

**SUSITNA
HYDROELECTRIC PROJECT**

**FEDERAL ENERGY REGULATORY COMMISSION
PROJECT No. 7114**

DRAFT

**CULTURAL RESOURCES
INVESTIGATIONS
1979-1985**

**VOLUME II
APPENDICES B and C**

DRAFT

SITY OF ALASKA

1

**MAY 1985
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ALASKA POWER AUTHORITY

SUSITNA HYDROELECTRIC PROJECT

CULTURAL RESOURCES INVESTIGATIONS

1979 - 1985

VOLUME II

APPENDICES B AND C

DRAFT

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APPENDIX B - SURVEY LOCALE FORM, SITE SURVEY FORM,
FIELD NOTEBOOK GUIDES,
AND SITE DATA FORM

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B.1 - SURVEY LOCALE FORM

This form is intended to insure that three kinds of data for each locale are recorded. These data will guide additional survey, evaluation of areas that may need no further work, and document areas surveyed and tested on-the-ground. If supplementary information to this form is included in fieldnotes, please note this on the form along with your name(s) and field book page number(s).

a. Describe the surface morphology noting topographic features, drainage, soils, variation in surface slope, etc.

This image shows a single sheet of white paper with horizontal black ruling lines. The lines are evenly spaced and run across the width of the page. There are approximately 20 lines visible. On the right side, there are some dark, irregular marks that appear to be from a scanner or a staple. The overall appearance is that of a clean, unused piece of stationery.

- b. What, if any, are the discrepancies between the definition of the geological unit (based on air photo interpretation) and the field observation of the unit? Would you characterize the total area as a single unit based on the homogeneity of surface morphology?

II. Identify areas within the locale that potentially may be eliminated from further archeological survey. Please provide objective criteria in your evaluation such as: 1) areas where testing is not feasible using standard archeological field techniques (areas of standing water, talus rubble); 2) areas where the substrata have been removed by natural erosion (indicate whether these areas have been surface examined for archeological materials); and 3) overly steep slopes. This would include slopes of greater than 15° to horizontal which you deem unlikely for site occurrence (describe and measure slope angle).

III. Identify areas within the locale which may have high archeological potential, based on known site locales from other areas and your field experience, including overlooks, river terrace and bluff edges, lake and stream margins, etc. Describe the location, extent, salient features, and tests (if applicable) for these locales, record these locations on USGS maps.

High archeological potential areas that should be investigated --

IV. Locate on maps where the survey team actually went on-the-ground, and location, number, size, and depth of test pits excavated and natural exposures examined. Describe the topographic setting, and relation to other physical features, such as lakes, streams, rivers, bluff, edges, nearby hills, elevation, etc., for sterile test pits.

Sites found in locale:

Number of shovel tests --

NAMES OF FIELD TEAM: (include relevant pages in fieldbook)

_____	Date _____	_____	Date _____
_____	Date _____	_____	Date _____
_____	Date _____	_____	Date _____
_____	Date _____	_____	Date _____
_____	Date _____	_____	Date _____
_____	Date _____	_____	Date _____

B.2 - SITE SURVEY FORM

AHRS NO.: _____
SURVEY LOCALE NO.: _____
UA NO.: _____

SUSITNA HYDROPOWER PROJECT

A. USGS QUAD: Talkeetna Mountains _____ Scale: 1:63,360

B. AIR PHOTO REFERENCE: Roll _____ Frames _____

C. TWP _____, RNG _____, Seward Meridian
_____ $\frac{1}{4}$ of the _____ $\frac{1}{4}$ of the _____ of Section _____

D. UTM: Zone 6 Easting _____ Northing _____

E. LATITUDE: _____ ° _____ ' _____ " LONGITUDE: _____ ° _____ ' _____ "

F. GEOLOGICAL UNIT: _____ No. _____

G. REGION: Devil Canyon _____ Watana _____ Other: _____

A. Site morphology. (See back of form for information required.)

B. Surrounding terrain morphology. (See back of form for information required.)

C. Ecosystem. (See back of sheet for descriptions.)

1. _____ Moist Tundra _____ High Brush _____ Other: _____
 _____ Lowland spruce-hardwood _____ Upland spruce-hardwood

2. Site vegetation and surface description:

3. Vegetation in surrounding area and surface description:

III. SITE:

A. Description:

1. Characteristics. (lithic scatter, stratified site, cabin, etc.)

number of shovel tests

number of test pits

(indicate on map)

2. Number, size and spatial relationship of features, etc.

3. Stratigraphy (if relevant):

B. Artifact inventory.

1. Surface:

a. Artifacts collected:

b. Artifacts observed but not collected:

2. Systematically excavated artifacts:

C. Period: _____ Unknown _____ Precontact
_____ Historic: Native _____ Non-Native _____

D. Size:

1. Observed Size: _____ x _____ meters
Justification for boundaries:

2. Estimated Size: _____ x _____ meters
Justification for boundaries:

E. Site disturbance (current and anticipated). Indicate expected effect of the hydroelectric project on the site.

1. Natural: _____

2. Human: _____

II. A. Site morphology.

1. What terrain feature is the site on: flat plain, sloping plain, continuous ridge, hill, point, shoreline, terrace, valley, etc.
2. What is the topographic context:
 - a. no topographic relief relative to surrounding terrain, higher topographic relief than surrounding terrain, lower topographic relief than surrounding terrain.
 - b. give elevation: 1) above sea level; 2) Relative to surrounding terrain.
3. Is the terrain feature continuous or discrete?
4. What is the size, shape and direction of this feature?
5. What is the relative position of the site on this feature?
6. Field of view:
 - a. direction and range of view;
 - b. what is in view?
 - c. would a change in the present vegetation increase or decrease view? How?
7. Describe any special attributes that make this site location unique.
8. Are there other settings similar to that of this site in the unit? Where?

II. B. Surrounding terrain morphology.

Describe surrounding landforms and water features in relation to the site. What is the direction, distance and difference in elevation of surrounding features? The following characteristics should provide a guide:

1. Streams and rivers:
 - a. proximity to site
 - b. access from site
 - c. are any in view from site?
 - d. has downcutting created valley wall constriction in this area?
 - e. is stream or river (1) shallow with rapids and sandbars, or (2) deep and smooth in this vicinity, etc.
 - f. is water clear or turbid?
 - g. what is the general width in this vicinity?
 - h. is terracing present?
 - i. in this area is the river course:
 1. straight;
 2. bending;
 3. serpentine.
 - j. are confluences with other streams or rivers nearby? How far?
 - k. what kind of terrain does this stream or river drain? (lakes, hills, marsh)
2. Lakes:
 - a. size in hectares using template.
 - b. inlet present? outlet present?
 - c. single lake or part of lake system?
 - d. characterize terrain surrounding lake (low, wet, steep, etc.)
 - e. is there any evidence that lake size is changing (vegetation overgrowth, old shorelines, etc.)
 - f. characteristics of shoreline. Old shorelines present?

ECOSYSTEMS LIKELY TO BE ENCOUNTERED IN PROJECT AREA

MOIST TUNDRA: Moist tundra ecosystems usually form a complete ground cover and are extremely productive during the growing season. They vary from almost continuous and uniformly developed cottongrass tussocks with sparse growth of other sedges and dwarf shrubs to stands where tussocks are scarce or lacking and dwarf shrubs are dominant. Associated species are arctagrostis, bluejoint, tufted hairgrass, mosses, alpine azalea, wood rush, mountain-avens, bistort, low-growing willows, dwarf birch, Labrador tea, green alder, Lapland rosebay, blueberry and mountain cranberry.

HIGH BRUSH: These are dense to open deciduous brush systems. Floodplain thickets: The subsystem is similar from the rivers of the southern coastal areas to the broad-braided rivers north of the Brooks Range. It develops quickly on newly exposed alluvial deposits that are periodically flooded. The dominant shrubs are willows and alders. Associated shrubs are dogwood, prickly rose, raspberry, buffaloberry and high bush cranberry. Birch-alder-willow thickets: This subsystem is found near timberline in interior Alaska. It consists of resin birch, American green alder, thinleaf alder and several willow species. Thickets may be extremely dense, or open and interspersed with reindeer lichens, low heath type shrubs, or patches of alpine tundra ecosystems. Other associated species are Sitka alder, bearberry, crowberry, Labrador tea, spirea, blueberry and mountain cranberry.

UPLAND SPRUCE-HARDWOOD FOREST: This ecosystem is a fairly dense interior forest composed of white spruce, birch, aspen and poplar. Black spruce typically grows on north slopes and poorly drained flat areas. Root depths are shallow. Fire scars are common. White spruce averaging 40 to 80 feet in height and up to 16 inches in diameter occurs in mixed stands on south facing slopes and well drained soils; forms pure stands near streams. Aspen and birch average 50 feet in height. Poplar averaging 80 feet in height and 24 inches in diameter occurs in scattered stands along streams. Undergrowth consists of mosses with grasses on drier sites and with brush on moist slopes. Typical plants are willow, alder, ferns, rose, high and low bush cranberry, raspberry, current and horsetail.

LOWLAND SPRUCE-HARDWOOD FOREST: This ecosystem is a dense to open interior lowland forest of evergreen and deciduous trees, including extensive pure stands of black spruce. Black spruce are slow growing and seldom exceed 8 inches in diameter or 50 feet in height. Cones of this tree open after fire and spread abundant seed, enabling black spruce to quickly invade burned areas. The slow-growing stunted tamarack is associated with black spruce in the wet lowlands. It seldom reaches a diameter of more than 6 inches. Rolling basins and knolls in the lowlands have a varied mixture of white spruce, black spruce, paper birch, aspen and poplar. Small bogs and muskegs are found in the depressions. Undergrowth species include willow, dwarf birch, low bush cranberry, blueberry, Labrador tea, crowberry, bearberry, cottongrass, ferns, horsetail, lichens and a thick cover of sphagnum and other mosses. Large areas burned since 1900 are covered by willow brush and very dense black spruce sapling stands.

AFTER: Major Ecosystems of Alaska. Joint Federal-State Land Use Planning Commission for Alaska. July 1973.

B.3 - FIELD NOTEBOOK GUIDELINES SECTION

	Locale/ Site:	SUSITNA	HYDROELECTRIC PROJECT	Test:	
	Topic:	INDEX		Level:	
<input type="checkbox"/>	Name:	H. TRUMAN	Date:	Page:	
	PAGE			DATE	
<input type="checkbox"/>		TLM 086			
	1	NARRATIVE - SITE ORIENTATION			B-4
<input type="checkbox"/>	2	PLAN MAP	N107 E99	SURFACE	B-4
	3	ARTIFACT SUMMARY	N107 E99	0-5 cm	B-4
	4-5	SOIL DESCRIPTION	N107 E99	0-5 cm	B-4
	6	PLAN MAP	N107 E99	5 cm	B-5
	7	NARRATIVE - FEATURES	N107 E99	5-10 cm	B-5
	8	ARTIFACT SUMMARY	N107 E99	5-10 cm	B-5
	9	SOIL DESCRIPTION	N107 E99	5-10 cm	B-5
<input type="checkbox"/>		SURVEY LOCAL	127		
	10	NARRATIVE - SHOVEL TESTS			B-7
<input type="checkbox"/>		TLM 269			
<input type="checkbox"/>	11	NARRATIVE - SITE DESCRIPTION			B-7
	12	PROFILE - EAST WALL - TEST PIT 1			B-7
	13	ARTIFACT SUMMARY - SCATTERS A, B, C			B-7

Figure B.3.1. Example of Index in Field Notebooks

Locale/	S. L. 133				
Site:				Test:	
Topic:	EXAMPLE	NARRATIVE		Level:	
Name:	B. SALLSBY		Date:	7/4/83	Page: 10
	TERRAIN AND	ARRIVED AT SURVEY LOCALE 133 AT			
	VEGETATION	8:15a WITH BOB, STEVE, & NENA.			
		LZ IN NW CORNER OF LOCALE.			
		TERRAIN ON TOP OF BLUFF IS FAIRLY			
		FLAT AND VEGETATED WITH DWARF			
		BIRCH AND SCATTERED SPRUCE.			
	SHOVEL	PUT IN 5 SHOVEL TESTS ON BLUFF			
	TESTS 1-5	DISTINCT LAYERS OF DEVL AND WATANA			
		TEPHRAS WERE OBSERVED, WITH			
		ANGULAR GRAVEL INTERSPERSED			
		THROUGHOUT THE SEDIMENT. NO			
		CULTURAL MATERIAL FOUND.			
	TLM 177	BOB FOUND A GRAY CHEST FLAKE			
		IN A SHOVEL TEST ON THE BLUFF			
		EDGE, SO WE BEGAN TO RECORD			
		THE SITE.			

