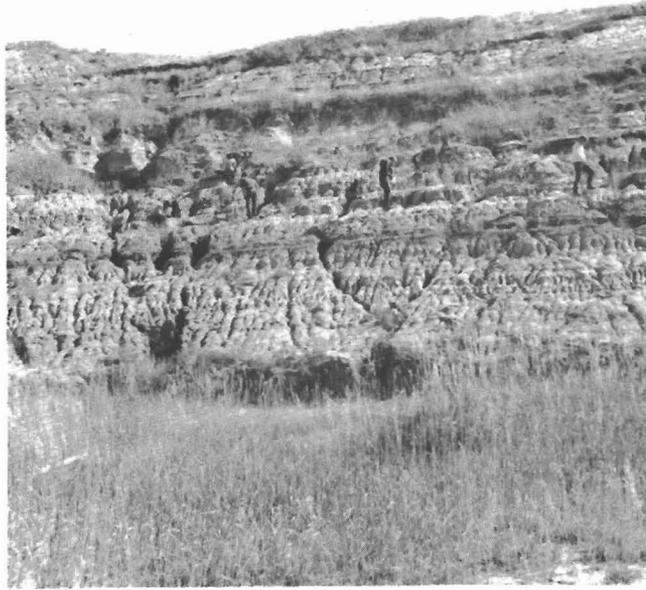


Figure 3. Small caves and tunnels associated with steep-sided gulleys on the Sentinel Butte Formation just south of Garrison Dam on the east side of the Missouri River Valley.

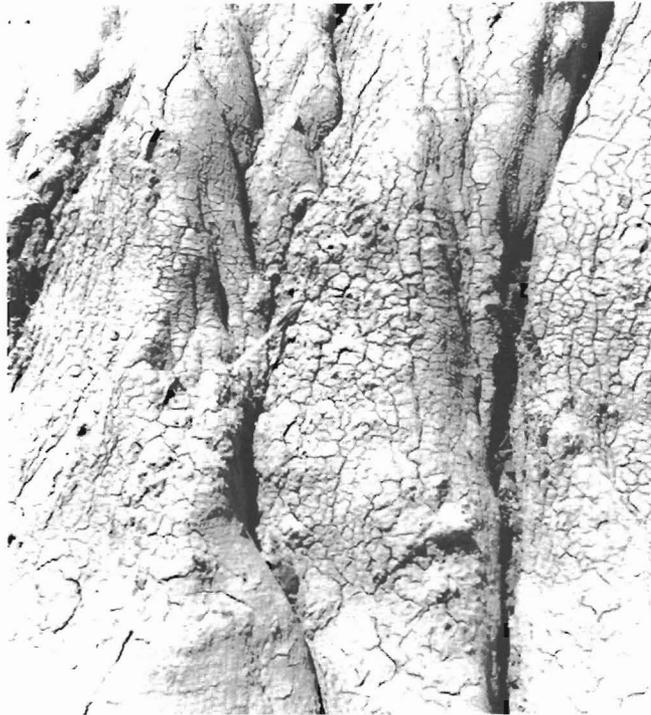


Figure 4. Modern drying cracks on the surface of a sandstone bed in the Sentinel Butte Formation near Medora. Note the steep-sided gulleys typical of this formation. Pen is 0.15 m long.

Light Minerals

Samples of sandstone and unlithified sand were collected from the Tongue River and Sentinel Butte Formations. Forty-five samples were collected from the Tongue River Formation and forty-eight samples were collected from the Sentinel Butte Formation at various locations in nine counties in western North Dakota and eastern Montana. The locations of the samples are shown in table 2. The samples were collected from various stratigraphic positions in both formations.

Thin sections were prepared either of sandstone or of mounted grains of uncemented sand. At least one hundred points were counted on each sandstone slide using a mechanical stage, and at least one hundred grains were counted on each slide of uncemented sand. The data were assembled and printed (table 3) by the FORTRAN program FOLKSS (available from me) to classify sandstones according to Folk's (1968) classification (fig. 5).

Figures 6 and 7 show that all sandstone samples of both formations are litharenites, according to Folk's (1968) classification. Classification of the litharenites, shown in figures 8 and 9, indicates that all sandstone samples of the Tongue River are sedimentary litharenites and many sandstone samples of the Sentinel Butte are volcanic litharenites. In other words, sedimentary-rock fragments are more abundant in the Tongue River than in the Sentinel Butte, and volcanic-rock fragments and metamorphic-rock fragments are more abundant in the Sentinel Butte than in the Tongue River. The sedimentary-rock fragments in both formations are largely finely to coarsely crystalline carbonate fragments.

So another means of distinguishing the two formations is available. If thin sections are cut, preferably of mounted grains of uncemented sand, at least 100 grains can be counted on each slide. The total number of sedimentary-rock fragments, volcanic-rock fragments, and metamorphic-rock fragments can be recalculated to 100 percent; if there are a large number of samples, this can be done using a computer program available from me. The three components are then plotted on a triangular diagram as in figures 8 and 9. If there are a large number of samples this can be done using the FORTRAN program TRI (Lumsden, 1973). A comparison of the plots with those in figures 8 and 9 should help to identify the formation. If the plots fall within those areas in which there is overlap between figures 8 and 9, there will be difficulty in identifying the formation on the basis of sandstone petrography alone.

Heavy Minerals

A comparison of the heavy minerals of the sandstone of the Tongue River and Sentinel Butte Formations was undertaken as a class project in a course in sedimentary petrology at the University of North Dakota in the spring of 1972. Table 1 presents some of the results of that study. Sample 1 is from the base of the Tongue River Formation in SE $\frac{1}{4}$ sec 29, T136N, R104W, Slope County. Samples 2 through 11 were collected at 6-meter vertical intervals from the Tongue River Formation in the cliff at the east side of Medora. Sample 11 is from the Medora Member about 26 m below the top of the formation. Samples 12 through 19 were collected from the Sentinel Butte Formation at various intervals successively from the base of the formation to a point 110 m above the base in Theodore Roosevelt National Memorial Park (North Unit) just east of Squaw Creek Campground. Sample 20 is from the sand bed at the top of the Sentinel Butte Formation on Sentinel Butte.

Two workers analyzed the samples from the Tongue River Formation and three workers analyzed the samples from the Sentinel Butte Formation. The data of table 1 are averages of the data of the workers. Before separation of the heavy minerals the original sample was sieved into the 2.0 ϕ to 4.0 ϕ size fraction. After separation, the heavy minerals were sieved into the 2.0 ϕ to 3.0 ϕ , 3.0 ϕ to 3.5 ϕ , and 3.5 ϕ to 4.0 ϕ size fractions and slides were prepared. One hundred grains were counted for each size fraction, excluding mica, opaque minerals, and rock fragments. In table 1 the percentages shown are averages of the three-size fractions, except for zircon, which best showed detectable differences between the two formations in the 3.5 ϕ to 4.0 ϕ size fraction.

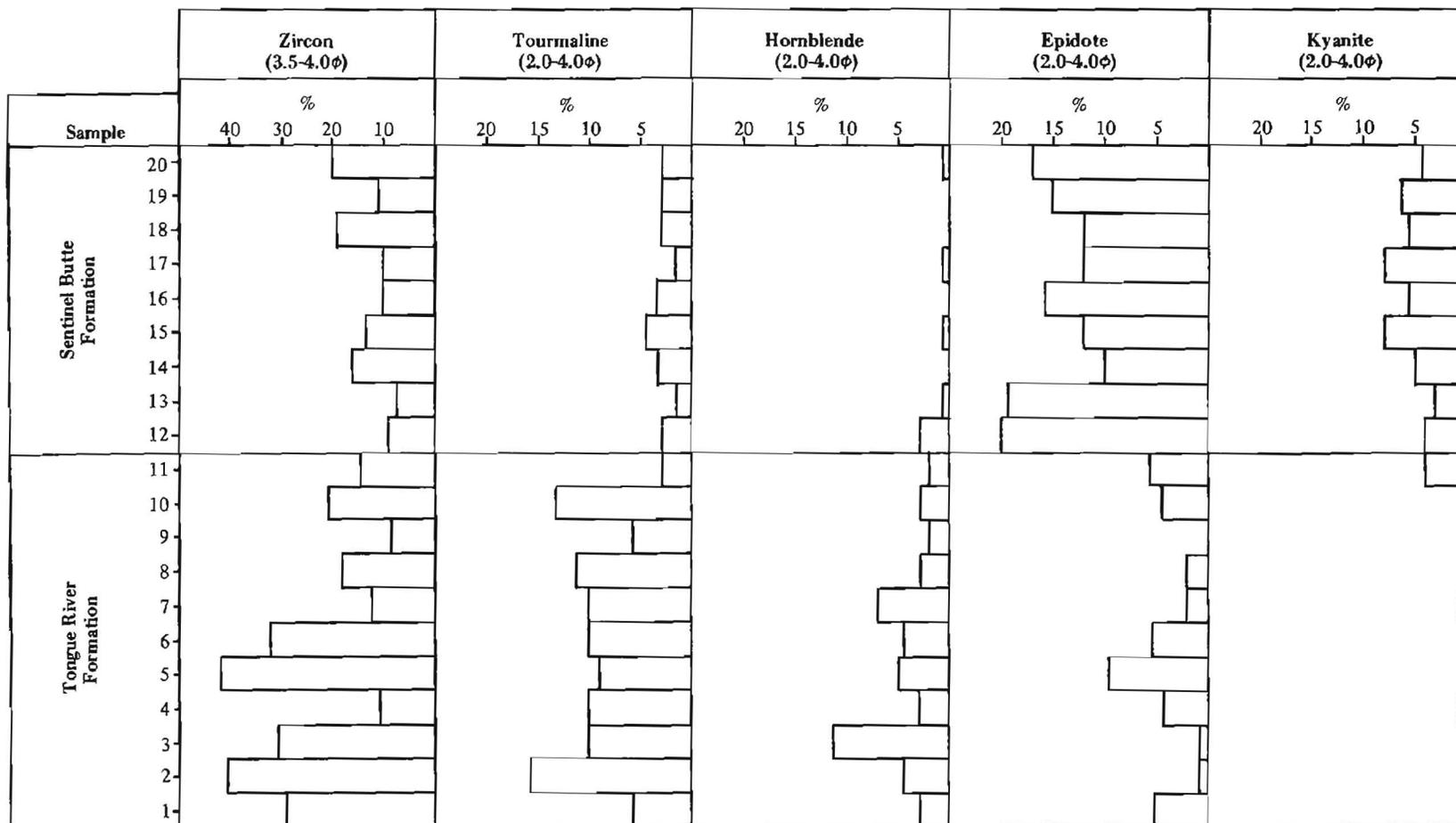


Table 1. Some heavy-mineral analyses of the Tongue River and Sentinel Butte Formations. Samples arranged in vertical sequence. Locations of samples and sources of data explained in text. Percentages are of the heavy-mineral fraction excluding mica, opaque minerals, and rock fragments. Data for each mineral are for size fraction indicated.

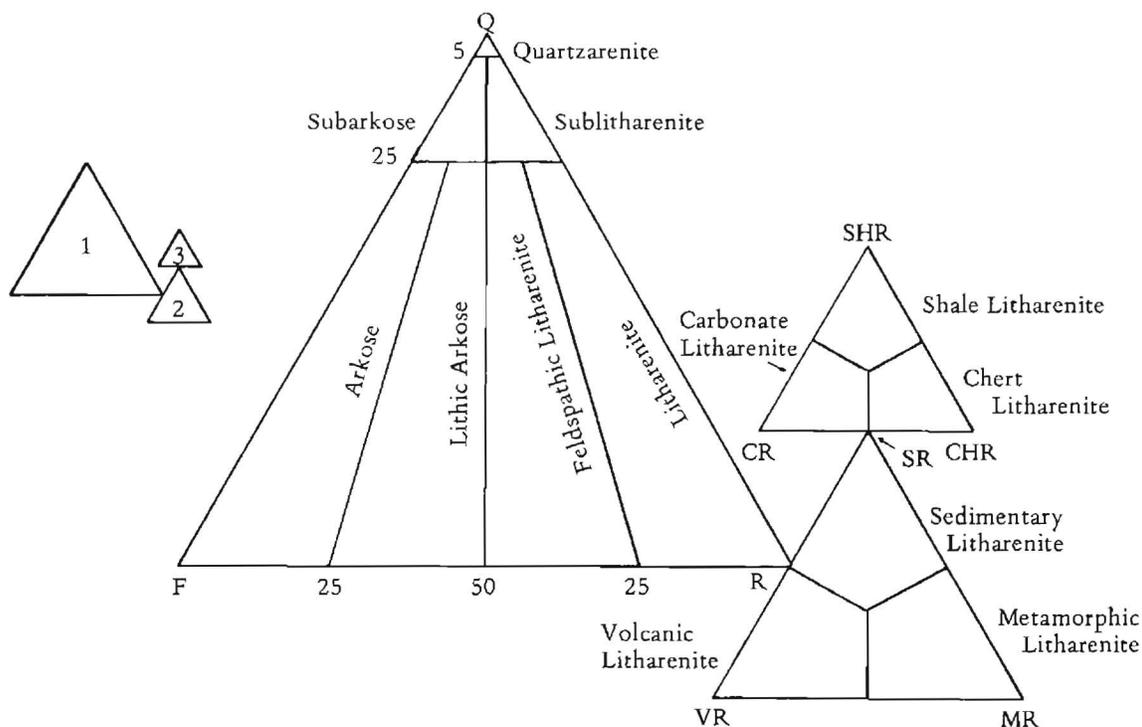


Figure 5. Folk's (1968) classification of sandstones used in this report. Triangle 2 is used to subdivide litharenites and triangle 3 is used to subdivide sedimentary litharenites. Symbols explained in title of table 3.

Table 1 shows that tourmaline is more abundant in the Tongue River Formation than in the Sentinel Butte Formation, and zircon is more abundant in the lower part of the Tongue River Formation than in the rest of the section. Probably this is because sedimentary rocks were more abundant in the source area of the Tongue River Formation than in the source area of the Sentinel Butte Formation (compare figs. 8 and 9). Zircon and tourmaline are very stable and probably had been concentrated in these sedimentary rocks during one or more previous sedimentary cycles. Following erosion of these sedimentary rocks the zircon and tourmaline were redeposited in the Tongue River Formation. It is not clear why hornblende is more abundant in the Tongue River Formation than in the Sentinel Butte Formation.

Figures 8 and 9 indicate that metamorphic rocks were more abundant in the source area of the Sentinel Butte Formation than in the source area of the Tongue River Formation. Probably this is because metamorphic rocks became exposed in the source area following erosion of much of the overlying cover of sedimentary rocks during deposition of the Tongue River Formation. This probably explains why kyanite and epidote, both metamorphic minerals, are more abundant in the Sentinel Butte than in the Tongue River (table 1).

Many other heavy minerals besides those listed in table 1 were counted, but data concerning them are not presented because they show no detectable differences between the two formations.

Clay Minerals

Emmanuel and Jacob (1974) studied the clay mineralogy in 80 samples from the Tongue River and 7 samples from Sentinel Butte Formations in the area near Medora. Figures 10 and 11 show typical X-ray diffractograms of the clay-size fraction of the Tongue River and Sentinel Butte Formations.

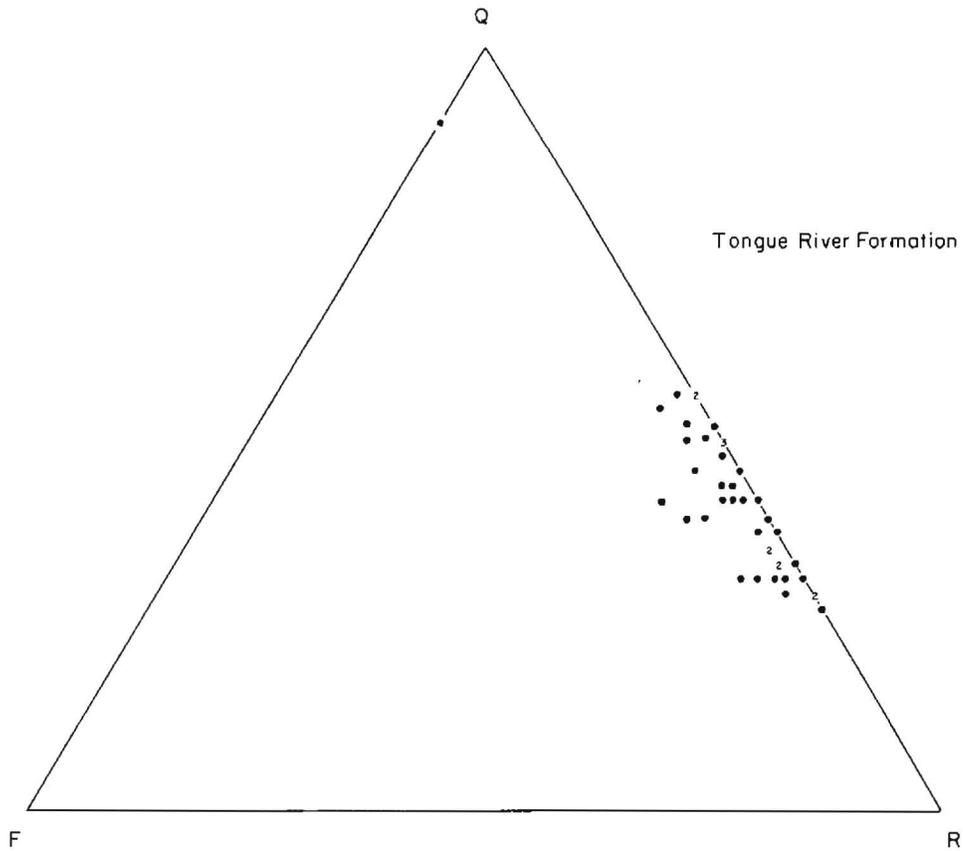


Figure 6. Sandstones of the Tongue River Formation plotted according to triangle 1 of figure 5. Numbers indicate where more than one sample occupy a point. Figure was printed by FORTRAN program TRI (Lumsden, 1973).