Figure B.3.2. Example of Narrative Format Page

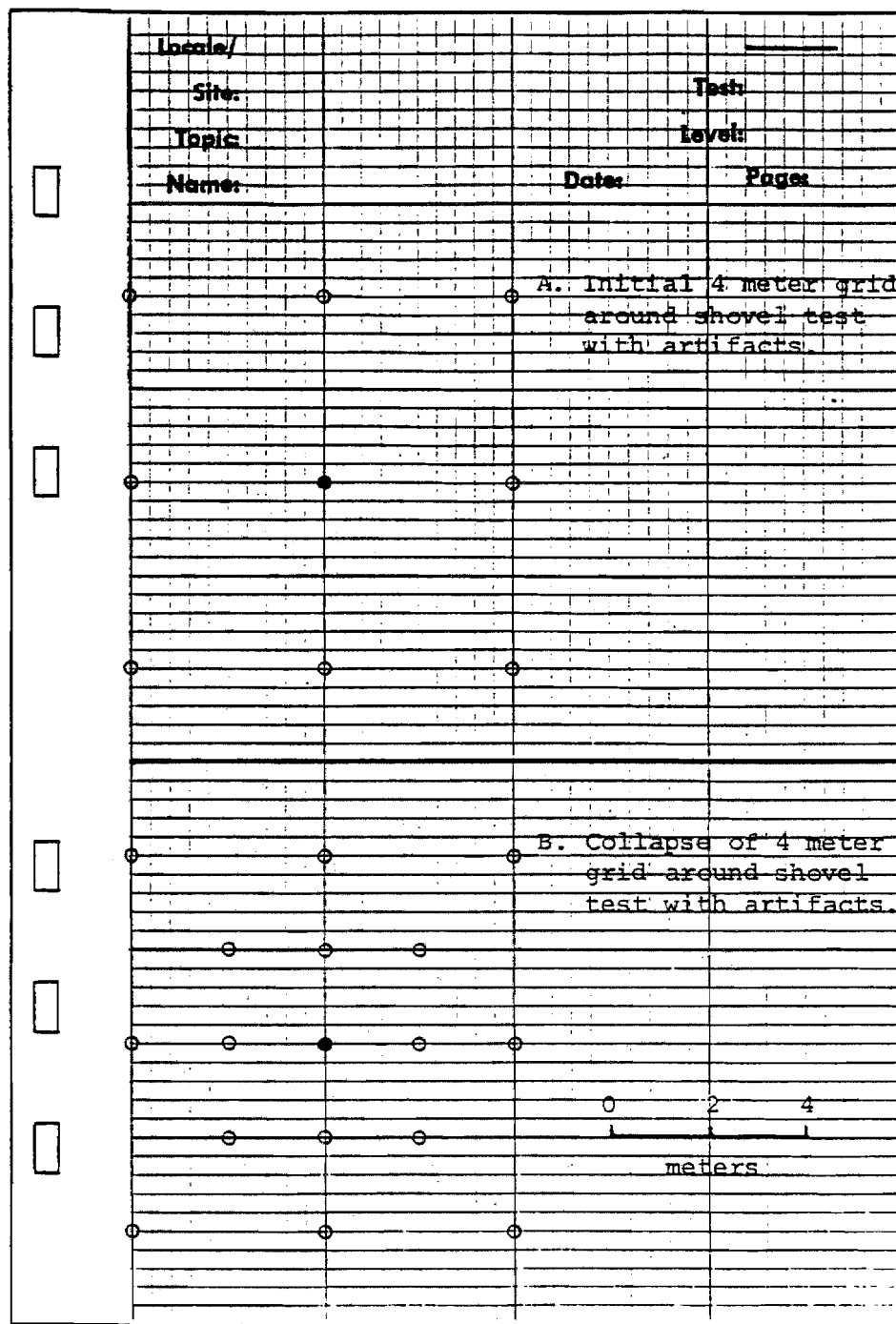


Figure B.3.3. Example of Shovel Test Expansion with Single Shovel Test with Cultural Material

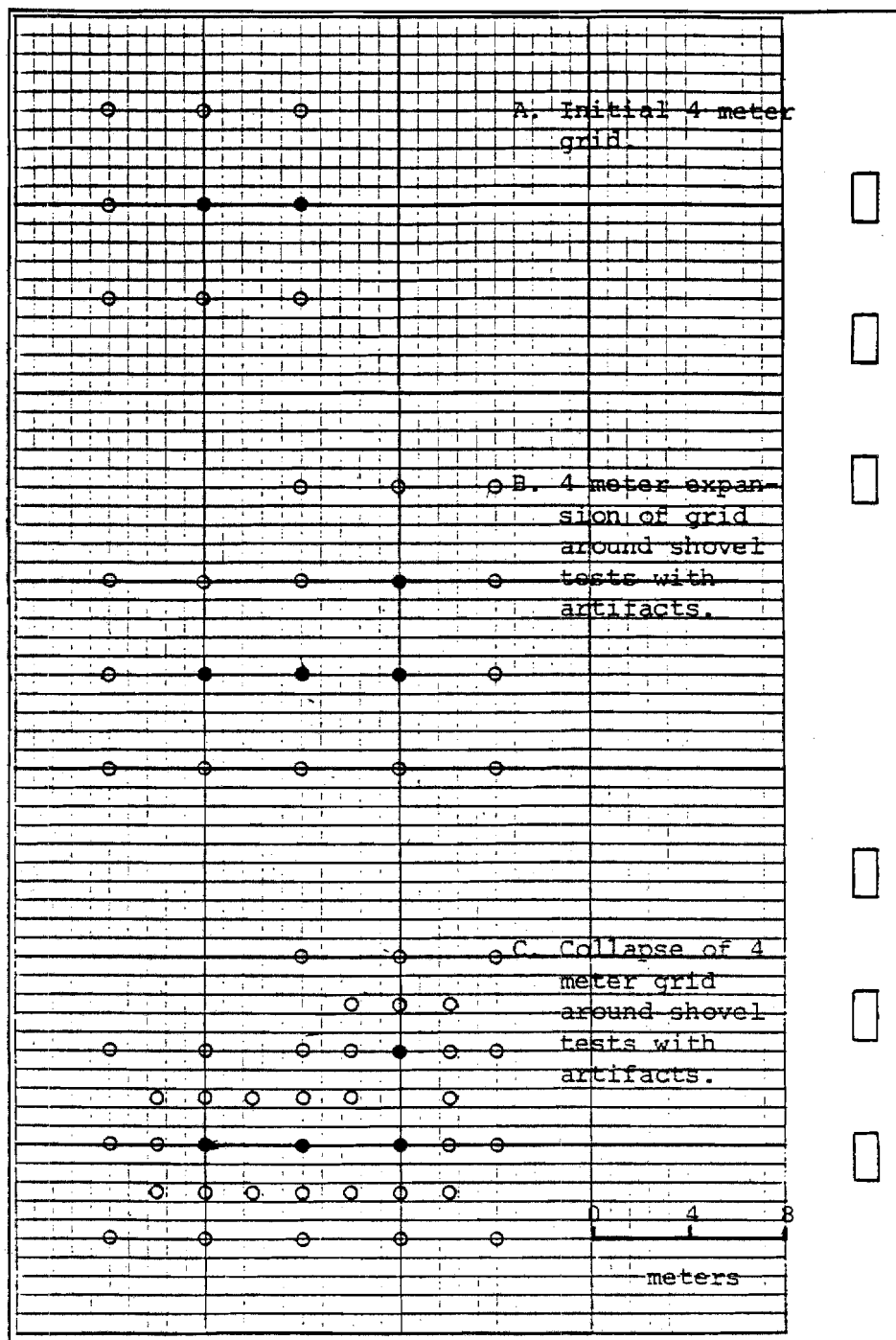


Figure B.3.4. Example of Shovel Test Expansion with Multiple Shovel Tests with Cultural Material

Locality/			
Site:		Task:	
Topic: FORMAT FOR TEST PIT PROFILE		Level:	
Name:		Date:	
		Pages:	
0		UNIT 1	
5		UNIT 2	
10		UNIT 3	
15		UNIT 4	
20		UNIT 5	
25			
CM BELOW SURFACE			
SOIL DESCRIPTION			
UNIT 1:			
UNIT 2:			
UNIT 3:			
UNIT 4:			
UNIT 5:			

Figure B.3.5. Format for Test Pit Profile

<u>MAP SYMBOLS</u>	
Surface Artifact	+
Depression	⌒
Test Pit	□
Shovel Test	⊙
Grid Test: w/ Artifacts	●
Grid Test: Sterile	○
Spruce Tree	*
Birch Tree	⊗
Dwarf Birch	⊙
Marsh	✱
Stream, Creek	~
Deadfall, Down Tree	⌵
Game Trail	---
Deflated Area	⊖
Boulders, Rocks, Outcrop	⬢
Intermediate Contour	⋯
Survey Monument	⦿

Figure B.3.6. Symbols Used for Survey Site Map

	Locale/				
	Site:			Test:	
	Topic:	MAPPING NOTES			Level:
<input type="checkbox"/>	Name:		Date:	Pages:	
	CREW :				
<input type="checkbox"/>					
<input type="checkbox"/>					
	DATUM:				
	STA.	+	H.I.	-	ELEV. NOTES
<input type="checkbox"/>					
<input type="checkbox"/>					
<input type="checkbox"/>					

Figure B.3.7. Mapping Notes Format




		MAPPING	SYMBOLS
<input type="checkbox"/>	PC	=	PARTY CHIEF
	T	=	INSTRUMENT PERSON
	M	=	BOOKLET
<input type="checkbox"/>	∞	=	CHAIN PERSON
	ø	=	ROD PERSON
<input type="checkbox"/>			
			TRUE NORTH
			GRID NORTH
			MAGNETIC NORTH
<input type="checkbox"/>	T.O.S.	=	TOP OF STAKE
	O.G.	=	ON GROUND
	E.O.C.	=	ERROR OF CLOSURE
<input type="checkbox"/>	STA.	=	GRID COORDINATES
	H.I.	=	HEIGHT OF INSTRUMENT
<input type="checkbox"/>	ELEV.	=	ELEVATION

Figure B.3.8. Mapping Notes Symbols

Locality/					
Site:	TLM 321			Test:	
Topic:	MAPPING NOTES			Level:	
Name:			Date:	Page:	
	CREW :				
	Pc 1/2 Ø	C. UTERMÖHLE			
	TIM	H. MASCHNER			
	∞	C. HEMPHILL			
	DATUM :	SET AT N100 E100 NAIL IN HUB			
		GRID NORTH = TRUE NORTH			
	STA.	+	H.I.	-	ELEV. NOTES
	N100 E100				0 ⁰⁰ DATUM
		1 ³²	1 ³²		
	N100 E100			1 ⁴⁷	-0 ¹⁵ O.G.
	NBS E100			3 ⁵⁷	-2 ⁵⁵ O.G.
	N90 E100			2 ⁵⁵	-1 ²³ T.O.S.
	N90 E100			2 ⁰⁰	-1 ⁴⁸ O.G.
	N100 E100			1 ³³	-0 ⁰¹ DATUM
					E.O.C. = -0 ⁰¹

Figure B.3.9. Example of Mapping Notes

SYMBOLS FOR TEST SQUARE PLAN VIEW			
	SQUARE DATUM		BONE FRAGMENTS - COLLECTED AS QUAD OR SCATTER
	LITHIC ARTIFACT		ELEVATION LOCATION
	LITHIC - COLLECTED AS QUAD OR SCATTER		INDISTINCT - DISTINCT CONTACT
	CHARCOAL PIECES/ FLOCKS		THERMALLY ALTERED ROCK
	CARBON STAINING - WITH ELEVATION		ROCK
	OXIDIZED SOIL		AREA NOT EXCAVATED
	ASH - CULTURAL		LOCATION OF SAMPLE C-14 = CHARCOAL S = SOIL
	BONE FRAGMENT		

Figure B.3.12. Symbols Used on Plan Map

	Locale/ Site:				Test:	
	Topic:	ARTIFACT DESCRIPTION			Level:	
<input type="checkbox"/>	Name:			Date:	Page:	
<input type="checkbox"/>	PROVENIENCE	RAW MATERIAL	DESCRIPTION			
<input type="checkbox"/>						
<input type="checkbox"/>						
<input type="checkbox"/>						
<input type="checkbox"/>						

Figure B.3.13. Artifact Description Format

ARTIFACT DESCRIPTION		EXPLANATION
<input type="checkbox"/>	PROVENIENCE	(IN CM)
<input type="checkbox"/>	N	= DISTANCE FROM SOUTH WALL TO CENTER OF ARTIFACT
<input type="checkbox"/>	E	= DISTANCE FROM WEST WALL TO CENTER OF ARTIFACT
<input type="checkbox"/>	D	= DEPTH OF ARTIFACT AT ITS BASE
RAW MATERIAL		TOOL TYPES
<input type="checkbox"/>	ARGILLITE	UNMODIFIED FLAKES
<input type="checkbox"/>	BASALT	MODIFIED FLAKES
<input type="checkbox"/>	CHALCEDONY	SCRAPERS
<input type="checkbox"/>	CHELT	BLADES
<input type="checkbox"/>	OBSYDIAN	MICROBLADES
<input type="checkbox"/>	QUARTZ	BURINS
<input type="checkbox"/>	QUARTZITE	BURIN SPALLS
<input type="checkbox"/>	RHYOLITE	BIFACES
<input type="checkbox"/>	METAL	PREFORMS
<input type="checkbox"/>	GLASS	NOTCHED POINTS
<input type="checkbox"/>	WOOD	STEMMED POINTS
		LEAF SHAPED POINTS
		LANCEOLATE POINTS

Figure B.3.14. Artifact Description Guidelines

	Locale/ Site:				Test:	
	Topic:	C-14 SAMPLE RECORD			Level:	
<input type="checkbox"/>	Name:			Date:	Page:	
	FIELD #	SAMPLE DESCRIPTION				
<input type="checkbox"/>	C.S. 1					
<input type="checkbox"/>						
<input type="checkbox"/>						
<input type="checkbox"/>						
<input type="checkbox"/>						

Figure B.3.16. C-14 Sample Recording Format

C-14 SAMPLE COLLECTION GUIDELINES				
DESCRIPTION				
A) PROVENIENCE - N, E, D (ALSO PLOTTED ON PLAN MAP)				
AND STRATIGRAPHIC UNIT				
B) SAMPLE DESCRIPTION - I.E., CHARCOAL, BONE, WOOD,				
PEAT, ETC.; PRESENCE OR ABSENCE OF MATRIX				
IN SAMPLE.				
C) ASSOCIATION WITHIN SQUARE (IN FEATURE,				
NEAR BONE CLUSTER, ETC.)				
D) ESTIMATED AGE - I.E., LESS THAN 1800 B.P.				
(ABOVE DEVIL TEPHRA)				
E) POSSIBLE CONTAMINATION - ROOTS, RODENT				
BURROW, ETC.				
F) ARCHEOLOGICAL AND/OR GEOLOGICAL SIGNIFICANCE,				
I.E., UPPER LIMITING DATE FOR TEPHRA DEPOSIT,				
DATES UPPER COMPONENT, ETC.				

Figure B.3.17. C-14 Sample Recording Guidelines

	Locale/ Site:				Test:
	Topic:	SOIL DESCRIPTION			Level:
<input type="checkbox"/>	Name:			Date:	Page:
	UNIT #	MUNSELL	UNIT DESCRIPTION		
<input type="checkbox"/>					
<input type="checkbox"/>					
<input type="checkbox"/>					
<input type="checkbox"/>					
<input type="checkbox"/>					

Figure B.3.18. Soil/Sediment Description Format

SYMBOLS FOR TEST SQUARE PROFILES		
	ROOTS	
	LOOSE PEAT / PEAT WITH ORGANICS	S
	HUMUS / FINELY SORTED ORGANICS	O
	CHARCOAL	L
	OXIDIZED HORIZON / GENERAL OXIDIZATION	S
	MOTTLING (COLOR) GREYED	
	LEACHED / UNOXIDIZED	
	SILTY SAND / SAND	S
	TEPHRA	E
	SANDY GRAVEL	D
	ROCKS / FROST SHATTERING	I
	DRIFT	M
		F
		N
		T
		S

Figure B.3.19. Symbols Used for Wall Profiles

SOIL DESCRIPTION GUIDELINES			
<input type="checkbox"/>	VARIABLES		
	SOIL : WET, DAMP, DRY		
	LIGHTING : OVERCAST, SUNNY, UNDER TARP		
<input type="checkbox"/>	MUNSELL		
	HUE		
<input type="checkbox"/>	VALUE / CHROMA		
	COLOR DESCRIPTION		
	DESCRIPTION		
	PARTICLE SIZE :	CLAY	—
		SILT	.0039 mm
		FINE SAND	.125 mm
		COARSE SAND	.25 mm
<input type="checkbox"/>		GRANULE	.5 mm
		PEBBLE	2 mm
		COBBLE	65 mm
<input type="checkbox"/>		BOULDER	250 mm
	SOIL MOISTURE		
<input type="checkbox"/>	TEXTURE		
	DEGREE OF SORTING		

Figure B.3.20. Soil/Sediment Description Guidelines

NATURE OF CONTACTS:						
THICKNESS - ABRUPT, CLEAR, GRADUAL,						<input type="checkbox"/>
DIFFUSE						
SHAPE - SMOOTH, WAVY, IRREGULAR,						<input type="checkbox"/>
BROKEN						
EXTENT OF UNITS: CONTINUOUS / DISCONTINUOUS						<input type="checkbox"/>
FROST FEATURES: PRESENT / ABSENT						<input type="checkbox"/>
CONDITION OF COBBLES: GRUS / BOULDERS / FRACTURES /						
POLISH / MAXIMUM SIZE OF COBBLES						
OR BOULDERS						
ORGANICS (INCLUDING CHARCOAL): PRESENCE / ABSENCE						
CULTURAL MATERIAL: PRESENCE / ABSENCE /						<input type="checkbox"/>
IN SITU / INTRUSIVE						
						<input type="checkbox"/>
						<input type="checkbox"/>

Figure B.3.21. Soil/Sediment Description Guidelines (Continued)

	Locale/				
	Site:			Test	
	Topic:	PHOTO LOG		Level:	
<input type="checkbox"/>	Name:		Date:	Page:	
		ROLL #		(B+W or COLOR)	
<input type="checkbox"/>					
	EXPOSURE #	SITE LOCATION	DIRECTION	SUBJECT	
<input type="checkbox"/>					
<input type="checkbox"/>					
<input type="checkbox"/>					
<input type="checkbox"/>					

Figure B.3.22. Photo Log Format

	Locale/ Site:				Test:
	Topic:	CHECKLIST FOR SURVEY LOCALE DATA SHEETS			Level:
<input type="checkbox"/>	Name:		Date:		Page:
	DATA SHEET	-			REFERENCE
<input type="checkbox"/>	NARRATIVE PAGES				
<input type="checkbox"/>					
	SURVEY LOCALE FORM				
	SURVEY LOCALE MAP				
	AHRS NUMBER(S)				
<input type="checkbox"/>					
<input type="checkbox"/>					
			ENTERED BY		
<input type="checkbox"/>			CHECKED BY		

Figure B.3.23. Checklist for Survey Locale Data Sheets

	Locale/				
	Site:			Test:	
	Topic:	CHECKLIST FOR SITE DATA SHEETS (SURVEY TESTING)		Level:	
<input type="checkbox"/>	Name:		Date:	Page:	
	DATA SHEET			REFERENCE	
<input type="checkbox"/>	NARRATIVE PAGES				
<input type="checkbox"/>					
	SITE FORM				
	SITE MAP				
	PROFILE				
	DRAFT NARRATIVE				
<input type="checkbox"/>	SITE PLOTTED :	UTM MASTER MAP			
		OTHER MAPS			
<input type="checkbox"/>					
<input type="checkbox"/>			ENTERED BY		
			CHECKED BY		

Figure B.3.24. Checklist for Site Data Sheets (Survey Testing)

	Locale/ Site:				Test:	
	Topic:	CHECKLIST FOR SITE DATA SHEETS (SYSTEMATIC TESTING)			Level:	
<input type="checkbox"/>	Name:			Date:	Page:	
	DATA SHEET				REFERENCE	
<input type="checkbox"/>	PLACEMENT & ELEVATION OF TEST SQUARES					
	FIELD NUMBERS (CHARCOAL)					
<input type="checkbox"/>						
	FIELD NUMBERS (TEPHRA / SOIL)					
	OTHER					
<input type="checkbox"/>						
<input type="checkbox"/>						
<input type="checkbox"/>				ENTERED BY		
				CHECKED BY		

Figure B.3.25. Checklist for Site Data Sheets (Systematic Testing)

Figure B.3.26. Checklist for Test Square Data Sheets

B.4 - SITE DATA CODING FORM

SITE DATA CODING FORM

CARD #	COLUMNS	VARIABLE	CODES	DESCRIPTION
1	1	QUAD	1 2 3 4 5	Talkeetna Mountains (TLM) Healy (HEA) Fairbanks (FAI) Tyonek (TYO) Anchorage (ANC)
	2-4	AHRS #	N	Three digits
	5	Locus	N	One digit (1=A, 2=B, ...)
	6	Quad Letter	1 2 3 4	A B C D
	7	Quad Number	N	(e.g., D-2)
	8-13	UTM Easting	N	Six digits
	14-20	UTM Northing	N	Seven digits
	21	Testing Level (highest)	0 1 2 3 4	AHRS files Survey Survey & grid Systematic Systematic & grid
	22-25	Elevation	N	Feet
	26	Method	0 1	Map Altimeter
	27-31	Observed Site Size	N	Square meters
	32	Method	0 1	Other than grid testing Grid testing
	33-36	Estimated Site Size	N	Square meters

<u>CARD #</u>	<u>COLUMNS</u>	<u>VARIABLE</u>	<u>CODES</u>	<u>DESCRIPTION</u>
1	37-38	Terrain Unit	1	Bxu - Unweathered, consolidated bedrock
			2	C - Colluvial deposits
			3	Cl - Landslide deposits
			4	Cs-f - Solifluction deposits
			5	Ffg - Granular alluvial fan
			6	FP - Floodplain deposits
			7	Fpt - Terrace
			8	Gfo - Outwash deposits
			9	Gfe - Esker deposits
			10	Gfk - Kame deposits
			11	Gta - Ablation till
			12	Gtb-f - Basal till (frozen)
			13	O - Organic deposits
			14	L-f - Lacustrines (frozen)
			15	L/Gta-f - Lacustrine sediments over ablation till (frozen)
			16	L/Gtb-f - Lacustrine deposits over basal till (frozen)
			17	Cs-f/Gtb-f - Solifluction deposits (frozen) over basal till (frozen)
			18	Cs-f/Gta - Solifluction deposits (frozen) over ablation till
			19	Cs-f/Fpt - Solifluction deposits (frozen) over terrace sediments
			20	Cs-f/Bxu - Solifluction deposits (frozen) over bedrock
			21	Gtb-f/Bxu - Frozen basal till over bedrock
			22	Gta/Bxu - Ablation till over unweathered bedrock
			23	C/Bxu + Bxu - Colluvium over bedrock and bedrock exposures
			24	C/Bxw + Bxw - Colluvium over weathered, poorly consolidated bedrock
			0 or 25	Unknown