In all samples of the Sentinel Butte, the montmorillonite peak at 14 to 15 Å is higher than either the mica peak at about 10 Å or the dehydrated halloysite peak at 7.1-7.2 Å (fig. 11). The montmorillonite peak in nearly all samples of the Sentinel Butte is higher than in samples of the Tongue River. The high montmorillonite content of the Sentinel Butte, which probably resulted from weathering of volcanic ash, probably is the cause of the color being darker than the color of the Tongue River.

In samples of the Tongue River Formation the mica peak at about 10 Å is higher than the montmorillonite peak at 14 to 15 Å (fig. 10). The quartz peak at 3.34 Å is the highest peak in most samples of the Tongue River, and it is much higher in the Tongue River samples than in the Sentinel Butte samples.

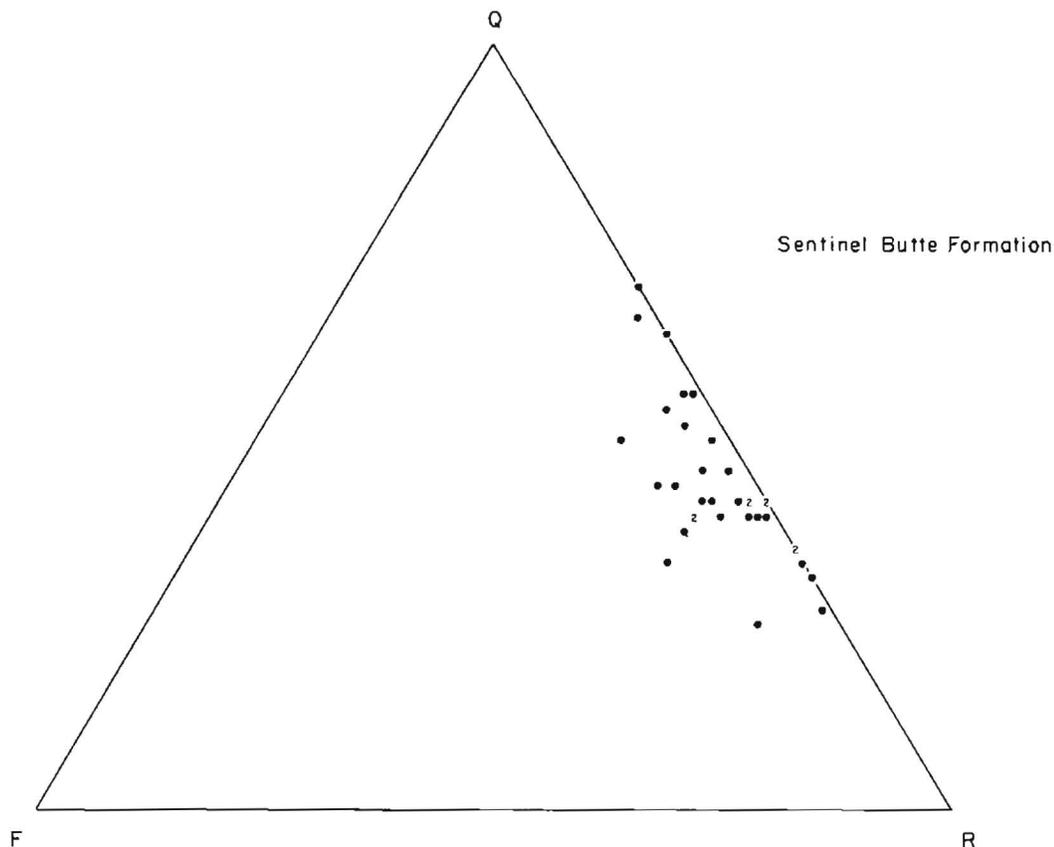


Figure 7. Sandstones of the Sentinel Butte Formation plotted according to triangle 1 of figure 5. Numbers indicate where more than one sample occupy a point. Figure was printed by FORTRAN program TR1 (Lumsden, 1973).

The calcite peak at about 3.01 \AA and the dolomite peak at 2.88 \AA are quite variable. Generally they are much lower in the Sentinel Butte samples than in the Tongue River samples. This confirms Royse's (1970) observation that the Sentinel Butte Formation is less calcareous than the Tongue River Formation.

The differences in clay mineralogy between the Tongue River and Sentinel Butte can be seen at a glance on a diffractogram. If a slide of the clay-size fraction is prepared using distilled water and it is scanned from $4^\circ 2\theta$ to $28^\circ 2\theta$, the diffractogram can be compared with figures 10 and 11 to help identify the formation.

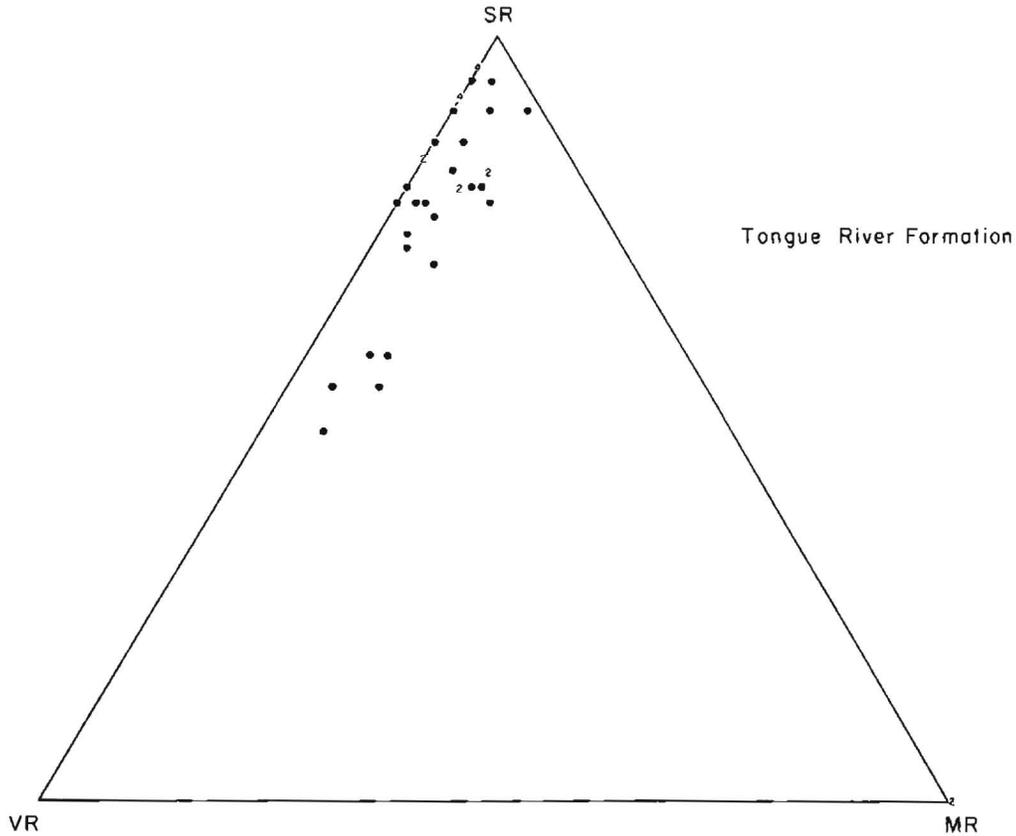


Figure 8. Sandstones of the Tongue River Formation plotted according to triangle 2 of figure 5. Numbers indicate where more than one sample occupy a point. Figure was printed by FORTRAN program TRI (Lumsden, 1973).

Silicified Wood

Silicified wood is much more common in the Sentinel Butte than in the Tongue River. Probably this is because volcanic-rock fragments are more abundant in the Sentinel Butte (fig. 9). One of the criteria used to identify these fragments is that they may contain glass. Glass is amorphous silica, which is more than ten times as soluble as crystalline silica at values of pH less than 9, and it is increasingly more soluble than crystalline silica at values greater than 9 (Krauskopf, 1967, fig. 6-3). So silica should have been abundant in solution in the interstitial water of the Sentinel Butte Formation throughout its history, and it should have been readily available for the silicification of wood.

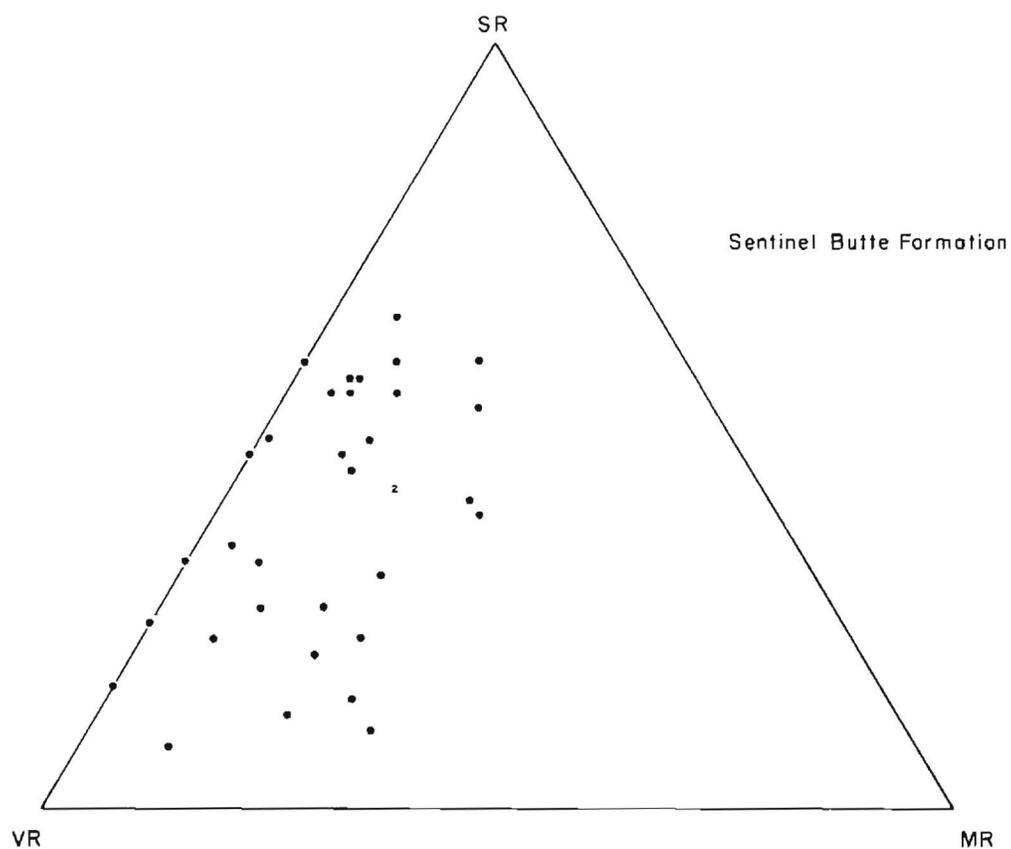


Figure 9. Sandstones of the Sentinel Butte Formation plotted according to triangle 2 of figure 5. Numbers indicate where more than one sample occupy a point. Figure was printed by FORTRAN program TRI (Lumsden, 1973).

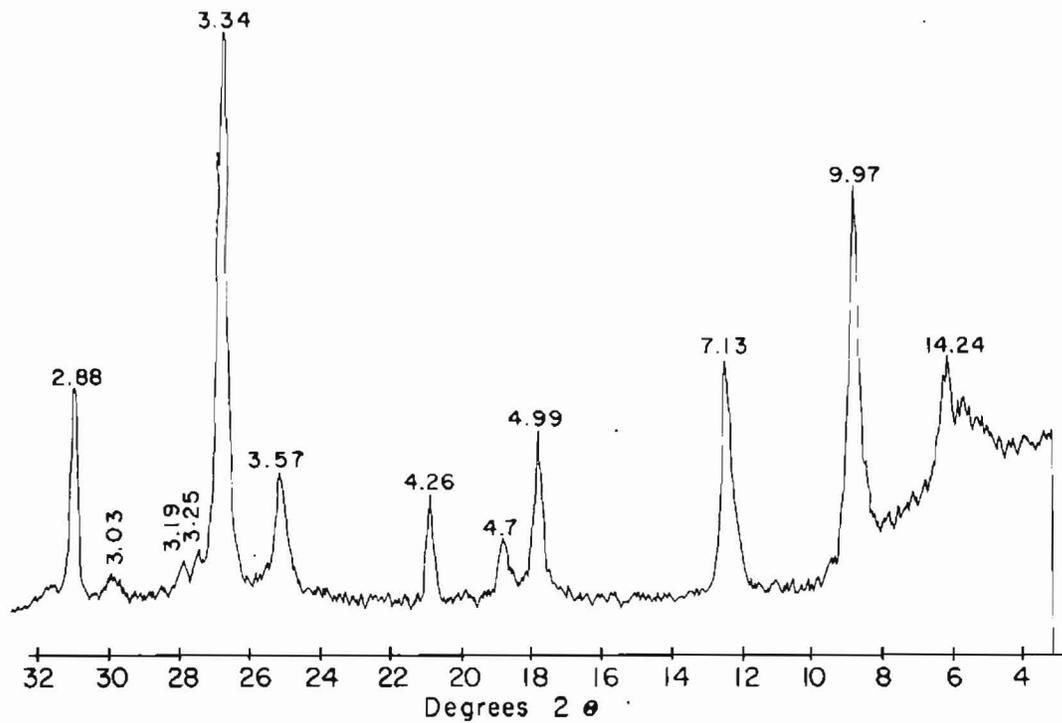


Figure 10. Typical X-ray diffractogram of the clay-size fraction of the Tongue River Formation (from Emmanuel and Jacob, 1974). Note that the mica peak at 9.97 Å is higher than the montmorillonite peak at 14.24 Å, and the quartz peak at 3.34 Å is the highest peak on the chart.

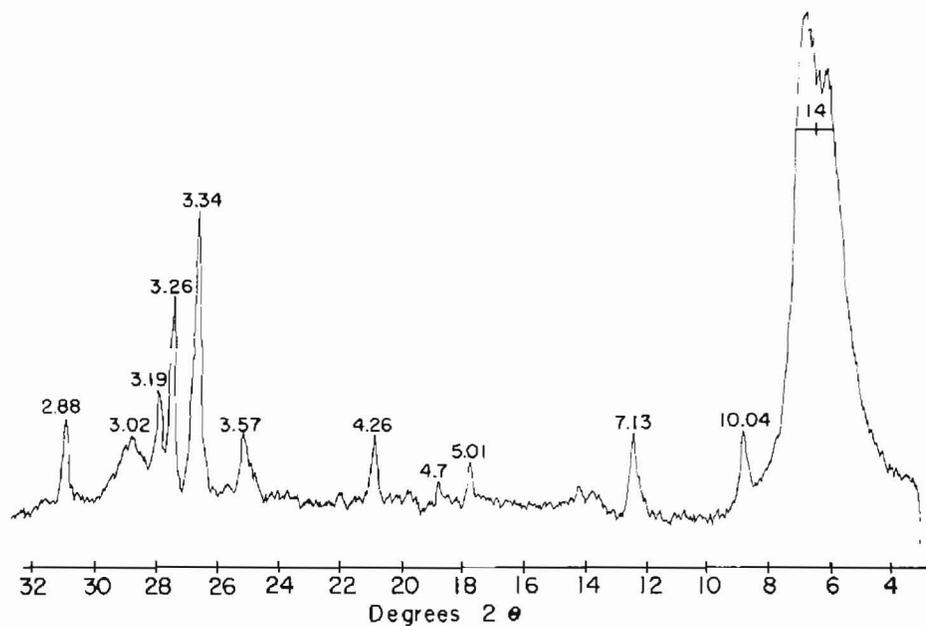


Figure 11. Typical X-ray diffractogram of the clay-size fraction of the Sentinel Butte Formation. Note that the montmorillonite peak at 14 Å is higher than the mica peak at 10 Å, and it is the highest peak on the chart. The quartz peak at 3.34 Å is lower than in the Tongue River Formation. The orthoclase peak at 3.26 Å is higher in this sample than in most others of the Sentinel Butte Formation.

SUMMARY

Weathered surfaces of the Tongue River Formation are generally buff, yellow, or light gray, and weathered surfaces of the overlying Sentinel Butte Formation are generally darker gray or brown. The darkness probably results from a greater content of montmorillonite. Sandstone in the Tongue River is much more friable than in the Sentinel Butte, and it weathers into more rounded, smoother surfaces, as do the other Tongue River lithologies. Small, rather straight gulleys with very steep sides, and small caves and tunnels are rare on exposures of the Tongue River and are absent on sandstone, but they are common on exposures of the Sentinel Butte, especially on sandstone.

Thick (a few tens of meters), tabular, laterally continuous sandstone beds are more common in the Sentinel Butte, and trough-shaped, laterally restricted sandstone beds are more common in the Tongue River. This difference is most easily used to differentiate the formations on good, large-scale exposures, but it might also be used where close control is available in the subsurface.

Sedimentary-rock fragments, consisting mostly of finely to coarsely crystalline carbonate, are more abundant constituents of the sandstone of the Tongue River, and volcanic-rock fragments and metamorphic-rock fragments are more abundant constituents of the sandstones of the Sentinel Butte. Triangular plots of rock-fragment type can be used to differentiate the two formations in both surface and subsurface sections.

Zircon, tourmaline, and hornblende are more common in the Tongue River than in the Sentinel Butte. The zircon and tourmaline were probably derived from sedimentary rocks in the source area. Kyanite and epidote, both metamorphic heavy minerals, are more abundant in the Sentinel Butte than in the Tongue River and were probably from metamorphic rocks in the source area. These differences can be used in either surface or subsurface sections, but the preparation and analysis of samples is tedious and time consuming.

X-ray diffractograms of the clay-size fraction of the Tongue River show high mica peaks at about 10 Å and high quartz peaks at 3.34 Å relative to other peaks in the samples. The clay-size fraction of the Sentinel Butte shows high montmorillonite peaks at 14 to 15 Å compared to other peaks. (The only other clay minerals that occur in either formation in recognizable quantities are dehydrated halloysite and chlorite.) The calcite peak at about 3.01 Å and the dolomite peak at 2.88 Å generally are much lower in Sentinel Butte samples. These differences can be used relatively easily to differentiate the formations in either surface or subsurface sections.

Silicified wood is much more common in the Sentinel Butte Formation than in the Tongue River Formation. This difference might be used to distinguish the formations in subsurface sections, but it probably is more easily used in surface sections.

REFERENCES

- Cherven, Victor B., 1973, High- and low-sinuosity stream deposits of the Sentinel Butte Formation (Paleocene) McKenzie County, North Dakota: Unpublished Master's Thesis, University of North Dakota, 73 p.
- Emmanuel, Richard, and Jacob, Arthur F., 1974, Mineralogy of the clay-size fraction of the Paleocene Tongue River and Sentinel Butte Formations near Medora, North Dakota: North Dakota Academy of Science, v. 28 (in preparation).
- Folk, R. L., 1968, Petrology of Sedimentary Rocks: Hemphill's Book Store, Austin, Texas, 170 p.
- Jacob, Arthur F., 1973, Depositional environments of Paleocene Tongue River Formation, western North Dakota: Am. Assoc. Petroleum Geologists Bull., v. 57, no. 6, p. 1038-1052.
- Johnson, Robert Post, 1973, Depositional environments of the upper part of the Sentinel Butte Formation, southeastern McKenzie County, North Dakota: Unpublished Master's Thesis, University of North Dakota, 63 p.
- Krauskopf, Konrad B., 1967, Introduction to geochemistry: McGraw-Hill Book Company, New York, 721 p.
- Leonard, A. G., and Smith, D. C., 1909, The Sentinel Butte lignite field, North Dakota and Montana: U.S. Geol. Survey Bull. 341, p. 15-35.
- Lumsden, David N., 1973, TRI: A FORTRAN subroutine to plot points on a triangular diagram: Geol. Soc. America Bull., v. 84, p. 1765-1768.
- Royse, Chester F., Jr., 1967, Tongue River-Sentinel Butte contact in western North Dakota: North Dakota Geol. Survey Rept. Inv. 45, 53 p.
- Royse, Chester F., Jr., 1970, A sedimentologic analysis of the Tongue River-Sentinel Butte interval (Paleocene) of the Williston Basin, western North Dakota: Sed. Geol., v. 4, p. 19-80.

Table 2. *Locations of sandstone samples of Tongue River and Sentinel Butte Formations.*

<u>Sample No.*</u>	Tongue River Formation			
	<u>Township N.</u>	<u>Range W.</u>	<u>Section</u>	<u>County</u>
101	140	102	NW¼ 25	Billings
102	140	102	NW¼ 25	Billings
103	140	102	NW¼ 25	Billings
104	140	102	NW¼ 25	Billings
105	140	102	NW¼ 25	Billings
112	142	102	NW¼ 12	Billings
113	143	102	SE¼ 14	Billings
114	143	102	SE¼ 14	Billings
115	141	101	SW¼ 5	Billings
116	141	101	SW¼ 5	Billings
121	140	102	SE¼ 22	Billings
122	140	102	SE¼ 22	Billings
123	140	102	SE¼ 22	Billings
129	137	101	NW¼ 29	Billings
130	137	101	NW¼ 29	Billings
131	136	102	SE¼ 25	Billings
132	136	102	SE¼ 25	Billings
133	136	104	SE¼ 29	Billings
134	136	104	SE¼ 29	Billings
135	136	104	SE¼ 29	Billings
136	129	95	SE¼ 20	Adams
137	129	95	SE¼ 20	Adams
139	130	98	NW¼ 15	Adams
140	130	98	NW¼ 15	Adams
141	130	97	SE¼ 10	Adams
142	130	97	SE¼ 10	Adams
143	151	103	NW¼ 1	McKenzie
144	151	103	NW¼ 1	McKenzie
146	151	104	NE¼ 13	McKenzie
147	150	104	NE¼ 22	McKenzie
148	150	104	NE¼ 22	McKenzie
149	150	104	NE¼ 22	Dawson Co., Mt.
150	150	104	NE¼ 22	Dawson Co., Mt.
151	140	102	NW¼ 20	Billings
152	140	102	NW¼ 20	Billings
153	129	94	NW¼ 16	Adams
154	129	94	NW¼ 16	Adams
155	129	92	NW¼ 14	Adams
156	129	92	NW¼ 14	Adams
157	129	92	SW¼ 15	Adams
158	129	92	SW¼ 15	Adams
159	130	88	NW¼ 32	Grant

*Sample numbers refer to the samples listed in table 3.

Sentinel Butte Formation

<u>Sample No.*</u>	<u>Location</u>			
	<u>Township N.</u>	<u>Range W.</u>	<u>Section</u>	<u>County</u>
201	146	84	SW¼ 9	McLean
202	146	84	SW¼ 9	McLean
204	148	90	NE¼ 22	McLean
206	148	90	NE¼ 22	McLean
207	151	94	NE¼ 5	McKenzie
208	150	94	NE¼ 4	McKenzie
209	150	94	NE¼ 4	McKenzie
210	148	95	SW¼ 23	Dunn
211	144	99	SE¼ 21	Billings
216	147	99	NE¼ 13	McKenzie
217	147	99	NE¼ 13	McKenzie
220	153	101	SE¼ 20	McKenzie
221	153	101	SE¼ 20	McKenzie
222	140	101	NE¼ 33	Billings
223	134	101	NW¼ 3	Slope
225	140	101	NE¼ 33	Billings
226	139	105	NW¼ 8	Golden Valley
227	139	105	NW¼ 8	Golden Valley
228	139	105	NW¼ 8	Golden Valley
229	139	105	NW¼ 8	Golden Valley
230	148	99	NW¼ 32	McKenzie
231	148	99	NW¼ 32	McKenzie
232	148	99	NW¼ 32	McKenzie
233	148	99	NW¼ 32	McKenzie
234	148	99	NW¼ 32	McKenzie
235	148	99	NW¼ 32	McKenzie
236	148	99	NW¼ 32	McKenzie
237	148	99	NW¼ 32	McKenzie
241	147	99	NW¼ 32	McKenzie
242	147	99	NW¼ 32	McKenzie
243	147	99	NW¼ 32	McKenzie
244	147	99	NW¼ 32	McKenzie
246	147	99	NW¼ 32	McKenzie
248	147	99	NW¼ 32	McKenzie

*Sample numbers refer to the samples listed in table 3.

Table 3. Petrographic data for sandstone samples of Tongue River and Sentinel Butte Formations. Sample locations given in table 2. Sample numbers 204, 206, 208, 302, 305, 306, 310, 312, and 313 are of thin sections of mounted grains of uncemented sand. Sample 303 is a sandy micrite that was counted in the same way as a thin section of mounted grains of uncemented sand. All other samples are cemented sandstones.

The meanings of the symbols in the table are as follows:

Q	Quartz	SHR	Shale Rock Fragments
STQ	Straight Quartz	CHR	Chert Rock Fragments
SLUQ	Slightly Undulose Quartz	VR	Volcanic Rock Fragments
STUQ	Strongly Undulose Quartz	MR	Metamorphic Rock Fragments
SCQ	Semi-Composite Quartz	C	Cement
CQ	Composite Quartz	CAC	Calcite Cement
CMQ	Composite-Metamorphic Quartz	SIC	Silica Cement
F	Feldspar	FEC	Iron-oxide Cement
KF	Potassium Feldspar	OC	Other Cement
PF	Plagioclase Feldspar	M	Matrix
G	Granite Fragments	P	Porosity
R	Rock Fragments	O	Other
CR	Carbonate Rock Fragments		

101. SAMPLE NO.	100. TOTAL POINTS COUNTED										
ORIGINAL DATA											
	Q	STQ	SLUQ	STUQ	SCQ	CQ	CMQ	F	KF	PF	G
21.	9.	8.	0.	0.	1.	3.	2.	2.	0.	0.	0.
	R	CR	SHR	CHR	VR	MR	C	CAC	SIC	FEC	OC
29.	12.	2.	11.	1.	2.	15.	0.	0.	0.	0.	0.
	M	P	O								
26.	6.	1.									
Q + F + R RECALCULATED TO 100 PERCENT											
40. PERCENT QTZ											
4. PERCENT FELDSPAR											
56. PERCENT RK FRAGS											
THIS SAMPLE IS A LITHARENITE											
SR + VR + MR RECALCULATED TO 100 PERCENT											
89. PERCENT SED RK FRAGS											
4. PERCENT VOLCANIC RK FRAGS											
7. PERCENT META RK FRAGS											
THIS SAMPLE IS A SEDIMENTARY LITHARENITE											
SHR + CR + CHR RECALCULATED TO 100 PERCENT											
8. PERCENT SHALE RK FRAGS											
48. PERCENT CARBONATE RK FRAGS											
44. PERCENT CHERT RK FRAGS											
THIS SAMPLE IS A CARBONATE LITHARENITE											

102. SAMPLE NO.	97. TOTAL POINTS COUNTED									
ORIGINAL DATA										
Q	STQ	SLUQ	STUQ	SCQ	CQ	CMQ	F	KF	PF	G
21.	11.	6.	1.	0.	0.	3.	1.	1.	0.	0.
R	CR	SHR	CHR	VR	MR	C	CAC	SIC	FEC	OC
40.	25.	3.	2.	8.	2.	16.	0.	0.	0.	0.
M	P	O								
18.	0.	1.								

Q + F + R RECALCULATED TO 100 PERCENT

34. PERCENT QTZ
2. PERCENT FELDSPAR
65. PERCENT RK FRAGS

THIS SAMPLE IS A LITHARENITE

SR + VR + MR RECALCULATED TO 100 PERCENT

75. PERCENT SED RK FRAGS
20. PERCENT VOLCANIC RK FRAGS
5. PERCENT META RK FRAGS

THIS SAMPLE IS A SEDIMENTARY LITHARENITE

SHR + CR + CHR RECALCULATED TO 100 PERCENT

10. PERCENT SHALE RK FRAGS
83. PERCENT CARBONATE RK FRAGS
7. PERCENT CHERT RK FRAGS

THIS SAMPLE IS A CARBONATE LITHARENITE

103. SAMPLE NO.	100. TOTAL POINTS COUNTED									
ORIGINAL DATA										
Q	STQ	SLUQ	STUQ	SCQ	CQ	CMQ	F	KF	PF	G
16.	8.	5.	0.	1.	0.	2.	0.	0.	0.	0.
R	CR	SHR	CHR	VR	MR	C	CAC	SIC	FEC	OC
42.	24.	7.	2.	9.	0.	14.	0.	0.	0.	0.
M	P	O								
28.	0.	0.								

Q + F + R RECALCULATED TO 100 PERCENT

28. PERCENT QTZ
0. PERCENT FELDSPAR
72. PERCENT RK FRAGS

THIS SAMPLE IS A LITHARENITE

SR + VR + MR RECALCULATED TO 100 PERCENT

79. PERCENT SED RK FRAGS
21. PERCENT VOLCANIC RK FRAGS
0. PERCENT META RK FRAGS

THIS SAMPLE IS A SEDIMENTARY LITHARENITE

SHR + CR + CHR RECALCULATED TO 100 PERCENT

21. PERCENT SHALE RK FRAGS
73. PERCENT CARBONATE RK FRAGS
6. PERCENT CHERT RK FRAGS

THIS SAMPLE IS A CARBONATE LITHARENITE

104. SAMPLE NO. 100. TOTAL POINTS COUNTED

ORIGINAL DATA

	Q	STQ	SLUQ	STUQ	SCQ	CQ	CMQ	F	KF	PF	G
23.	9.	3.	5.	0.	0.	6.	0.	0.	0.	0.	0.
	R	CR	SHR	CHR	VR	MR	C	CAC	SIC	FEC	OC
26.	18.	1.	1.	2.	0.	13.	10.	0.	3.	0.	0.
	M	P	0								
38.	0.	0.									

Q + F + R RECALCULATED TO 100 PERCENT

47. PERCENT QTZ
0. PERCENT FELDSPAR
53. PERCENT RK FRAGS

THIS SAMPLE IS A LITHARENITE

SR + VR + MR RECALCULATED TO 100 PERCENT

91. PERCENT SED RK FRAGS
9. PERCENT VOLCANIC RK FRAGS
0. PERCENT META RK FRAGS

THIS SAMPLE IS A SEDIMENTARY LITHARENITE

SHR + CR + CHR RECALCULATED TO 100 PERCENT

5. PERCENT SHALE RK FRAGS
90. PERCENT CARBONATE RK FRAGS
5. PERCENT CHERT RK FRAGS

THIS SAMPLE IS A CARBONATE LITHARENITE

105. SAMPLE NO. 100. TOTAL POINTS COUNTED

ORIGINAL DATA

	Q	STQ	SLUQ	STUQ	SCQ	CQ	CMQ	F	KF	PF	G
27.	10.	9.	3.	0.	0.	5.	0.	0.	0.	0.	0.
	R	CR	SHR	CHR	VR	MR	C	CAC	SIC	FEC	OC
24.	15.	5.	1.	1.	0.	9.	8.	0.	1.	0.	0.
	M	P	0								
40.	0.	0.									

Q + F + R RECALCULATED TO 100 PERCENT

53. PERCENT QTZ
0. PERCENT FELDSPAR
47. PERCENT RK FRAGS

THIS SAMPLE IS A LITHARENITE

SR + VR + MR RECALCULATED TO 100 PERCENT

95. PERCENT SED RK FRAGS
5. PERCENT VOLCANIC RK FRAGS
0. PERCENT META RK FRAGS

THIS SAMPLE IS A SEDIMENTARY LITHARENITE

SHR + CR + CHR RECALCULATED TO 100 PERCENT

24. PERCENT SHALE RK FRAGS
71. PERCENT CARBONATE RK FRAGS
5. PERCENT CHERT RK FRAGS

THIS SAMPLE IS A CARBONATE LITHARENITE

112. SAMPLE NO. 100. TOTAL POINTS COUNTED

ORIGINAL DATA

Q	STQ	SLUQ	STUQ	SCQ	CQ	CMQ	F	KF	PF	G
20.	9.	5.	2.	0.	0.	2.	0.	0.	0.	0.
R	CR	SHR	CHR	VR	MR	C	CAC	SIC	FEC	OC
27.	13.	4.	3.	3.	2.	15.	8.	3.	2.	2.
M	P	D								
29.	9.	0.								