CARD #	COLUMNS	VARIABLE	CODES	DESCRIPTION
1	39-40	Vegetation (After UA Experimental Station)	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 0 or 21	R - Rock MCT - Mat and cushion tundra SGT - Sedge grass tundra WSG - Wet sedge grass OSB - Open black spruce WSB - Woodland black spruce OSW - Open white spruce WSW - Woodland white spruce CBF - Closed birch forest OBF - Open birch forest CP - Closed balsam poplar OP - Open balsam poplar CM - Closed mixed forest OM - Open mixed forest CTS - Closed tall shrub OTS - Open tall shrub B - Birch shrub W - Willow shrub LS - Low shrub G - Grassland Unknown
	41-42	Landform	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18	Plain - flat Plain - sloping Mountain, hill, etc. Crag and tail Kame Esker Kettle Moraine Terrace - river Terrace - kame Ridge Saddle Valley Lake shore Stream margin Stream confluence Lake outlet/inlet Floodplain

CARD #	COLUMNS	VARIABLE	CODES	DESCRIPTION
1		<u>Proximity</u> Terrain features within 1 km	0 1	Absent Present
43		Lakes	N	
44		Streams	N	
45		Rivers and major Tributaries	N	
46		Wetlands	N	
47		Mineral licks	N	
48-50		<u>NOT USED</u>		
51-52		Land Status	0 1 2 3 4 5 6 7 8 9 10 11 12 13	U - Unknown PR - Private VS - Village Section VS-Ch - Village Selection Chickaloon VS-Kn - Village Selection Knik VS-Ty - Village Selection Tyone BA - Borough Approved or Patented SP - State Patented SS - State Selected SSS - State Selected Suspended F-BLM - BLM F-USAF - U.S. Airforce F-USAR - U.S. Army AK - Alaska Railroad
		<u>Testing Frequency</u>		
53-54		Survey		
		Shovel Tests	N	
55		Test pits	N	
56-58		Grid shovel Tests	N	
59-60		Test Squares	N	

CARD #	COLUMNS	VARIABLE	CODES	DESCRIPTION
--------	---------	----------	-------	-------------

1

Testing and Accession Numbers

				<u>Testing Level</u>
			0	Not tested
			1	Survey only
			2	Survey &/ Grid
			3	Systematic (+/- survey)
			4	Systematic & Grid (+ or - survey)
61	1980 Testing Level			
62-64	UA80-	N		Accession Number (3 digits)
65	1981 Testing Level			
66-68	UA81-	N		Accession Number (3 digits)
69	1982 Testing Level			
70-72	UA82-	N		Accession Number (3 digits)
73	1983 Testing Level			
74-76	UA83-	N		Accession Number (3 digits)
77	1984 Testing Level			
78-80	UA84-	N		Accession Number (3 digits)

CARD #	COLUMNS	VARIABLE	CODES	DESCRIPTION
--------	---------	----------	-------	-------------

2

1

Card number

2

Stratigraphic
Units Present

0

Absent

1

Present

2

Unknown Surface

3

Surface

4

Organics (current)

5

Organic silt (current)

6

Eolian or other

7

Organics (buried)

8

Organic silt (buried)

9

Devil tephra

10

Eolian sand or other

11

Watana tephra (oxidized or unknown)

12

Watana tephra (unoxidized)

13

Paleosol, eolian, or other

14

Oshetna tephra

15

Eolian sand

16

Paleosol or other

17

Eolian sand

18

Drift

19

Bedrock

20

Unknown subsurface

STRATIGRAPHIC POSITION

Upper Limit

1

Unknown Surface

21-22

Unit code

2

Surface

23-24

/unit code

3

Organics (current)

4

Organic silt (current)

5

Eolian sand or other

6

Organics (buried)

7

Organic silt (buried)

8

Devil tephra

9

Eolian sand or other

10

Watana tephra (oxidized)

11

Watana tephra (unoxidized)

12

Paleosol, eolian, or other

13

Oshetna tephra

14

Eolian sand

15

Paleosol or other

16

Eolian sand

17

Drift

18

Bedrock

19

Unknown subsurface

Note: use same code in
both positions if not a
contact.

CARD #	COLUMNS	VARIABLE	CODES	DESCRIPTION
2				

Dates from site

Upper Limiting Date

29-32	B.P.
33-35	S.D.

Unit Date

36-39	B.P.
40-42	S.D.

Lower Limiting Date

43-46	B.P.
47-49	S.D.

UNIDENTIFIABLE MAMMAL BONES

Medium = large mammal

50-51	Skull - burned/calcined
52-53	" unburned

54-55	Axial - burned/calcined
56-57	" unburned

58-59	Other identified elements - burned/calcined
60-61	" " " unburned

62-65	Unidentified elements - burned/calcined
66-69	" " " unburned

Small = medium mammal

70-71	Total number of bones burned/calcined
72-73	" " " " unburned

Mammal (unidentified)

74-75	Total number of bones burned/calcined
76-77	" " " " unburned

Other bones (bird & miscellaneous)

78-79	Total number of bones
-------	-----------------------

80	First card set for site	0	No
		1	Yes

CARD #	COLUMNS	VARIABLE	CODES	DESCRIPTION
--------	---------	----------	-------	-------------

3

1

Card Number

3

Caribou

Skull & antler

2-3	Positive - burned/calcined
4-5	" - unburned
6-7	Tentative - burned/calcined
8-9	" - unburned

Axial (ribs & vertebrae)

10-11	Positive - burned/calcined
12-13	" - unburned
14-15	Tentative - burned/calcined
16-17	" - unburned

Shoulder & pelvic girdles

18-19	Positive - burned/calcined
20-21	" - unburned
22-23	Tentative - burned/calcined
24-25	" - unburned

Limbs

26-27	Positive - burned/calcined
28-29	" - unburned
30-31	Tentative - burned/calcined
32-33	" - unburned

Extremities

34-35	Positive - burned/calcined
36-37	" - unburned
38-39	Tentative - burned/calcined
40-41	" - unburned

CARD #	COLUMNS	VARIABLE	CODES	DESCRIPTION
--------	---------	----------	-------	-------------

3

MOOSE

		Skull & antler		
42		Positive - burned/calcined		
43		" - unburned		
44		Tentative - burned/calcined		
45		" - unburned		

		Axial (ribs & vertebrae)		
46		Positive - burned/calcined		
47		" - unburned		
48		Tentative - burned/calcined		
49		" - unburned		

		Shoulder & pelvic girdles		
50		Positive - burned/calcined		
51		" - unburned		
52		Tentative - burned/calcined		
53		" - unburned		

		Limbs		
54		Positive - burned/calcined		
55		" - unburned		
56		Tentative - burned/calcined		
57		" - unburned		

		Extremities		
58		Positive - burned/calcined		
59		" - unburned		
60		Tentative - burned/calcined		
61		" - unburned		

OTHER IDENTIFIABLE MAMMALS

62		Number of species		
63-64		Number of bones		

FLORA

0	None
1	Seeds
2	Macrofossils
3	Seeds & macrofossils
4	Charred seeds
5	Charred macrofossils (charcoal)
6	Charred seeds & macrofossils

<u>CARD #</u>	<u>COLUMNS</u>	<u>VARIABLE</u>	<u>CODES</u>	<u>DESCRIPTION</u>
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3

Non-Lithic Artifacts

66-67	Bone/antler	N	Number
68-69	Metal	N	Number
70-71	Glass	N	Number
72-73	Wood	N	Number
74	Other	N	Number

Features

0	Absent
1	Possibly present
2	Present

75	Cultural depression
76	Hearth
77	Historic structure (e.g., cabin, grave, mine, etc.)
78	Stone feature

CARD #	COLUMNS	VARIABLE	CODES	DESCRIPTION
4				
	1	Card Number	4	
		<u>Collected Lithic Artifacts by Raw Material</u> (Greater than 1/8")		
		<u>Unmodified Flakes</u>		
	2-6	Argillite		
	7-11	Basalt		
	12-15	Chalcedony		
	16-19	Chert		
	20-23	Obsidian		
	24-27	Quartz		
	28-31	Quartzite		
	32-34	Rhyolite		
	35	Igneous		
	36	Metamorphic		
	37	Sedimentary		
		<u>Modified Flakes</u>		
	38-39	Argillite		
	40-41	Basalt		
	42-43	Chalcedony		
	44-45	Chert		
	46-47	Obsidian		
	48-49	Quartz		
	50-51	Quartzite		
	52-53	Rhyolite		
	54	Igneous		
	55	Metamorphic		
	56	Sedimentary		
		<u>Scrapers</u>		
	57-58	Argillite		
	59-60	Basalt		
	61-62	Chalcedony		
	63-64	Chert		
	65-66	Obsidian		
	67-68	Quartz		
	69-70	Quartzite		
	71-72	Rhyolite		
	73	Igneous		
	74	Metamorphic		
	75	Sedimentary		

CARD #	COLUMNS	VARIABLE	CODES	DESCRIPTION
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5

1	Card Number	5	
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Blades

2-3	Argillite
4-5	Basalt
6-7	Chalcedony
8-9	Chert
10-11	Obsidian
12-13	Quartz
14-15	Quartzite
16-17	Rhyolite
18	Igneous
19	Metamorphic
20	Sedimentary

Microblades

21-22	Argillite
23	Basalt
24-25	Chalcedony
26-28	Chert
29-30	Obsidian
31	Quartz
32	Quartzite
33	Rhyolite
34	Igneous
35	Metamorphic
36	Sedimentary

Burins

37	Argillite
38	Basalt
39	Chalcedony
40	Chert
41	Obsidian
42	Quartz
43	Quartzite
44	Rhyolite
45	Igneous
46	Metamorphic
47	Sedimentary

CARD #	COLUMNS	VARIABLE	CODES	DESCRIPTION
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5

Burin Spalls

48	Argillite
49	Basalt
50	Chalcedony
51	Chert
52	Obsidian
53	Quartz
54	Quartzite
55	Rhyolite
56	Igneous
57	Metamorphic
58	Sedimentary

Bifaces

59-60	Argillite
61-62	Basalt
63-64	Chalcedony
65-66	Chert
67-68	Obsidian
69-70	Quartz
71-72	Quartzite
73-74	Rhyolite
75	Igneous
76	Metamorphic
77	Sedimentary

<u>CARD #</u>	<u>COLUMNS</u>	<u>VARIABLE</u>	<u>CODES</u>	<u>DESCRIPTION</u>
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6 .

1	Card Number	6	
---	-------------	---	--

Preforms

2	Argillite
3	Basalt
4	Chalcedony
5	Chert
6	Obsidian
7	Quartz
8	Quartzite
9	Rhyolite
10	Igneous
11	Metamorphic
12	Sedimentary

Notched Points

13-14	Argillite
15-16	Basalt
17-18	Chalcedony
19-20	Chert
21-22	Obsidian
23-24	Quartz
25-26	Quartzite
27-28	Rhyolite
29	Igneous
30	Metamorphic
31	Sedimentary

Stemmed Points

32	Argillite
33	Basalt
34	Chalcedony
35	Chert
36	Obsidian
37	Quartz
38	Quartzite
39	Rhyolite
40	Igneous
41	Metamorphic
42	Sedimentary

CARD #	COLUMNS	VARIABLE	CODES	DESCRIPTION
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6

Leaf-Shaped Points

43	Argillite
44	Basalt
45	Chalcedony
46	Chert
47	Obsidian
48	Quartz
49	Quartzite
50	Rhyolite
51	Igneous
52	Metamorphic
53	Sedimentary

Lanceolate Points

54	Argillite
55	Basalt
56	Chalcedony
57	Chert
58	Obsidian
59	Quartz
60	Quartzite
61	Rhyolite
62	Igneous
63	Metamorphic
64	Sedimentary

Triangular Points

65	Argillite
66	Basalt
67	Chalcedony
68	Chert
69	Obsidian
70	Quartz
71	Quartzite
72	Rhyolite
73	Igneous
74	Metamorphic
75	Sedimentary

CARD #	COLUMNS	VARIABLE	CODES	DESCRIPTION
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7

1	Card Number	7
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Microblade Cores

2	Argillite
3	Basalt
4	Chalcedony
5	Chert
6	Obsidian
7	Quartz
8	Quartzite
9	Rhyolite
10	Igneous
11	Metamorphic
12	Sedimentary