Q + F + R RECALCULATED TO 100 PERCENT

43. PERCENT QTZ
0. PERCENT FELDSPAR
57. PERCENT RK FRAGS

THIS SAMPLE IS A LITHARENITE

SR + VR + MR RECALCULATED TO 100 PERCENT

80. PERCENT SED RK FRAGS
12. PERCENT VOLCANIC RK FRAGS
8. PERCENT META RK FRAGS

THIS SAMPLE IS A SEDIMENTARY LITHARENITE

SHR + CR + CHR RECALCULATED TO 100 PERCENT

20. PERCENT SHALE RK FRAGS
65. PERCENT CARBONATE RK FRAGS
15. PERCENT CHERT RK FRAGS

THIS SAMPLE IS A CARBONATE LITHARENITE

113. SAMPLE NO. 100. TOTAL POINTS COUNTED

ORIGINAL DATA

Q	STQ	SLUQ	STUQ	SCQ	CQ	CMQ	F	KF	PF	G
18.	7.	5.	1.	0.	3.	2.	0.	0.	0.	0.
R	CR	SHR	CHR	VR	MR	C	CAC	SIC	FEC	OC
38.	30.	1.	1.	3.	0.	17.	11.	4.	2.	0.
M	P	D								
22.	5.	0.								

Q + F + R RECALCULATED TO 100 PERCENT

32. PERCENT QTZ
0. PERCENT FELDSPAR
68. PERCENT RK FRAGS

THIS SAMPLE IS A LITHARENITE

SR + VR + MR RECALCULATED TO 100 PERCENT

91. PERCENT SED RK FRAGS
9. PERCENT VOLCANIC RK FRAGS
0. PERCENT META RK FRAGS

THIS SAMPLE IS A SEDIMENTARY LITHARENITE

SHR + CR + CHR RECALCULATED TO 100 PERCENT

3. PERCENT SHALE RK FRAGS
94. PERCENT CARBONATE RK FRAGS
3. PERCENT CHERT RK FRAGS

THIS SAMPLE IS A CARBONATE LITHARENITE

114. SAMPLE NO. 100. TOTAL POINTS COUNTED

ORIGINAL DATA

Q	STQ	SLUQ	STUQ	SCQ	CQ	CMQ	F	KF	PF	G
18.	7.	0.	8.	0.	1.	2.	4.	1.	0.	3.
R	CR	SHR	CHR	VR	MR	C	CAC	SIC	FEC	OC
25.	23.	0.	1.	1.	0.	11.	11.	0.	0.	0.
M	P	O								
31.	4.	7.								

Q + F + R RECALCULATED TO 100 PERCENT

38. PERCENT QTZ
9. PERCENT FELDSPAR
53. PERCENT RK FRAGS

THIS SAMPLE IS A LITHARENITE

SR + VR + MR RECALCULATED TO 100 PERCENT

96. PERCENT SED RK FRAGS
4. PERCENT VOLCANIC RK FRAGS
0. PERCENT META RK FRAGS

THIS SAMPLE IS A SEDIMENTARY LITHARENITE

SHR + CR + CHR RECALCULATED TO 100 PERCENT

0. PERCENT SHALE RK FRAGS
96. PERCENT CARBONATE RK FRAGS
4. PERCENT CHERT RK FRAGS

THIS SAMPLE IS A CARBONATE LITHARENITE

115. SAMPLE NO. 101. TOTAL POINTS COUNTED

ORIGINAL DATA

Q	STQ	SLUQ	STUQ	SCQ	CQ	CMQ	F	KF	PF	G
19.	8.	6.	1.	0.	1.	3.	2.	0.	0.	2.
R	CR	SHR	CHR	VR	MR	C	CAC	SIC	FEC	OC
28.	19.	2.	5.	2.	0.	8.	8.	0.	0.	0.
M	P	O								
39.	0.	5.								

Q + F + R RECALCULATED TO 100 PERCENT

39. PERCENT QTZ
4. PERCENT FELDSPAR
57. PERCENT RK FRAGS

THIS SAMPLE IS A LITHARENITE

SR + VR + MR RECALCULATED TO 100 PERCENT

93. PERCENT SED RK FRAGS
7. PERCENT VOLCANIC RK FRAGS
0. PERCENT META RK FRAGS

THIS SAMPLE IS A SEDIMENTARY LITHARENITE

SHR + CR + CHR RECALCULATED TO 100 PERCENT

8. PERCENT SHALE RK FRAGS
73. PERCENT CARBONATE RK FRAGS
19. PERCENT CHERT RK FRAGS

THIS SAMPLE IS A CARBONATE LITHARENITE

116. SAMPLE NO. 100. TOTAL POINTS COUNTED

ORIGINAL DATA

Q	STQ	SLUQ	STUQ	SCQ	CQ	CMQ	F	KF	PF	G
21.	6.	7.	2.	1.	2.	3.	1.	0.	0.	1.
R	CR	SHR	CHR	VR	MR	C	CAC	SIC	FEC	OC
31.	21.	4.	3.	2.	1.	6.	5.	0.	1.	0.
M	P	O								
35.	0.	6.								

Q + F + R RECALCULATED TO 100 PERCENT

40. PERCENT QTZ
2. PERCENT FELDSPAR
58. PERCENT RK FRAGS

THIS SAMPLE IS A LITHARENITE

SR + VR + MR RECALCULATED TO 100 PERCENT

90. PERCENT SED RK FRAGS
6. PERCENT VOLCANIC RK FRAGS
3. PERCENT META RK FRAGS

THIS SAMPLE IS A SEDIMENTARY LITHARENITE

SHR + CR + CHR RECALCULATED TO 100 PERCENT

14. PERCENT SHALE RK FRAGS
75. PERCENT CARBONATE RK FRAGS
11. PERCENT CHERT RK FRAGS

THIS SAMPLE IS A CARBONATE LITHARENITE

121. SAMPLE NO. 100. TOTAL POINTS COUNTED

ORIGINAL DATA

Q	STQ	SLUQ	STUQ	SCQ	CQ	CMQ	F	KF	PF	G
29.	10.	10.	3.	0.	1.	5.	1.	0.	0.	1.
R	CR	SHR	CHR	VR	MR	C	CAC	SIC	FEC	OC
24.	10.	1.	3.	8.	2.	6.	4.	1.	1.	0.
M	P	O								
35.	1.	4.								

Q + F + R RECALCULATED TO 100 PERCENT

54. PERCENT QTZ
2. PERCENT FELDSPAR
44. PERCENT RK FRAGS

THIS SAMPLE IS A LITHARENITE

SR + VR + MR RECALCULATED TO 100 PERCENT

58. PERCENT SED RK FRAGS
33. PERCENT VOLCANIC RK FRAGS
8. PERCENT META RK FRAGS

THIS SAMPLE IS A SEDIMENTARY LITHARENITE

SHR + CR + CHR RECALCULATED TO 100 PERCENT

7. PERCENT SHALE RK FRAGS
71. PERCENT CARBONATE RK FRAGS
21. PERCENT CHERT RK FRAGS

THIS SAMPLE IS A CARBONATE LITHARENITE

122. SAMPLE NO. 100. TOTAL POINTS COUNTED

ORIGINAL DATA

	Q	STQ	SLUQ	STUQ	SCQ	CQ	CMQ	F	KF	PF	G
26.	3.	12.		4.	1.	0.	4.	2.	0.	0.	0.
	R	CR	SHR	CHR	VR	MR	C	CAC	SIC	FEC	OC
26.	9.	8.		1.	6.	2.	5.	5.	0.	0.	0.
	M	P	O								
37.	0.	4.									

Q + F + R RECALCULATED TO 100 PERCENT

48. PERCENT QTZ
4. PERCENT FELDSPAR
48. PERCENT RK FRAGS

THIS SAMPLE IS A LITHARENITE

SR + VR + MR RECALCULATED TO 100 PERCENT

69. PERCENT SED RK FRAGS
23. PERCENT VOLCANIC RK FRAGS
8. PERCENT META RK FRAGS

THIS SAMPLE IS A SEDIMENTARY LITHARENITE

SHR + CR + CHR RECALCULATED TO 100 PERCENT

44. PERCENT SHALE RK FRAGS
50. PERCENT CARBONATE RK FRAGS
6. PERCENT CHERT RK FRAGS

THIS SAMPLE IS A CARBONATE LITHARENITE

123. SAMPLE NO. 100. TOTAL POINTS COUNTED

ORIGINAL DATA

	Q	STQ	SLUQ	STUQ	SCQ	CQ	CMQ	F	KF	PF	G
22.	2.	11.		4.	0.	0.	5.	0.	0.	0.	0.
	R	CR	SHR	CHR	VR	MR	C	CAC	SIC	FEC	OC
35.	25.	2.		0.	7.	1.	7.	6.	1.	0.	0.
	M	P	O								
34.	0.	2.									

Q + F + R RECALCULATED TO 100 PERCENT

39. PERCENT QTZ
0. PERCENT FELDSPAR
61. PERCENT RK FRAGS

THIS SAMPLE IS A LITHARENITE

SR + VR + MR RECALCULATED TO 100 PERCENT

77. PERCENT SED RK FRAGS
20. PERCENT VOLCANIC RK FRAGS
3. PERCENT META RK FRAGS

THIS SAMPLE IS A SEDIMENTARY LITHARENITE

SHR + CR + CHR RECALCULATED TO 100 PERCENT

7. PERCENT SHALE RK FRAGS
93. PERCENT CARBONATE RK FRAGS
0. PERCENT CHERT RK FRAGS

THIS SAMPLE IS A CARBONATE LITHARENITE

129. SAMPLE NO.	100. TOTAL POINTS COUNTED									
ORIGINAL DATA										
Q	STQ	SLUQ	STUQ	SCQ	CQ	CMQ	F	KF	PF	G
24.	5.	7.	7.	0.	0.	5.	2.	1.	0.	1.
R	CR	SHR	CHR	VR	MR	C	CAC	SIC	FEC	OC
33.	20.	4.	2.	5.	2.	11.	8.	0.	3.	0.
M	P	0								
21.	1.	8.								

Q + F + R RECALCULATED TO 100 PERCENT

41. PERCENT QTZ
3. PERCENT FELDSPAR
56. PERCENT RK FRAGS

THIS SAMPLE IS A LITHARENITE

SR + VR + MR RECALCULATED TO 100 PERCENT

79. PERCENT SED RK FRAGS
15. PERCENT VOLCANIC RK FRAGS
6. PERCENT META RK FRAGS

THIS SAMPLE IS A SEDIMENTARY LITHARENITE

SHR + CR + CHR RECALCULATED TO 100 PERCENT

15. PERCENT SHALE RK FRAGS
77. PERCENT CARBONATE RK FRAGS
8. PERCENT CHERT RK FRAGS

THIS SAMPLE IS A CARBONATE LITHARENITE

130. SAMPLE NO.	100. TOTAL POINTS COUNTED									
ORIGINAL DATA										
Q	STQ	SLUQ	STUQ	SCQ	CQ	CMQ	F	KF	PF	G
24.	9.	7.	0.	1.	1.	6.	3.	3.	0.	0.
R	CR	SHR	CHR	VR	MR	C	CAC	SIC	FEC	OC
28.	19.	3.	2.	3.	1.	3.	2.	0.	1.	0.
M	P	0								
38.	1.	3.								

Q + F + R RECALCULATED TO 100 PERCENT

44. PERCENT QTZ
5. PERCENT FELDSPAR
51. PERCENT RK FRAGS

THIS SAMPLE IS A LITHARENITE

SR + VR + MR RECALCULATED TO 100 PERCENT

86. PERCENT SED RK FRAGS
11. PERCENT VOLCANIC RK FRAGS
4. PERCENT META RK FRAGS

THIS SAMPLE IS A SEDIMENTARY LITHARENITE

SHR + CR + CHR RECALCULATED TO 100 PERCENT

13. PERCENT SHALE RK FRAGS
79. PERCENT CARBONATE RK FRAGS
8. PERCENT CHERT RK FRAGS

THIS SAMPLE IS A CARBONATE LITHARENITE

131. SAMPLE NO. 100. TOTAL POINTS COUNTED

ORIGINAL DATA

	Q	STQ	SLUQ	STUQ	SCQ	CQ	CMQ	F	KF	PF	G
30.	6.	11.	4.	0.	0.	9.	2.	0.	2.	0.	0.
	R	CR	SHR	CHR	VR	MR	C	CAC	SIC	FEC	OC
28.	18.	6.	2.	0.	0.	18.	16.	2.	0.	0.	0.
	M	P	O								
21.	1.	0.									

Q + F + R RECALCULATED TO 100 PERCENT

50. PERCENT QTZ
3. PERCENT FELDSPAR
47. PERCENT RK FRAGS

THIS SAMPLE IS A LITHARENITE

SR + VR + MR RECALCULATED TO 100 PERCENT

100. PERCENT SED RK FRAGS
0. PERCENT VOLCANIC RK FRAGS
0. PERCENT META RK FRAGS

THIS SAMPLE IS A SEDIMENTARY LITHARENITE

SHR + CR + CHR RECALCULATED TO 100 PERCENT

23. PERCENT SHALE RK FRAGS
69. PERCENT CARBONATE RK FRAGS
8. PERCENT CHERT RK FRAGS

THIS SAMPLE IS A CARBONATE LITHARENITE

132. SAMPLE NO. 100. TOTAL POINTS COUNTED

ORIGINAL DATA

	Q	STQ	SLUQ	STUQ	SCQ	CQ	CMQ	F	KF	PF	G
23.	2.	8.	6.	0.	2.	5.	2.	2.	0.	0.	0.
	R	CR	SHR	CHR	VR	MR	C	CAC	SIC	FEC	OC
31.	16.	6.	2.	4.	3.	8.	7.	0.	1.	0.	0.
	M	P	O								
34.	2.	0.									

Q + F + R RECALCULATED TO 100 PERCENT

41. PERCENT QTZ
4. PERCENT FELDSPAR
55. PERCENT RK FRAGS

THIS SAMPLE IS A LITHARENITE

SR + VR + MR RECALCULATED TO 100 PERCENT

77. PERCENT SED RK FRAGS
13. PERCENT VOLCANIC RK FRAGS
10. PERCENT META RK FRAGS

THIS SAMPLE IS A SEDIMENTARY LITHARENITE

SHR + CR + CHR RECALCULATED TO 100 PERCENT

25. PERCENT SHALE RK FRAGS
67. PERCENT CARBONATE RK FRAGS
8. PERCENT CHERT RK FRAGS

THIS SAMPLE IS A CARBONATE LITHARENITE

133. SAMPLE NO.	100. TOTAL							POINTS COUNTED			
ORIGINAL DATA											
Q	STQ	SLUQ	STUQ	SCQ	CQ	CMQ	F	KF	PF	G	
21.	4.	2.	3.	1.	1.	10.	2.	0.	0.	0.	
R	CR	SHR	CHR	VR	MR	C	CAC	SIC	FEC	OC	
47.	28.	4.	6.	7.	2.	7.	5.	1.	1.	0.	
M	P	O									
20.	0.	3.									

Q + F + R RECALCULATED TO 100 PERCENT

30. PERCENT QTZ
3. PERCENT FELDSPAR
67. PERCENT RK FRAGS

THIS SAMPLE IS A LITHARENITE

SR + VR + MR RECALCULATED TO 100 PERCENT

81. PERCENT SED RK FRAGS
15. PERCENT VOLCANIC RK FRAGS
4. PERCENT META RK FRAGS

THIS SAMPLE IS A SEDIMENTARY LITHARENITE

SHR + CR + CHR RECALCULATED TO 100 PERCENT

11. PERCENT SHALE RK FRAGS
74. PERCENT CARBONATE RK FRAGS
16. PERCENT CHERT RK FRAGS

THIS SAMPLE IS A CARBONATE LITHARENITE

134. SAMPLE NO.	100. TOTAL							POINTS COUNTED			
ORIGINAL DATA											
Q	STQ	SLUQ	STUQ	SCQ	CQ	CMQ	F	KF	PF	G	
15.	4.	4.	1.	0.	0.	6.	0.	0.	0.	0.	
R	CR	SHR	CHR	VR	MR	C	CAC	SIC	FEC	OC	
41.	24.	6.	3.	5.	3.	7.	7.	0.	0.	0.	
M	P	O									
29.	1.	7.									

Q + F + R RECALCULATED TO 100 PERCENT

27. PERCENT QTZ
0. PERCENT FELDSPAR
73. PERCENT RK FRAGS

THIS SAMPLE IS A LITHARENITE

SR + VR + MR RECALCULATED TO 100 PERCENT

80. PERCENT SED RK FRAGS
12. PERCENT VOLCANIC RK FRAGS
7. PERCENT META RK FRAGS

THIS SAMPLE IS A SEDIMENTARY LITHARENITE

SHR + CR + CHR RECALCULATED TO 100 PERCENT

18. PERCENT SHALE RK FRAGS
73. PERCENT CARBONATE RK FRAGS
9. PERCENT CHERT RK FRAGS

THIS SAMPLE IS A CARBONATE LITHARENITE

135. SAMPLE NO. 100. TOTAL POINTS COUNTED

ORIGINAL DATA

	Q	STQ	SLUQ	STUQ	SCQ	CQ	CMQ	F	KF	PF	G
21.	8.	8.	3.	0.	0.	2.	1.	1.	0.	0.	0.
R	CR	SHR	CHR	VR	MR	C	CAC	SIC	FEC	OC	OC
39.	22.	4.	6.	4.	3.	3.	3.	0.	0.	0.	0.
M	P	0									
31.	1.	4.									

Q + F + R RECALCULATED TO 100 PERCENT

34. PERCENT QTZ
2. PERCENT FELDSPAR
64. PERCENT RK FRAGS

THIS SAMPLE IS A LITHARENITE

SR + VR + MR RECALCULATED TO 100 PERCENT

82. PERCENT SED RK FRAGS
10. PERCENT VOLCANIC RK FRAGS
8. PERCENT META RK FRAGS

THIS SAMPLE IS A SEDIMENTARY LITHARENITE

SHR + CR + CHR RECALCULATED TO 100 PERCENT

13. PERCENT SHALE RK FRAGS
69. PERCENT CARBONATE RK FRAGS
19. PERCENT CHERT RK FRAGS

THIS SAMPLE IS A CARBONATE LITHARENITE

136. SAMPLE NO. 100. TOTAL POINTS COUNTED

ORIGINAL DATA

	Q	STQ	SLUQ	STUQ	SCQ	CQ	CMQ	F	KF	PF	G
16.	6.	5.	3.	1.	0.	1.	0.	0.	0.	0.	0.
R	CR	SHR	CHR	VR	MR	C	CAC	SIC	FEC	OC	OC
39.	32.	4.	2.	0.	0.	21.	20.	0.	1.	0.	0.
M	P	0									
15.	5.	4.									

Q + F + R RECALCULATED TO 100 PERCENT

29. PERCENT QTZ
0. PERCENT FELDSPAR
71. PERCENT RK FRAGS

THIS SAMPLE IS A LITHARENITE

SR + VR + MR RECALCULATED TO 100 PERCENT

100. PERCENT SED RK FRAGS
0. PERCENT VOLCANIC RK FRAGS
0. PERCENT META RK FRAGS

THIS SAMPLE IS A SEDIMENTARY LITHARENITE

SHR + CR + CHR RECALCULATED TO 100 PERCENT

11. PERCENT SHALE RK FRAGS
84. PERCENT CARBONATE RK FRAGS
5. PERCENT CHERT RK FRAGS

THIS SAMPLE IS A CARBONATE LITHARENITE

137. SAMPLE NO. 100. TOTAL POINTS COUNTED

ORIGINAL DATA

Q	STQ	SLUQ	STUQ	SCQ	CQ	CMQ	F	KF	PF	G
23.	10.	5.	3.	0.	0.	5.	1.	0.	0.	1.
R	CR	SHR	CHR	VR	MR	C	CAC	SIC	FEC	OC
40.	29.	3.	4.	1.	3.	4.	4.	0.	0.	0.
M	P	O								
28.	4.	0.								

Q + F + R RECALCULATED TO 100 PERCENT

36. PERCENT QTZ
2. PERCENT FELDSPAR
63. PERCENT RK FRAGS

THIS SAMPLE IS A LITHARENITE

SR + VR + MR RECALCULATED TO 100 PERCENT

90. PERCENT SED RK FRAGS
2. PERCENT VOLCANIC RK FRAGS
7. PERCENT META RK FRAGS

THIS SAMPLE IS A SEDIMENTARY LITHARENITE

SHR + CR + CHR RECALCULATED TO 100 PERCENT

8. PERCENT SHALE RK FRAGS
81. PERCENT CARBONATE RK FRAGS
11. PERCENT CHERT RK FRAGS

THIS SAMPLE IS A CARBONATE LITHARENITE

138. SAMPLE NO. 100. TOTAL POINTS COUNTED

ORIGINAL DATA

Q	STQ	SLUQ	STUQ	SCQ	CQ	CMQ	F	KF	PF	G
22.	10.	9.	2.	0.	0.	2.	0.	0.	0.	0.
R	CR	SHR	CHR	VR	MR	C	CAC	SIC	FEC	OC
25.	19.	5.	0.	0.	0.	19.	14.	2.	2.	1.
M	P	O								
24.	6.	4.								

Q + F + R RECALCULATED TO 100 PERCENT

47. PERCENT QTZ
0. PERCENT FELDSPAR
53. PERCENT RK FRAGS

THIS SAMPLE IS A LITHARENITE

SR + VR + MR RECALCULATED TO 100 PERCENT

100. PERCENT SED RK FRAGS
0. PERCENT VOLCANIC RK FRAGS
0. PERCENT META RK FRAGS

THIS SAMPLE IS A SEDIMENTARY LITHARENITE

SHR + CR + CHR RECALCULATED TO 100 PERCENT

21. PERCENT SHALE RK FRAGS
79. PERCENT CARBONATE RK FRAGS
0. PERCENT CHERT RK FRAGS

THIS SAMPLE IS A CARBONATE LITHARENITE

139. SAMPLE NO. 100. TOTAL POINTS COUNTED

ORIGINAL DATA

	Q	STQ	SLUQ	STUQ	SCQ	CQ	CMQ	F	KF	PF	G
14.	6.	4.	2.	0.	0.	2.	0.	0.	0.	0.	0.
R	CR	SHR	CHR	VR	MR	C	CAC	SIC	FEC	OC	
23.	16.	3.	2.	2.	0.	8.	7.	1.	0.	0.	
M	P	O									
46.	2.	7.									

Q + F + R RECALCULATED TO 100 PERCENT

38. PERCENT QTZ
0. PERCENT FELDSPAR
62. PERCENT RK FRAGS

THIS SAMPLE IS A LITHARENITE

SR + VR + MR RECALCULATED TO 100 PERCENT

91. PERCENT SED RK FRAGS
9. PERCENT VOLCANIC RK FRAGS
0. PERCENT META RK FRAGS

THIS SAMPLE IS A SEDIMENTARY LITHARENITE

SHR + CR + CHR RECALCULATED TO 100 PERCENT

14. PERCENT SHALE RK FRAGS
76. PERCENT CARBONATE RK FRAGS
10. PERCENT CHERT RK FRAGS

THIS SAMPLE IS A CARBONATE LITHARENITE

140. SAMPLE NO. 100. TOTAL POINTS CCUNTED

ORIGINAL DATA

	Q	STQ	SLUQ	STUQ	SCQ	CQ	CMQ	F	KF	PF	G
25.	9.	7.	5.	0.	1.	3.	0.	0.	0.	0.	0.
-R-	CR	SHR	CHR	VR	MR	C	CAC	SIC	FEC	OC	
28.	17.	2.	3.	4.	2.	7.	6.	0.	1.	0.	
M	P	O									
35.	3.	2.									

Q + F + R RECALCULATED TO 100 PERCENT

47. PERCENT QTZ
0. PERCENT FELDSPAR
53. PERCENT RK FRAGS

THIS SAMPLE IS A LITHARENITE

SR + VR + MR RECALCULATED TO 100 PERCENT

79. PERCENT SED RK FRAGS
14. PERCENT VOLCANIC RK FRAGS
7. PERCENT META RK FRAGS

THIS SAMPLE IS A SFDIMENTARY LITHARENITE

SHR + CR + CHR RECALCULATED TO 100 PERCENT

9. PERCENT SHALE RK FRAGS
77. PERCENT CARBONATE RK FRAGS
14. PERCENT CHERT RK FRAGS

THIS SAMPLE IS A CARBONATE LITHARENITE

141. SAMPLE NO.	100. TOTAL POINTS COUNTED									
ORIGINAL DATA										
Q	STQ	SLUQ	STUQ	SCQ	CQ	CMQ	F	KF	PF	G
20.	9.	8.	2.	0.	0.	1.	2.	1.	0.	1.
R	CR	SHR	CHR	VR	MR	C	CAC	SIC	FEC	DC
47.	26.	7.	3.	10.	1.	23.	23.	0.	0.	0.
M	P	O								
5.	1.	2.								

Q + F + R RECALCULATED TO 100 PERCENT

29. PERCENT QTZ
3. PERCENT FELDSPAR
68. PERCENT RK FRAGS

THIS SAMPLE IS A LITHARENITE

SR + VR + MR RECALCULATED TO 100 PERCENT

77. PERCENT SED RK FRAGS
21. PERCENT VOLCANIC RK FRAGS
2. PERCENT META RK FRAGS

THIS SAMPLE IS A SEDIMENTARY LITHARENITE

SHR + CR + CHR RECALCULATED TO 100 PERCENT

19. PERCENT SHALE RK FRAGS
72. PERCENT CARBONATE RK FRAGS
8. PERCENT CHERT RK FRAGS

THIS SAMPLE IS A CARBONATE LITHARENITE

142. SAMPLE NO.	100. TOTAL POINTS COUNTED									
ORIGINAL DATA										
Q	STQ	SLUQ	STUQ	SCQ	CQ	CMQ	F	KF	PF	G
25.	13.	3.	2.	0.	3.	4.	0.	0.	0.	0.
R	CR	SHR	CHR	VR	MR	C	CAC	SIC	FEC	DC
44.	24.	7.	10.	2.	1.	19.	19.	0.	0.	0.
M	P	O								
10.	0.	2.								

Q + F + R RECALCULATED TO 100 PERCENT

36. PERCENT QTZ
0. PERCENT FELDSPAR
64. PERCENT RK FRAGS

THIS SAMPLE IS A LITHARENITE

SR + VR + MR RECALCULATED TO 100 PERCENT

93. PERCENT SED RK FRAGS
5. PERCENT VOLCANIC RK FRAGS
2. PERCENT META RK FRAGS

THIS SAMPLE IS A SEDIMENTARY LITHARENITE

SHR + CR + CHR RECALCULATED TO 100 PERCENT

17. PERCENT SHALE RK FRAGS
59. PERCENT CARBONATE RK FRAGS
24. PERCENT CHERT RK FRAGS

THIS SAMPLE IS A CARBONATE LITHARENITE

143. SAMPLE NO. 100. TOTAL POINTS COUNTED

ORIGINAL DATA

Q	STQ	SLUQ	STUQ	SCQ	CQ	CMQ	F	KF	PF	G
23.	1.	12.	4.	0.	1.	5.	2.	2.	0.	0.
R	CR	SHR	CHR	VR	MR	C	CAC	SIC	FEC	OC
19.	7.	6.	4.	2.	0.	3.	0.	0.	0.	0.
M	P	O								
39.	10.	4.								

Q + F + R RECALCULATED TO 100 PERCENT

52. PERCENT QTZ
5. PERCENT FELDSPAR
43. PERCENT RK FRAGS

THIS SAMPLE IS A LITHARENITE

SR + VR + MR RECALCULATED TO 100 PERCENT

89. PERCENT SED RK FRAGS
11. PERCENT VOLCANIC RK FRAGS
0. PERCENT META RK FRAGS

THIS SAMPLE IS A SEDIMENTARY LITHARENITE

SHR + CR + CHR RECALCULATED TO 100 PERCENT

35. PERCENT SHALE RK FRAGS
41. PERCENT CARBONATE RK FRAGS
24. PERCENT CHERT RK FRAGS

THIS SAMPLE IS A CARBONATE LITHARENITE

144. SAMPLE NO. 100. TOTAL POINTS COUNTED

ORIGINAL DATA

Q	STQ	SLUQ	STUQ	SCQ	CQ	CMQ	F	KF	PF	G
17.	6.	6.	2.	0.	0.	3.	3.	1.	1.	1.
R	CR	SHR	CHR	VR	MR	C	CAC	SIC	FEC	OC
37.	30.	0.	4.	3.	0.	7.	5.	0.	2.	0.
M	P	O								
31.	0.	5.								

Q + F + R RECALCULATED TO 100 PERCENT

30. PERCENT QTZ
5. PERCENT FELDSPAR
65. PERCENT RK FRAGS

THIS SAMPLE IS A LITHARENITE

SR + VR + MR RECALCULATED TO 100 PERCENT

92. PERCENT SED RK FRAGS
8. PERCENT VOLCANIC RK FRAGS
0. PERCENT META RK FRAGS

THIS SAMPLE IS A SEDIMENTARY LITHARENITE

SHR + CR + CHR RECALCULATED TO 100 PERCENT

0. PERCENT SHALE RK FRAGS
88. PERCENT CARBONATE RK FRAGS
12. PERCENT CHERT RK FRAGS

THIS SAMPLE IS A CARBONATE LITHARENITE

146. SAMPLE NO. 100. TOTAL POINTS COUNTED

ORIGINAL DATA

	Q	STQ	SLUQ	STUQ	SCQ	CQ	CMQ	F	KF	PF	G
13.	5.	4.	2.	0.	0.	2.	0.	0.	0.	0.	0.
	R	CR	SHR	CHR	VR	MR	C	CAC	SIC	FEC	OC
38.	29.	7.	4.	2.	0.	21.	21.	0.	0.	0.	0.
	M	P	O								
24.	0.	4.									

Q + F + R RECALCULATED TO 100 PERCENT

25. PERCENT QTZ
0. PERCENT FELDSPAR
75. PERCENT RK FRAGS

THIS SAMPLE IS A LITHARENITE

SR + VR + MR RECALCULATED TO 100 PERCENT

95. PERCENT SED RK FRAGS
5. PERCENT VOLCANIC RK FRAGS
0. PERCENT META RK FRAGS

THIS SAMPLE IS A SEDIMENTARY LITHARENITE

SHR + CR + CHR RECALCULATED TO 100 PERCENT

8. PERCENT SHALE RK FRAGS
81. PERCENT CARBONATE RK FRAGS
11. PERCENT CHERT RK FRAGS

THIS SAMPLE IS A CARBONATE LITHARENITE

147. SAMPLE NO. 100. TOTAL POINTS COUNTED

ORIGINAL DATA

	Q	STQ	SLUQ	STUQ	SCQ	CQ	CMQ	F	KF	PF	G
18.	6.	5.	3.	0.	0.	4.	2.	2.	0.	0.	0.
	R	CR	SHR	CHR	VR	MR	C	CAC	SIC	FEC	OC
39.	16.	7.	8.	6.	2.	3.	3.	0.	0.	0.	0.
	M	P	O								
24.	13.	1.									

Q + F + R RECALCULATED TO 100 PERCENT

31. PERCENT QTZ
3. PERCENT FELDSPAR
66. PERCENT RK FRAGS

THIS SAMPLE IS A LITHARENITE

SR + VR + MR RECALCULATED TO 100 PERCENT

79. PERCENT SED RK FRAGS
15. PERCENT VOLCANIC RK FRAGS
5. PERCENT META RK FRAGS

THIS SAMPLE IS A SEDIMENTARY LITHARENITE

SHR + CR + CHR RECALCULATED TO 100 PERCENT

23. PERCENT SHALE RK FRAGS
52. PERCENT CARBONATE RK FRAGS
26. PERCENT CHERT RK FRAGS

THIS SAMPLE IS A CARBONATE LITHARENITE

148. SAMPLE NO. 100. TOTAL POINTS COUNTED

ORIGINAL DATA

Q	STQ	SLUQ	STUQ	SCQ	CQ	CMQ	F	KF	PF	G
18.	8.	8.	1.	0.	0.	1.	2.	1.	0.	1.
R	CR	SHR	CHR	VR	MR	C	CAC	SIC	FEC	OC
45.	33.	1.	4.	7.	0.	3.	2.	1.	0.	0.
M	P	Q								
25.	7.	0.								

Q + F + R RECALCULATED TO 100 PERCENT

28. PERCENT QTZ
3. PERCENT FELDSPAR
69. PERCENT RK FRAGS

THIS SAMPLE IS A LITHARENITE

SR + VR + MR RECALCULATED TO 100 PERCENT

84. PERCENT SED RK FRAGS
16. PERCENT VOLCANIC RK FRAGS
0. PERCENT META RK FRAGS

THIS SAMPLE IS A SEDIMENTARY LITHARENITE

SHR + CR + CHR RECALCULATED TO 100 PERCENT

3. PERCENT SHALE RK FRAGS
87. PERCENT CARBONATE RK FRAGS
11. PERCENT CHERT RK FRAGS

THIS SAMPLE IS A CARBONATE LITHARENITE

149. SAMPLE NO. 100. TOTAL POINTS COUNTED

ORIGINAL DATA

Q	STQ	SLUQ	STUQ	SCQ	CQ	CMQ	F	KF	PF	G
24.	8.	12.	1.	0.	2.	1.	1.	0.	0.	1.
R	CR	SHR	CHR	VR	MR	C	CAC	SIC	FEC	OC
28.	18.	5.	1.	4.	0.	2.	1.	0.	1.	0.
M	P	Q								
39.	4.	2.								