Microblade Tablets

13	Argillite
14	Basalt
15	Chalcedony
16	Chert
17	Obsidian
18	Quartz
19	Quartzite
20	Rhyolite
21	Igneous
22	Metamorphic
23	Sedimentary

Blade Cores

24	Argillite
25	Basalt
26	Chalcedony
27	Chert
28	Obsidian
29	Quartz
30	Quartzite
31	Rhyolite
32	Igneous
33	Metamorphic
34	Sedimentary

<u>CARD #</u>	<u>COLUMNS</u>	<u>VARIABLE</u>	<u>CODES</u>	<u>DESCRIPTION</u>
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7

Rejuvenation Flakes

35	Argillite
36	Basalt
37	Chalcedony
38	Chert
39	Obsidian
40	Quartz
41	Quartzite
42	Rhyolite
43	Igneous
44	Metamorphic
45	Sedimentary

Flake Cores

46	Argillite
47	Basalt
48	Chalcedony
49	Chert
50	Obsidian
51	Quartz
52	Quartzite
53	Rhyolite
54	Igneous
55	Metamorphic
56	Sedimentary

57	Hammerstones
----	--------------

58	Abraders
----	----------

59	Tchitos
----	---------

60	Notched pebbles
----	-----------------

61-63	Thermally altered rocks
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64-66	Ochre
-------	-------

CARD #	COLUMNS	VARIABLE	CODES	DESCRIPTION
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7

Cobbles and cobble fragments

67-68	Argillite
69-70	Basalt
71	Chalcedony
72-73	Chert
74	Obsidian
75	Quartz
76	Quartzite
77	Rhyolite
78-80	Other

8

Land

1 = Present
0 = Absent

2	Plain - flat
3	Plain - sloping
4	Mountain, hill, etc.
5	Crag and tail
6	Kame
7	Esker
8	Kettle
9	Moraine
10	Terrace - river
11	Terrace - kame
12	Ridge
13	Saddle
14	Valley
15	Lake shore
16	Stream margin
17	Stream confluence - minor streams
18	Lake outlet/inlet
19	Floodplain
20	River Margin
21	Stream & river confluence
22	River & river confluence

CARD #	COLUMNS	VARIABLE	CODES	DESCRIPTION
--------	---------	----------	-------	-------------

9

IMPACT ASSESSMENT FOR RESERVOIRS

1	Reservoir	0	N/A
		1	Devil
		2	Watana
2	Proximity	0	N/A
		1	Immediate
		2	Adjacent
3	Reservoir Zone	0	N/A
		1	1a
		2	1b
		3	2
		4	3
		5	4
6	5		
4-8	Vertical Distance from Reservoir	#	Feet (else blank)
9-13	Horizontal Distance from Reservoir	#	Feet (else blank)
<u>Expected Impact</u>			
14	Type	0	N/A
		1	Direct Impact
		2	Indirect Impact
		3	Potential Impact
		4	No Impact
15	Category	0	N/A
		1	Mechanical
		2	Biological
		3	Human & other
16	Level	0	N/A
		1	Large Scale
		2	Medium Scale
		3	Small Scale

CARD #	COLUMNS	VARIABLE	CODES	DESCRIPTION
--------	---------	----------	-------	-------------

9

IMPACT ASSESSMENT FOR OTHER PROJECT
FEATURES AND FACILITIES

FEATURE AND AREA

- | | |
|---|---------------------------------------------------------------------------------------------------------------|
| 0 | Other |
| 0 | - None |
| 1 | - Found by nonarcheologists |
| 2 | - Found in association with facility, feature, or area which was subsequently modified, relocated, or deleted |
| 3 | - Found prior to project commencement |
| 4 | - Found during geoarcheology studies |
| 5 | - Found by archeologist but not within 1/2 mile of project facilities or features |
| 1 | Access Route (AR) |
| 0 | - (Not required) |
| 2 | Access Route Borrow (ARB) |
| 0 | - (Note required) |
| 3 | Borrow (B) |
| 1 | - Borrow Area C |
| 2 | - Borrow Area E |
| 3 | - Borrow Area F |
| 4 | - Borrow Area H |
| 5 | - Borrow Area I |
| 6 | - Borrow Area J |
| 4 | Geotechnical Area |
| 0 | - (Not Required) |
| 5 | Recreation Area (RA) |
| 1 | - Recreation Area D |
| 2 | - Recreation Area H |
| 3 | - Recreation Area I |
| 4 | - Recreation Area J |
| 5 | - Recreation Area K |
| 6 | - Recreation Area L |
| 7 | - Recreation Area Q |

CARD #	COLUMNS	VARIABLE	CODES	DESCRIPTION
--------	---------	----------	-------	-------------

9

- | | | |
|---|--------------------------|-------------------------------------------------------------------------------------------------------------|
| 6 | Railroad | 0 - (Not required) |
| 7 | Transmission Route | 1 - Healy to Fairbanks
2 - Willow to Anchorage
3 - Watana Dam to Intertie |
| 8 | Watana Construction Area | 1 - Permanent Airstrip
2 - Watana Construction Camp
3 - Watana Construction Village
4 - Watana Dam |

Proximity

- | | |
|---|-----------|
| 0 | N/A |
| 1 | Immediate |
| 2 | Adjacent |

Vertical Distance from Facility or Feature	#	Feet (else blank)
--------------------------------------------------	---	-------------------

Horizontal Distance from Facility or Feature	#	Feet (else blank)
----------------------------------------------------	---	-------------------

Expected Impact

- | | | |
|------|---|------------------|
| Type | 0 | N/A |
| | 1 | Direct Impact |
| | 2 | Indirect Impact |
| | 3 | Potential Impact |
| | 4 | No Impact |

- | | | |
|----------|---|---------------|
| Category | 0 | N/A |
| | 1 | Mechanical |
| | 2 | Biological |
| | 3 | Human & other |

- | | | |
|-------|---|--------------|
| Level | 0 | N/A |
| | 1 | Large Scale |
| | 2 | Medium Scale |
| | 3 | Small Scale |

<u>CARD #</u>	<u>COLUMNS</u>	<u>VARIABLE</u>	<u>CODES</u>	<u>DESCRIPTION</u>
---------------	----------------	-----------------	--------------	--------------------

9

Feature or Facility 1

17	Feature
18	Area
19	Proximity
20-24	Vertical Distance
25-29	Horizontal Distance
30	Type
31	Category
32	Level

Feature or Facility 2

33	Feature
34	Area
35	Proximity
36-40	Vertical Distance
41-45	Horizontal Distance
46	Type
47	Category
48	Level

Feature or Facility 3

49	Feature
50	Area
51	Proximity
52-56	Vertical Distance
57-61	Horizontal Distance
62	Type
63	Category
64	Level

Feature or Facility 4

65	Feature
66	Area
67	Proximity
68-72	Vertical Distance
72-77	Horizontal Distance
78	Type
79	Category
80	Level

APPENDIX C - TEPHRA ANALYSIS

APPENDIX C - TEPHRA ANALYSIS

C.1 - Introduction

Tephra (volcanic ash) layers were identified at most of the sites found during the cultural resources survey. At least three, and possibly four, tephras were identified in the field and samples were collected from various sites within the study area. Analysis was conducted on samples taken from terrestrial settings. Tephras found in lacustrine settings are discussed in Chapter 8.

The petrographic study discussed here was conducted to: 1) determine whether the soil/sediments identified in the field as tephra were, in fact, tephra; 2) characterize the mineralogy and glass shard morphology of the tephra; and 3) determine the number of tephras present. Successful discrimination of the tephras provided a method to correlate and date archeological components within the Susitna River valley.

The 29 samples analyzed were selected from ten systematically tested sites, distributed across 48 km adjacent to the Susitna River (Figure C.1). These specimens provided a representative suite of samples, both stratigraphically and geographically within the project area. (Table C.1). Analysis of these samples should accurately characterize the tephras present in the valley.

C.2 - Analytical Methods

The samples were prepared following the procedure suggested by Steen-McIntyre (1977). The volume of material used and the color of each sample (when moistened) were recorded. The samples were then rinsed several times in distilled water, and the suspended fines and floating organic material were decanted off. Three to five times the sample's volume of sodium hypochlorite (household bleach) was then added to each sample and the mixture heated in a boiling water bath for 15 minutes to remove any organic cementing agents (Steen-McIntyre 1977).

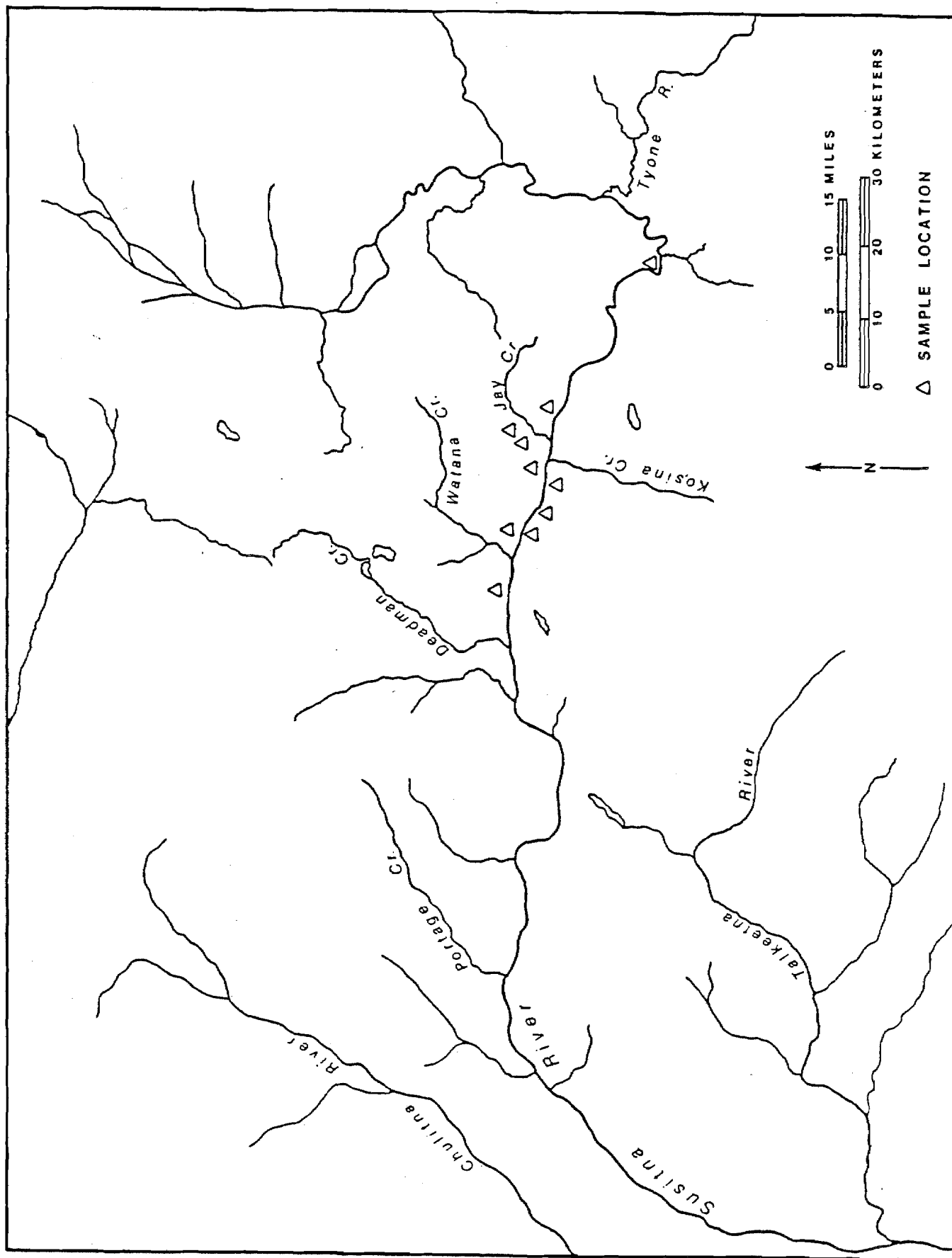


Figure C.1. Sample Location Map

Table C.1

Stratigraphic Location of Samples from the Susitna Tephra

Strati- graphic Location	Sample Sites									
	TLM 039	TLM 040	TLM 042	TLM 043	TLM 046	TLM 062	TLM 069	TLM 128	TLM 130	TLM 143
Devil	X	X		X	X	X		X	X	X
Oxidized Watana	X		X					X	X	X
Unoxidized Watana	X				X		X	X	X	X
Oshetna	X	X		X	X	X	X	X	X	X

The liquid was then decanted off and the sample was rinsed once with distilled water. Suspended fines were again decanted off. A solution of 6 N hydrochloric acid was then added to the samples to dissolve iron oxide cement. After the acid was decanted off, the sample was rinsed twice with distilled water and air dried. After drying, the samples were sieved using 16 mesh (1 mm), 32 mesh (0.5 mm), 60 mesh (0.25 mm), and 250 mesh (0.062 mm) sieves. The volume of each size fraction was recorded. The sample size used in the petrographic analysis consisted of grains between 60 and 250 mesh (0.25 and 0.063 mm). This fraction was washed in distilled water in a sonic cleaner for 10 to 15 minutes. The procedure was then repeated using acetone, and then the sample was air dried. Once dry, this fraction was again screened using a 250 mesh sieve. The -250 mesh fraction was discarded, while the +250 mesh fraction was stored for analysis.

Grain mounts were made by mixing a small portion of each sample with several drops of histoclad on a glass slide, and allowing the histoclad to set. Each sample was mixed thoroughly before a small scoop of it was taken in an attempt to get a representative split.

Each sample was examined under binocular and petrographic microscopes. Four hundred to six hundred grain counts were made of 16 samples using Galehouse's (1969) area method. All grains within the field of view at 100x magnification were counted, and each sample had four fields of view counted. The percentage of mineral grains in each sample was then calculated.

Nineteen samples from the Devil, Oxidized Watana, and Unoxidized Watana tephras had 98 to 160 grain counts of their glass fraction to characterize the glass shard morphology of the tephras. Three samples were counted three times to test the reproducibility of the grain counts. The results are listed in Table C.2 and suggest that the grain counts are accurate to within ± 6 percent.

Table C.2

Reproducibility of Glass Shard Counts

Sample	Count 1		Count 2		Count 3		Mean	Standard Deviation
	% Scoria	% Vesic.	% Scoria	% Vesic.	% Scoria	% Vesic.		
ATC- 0006	28.8	71.1	43.8	56.2	42.2	57.8	38.3	6.7
ATC- 0015	28.7	71.3	50.5	49.5	51.5	48.5	43.6	10.5
ATC- 0019	86.6	13.4	91.1	8.9	89.4	10.6	89.04	1.8

Where % scoria = percent scoriaceous glass shards; % vesic. = percent vesicular glass shards.

Eight samples were examined using a scanning electron microscope (SEM) to make a high magnification study of glass shard morphology. The eight samples were glued to aluminum stubs using a thinned carbon adhesive, and then coated with a thin layer of gold using an SPI sputter coater. The coater was run for eight minutes to reduce the amount of sample charging. Samples were scanned at 100x and then photographs were taken at higher magnification (220x to 1000x).

C.3 - Granulometric Analysis

Granulometric analyses were conducted on 15 samples. Many of the samples were too small (less than 5 milliliters) to conduct acceptable analyses. The results are listed in Table C.3 and are shown graphically in Figure C.2. The small standard deviation of the Oxidized Watana tephra is due to the small number of samples, and not to high precision of the data. The analyses indicate that the tephras are dominated by the fine silt and clay-sized fraction (-250 mesh). The coarse sand fraction generally represented an insignificant portion of the sample.

C.4 - Appearance Under Binocular Microscope

Glass appears as white grains under a binocular microscope. Transparent and translucent grains exhibit both cleavage surfaces and conchoidal fracture, suggesting that a portion of the transparent grains are feldspar.

(a) Devil Tephra

This tephra is dominated by white angular grains, followed in decreasing abundance by transparent and translucent grains, green laths, and opaque minerals. The white glass commonly mantles the green laths.

(b) Oxidized Watana Tephra

White glass shards are the dominant grain followed by transparent and translucent grains, green laths, and opaque minerals. White glass

Table C.3.

Grain Size Analysis for 15 Susitna Tephra

Sample #	Vol. % +60 mesh	Vol. % -60 +250 mesh	Vol. % -250 mesh	Stratigraphic Location
ATC-0001	3	17.4	79.6	Devil
ATC-0002	3	16.3	81.7	O. Watana
ATC-0003	0.0	22.1	77.9	U. Watana
ATC-0004	34.8	39.1	26.1	Oshetna
ATC-0006	tr	17.9	82.1	O. Watana
ATC-0007	tr	24.1	75.9	U. Watana
ATC-0008	tr	23.8	76.2	U. Watana
ATC-0009	3	23.6	73.4	Oshetna
ATC-0010	tr	20.0	80.0	Devil
ATC-0012	0.0	18.3	81.7	U. Watana
ATC-0013	tr	35.5	64.5	Oshetna
ATC-0017	tr	19.0	81.0	U. Watana

Table C.3. (Continued)

Sample #	Vol. % +60 mesh	Vol. % -60 +250 mesh	Vol. % -250 mesh	Stratigraphic Location
ATC-0019	0.0	36.9	63.1	U. Watana
ATC-0025	4.3	30.2	65.5	Devil
ATC-0028	3	19.8	77.2	Devil

Devil: Mean^{*} = 21.9, Standard Deviation = 4.9

O. Watana: Mean^{*} = 17.0, Standard Deviation = 1.1

U. Watana: Mean^{*} = 24.0, Standard Deviation = 6.2

Oshetna: Mean^{*} = 32.7, Standard Deviation = 6.5

* Mean of Vol. % - 60 ± 250 mesh

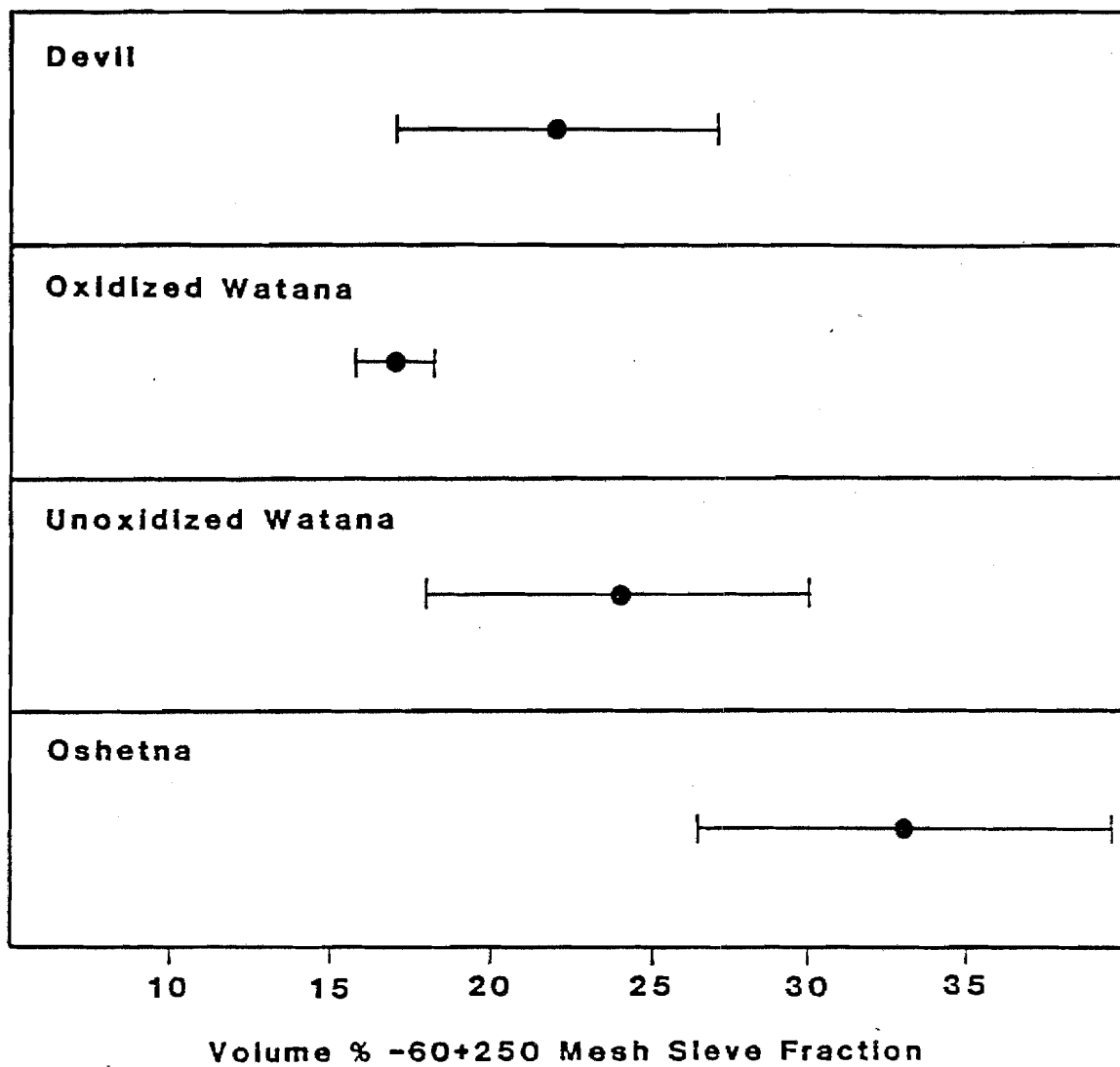


Figure C.2. Granulometric Analysis of Susitna Tephras

(c) Unoxidized Watana Tephra

The Unoxidized Watana appears quite similar to the Oxidized Watana. Biotite is also a minor constituent of this tephra.

(d) Oshetna Tephra

Transparent and translucent fragments are the dominant grains, followed by green crystal fragments, and opaque minerals. White glass is a rare constituent of the tephra. The green crystals are generally short angular flakes without glass mantles. Biotite is more abundant in this tephra than in the others.

C.5 - Mineralogy

(a) Hornblende

Two varieties are present: 1) euhedral to subhedral laths having green to olive green, or dark green pleochroism, and 2) subhedral to anhedral fragments with green to blue-green pleochroism. The euhedral to subhedral green laths are the dominant type in the Devil, Oxidized Watana, and Unoxidized Watana tephtras, while the blue-green variety is common only in the Oshetna tephra. The green laths are commonly mantled by glass and usually contain inclusions of opaque minerals. The blue-green variety lacks attached glass, and is generally free of opaque inclusions. Both amphiboles are biaxial negative and exhibit some twinning.

(b) Orthopyroxene

Orthopyroxene occurs as biaxial negative hypersthene. The hypersthene is subhedral to euhedral and is commonly mantled by glass. This is true even in the glass-poor Oshetna tephra. The phenocrysts range between 0.02 and 0.3 mm in length, are length slow, and have either pale green to pink, or pale green to yellow, pleochroism. The hypersthene commonly occurs as interpenetration twins. Inclusions in the phenocrysts include

opaque minerals and smaller crystals of orthopyroxene. The mineral is uncommon in the three upper tephras, and only reaches relatively abundant levels in the Oshetna tephra.

(c) Plagioclase

Two populations of the mineral are present. The most abundant variety consists of anhedral, angular to subangular, grains lacking attached glass. The birefringence increases towards the center of these grains indicating a platy habit which is thickest at the middle. Zoning is common, while twinning is not. The lack of albite twins made it impossible to estimate anorthite composition.

The second variety is less common and is characterized by low birefringent euhedral to subhedral grains, mantled by glass, and having albite and carlsbad twins. Concentric and oscillatory zoning are common in this variety of plagioclase. Compositional estimates, using the Michel-Levy method (Kerr 1977), ranged between An_{25} and An_{41} for the Devil tephra, An_{25} and An_{49} for the Oxidized Watana, An_{23} and An_{30} for the Unoxidized Watana, and between An_{30} and An_{32} for the Oshetna tephra.