Q + F + R RECALCULATED TO 100 PERCENT

45. PERCENT QTZ
2. PERCENT FELDSPAR
53. PERCENT RK FRAGS

THIS SAMPLE IS A LITHARENITE

SR + VR + MR RECALCULATED TO 100 PERCENT

86. PERCENT SED RK FRAGS
14. PERCENT VOLCANIC RK FRAGS
0. PERCENT META RK FRAGS

THIS SAMPLE IS A SEDIMENTARY LITHARENITE

SHR + CR + CHR RECALCULATED TO 100 PERCENT

21. PERCENT SHALE RK FRAGS
75. PERCENT CARBONATE RK FRAGS
4. PERCENT CHERT RK FRAGS

THIS SAMPLE IS A CARBONATE LITHARENITE

150. SAMPLE NO.	100. TOTAL						POINTS COUNTED			
ORIGINAL DATA										
Q	STQ	SLUQ	STUQ	SCQ	CQ	CMQ	F	KF	PF	G
18.	14.	3.	0.	0.	0.	1.	1.	0.	1.	0.
R	CR	SHR	CHR	VR	MR	C	CAC	SIC	FEC	DC
37.	32.	1.	2.	2.	0.	17.	16.	0.	1.	0.
M	P	0								
26.	1.	0.								

Q + F + R RECALCULATED TO 100 PERCENT

32. PERCENT QTZ
2. PERCENT FELDSPAR
66. PERCENT RK FRAGS

THIS SAMPLE IS A LITHARENITE

SR + VR + MR RECALCULATED TO 100 PERCENT

95. PERCENT SED RK FRAGS
5. PERCENT VOLCANIC RK FRAGS
0. PERCENT META RK FRAGS

THIS SAMPLE IS A SEDIMENTARY LITHARENITE

SHR + CR + CHR RECALCULATED TO 100 PERCENT

3. PERCENT SHALE RK FRAGS
91. PERCENT CARBONATE RK FRAGS
6. PERCENT CHERT RK FRAGS

THIS SAMPLE IS A CARBONATE LITHARENITE

151. SAMPLE NO.	101. TOTAL						POINTS COUNTED			
ORIGINAL DATA										
Q	STQ	SLUQ	STUQ	SCQ	CQ	CMQ	F	KF	PF	G
19.	7.	3.	3.	0.	0.	6.	2.	1.	0.	1.
R	CR	SHR	CHR	VR	MR	C	CAC	SIC	FEC	DC
41.	28.	2.	2.	6.	3.	5.	5.	0.	0.	0.
M	P	0								
29.	1.	4.								

Q + F + R RECALCULATED TO 100 PERCENT

31. PERCENT QTZ
3. PERCENT FELDSPAR
66. PERCENT RK FRAGS

THIS SAMPLE IS A LITHARENITE

SR + VR + MR RECALCULATED TO 100 PERCENT

78. PERCENT SED RK FRAGS
15. PERCENT VOLCANIC RK FRAGS
7. PERCENT META RK FRAGS

THIS SAMPLE IS A SEDIMENTARY LITHARENITE

SHR + CR + CHR RECALCULATED TO 100 PERCENT

6. PERCENT SHALE RK FRAGS
88. PERCENT CARBONATE RK FRAGS
6. PERCENT CHERT RK FRAGS

THIS SAMPLE IS A CARBONATE LITHARENITE

152. SAMPLE NO. 125. TOTAL POINTS COUNTED

ORIGINAL DATA

Q	STQ	SLUQ	STUQ	SCQ	CQ	CMQ	F	KF	PF	G
30.	10.	7.	3.	3.	0.	7.	1.	1.	0.	0.
R	CR	SHR	CHR	VR	MR	C	CAC	SIC	FEC	OC
31.	17.	2.	4.	7.	1.	3.	0.	0.	3.	0.
M	P	O								
29.	23.	8.								

Q + F + R RECALCULATED TO 100 PERCENT

48. PERCENT QTZ
2. PERCENT FELDSPAR
50. PERCENT RK FRAGS

THIS SAMPLE IS A LITHARENITE

SR + VR + MR RECALCULATED TO 100 PERCENT

74. PERCENT SED RK FRAGS
23. PERCENT VOLCANIC RK FRAGS
3. PERCENT META RK FRAGS

THIS SAMPLE IS A SEDIMENTARY LITHARENITE

SHR + CR + CHR RECALCULATED TO 100 PERCENT

9. PERCENT SHALE RK FRAGS
74. PERCENT CARBONATE RK FRAGS
17. PERCENT CHERT RK FRAGS

THIS SAMPLE IS A CARBONATE LITHARENITE

153. SAMPLE NO. 100. TOTAL POINTS COUNTED

ORIGINAL DATA

Q	STQ	SLUQ	STUQ	SCQ	CQ	CMQ	F	KF	PF	G
19.	4.	10.	1.	0.	0.	4.	4.	1.	1.	2.
R	CR	SHR	CHR	VR	MR	C	CAC	SIC	FEC	OC
28.	0.	8.	7.	10.	3.	1.	0.	0.	0.	0.
M	P	O								
24.	18.	6.								

Q + F + R RECALCULATED TO 100 PERCENT

37. PERCENT QTZ
8. PERCENT FELDSPAR
55. PERCENT RK FRAGS

THIS SAMPLE IS A LITHARENITE

SR + VR + MR RECALCULATED TO 100 PERCENT

54. PERCENT SED RK FRAGS
36. PERCENT VOLCANIC RK FRAGS
11. PERCENT META RK FRAGS

THIS SAMPLE IS A SEDIMENTARY LITHARENITE

SHR + CR + CHR RECALCULATED TO 100 PERCENT

53. PERCENT SHALE RK FRAGS
0. PERCENT CARBONATE RK FRAGS
47. PERCENT CHERT RK FRAGS

THIS SAMPLE IS A SHALE LITHARENITE

154. SAMPLE NO.	100. TOTAL POINTS COUNTED									
ORIGINAL DATA										
Q	STQ	SLUQ	STUQ	SCQ	CQ	CMQ	F	KF	PF	G
20.	2.	9.	3.	0.	0.	6.	6.	4.	1.	1.
R	CR	SHR	CHR	VR	MR	C	CAC	SIC	FEC	DC
25.	11.	3.	4.	6.	1.	32.	30.	1.	1.	0.
M	P	O								
7.	5.	5.								

Q + F + R RECALCULATED TO 100 PERCENT

39. PERCENT QTZ
12. PERCENT FELDSPAR
49. PERCENT RK FRAGS

THIS SAMPLE IS A LITHARENITE

SR + VR + MR RECALCULATED TO 100 PERCENT

72. PERCENT SED RK FRAGS
24. PERCENT VOLCANIC RK FRAGS
4. PERCENT META RK FRAGS

THIS SAMPLE IS A SEDIMENTARY LITHARENITE

SHR + CR + CHR RECALCULATED TO 100 PERCENT

17. PERCENT SHALE RK FRAGS
61. PERCENT CARBONATE RK FRAGS
22. PERCENT CHERT RK FRAGS

THIS SAMPLE IS A CARBONATE LITHARENITE

155. SAMPLE NO.	100. TOTAL POINTS COUNTED									
ORIGINAL DATA										
Q	STQ	SLUQ	STUQ	SCQ	CQ	CMQ	F	KF	PF	G
21.	7.	12.	0.	0.	0.	2.	0.	0.	0.	0.
R	CR	SHR	CHR	VR	MR	C	CAC	SIC	FEC	DC
18.	8.	0.	7.	3.	0.	41.	39.	1.	1.	0.
M	P	O								
17.	1.	2.								

Q + F + R RECALCULATED TO 100 PERCENT

54. PERCENT QTZ
0. PERCENT FELDSPAR
46. PERCENT RK FRAGS

THIS SAMPLE IS A LITHARENITE

SR + VR + MR RECALCULATED TO 100 PERCENT

83. PERCENT SED RK FRAGS
17. PERCENT VOLCANIC RK FRAGS
0. PERCENT META RK FRAGS

THIS SAMPLE IS A SEDIMENTARY LITHARENITE

SHR + CR + CHR RECALCULATED TO 100 PERCENT

0. PERCENT SHALE RK FRAGS
53. PERCENT CARBONATE RK FRAGS
47. PERCENT CHERT RK FRAGS

THIS SAMPLE IS A CARBONATE LITHARENITE

156. SAMPLE NO. 80. TOTAL POINTS COUNTED

ORIGINAL DATA

Q	STQ	SLUQ	STUQ	SCQ	CQ	CMQ	F	KF	PF	G
19.	6.	5.	3.	0.	1.	4.	6.	3.	2.	1.
R	CR	SHR	CHR	VR	MR	C	CAC	SIC	FEC	OC
27.	8.	2.	2.	14.	1.	17.	0.	1.	16.	21.
M	P	O								
7.	4.	0.								

Q + F + R RECALCULATED TO 100 PERCENT

37. PERCENT QTZ
12. PERCENT FELDSPAR
52. PERCENT RK FRAGS

THIS SAMPLE IS A LITHARENITE

SR + VR + MR RECALCULATED TO 100 PERCENT

44. PERCENT SED RK FRAGS
52. PERCENT VOLCANIC RK FRAGS
4. PERCENT META RK FRAGS

THIS SAMPLE IS A VOLCANIC LITHARENITE

157. SAMPLE NO. 100. TOTAL POINTS COUNTED

ORIGINAL DATA

Q	STQ	SLUQ	STUQ	SCQ	CQ	CMQ	F	KF	PF	G
26.	9.	9.	2.	2.	0.	4.	0.	0.	0.	0.
R	CR	SHR	CHR	VR	MR	C	CAC	SIC	FEC	OC
27.	20.	1.	0.	6.	0.	24.	23.	0.	0.	1.
M	P	O								
18.	2.	3.								

Q + F + R RECALCULATED TO 100 PERCENT

49. PERCENT QTZ
0. PERCENT FELDSPAR
51. PERCENT RK FRAGS

THIS SAMPLE IS A LITHARENITE

SR + VR + MR RECALCULATED TO 100 PERCENT

78. PERCENT SED RK FRAGS
22. PERCENT VOLCANIC RK FRAGS
0. PERCENT META RK FRAGS

THIS SAMPLE IS A SEDIMENTARY LITHARENITE

SHR + CR + CHR RECALCULATED TO 100 PERCENT

5. PERCENT SHALE RK FRAGS
95. PERCENT CARBONATE RK FRAGS
0. PERCENT CHERT RK FRAGS

THIS SAMPLE IS A CARBONATE LITHARENITE

158. SAMPLE NO.	100. TOTAL POINTS COUNTED									
ORIGINAL DATA										
Q	STQ	SLUQ	STUQ	SCQ	CQ	CMQ	F	KF	PF	G
26.	3.	10.	2.	2.	0.	9.	0.	0.	0.	0.
R	CR	SHR	CHR	VR	MR	C	CAC	SIC	FEC	OC
28.	12.	2.	2.	10.	2.	15.	1.	0.	9.	4.
M	P	0								
16.	10.	5.								

Q + F + R RECALCULATED TO 100 PERCENT

48. PERCENT QTZ
0. PERCENT FELDSPAR
52. PERCENT RK FRAGS

THIS SAMPLE IS A LITHARENITE

SR + VR + MR RECALCULATED TO 100 PERCENT

57. PERCENT SED RK FRAGS
30. PERCENT VOLCANIC RK FRAGS
7. PERCENT META RK FRAGS

THIS SAMPLE IS A SEDIMENTARY LITHARENITE

SHR + CR + CHR RECALCULATED TO 100 PERCENT

13. PERCENT SHALE RK FRAGS
75. PERCENT CARBONATE RK FRAGS
13. PERCENT CHERT RK FRAGS

THIS SAMPLE IS A CARBONATE LITHARENITE

159. SAMPLE NO.	100. TOTAL POINTS CCUNTED									
ORIGINAL DATA										
Q	STQ	SLUQ	STUQ	SCQ	CQ	CMQ	F	KF	PF	G
17.	8.	3.	1.	0.	0.	5.	5.	2.	3.	0.
R	CR	SHR	CHR	VR	MR	C	CAC	SIC	FEC	OC
37.	14.	3.	3.	15.	2.	11.	11.	0.	0.	0.
M	P	0								
28.	0.	2.								

Q + F + R RECALCULATED TO 100 PERCENT

29. PERCENT QTZ
8. PERCENT FELDSPAR
63. PERCENT RK FRAGS

THIS SAMPLE IS A LITHARENITE

SR + VR + MR RECALCULATED TO 100 PERCENT

54. PERCENT SED RK FRAGS
41. PERCENT VOLCANIC RK FRAGS
5. PERCENT META RK FRAGS

THIS SAMPLE IS A SEDIMENTARY LITHARENITE

SHR + CR + CHR RECALCULATED TO 100 PERCENT

15. PERCENT SHALE RK FRAGS
70. PERCENT CARBONATE RK FRAGS
15. PERCENT CHERT RK FRAGS

THIS SAMPLE IS A CARBONATE LITHARENITE

201. SAMPLE NO. 140. TOTAL POINTS COUNTED

ORIGINAL DATA

Q	STQ	SLUQ	STUQ	SCQ	CO	CMQ	F	KF	PF	G
27.	3.	10.	5.	2.	0.	7.	4.	2.	0.	2.
R	CR	SHR	CHR	VR	MR	C	CAC	SIC	FEC	OC
36.	3.	4.	4.	25.	0.	8.	0.	0.	1.	7.
M	P	O								
37.	21.	7.								

Q + F + R RECALCULATED TO 100 PERCENT

40. PERCENT QTZ
6. PERCENT FELDSPAR
54. PERCENT RK FRAGS

THIS SAMPLE IS A LITHARENITE

SR + VR + MR RECALCULATED TO 100 PERCENT

31. PERCENT SED RK FRAGS
69. PERCENT VOLCANIC RK FRAGS
0. PERCENT META RK FRAGS

THIS SAMPLE IS A VOLCANIC LITHARENITE

202. SAMPLE NO. 98. TOTAL POINTS COUNTED

ORIGINAL DATA

Q	STQ	SLUQ	STUQ	SCQ	CO	CMQ	F	KF	PF	G
28.	3.	12.	1.	2.	0.	10.	3.	5.	0.	1.
R	CR	SHR	CHR	VR	MR	C	CAC	SIC	FEC	OC
38.	7.	5.	5.	2.	0.	4.	0.	0.	2.	2.
M	P	O								
14.	11.	0.								

Q + F + R RECALCULATED TO 100 PERCENT

41. PERCENT QTZ
4. PERCENT FELDSPAR
55. PERCENT RK FRAGS

THIS SAMPLE IS A LITHARENITE

SR + VR + MR RECALCULATED TO 100 PERCENT

89. PERCENT SED RK FRAGS
11. PERCENT VOLCANIC RK FRAGS
0. PERCENT META RK FRAGS

THIS SAMPLE IS A SEDIMENTARY LITHARENITE

SHR + CR + CHR RECALCULATED TO 100 PERCENT

29. PERCENT SHALE RK FRAGS
41. PERCENT CARBONATE RK FRAGS
29. PERCENT CHERT RK FRAGS

THIS SAMPLE IS A CARBONATE LITHARENITE

204. SAMPLE NO. 80. TOTAL POINTS COUNTED

ORIGINAL DATA

Q	STQ	SLUQ	STUQ	SCQ	CQ	CMQ	F	KF	PF	G
34.	3.	9.	4.	5.	0.	13.	12.	6.	2.	4.
R	CR	SHR	CHR	VR	MR	C	CAC	SIC	FEC	OC
31.	0.	3.	2.	30.	16.	0.	0.	0.	0.	0.
M	P	O								
0.	0.	3.								

Q + F + R RECALCULATED TO 100 PERCENT

44. PERCENT QTZ
16. PERCENT FELDSPAR
40. PERCENT RK FRAGS

THIS SAMPLE IS A FELDSPATHIC LITHARENITE

SR + VR + MR RECALCULATED TO 100 PERCENT

10. PERCENT SED RK FRAGS
59. PERCENT VOLCANIC RK FRAGS
31. PERCENT META RK FRAGS

THIS SAMPLE IS A VOLCANIC LITHARENITE

206. SAMPLE NO. 100. TOTAL POINTS COUNTED

ORIGINAL DATA

Q	STQ	SLUQ	STUQ	SCQ	CQ	CMQ	F	KF	PF	G
37.	3.	9.	1.	4.	0.	20.	6.	2.	2.	2.
R	CR	SHR	CHR	VR	MR	C	CAC	SIC	FEC	OC
54.	0.	4.	8.	29.	13.	0.	0.	0.	0.	0.
M	P	O								
0.	0.	3.								