(d) Opaque Minerals

These minerals generally occur as subhedral to anhedral grains less than 0.2 mm in diameter. Opaque minerals are common inclusions in glass, plagioclase, orthopyroxene, and hornblende. The cubic shape of the grains suggests that they are magnetite.

(e) Quartz

Quartz is present in the tephra in unknown quantities and is recognized by its conchoidal fracture, low birefringence, low relief, and uniaxial positive interference. It appears as anhedral angular grains lacking glass mantles. The similarity in appearance between quartz and the plagioclase lacking glass mantles resulted in the two grains being lumped together in the grain counts.

(f) Minor Accessory Minerals

Biotite occurs as anhedral, subangular to subrounded, red-brown to yellow-brown pleochroic grains. It is a rare mineral in the Oxidized Watana, Unoxidized Watana, and Oshetna tephtras. None of the grains seen had any attached glass. Clinopyroxene, zircon, and apatite are also present in trace amounts in the four tephtras. The clinopyroxene is characterized by its pale green nonpleochroic color in plane light, its biaxial positive interference and inclined extinction. It is subhedral to anhedral and is most common in the Oshetna tephtra. Zircon is present as anhedral to euhedral grains. It is recognized by its very high relief and birefringence, parallel extinction, and its uniaxial positive interference. None of the zircon has any attached glass. Apatite occurs as small inclusions in plagioclase phenocrysts.

C.6 - Grain Count Analyses

Sixteen samples had between 350 and 700 grains counted to get an accurate estimate of the percentage of different minerals in each sample. The samples were grouped according to stratigraphic position and the mean and standard deviation for each mineral were calculated. The mean values are listed in Table C.4. Figures C.3, C.4, and C.5 compare the mean and deviation for each mineral in all four tephtras. The only case where the mineralogy is different is in the Oshetna tephtra, where the percentage of glass shards is much lower, and the percentages of plagioclase and quartz much higher, than in the other tephtras.

C.7 - Glass Shard Morphology

The glass shards in these tephtras have morphological characteristics typical of rhyolitic glasses (Heiken 1972). They are vesicular, with the shape of the vesicles controlling the shape of the shards. Two types of glass shards were observed: 1) grains with relatively few vesicles resulting in the glass appearing transparent and angular in plane light, and 2) scoriaceous grains with subangular to subrounded

Table C.4

Mean Percentage Values for Grain Counts of Susitna Tephra

Tephra	Hb	Bio	Opx	Cpx	Opq	Pl/Q	Pl/G	Zirc	Gl	Lith
Devil	14.0	0.1	0.6	0.0	2.5	26.4	7.2	0.2	48.4	0.5
Oxidized										
Watana	11.4	0.4	0.6	0.1	2.9	41.1	8.5	0.3	34.2	0.5
Unoxidized										
Watana	15.1	0.1	0.2	0.0	3.1	21.9	12.9	0.0	46.3	0.3
Oshetna	9.4	0.3	2.8	0.3	4.2	75.6	2.3	0.6	3.1	1.3

Hb = Hornblende

Bio = Biotite

Opx = Orthopyroxene

Cpx = Clinopyroxene

Opq = Opaque minerals

Pl/Q = Plagioclase and quartz lacking glass mantles

Pl/G = Plagioclase with glass mantles

Zirc = Zircon

Gl = Glass

Lith = Lithic fragments

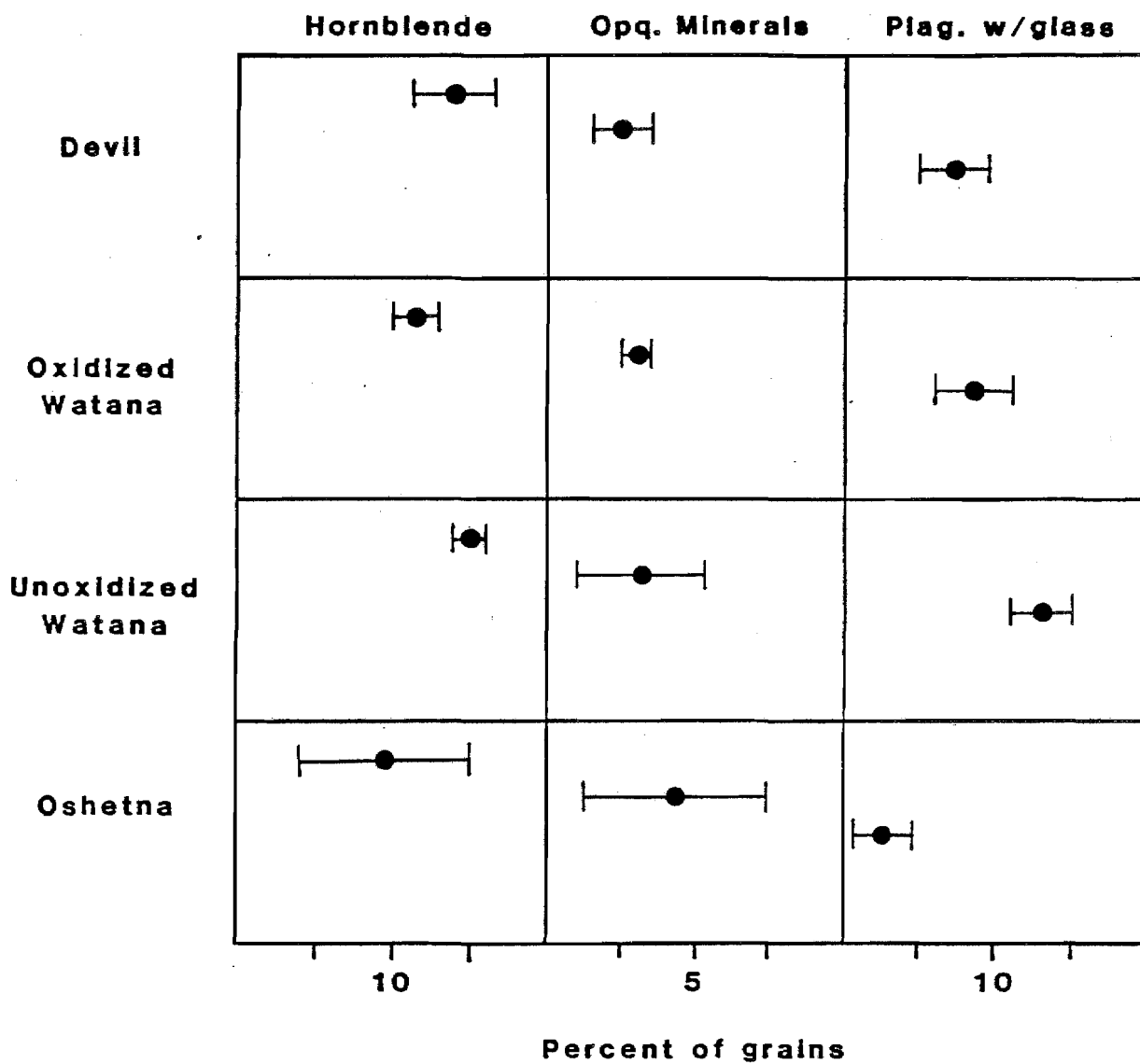


Figure C.3. Percentages of Minerals in the Susitna Tephra

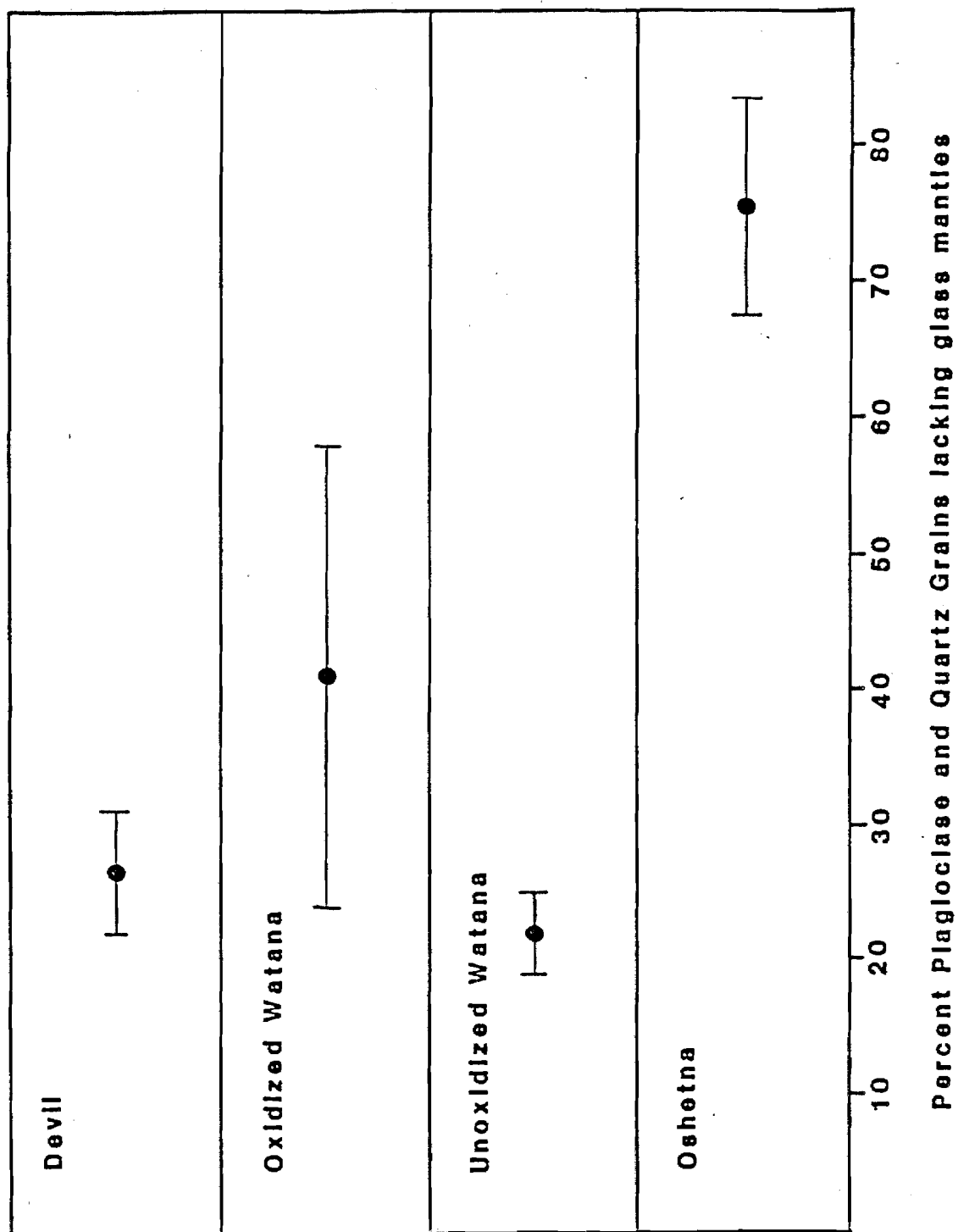


Figure C.4. Percentage of Plagioclase and Quartz Grains Lacking Glass Mantles in the Susitna Tephra