Q + F + R RECALCULATED TO 100 PERCENT

38. PERCENT QTZ
6. PERCENT FELDSPAR
56. PERCENT RK FRAGS

THIS SAMPLE IS A LITHARENITE

SR + VR + MR RECALCULATED TO 100 PERCENT

22. PERCENT SED RK FRAGS
54. PERCENT VOLCANIC RK FRAGS
24. PERCENT META RK FRAGS

THIS SAMPLE IS A VOLCANIC LITHARENITE

207. SAMPLE NO. 130. TOTAL POINTS COUNTED

ORIGINAL DATA

	Q	STQ	SLUQ	STUQ	SCQ	CQ	CMQ	F	KF	PF	G
27.	3.	11.	5.	1.	0.	7.	2.	2.	0.	0.	0.
	R	CR	SHR	CHR	VR	MR	C	CAC	SIC	FEC	OC
40.	13.	4.	2.	21.	0.	3.	0.	0.	0.	0.	3.
	M	P									
34.	16.	8.									

Q + F + R RECALCULATED TO 100 PERCENT

39. PERCENT QTZ
3. PERCENT FELDSPAR
58. PERCENT RK FRAGS

THIS SAMPLE IS A LITHARENITE

SR + VR + MR RECALCULATED TO 100 PERCENT

47. PERCENT SED RK FRAGS
52. PERCENT VOLCANIC RK FRAGS
0. PERCENT META RK FRAGS

THIS SAMPLE IS A VOLCANIC LITHARENITE

208. SAMPLE NO. 97. TOTAL POINTS COUNTED

ORIGINAL DATA

	Q	STQ	SLUQ	STUQ	SCQ	CQ	CMQ	F	KF	PF	G
37.	11.	11.	2.	3.	0.	10.	0.	0.	0.	0.	0.
	R	CR	SHR	CHR	VR	MR	C	CAC	SIC	FEC	OC
56.	17.	3.	5.	25.	6.	0.	0.	0.	0.	0.	0.
	M	P									
0.	0.	4.									

Q + F + R RECALCULATED TO 100 PERCENT

40. PERCENT QTZ
0. PERCENT FELDSPAR
60. PERCENT RK FRAGS

THIS SAMPLE IS A LITHARENITE

SR + VR + MR RECALCULATED TO 100 PERCENT

45. PERCENT SED RK FRAGS
45. PERCENT VOLCANIC RK FRAGS
11. PERCENT META RK FRAGS

THIS SAMPLE IS A VOLCANIC LITHARENITE

209. SAMPLF NO.		150. TOTAL					POINTS CCUNTED				
ORIGINAL DATA											
Q	STQ	SLUQ	STUQ	SCQ	CQ	CMQ	F	KF	PF	G	
23.	11.	10.	0.	0.	0.	2.	0.	0.	0.	0.	
R	CR	SHR	CHR	VR	MR	C	CAC	SIC	FEC	DC	
35.	19.	1.	0.	13.	2.	49.	49.	0.	0.	0.	
M	P	O									
16.	24.	3.									

Q + F + R RECALCULATED TO 100 PERCENT

40. PERCENT QTZ
0. PERCENT FELDSPAR
60. PERCENT RK FRAGS

THIS SAMPLE IS A LITHARENITE

SR + VR + MR RECALCULATED TO 100 PERCENT

57. PERCENT SED RK FRAGS
37. PERCENT VOLCANIC RK FRAGS
6. PERCENT META RK FRAGS

THIS SAMPLE IS A SEDIMENTARY LITHARENITE

SHR + CR + CHR RECALCULATED TO 100 PERCENT

5. PERCENT SHALE RK FRAGS
95. PERCENT CARBONATE RK FRAGS
0. PERCENT CHERT RK FRAGS

THIS SAMPLE IS A CARBONATE LITHARENITE

210. SAMPLE NO.		125. TOTAL					POINTS CCUNTED				
ORIGINAL DATA											
Q	STQ	SLUQ	STUQ	SCQ	CQ	CMQ	F	KF	PF	G	
20.	5.	6.	3.	0.	0.	6.	9.	4.	1.	4.	
R	CR	SHR	CHR	VR	MR	C	CAC	SIC	FEC	DC	
33.	3.	2.	5.	16.	7.	43.	39.	0.	3.	1.	
M	P	O									
14.	3.	3.									

Q + F + R RECALCULATED TO 100 PERCENT

32. PERCENT QTZ
15. PERCENT FELDSPAR
53. PERCENT RK FRAGS

THIS SAMPLE IS A LITHARENITE

SR + VR + MR RECALCULATED TO 100 PERCENT

30. PERCENT SED RK FRAGS
48. PERCENT VOLCANIC RK FRAGS
21. PERCENT META RK FRAGS

THIS SAMPLE IS A VOLCANIC LITHARENITE

211. SAMPLE NO. 100. TOTAL POINTS COUNTED

ORIGINAL DATA

Q	STQ	SLUQ	STUQ	SCQ	CQ	CMQ	F	KF	PF	G
26.	3.	14.	3.	2.	0.	4.	7.	2.	2.	3.
R	CR	SHR	CHR	VR	MR	C	CAC	SIC	FEC	OC
22.	1.	3.	1.	17.	0.	2.	0.	0.	1.	1.
M	P	O								
23.	18.	2.								

Q + F + R RECALCULATED TO 100 PERCENT

47. PERCENT QTZ
13. PERCENT FELDSPAR
40. PERCENT RK FRAGS

THIS SAMPLE IS A FELDSPATHIC LITHARENITE

SR + VR + MR RECALCULATED TO 100 PERCENT

23. PERCENT SED RK FRAGS
77. PERCENT VOLCANIC RK FRAGS
0. PERCENT META RK FRAGS

THIS SAMPLE IS A VOLCANIC LITHARENITE

216. SAMPLE NO. 119. TOTAL POINTS COUNTED

ORIGINAL DATA

Q	STQ	SLUQ	STUQ	SCQ	CQ	CMQ	F	KF	PF	G
19.	4.	10.	3.	0.	0.	0.	20.	10.	0.	1.
R	CR	SHR	CHR	VR	MR	C	CAC	SIC	FEC	OC
28.	1.	1.	5.	16.	5.	1.	0.	0.	1.	0.
M	P	O								
23.	26.	2.								

Q + F + R RECALCULATED TO 100 PERCENT

28. PERCENT QTZ
30. PERCENT FELDSPAR
42. PERCENT RK FRAGS

THIS SAMPLE IS A FELDSPATHIC LITHARENITE

SR + VR + MR RECALCULATED TO 100 PERCENT

25. PERCENT SED RK FRAGS
57. PERCENT VOLCANIC RK FRAGS
18. PERCENT META RK FRAGS

THIS SAMPLE IS A VOLCANIC LITHARENITE

217. SAMPLE NO.	141. TOTAL POINTS COUNTED									
ORIGINAL DATA										
Q	STQ	SLUQ	STUQ	SCQ	CQ	CMQ	F	KF	PF	G
17.	5.	3.	1.	3.	1.	4.	4.	1.	1.	2.
R	CR	SHR	CHR	VR	MR	C	CAC	SIC	FEC	OC
24.	7.	0.	2.	8.	7.	61.	59.	1.	1.	0.
M	P	0								
27.	2.	6.								

Q + F + R RECALCULATED TO 100 PERCENT

38. PERCENT QTZ
9. PERCENT FELDSPAR
53. PERCENT RK FRAGS

THIS SAMPLE IS A LITHARENITE

SR + VR + MR RECALCULATED TO 100 PERCENT

38. PERCENT SED RK FRAGS
33. PERCENT VOLCANIC RK FRAGS
29. PERCENT META RK FRAGS

THIS SAMPLE IS A SEDIMENTARY LITHARENITE

SHR + CR + CHR RECALCULATED TO 100 PERCENT

0. PERCENT SHALE RK FRAGS
78. PERCENT CARBONATE RK FRAGS
22. PERCENT CHERT RK FRAGS

THIS SAMPLE IS A CARBONATE LITHARENITE

220. SAMPLE NO.	100. TOTAL POINTS COUNTED									
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ORIGINAL DATA										
Q	STQ	SLUQ	STUQ	SCQ	CQ	CMQ	F	KF	PF	G
18.	1.	10.	4.	0.	0.	3.	0.	0.	0.	0.
R	CR	SHR	CHR	VR	MR	C	CAC	SIC	FEC	OC
36.	2.	1.	8.	22.	3.	5.	0.	1.	2.	2.
M	P	0								
27.	9.	5.								

Q + F + R RECALCULATED TO 100 PERCENT

33. PERCENT QTZ
0. PERCENT FELDSPAR
67. PERCENT RK FRAGS

THIS SAMPLE IS A LITHARENITE

SR + VR + MR RECALCULATED TO 100 PERCENT

31. PERCENT SED RK FRAGS
61. PERCENT VOLCANIC RK FRAGS
8. PERCENT META RK FRAGS

THIS SAMPLE IS A VOLCANIC LITHARENITE

221. SAMPLE NO. 101. TOTAL POINTS COUNTED

ORIGINAL DATA

	Q	STQ	SLUQ	STUQ	SCQ	CQ	CMQ	F	KF	PF	G
15.	3.	5.	1.	0.	0.	6.	1.	0.	0.	1.	
	R	CR	SHR	CHR	VR	MR	C	CAC	SIC	FEC	OC
19.	7.	1.	2.	8.	1.	30.	29.	1.	0.	0.	
	M	P									
33.	0.	3.									

Q + F + R RECALCULATED TO 100 PERCENT

43. PERCENT QTZ
3. PERCENT FELDSPAR
54. PERCENT RK FRAGS

THIS SAMPLE IS A LITHARENITE

SR + VR + MR RECALCULATED TO 100 PERCENT

53. PERCENT SED RK FRAGS
42. PERCENT VOLCANIC RK FRAGS
5. PERCENT META RK FRAGS

THIS SAMPLE IS A SEDIMENTARY LITHARENITE

SHR + CR + CHR RECALCULATED TO 100 PERCENT

10. PERCENT SHALE RK FRAGS
70. PERCENT CARBONATE RK FRAGS
20. PERCENT CHERT RK FRAGS

THIS SAMPLE IS A CARBONATE LITHARENITE

222. SAMPLE NO. 100. TOTAL POINTS COUNTED

ORIGINAL DATA

	Q	STQ	SLUQ	STUQ	SCQ	CQ	CMQ	F	KF	PF	G
10.	5.	1.	1.	0.	1.	2.	0.	0.	0.	0.	
	R	CR	SHR	CHR	VR	MR	C	CAC	SIC	FEC	OC
21.	8.	2.	2.	9.	0.	34.	34.	0.	0.	0.	
	M	P									
32.	3.	0.									

Q + F + R RECALCULATED TO 100 PERCENT

32. PERCENT QTZ
0. PERCENT FELDSPAR
68. PERCENT RK FRAGS

THIS SAMPLE IS A LITHARENITE

SR + VR + MR RECALCULATED TO 100 PERCENT

57. PERCENT SED RK FRAGS
43. PERCENT VOLCANIC RK FRAGS
0. PERCENT META RK FRAGS

THIS SAMPLE IS A SEDIMENTARY LITHARENITE

SHR + CR + CHR RECALCULATED TO 100 PERCENT

17. PERCENT SHALE RK FRAGS
67. PERCENT CARBONATE RK FRAGS
17. PERCENT CHERT RK FRAGS

THIS SAMPLE IS A CARBONATE LITHARENITE

223. SAMPLE NO.		100. TOTAL					POINTS COUNTED				
ORIGINAL DATA											
Q	STQ	SLUQ	STUQ	SCQ	CQ	CMQ	F	KF	PF	G	
14.	5.	2.	0.	0.	1.	6.	0.	0.	0.	0.	
R	CR	SHR	CHR	VR	MR	C	CAC	SIC	FEC	OC	
28.	14.	0.	4.	8.	2.	34.	33.	1.	0.	0.	
M	P	O									
20.	2.	2.									

Q + F + R RECALCULATED TO 100 PERCENT

- 33. PERCENT QTZ
- 0. PERCENT FELDSPAR
- 67. PERCENT RK FRAGS

THIS SAMPLE IS A LITHARENITE

SR + VR + MR RECALCULATED TO 100 PERCENT

- 64. PERCENT SED RK FRAGS
- 20. PERCENT VOLCANIC RK FRAGS
- 7. PERCENT META RK FRAGS

THIS SAMPLE IS A SEDIMENTARY LITHARENITE

SHR + CR + CHR RECALCULATED TO 100 PERCENT

- 0. PERCENT SHALE RK FRAGS
- 78. PERCENT CARBONATE RK FRAGS
- 22. PERCENT CHERT RK FRAGS

THIS SAMPLE IS A CARBONATE LITHARENITE

225. SAMPLE NO.		100. TOTAL					POINTS COUNTED				
ORIGINAL DATA											
Q	STQ	SLUQ	STUQ	SCQ	CQ	CMQ	F	KF	PF	G	
21.	5.	10.	3.	1.	1.	1.	1.	1.	0.	0.	
R	CR	SHR	CHR	VR	MR	C	CAC	SIC	FEC	OC	
35.	16.	1.	2.	12.	4.	5.	1.	0.	0.	4.	
M	P	O									
23.	12.	3.									

Q + F + R RECALCULATED TO 100 PERCENT

- 37. PERCENT QTZ
- 2. PERCENT FELDSPAR
- 61. PERCENT RK FRAGS

THIS SAMPLE IS A LITHARENITE

SR + VR + MR RECALCULATED TO 100 PERCENT

- 54. PERCENT SED RK FRAGS
- 34. PERCENT VOLCANIC RK FRAGS
- 11. PERCENT META RK FRAGS

THIS SAMPLE IS A SEDIMENTARY LITHARENITE

SHR + CR + CHR RECALCULATED TO 100 PERCENT

- 5. PERCENT SHALE RK FRAGS
- 84. PERCENT CARBONATE RK FRAGS
- 11. PERCENT CHERT RK FRAGS

THIS SAMPLE IS A CARBONATE LITHARENITE

226. SAMPLE NO. 100. TOTAL POINTS COUNTED

ORIGINAL DATA

	Q	STQ	SLUQ	STUQ	SCQ	CQ	CMQ	F	KF	PF	G
26.	5.	9.	3.	2.	2.	5.	6.	2.	1.	3.	
R	CR	SHR	CHR	VR	MR	C	CAC	SIC	FEC	DC	
31.	0.	4.	1.	26.	0.	2.	0.	0.	0.	2.	
M	P	O									
22.	12.	1.									

Q + F + R RECALCULATED TO 100 PERCENT

41. PERCENT QTZ
10. PERCENT FELDSPAR
49. PERCENT RK FRAGS

THIS SAMPLE IS A LITHARENITE

SR + VR + MR RECALCULATED TO 100 PERCENT

16. PERCENT SED RK FRAGS
84. PERCENT VOLCANIC RK FRAGS
0. PERCENT META RK FRAGS

THIS SAMPLE IS A VOLCANIC LITHARENITE

227. SAMPLE NO. 100. TOTAL POINTS COUNTED

ORIGINAL DATA

	Q	STQ	SLUQ	STUQ	SCQ	CQ	CMQ	F	KF	PF	G
15.	5.	6.	0.	0.	1.	3.	1.	0.	1.	0.	
R	CR	SHR	CHR	VR	MR	C	CAC	SIC	FEC	DC	
44.	0.	4.	1.	30.	9.	2.	0.	0.	0.	2.	
M	P	O									
24.	11.	3.									

Q + F + R RECALCULATED TO 100 PERCENT

25. PERCENT QTZ
2. PERCENT FELDSPAR
73. PERCENT RK FRAGS

THIS SAMPLE IS A LITHARENITE

SR + VR + MR RECALCULATED TO 100 PERCENT

11. PERCENT SED RK FRAGS
68. PERCENT VOLCANIC RK FRAGS
20. PERCENT META RK FRAGS

THIS SAMPLE IS A VOLCANIC LITHARENITE

228. SAMPLE NO. 100. TOTAL POINTS COUNTED

ORIGINAL DATA

Q	STQ	SLUQ	STUQ	SCQ	CQ	CMQ	F	KF	PF	G
24.	8.	5.	3.	2.	2.	4.	2.	0.	1.	1.
R	CR	SHR	CHR	VR	MR	C	CAC	SIC	FEC	DC
34.	0.	2.	5.	24.	3.	0.	0.	0.	0.	0.
M	P	D								
25.	12.	3.								