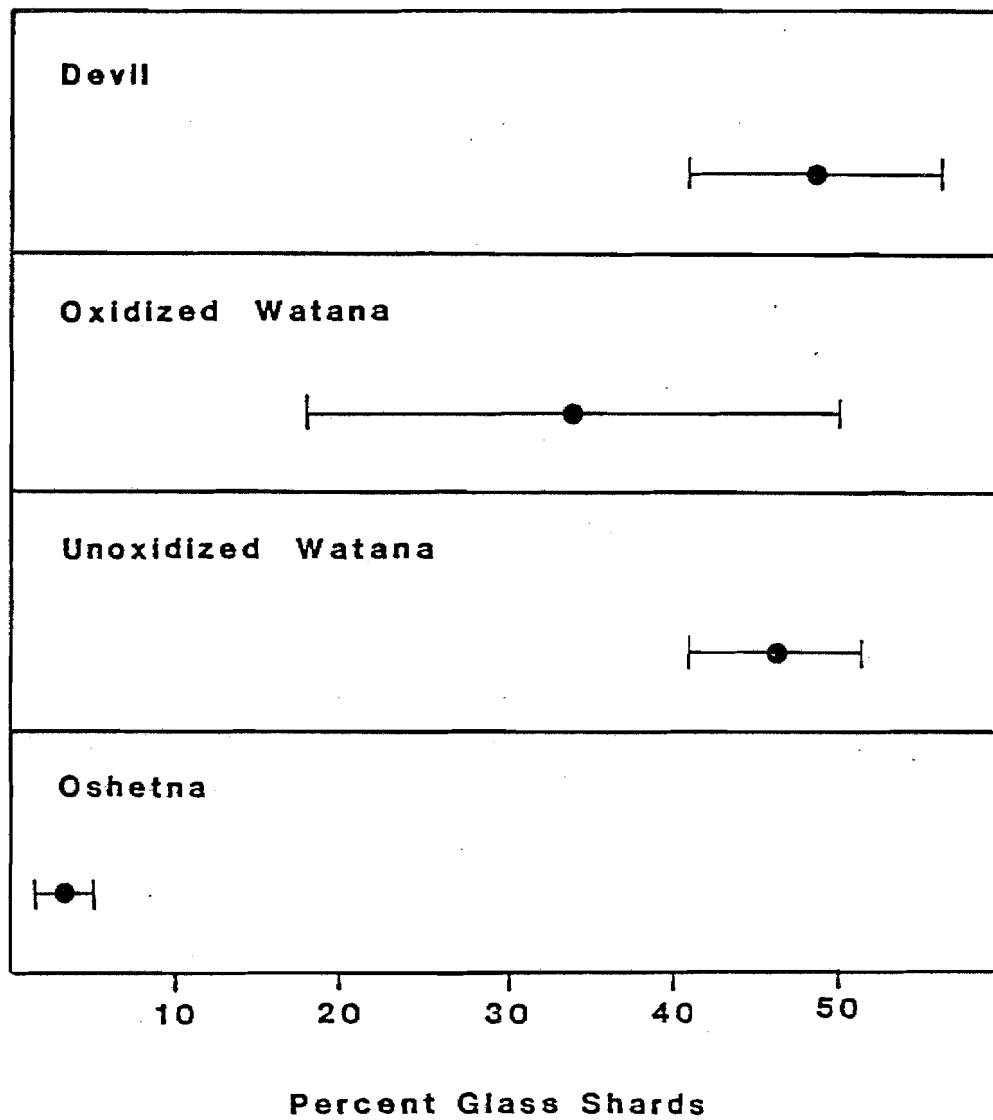


Figure C.5. Percentage of Glass Shards in the Susitna Tephras

shapes. This second type of glass shard appears brownish in plane light because the numerous small vesicles tend to refract the light rather than allowing it to pass through relatively undisturbed. Vesicle shapes range from tubelike to spherical.

Point counts of the two glass shard types were conducted on 19 grain mounts and the results are shown in Table C.5. The means and standard deviations for each of the three tephras were calculated, and are listed in Table C.6, and shown in Figure C.6.

The Oshetna tephra was not counted because of the low abundance of glass shards.

Two cases are shown for both Oxidized and Unoxidized Watana tephras. In each group one sample had very low counts of scoriaceous glass, which resulted in the large standard deviations seen in case 1. Removal of these samples resulted in the higher mean values and smaller standard deviations seen in case 2. It is unclear why these samples had such low counts. Examination of the grain mounts does not suggest that they are in any other way unusual.

C.8 - Discussion

The presence of individual glass shards and glass shards adhering to minerals in all 29 samples indicates that the four layers seen in the field are tephras. The tephras are very fine grained, with only a minute portion of the sample coarser than 60 mesh (0.25 mm). The large standard deviations for the sieve analyses do not allow for discrimination of any of the tephras. The mineralogy of the tephras is remarkably uniform and consists of plagioclase, hornblende, opaque minerals, orthopyroxene, quartz, biotite, clinopyroxene, zircon, and apatite in decreasing order of abundance. Two types of plagioclase and hornblende are present in the tephras. Those phenocrysts that have attached glass can be attributed to the tephras, however the origin for the blue-green variety of hornblende and the plagioclase lacking glass mantles is uncertain. The angular shapes of these latter grains do not

Table C.5

Scoriaceous vs. Vesicular Glass Shards

Sample	% Scoriaceous	% Vesicular	Stratigraphic Location
ATC-001	41.9	59.1	Devil
ATC-0002	58.8	41.2	O. Watana
ATC-0003	88.8	11.2	U. Watana
ATC-0005	43.9	56.1	Devil
ATC-0006	40.0	60.0	O. Watana
ATC-0007	88.2	11.8	U. Watana
ATC-0008	54.3	45.7	U. Watana
ATC-0010	14.4	84.6	Devil
ATC-0011	49.5	50.5	O. Watana
ATC-0012	28.0	72.0	U. Watana
ATC-0015	40.0	60.0	Devil
ATC-0017	63.11	36.9	U. Watana
ATC-0018	22.2	77.8	Devil

Table C.5. (Continued)

Sample	% Scoriaceous	% Vesicular	Stratigraphic Location
ATC-0019	83.0	17.0	U. Watana
ATC-0021	28.4	71.6	Devil
ATC-0022	21.3	78.7	O. Watana
ATC-0023	58.4	41.6	U. Watana
ATC-0025	28.9	71.1	Devil
ATC-0027	56.4	43.6	O. Watana

Table C.6

Means and Standard Deviations for Devil, Oxidized Watana, and Unoxidized Watana Tephra Glass Shard Counts

Tephra	No. of Samples Used	Mean	Standard Deviation
Devil	7	31.5	10.0
O. Watana (1)	5	45.2	13.6
O. Watana (2)	4	51.2	7.3
U. Watana (1)	7	66.3	20.5
U. Watana (2)	6	72.6	14.4

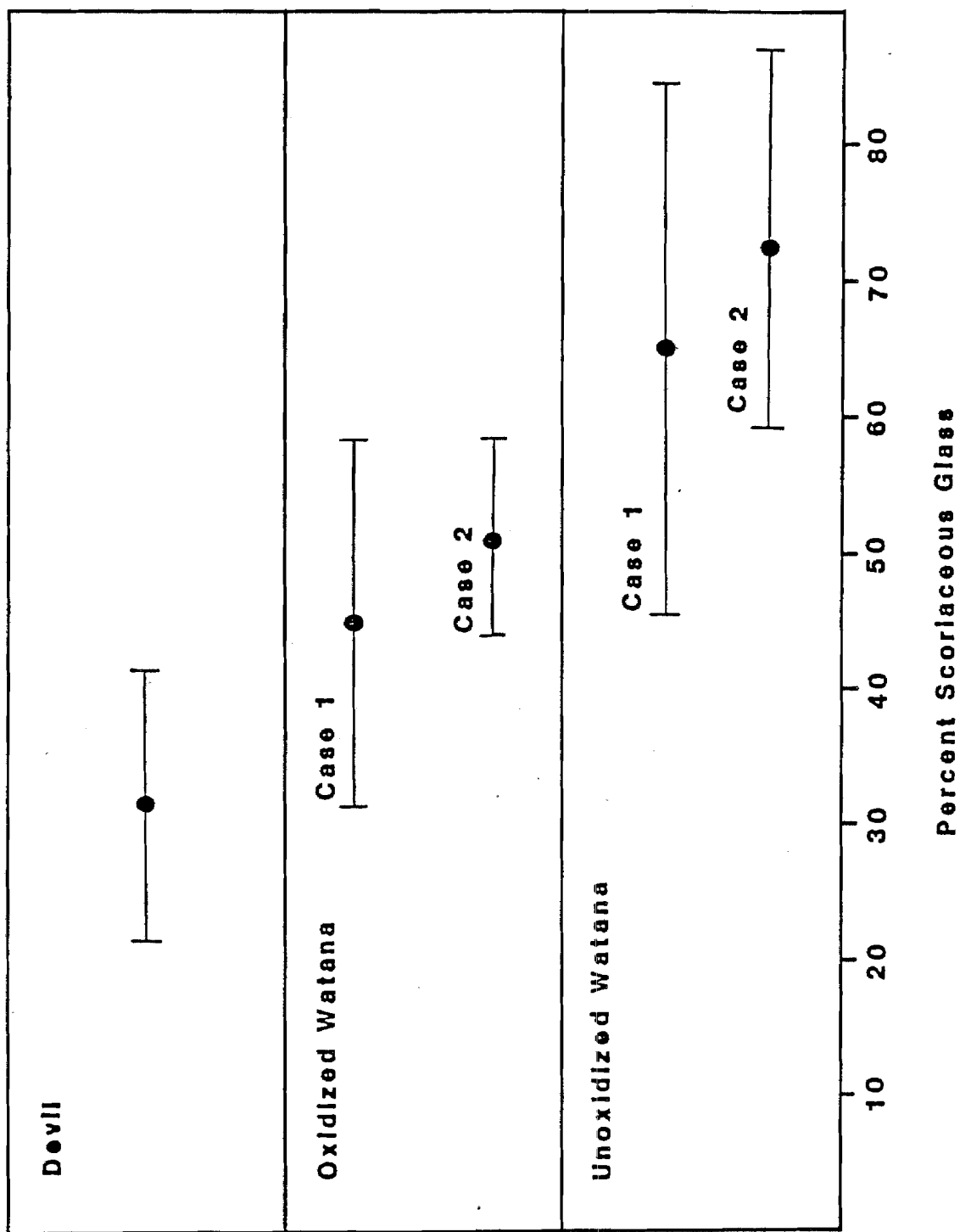


Figure C.6. Percentage of Scoriaceous Glass in the Devil and Watana Tephra

indicate much, if any, transport, yet the differences between them and the phenocrysts which do have glass mantles suggest a different origin. Similar problems arise in interpreting the origin of the quartz, zircon, and biotite. Without attached glass it is unclear whether these minerals represent detrital contaminants or primary volcanic material.

Of the four tephras, only the Oshetna can be distinguished on the basis of mineralogy. Figures C.3 and C.4 show that it has a much higher percentage of plagioclase and quartz, and a much lower percentage of glass shards, than any of the other tephras.

Based on glass morphology, the Devil and Unoxidized Watana tephras can be distinguished with a fair degree of confidence. Table C.4 shows that all of the Devil tephra samples have less than 50% scoriaceous glass shards, while 57% of the Unoxidized Watana tephra have greater than 60% scoriaceous glass shards, and 86% have greater than 50% scoriaceous glass shards. The Oxidized Watana tephra has percentages of scoriaceous glass shards which overlap the fields of the two other tephras.

C.9 - Conclusions

Three out of the four tephras can be distinguished based on this petrographic study. While stratigraphic evidence suggests that the Oxidized Watana tephra is a separate unit from the Unoxidized Watana and the Devil tephras, the petrographic evidence is unclear. The remarkable mineralogic similarities between the three upper tephras suggest that they are derived from the same volcanic vent. If this is the case, geochemical studies of the glass shards and phenocrysts will probably be needed to clarify the distinctions between the three upper tephras. The Oshetna tephra is clearly distinguishable from the other tephras due to the differences in mineralogy and the proportion of glass shards. These differences may be due to its greater age or a different source. It is generally agreed that tephra correlation must be based upon several criteria, and not on a single criterion (Westgate and Gorton 1981). Stratigraphic and petrographic data are now available for the Susitna tephras, and geochemical studies of the tephras would aid in clarifying

the distinctions between tephra units. Numerous authors have used geochemistry to distinguish between tephras, as well as identifying several tephras in a layer which was thought to be a single unit (Smith and Westgate 1969; Izett 1970 et al.; Westgate 1977; Scheidegger et al. 1978; Westgate and Evans 1978; and Larsen 1981).

In addition to the geochemical analyses, detailed petrographic work would probably reduce the variance in the analyses that have been conducted and may clarify the distinctions between the three upper tephras.

C.10 - Archeological Significance

The petrographic analysis largely agrees with the field evidence that there are three, and probably four, tephra units in the Susitna River valley. This corroborating evidence should give a high degree of confidence to the correlation of components from different sites which are found between the same tephra units. These analyses may also aid correlation of components associated with tephra in other parts of south-central Alaska, where the tephras can be shown to be identical to the Susitna tephras.