Q + F + R RECALCULATED TO 100 PERCENT

40. PERCENT QTZ
3. PERCENT FELDSPAR
57. PERCENT RK FRAGS

THIS SAMPLE IS A LITHARENITE

SR + VR + MR RECALCULATED TO 100 PERCENT

21. PERCENT SED RK FRAGS
71. PERCENT VOLCANIC RK FRAGS
9. PERCENT META RK FRAGS

THIS SAMPLE IS A VOLCANIC LITHARENITE

229. SAMPLE NO. 100. TOTAL POINTS COUNTED

ORIGINAL DATA

Q	STQ	SLUQ	STUQ	SCQ	CQ	CMQ	F	KF	PF	G
17.	2.	9.	3.	0.	0.	3.	0.	0.	0.	0.
R	CR	SHR	CHR	VR	MR	C	CAC	SIC	FEC	DC
39.	0.	2.	1.	32.	4.	1.	0.	0.	1.	0.
M	P	D								
37.	5.	1.								

Q + F + R RECALCULATED TO 100 PERCENT

30. PERCENT QTZ
0. PERCENT FELDSPAR
70. PERCENT RK FRAGS

THIS SAMPLE IS A LITHARENITE

SR + VR + MR RECALCULATED TO 100 PERCENT

8. PERCENT SED RK FRAGS
82. PERCENT VOLCANIC RK FRAGS
10. PERCENT META RK FRAGS

THIS SAMPLE IS A VOLCANIC LITHARENITE

230. SAMPLE NO. 100. TOTAL POINTS COUNTED

ORIGINAL DATA

	Q	STQ	SLUQ	STUQ	SCQ	CQ	CMQ	F	KF	PF	G
23.	7.	3.	3.	5.	1.	4.	1.	0.	1.	0.	
	R	CR	SHR	CHR	VR	MR	C	CAC	SIC	FEC	OC
24.	4.	4.	0.	15.	1.	37.	35.	1.	1.	0.	
	M	P	O								
13.	0.	2.									

Q + F + R RECALCULATED TO 100 PERCENT

48. PERCENT QTZ
2. PERCENT FELDSPAR
50. PERCENT RK FRAGS

THIS SAMPLE IS A LITHARENITE

SR + VR + MR RECALCULATED TO 100 PERCENT

33. PERCENT SED RK FRAGS
63. PERCENT VOLCANIC RK FRAGS
4. PERCENT META RK FRAGS

THIS SAMPLE IS A VOLCANIC LITHARENITE

231. SAMPLE NO. 100. TOTAL POINTS COUNTED

ORIGINAL DATA

	Q	STQ	SLUQ	STUQ	SCQ	CQ	CMQ	F	KF	PF	G
17.	6.	3.	0.	5.	0.	3.	1.	0.	1.	0.	
	R	CR	SHR	CHR	VR	MR	C	CAC	SIC	FEC	OC
27.	4.	4.	7.	10.	2.	40.	39.	1.	0.	0.	
	M	P	O								
8.	0.	7.									

Q + F + R RECALCULATED TO 100 PERCENT

38. PERCENT QTZ
2. PERCENT FELDSPAR
60. PERCENT RK FRAGS

THIS SAMPLE IS A LITHARENITE

SR + VR + MR RECALCULATED TO 100 PERCENT

56. PERCENT SED RK FRAGS
37. PERCENT VOLCANIC RK FRAGS
7. PERCENT META RK FRAGS

THIS SAMPLE IS A SEDIMENTARY LITHARENITE

SHR + CR + CHR RECALCULATED TO 100 PERCENT

27. PERCENT SHALE RK FRAGS
27. PERCENT CARBONATE RK FRAGS
47. PERCENT CHERT RK FRAGS

THIS SAMPLE IS A CHERT LITHARENITE

232. SAMPLE NO. 121. TOTAL POINTS COUNTED

ORIGINAL DATA

Q	STQ	SLUQ	STUQ	SCQ	CQ	CMQ	F	KF	PF	G
24.	10.	12.	1.	1.	0.	0.	0.	0.	0.	0.
R	CR	SHR	CHR	VR	MR	C	CAC	SIC	FEC	OC
15.	5.	2.	1.	3.	1.	53.	52.	0.	1.	0.
M	P	O								
14.	8.	7.								

Q + F + R RECALCULATED TO 100 PERCENT

62. PERCENT QTZ
0. PERCENT FELDSPAR
38. PERCENT RK FRAGS

THIS SAMPLE IS A LITHARENITE

SR + VR + MR RECALCULATED TO 100 PERCENT

67. PERCENT SED RK FRAGS
25. PERCENT VOLCANIC RK FRAGS
8. PERCENT META RK FRAGS

THIS SAMPLE IS A SEDIMENTARY LITHARENITE

SHR + CR + CHR RECALCULATED TO 100 PERCENT

25. PERCENT SHALE RK FRAGS
63. PERCENT CARBONATE RK FRAGS
13. PERCENT CHERT RK FRAGS

THIS SAMPLE IS A CARBONATE LITHARENITE

233. SAMPLE NO. 100. TOTAL POINTS COUNTED

ORIGINAL DATA

Q	STQ	SLUQ	STUQ	SCQ	CQ	CMQ	F	KF	PF	G
26.	11.	9.	0.	2.	2.	2.	1.	0.	1.	0.
R	CR	SHR	CHR	VR	MR	C	CAC	SIC	FEC	OC
21.	12.	0.	0.	5.	4.	41.	41.	0.	0.	0.
M	P	O								
9.	0.	2.								

Q + F + R RECALCULATED TO 100 PERCENT

54. PERCENT QTZ
2. PERCENT FELDSPAR
44. PERCENT RK FRAGS

THIS SAMPLE IS A LITHARENITE

SR + VR + MR RECALCULATED TO 100 PERCENT

57. PERCENT SED RK FRAGS
24. PERCENT VOLCANIC RK FRAGS
19. PERCENT META RK FRAGS

THIS SAMPLE IS A SEDIMENTARY LITHARENITE

SHR + CR + CHR RECALCULATED TO 100 PERCENT

0. PERCENT SHALE RK FRAGS
100. PERCENT CARBONATE RK FRAGS
0. PERCENT CHERT RK FRAGS

THIS SAMPLE IS A CARBONATE LITHARENITE

234. SAMPLE NO. 101. TOTAL POINTS COUNTED

ORIGINAL DATA

Q	STQ	SLUQ	STUQ	SCQ	CQ	CMQ	F	KF	PF	G
27.	2.	10.	7.	1.	1.	6.	3.	1.	0.	2.
R	CR	SHR	CHR	VR	MR	C	CAC	SIC	FEC	OC
31.	8.	7.	1.	8.	7.	1.	0.	0.	1.	0.
M	P	O								
11.	25.	3.								

Q + F + R RECALCULATED TO 100 PERCENT

44. PERCENT QTZ
5. PERCENT FELDSPAR
51. PERCENT RK FRAGS

THIS SAMPLE IS A LITHARENITE

SR + VR + MR RECALCULATED TO 100 PERCENT

52. PERCENT SED RK FRAGS
26. PERCENT VOLCANIC RK FRAGS
23. PERCENT META RK FRAGS

THIS SAMPLE IS A SEDIMENTARY LITHARENITE

SHR + CR + CHR RECALCULATED TO 100 PERCENT

44. PERCENT SHALE RK FRAGS
50. PERCENT CARBONATE RK FRAGS
6. PERCENT CHERT RK FRAGS

THIS SAMPLE IS A CARBONATE LITHARENITE

235. SAMPLE NO. 100. TOTAL POINTS COUNTED

ORIGINAL DATA

Q	STQ	SLUQ	STUQ	SCQ	CQ	CMQ	F	KF	PF	G
31.	4.	14.	9.	1.	0.	3.	0.	0.	0.	0.
R	CR	SHR	CHR	VR	MR	C	CAC	SIC	FEC	OC
15.	4.	1.	1.	5.	4.	10.	6.	0.	2.	2.
M	P	O								
21.	22.	1.								

Q + F + R RECALCULATED TO 100 PERCENT

67. PERCENT QTZ
0. PERCENT FELDSPAR
33. PERCENT RK FRAGS

THIS SAMPLE IS A LITHARENITE

SR + VR + MR RECALCULATED TO 100 PERCENT

40. PERCENT SED RK FRAGS
33. PERCENT VOLCANIC RK FRAGS
27. PERCENT META RK FRAGS

THIS SAMPLE IS A SEDIMENTARY LITHARENITE

SHR + CR + CHR RECALCULATED TO 100 PERCENT

17. PERCENT SHALE RK FRAGS
67. PERCENT CARBONATE RK FRAGS
17. PERCENT CHERT RK FRAGS

THIS SAMPLE IS A CARBONATE LITHARENITE

236. SAMPLE NO.	100. TOTAL						POINTS COUNTED				
ORIGINAL DATA											
Q	STQ	SLUQ	STUQ	SCQ	CQ	CMQ	F	KF	PF	G	
19.	P.	6.	2.	0.	1.	2.	1.	0.	0.	1.	
R	CR	SHR	CHR	VR	MR	C	CAC	SIC	FEC	OC	
10.	2.	0.	0.	6.	2.	41.	38.	2.	1.	0.	
M	P	0									
17.	11.	1.									

Q + F + R RECALCULATED TO 100 PERCENT

63. PERCENT QTZ
 3. PERCENT FELDSPAR
 33. PERCENT RK FRAGS

THIS SAMPLE IS A LITHARENITE

SR + VR + MR RECALCULATED TO 100 PERCENT

20. PERCENT SED RK FRAGS
 60. PERCENT VOLCANIC RK FRAGS
 20. PERCENT META RK FRAGS

THIS SAMPLE IS A VOLCANIC LITHARENITE

237. SAMPLE NO.	100. TOTAL						POINTS COUNTED				
ORIGINAL DATA											
Q	STQ	SLUQ	STUQ	SCQ	CQ	CMQ	F	KF	PF	G	
25.	1.	9.	1.	3.	0.	11.	3.	2.	0.	1.	
R	CR	SHR	CHR	VR	MR	C	CAC	SIC	FEC	OC	
40.	9.	4.	4.	16.	7.	2.	1.	0.	1.	0.	
M	P	0									
7.	21.	2.									

Q + F + R RECALCULATED TO 100 PERCENT

37. PERCENT QTZ
 4. PERCENT FELDSPAR
 59. PERCENT RK FRAGS

THIS SAMPLE IS A LITHARENITE

SR + VR + MR RECALCULATED TO 100 PERCENT

42. PERCENT SED RK FRAGS
 40. PERCENT VOLCANIC RK FRAGS
 17. PERCENT META RK FRAGS

THIS SAMPLE IS A SEDIMENTARY LITHARENITE

SHR + CR + CHR RECALCULATED TO 100 PERCENT

24. PERCENT SHALE RK FRAGS
 53. PERCENT CARBONATE RK FRAGS
 24. PERCENT CHERT RK FRAGS

THIS SAMPLE IS A CARBONATE LITHARENITE

241. SAMPLE NO. 100. TOTAL POINTS COUNTED

ORIGINAL DATA

	Q	STO	SLUQ	STUQ	SCQ	CQ	CMQ	F	KF	PF	G
11.	1.	4.	1.	1.	0.	4.	4.	0.	0.	4.	
	R	CR	SHR	CHR	VR	MR	C	CAC	SIC	FEC	OC
30.	13.	3.	1.	10.	3.	20.	19.	0.	0.	1.	
	M	P	O								
32.	0.	3.									

Q + F + R RECALCULATED TO 100 PERCENT

24. PERCENT QTZ
9. PERCENT FELDSPAR
67. PERCENT RK FRAGS

THIS SAMPLE IS A LITHARENITE

SR + VR + MR RECALCULATED TO 100 PERCENT

57. PERCENT SED RK FRAGS
33. PERCENT VOLCANIC RK FRAGS
10. PERCENT META RK FRAGS

THIS SAMPLE IS A SEDIMENTARY LITHARENITE

SHR + CR + CHR RECALCULATED TO 100 PERCENT

18. PERCENT SHALE RK FRAGS
76. PERCENT CARBONATE RK FRAGS
6. PERCENT CHERT RK FRAGS

THIS SAMPLE IS A CARBONATE LITHARENITE

242. SAMPLE NO. 101. TOTAL POINTS COUNTED

ORIGINAL DATA

	Q	STO	SLUQ	STUQ	SCQ	CQ	CMQ	F	KF	PF	G
18.	1.	6.	3.	3.	0.	5.	4.	1.	2.	1.	
	R	CR	SHR	CHR	VR	MR	C	CAC	SIC	FEC	OC
25.	9.	2.	1.	10.	3.	16.	13.	0.	2.	1.	
	M	P	O								
35.	1.	2.									

Q + F + R RECALCULATED TO 100 PERCENT

38. PERCENT QTZ
9. PERCENT FELDSPAR
53. PERCENT RK FRAGS

THIS SAMPLE IS A LITHARENITE

SR + VR + MR RECALCULATED TO 100 PERCENT

48. PERCENT SED RK FRAGS
40. PERCENT VOLCANIC RK FRAGS
12. PERCENT META RK FRAGS

THIS SAMPLE IS A SEDIMENTARY LITHARENITE

SHR + CR + CHR RECALCULATED TO 100 PERCENT

17. PERCENT SHALE RK FRAGS
75. PERCENT CARBONATE RK FRAGS
8. PERCENT CHERT RK FRAGS

THIS SAMPLE IS A CARBONATE LITHARENITE

243. SAMPLE NO. 100. TOTAL POINTS COUNTED

ORIGINAL DATA

Q	STQ	SLUQ	STUQ	SCQ	CQ	CMQ	F	KF	PF	G
32.	4.	11.	3.	4.	0.	10.	1.	0.	0.	1.
R	CR	SHR	CHR	VR	MR	C	CAC	SIC	FEC	OC
27.	3.	2.	2.	17.	3.	10.	2.	0.	6.	2.
M	P	O								
11.	15.	4.								

Q + F + R RECALCULATED TO 100 PERCENT

53. PERCENT QTZ
2. PERCENT FELDSPAR
45. PERCENT RK FRAGS

THIS SAMPLE IS A LITHARENITE

SR + VR + MR RECALCULATED TO 100 PERCENT

26. PERCENT SED RK FRAGS
63. PERCENT VOLCANIC RK FRAGS
11. PERCENT META RK FRAGS

THIS SAMPLE IS A VOLCANIC LITHARENITE

244. SAMPLE NO. 100. TOTAL POINTS COUNTED

ORIGINAL DATA

Q	STQ	SLUQ	STUQ	SCQ	CQ	CMQ	F	KF	PF	G
33.	4.	12.	8.	3.	0.	6.	3.	1.	1.	1.
R	CR	SHR	CHR	VR	MR	C	CAC	SIC	FEC	OC
27.	6.	4.	1.	11.	5.	0.	0.	0.	0.	0.
M	P	O								
10.	19.	8.								

Q + F + R RECALCULATED TO 100 PERCENT

52. PERCENT QTZ
5. PERCENT FELDSPAR
43. PERCENT RK FRAGS

THIS SAMPLE IS A LITHARENITE

SR + VR + MR RECALCULATED TO 100 PERCENT

41. PERCENT SED RK FRAGS
41. PERCENT VOLCANIC RK FRAGS
19. PERCENT META RK FRAGS

THIS SAMPLE IS A VOLCANIC LITHARENITE

246. SAMPLE NO. 100. TOTAL POINTS COUNTED

ORIGINAL DATA

Q	STQ	SLUQ	STUQ	SCQ	CQ	CMQ	F	KF	PF	G
16.	2.	8.	2.	1.	0.	3.	4.	2.	1.	1.
R	CR	SHR	CHR	VR	MR	C	CAC	SIC	FEC	OC
18.	5.	2.	1.	8.	2.	19.	19.	0.	0.	0.
M	P									
41.	0.	2.								

Q + F + R RECALCULATED TO 100 PERCENT

42. PERCENT QTZ
11. PERCENT FELDSPAR
47. PERCENT RK FRAGS

THIS SAMPLE IS A LITHARENITE

SR + VR + MR RECALCULATED TO 100 PERCENT

44. PERCENT SED RK FRAGS
44. PERCENT VOLCANIC RK FRAGS
11. PERCENT META RK FRAGS

THIS SAMPLE IS A VOLCANIC LITHARENITE

248. SAMPLE NO. 100. TOTAL POINTS COUNTED

ORIGINAL DATA

Q	STQ	SLUQ	STUQ	SCQ	CQ	CMQ	F	KF	PF	G
31.	1.	11.	6.	3.	1.	9.	3.	0.	0.	3.
R	CR	SHR	CHR	VR	MR	C	CAC	SIC	FEC	OC
29.	0.	2.	2.	17.	8.	3.	0.	0.	3.	0.
M	P									
4.	26.	4.								

Q + F + R RECALCULATED TO 100 PERCENT

49. PERCENT QTZ
5. PERCENT FELDSPAR
46. PERCENT RK FRAGS

THIS SAMPLE IS A LITHARENITE

SR + VR + MR RECALCULATED TO 100 PERCENT

14. PERCENT SED RK FRAGS
59. PERCENT VOLCANIC RK FRAGS
28. PERCENT META RK FRAGS

THIS SAMPLE IS A VOLCANIC LITHARENITE

