Yukon-Charley Rivers National Preserve

National Park Service
U.S. Department of the Interior

Yukon-Charley Rivers National Preserve
P{.OP. Box 1677
Eagle, Alaska 99738

Geology Down the Yukon

Introduction

Yukon-Charley Rivers National Preserve is one of the rare locations in North America where so much of geologic history is preserved (**FIGURE 1**) (Precambrian era to the Cenozoic). The Yukon River meanders through the preserve for a distance of approximately 130 river miles and drops about 200 feet along its route. The Yukon River and its tributaries cut rough-hewn cliffs, exposing remarkably complete records of the floral and faunal history of Eastcentral Alaska.

Glaciation

Since less than five percent of the preserve was ever glaciated, most of the geologic and paleontologic records are not buried under glacial debris. Glaciers that did form were not broad ice sheets, but alpine glaciers formed only in the highest portions of the Charley and Seventymile river drainages.

Tintina Fault

The Tintina Fault (**FIGURE 2**) divides the preserve into two distinct geologic areas. The Tintina Fault is a strike-slip fault* that runs parallel to the Yukon River corridor six to twelve miles south of the river. This fault is one of the great fault systems in western North America, extending 600 miles from northeastern British Columbia into Alaska.

Northeast of the Tintina Fault, the greatest bedrock diversity occurs in a triangle formed by the Nation and Yukon Rivers and the Canadian border. This triangular area is the only portion of Eastcentral Alaska thought to be part of theoriginal North American plate and it comprises a sequence of unmetamorphosed* sediments* (Precambrian, Cambrian, Ordovician, Silurian, Devonian, and Mississippian). These sedimentary rocks were once part of a continental margin and contain an outstanding record of marine faunal evolution that includes ammonites, trilobites, brachiopods, and corals. The oldest known microfossils* from northwestern North America are also found in this triangular area.

The area southwest of the Tintina Fault is a sequence of complex igneous* rocks, metamorphic* sedimentary rocks, and volcanic rocks. These rocks were probably metamorphosed and reformed when several small plates collided to form Alaska during the Cretaceous.

Geologic Features

While floating the Yukon River between Eagle and the northwestern boundary of the preserve, you can observe many of the unique geological features described above by following the river maps and lettered descriptions attached. **FIGURE 1** shows the given names and ages of the rock formations along the Yukon River and the associated biological development. **FIGURE 2** shows the location of the Tintina Fault and where different rock types are located.

Geologic Features Map 1

A. Eagle Bluff, the rust colored cliff dominating the skyline northwest of town, is composed mainly of greenstone*****. The rusty color results from oxidation of iron in the greenstone. Thick veins of quartz cut through the bluff.

B. Folded and faulted layers of shale*****, sandstone, mudstone*****, and conglomerate***** are exposed on the left side of the river between Eagle Bluff and Sixmile Bend. This is the Nation River Formation (Devonian).

C. Thick conglomerates in the Nation River Formation form cliffs on the right side of the river at Sixmile Bend and probably represent a filled channel on the sea floor (Devonian).

D. As one rounds Sixmile Bend, a vibrant red slope dominates the distant scenery. This slope is near the mouth of the Seventymile River and is composed of Ford Lake Shale (Devonian – Mississippian). Oxidation of iron also causes this brilliant orange-red color.

E. Simon's Bluff, just past Sixmile Bend, is also composed of Ford Lake Shale. Large, round, yellow nodules are common in the shale.

F. Calico Bluff welcomes the river traveler to Yukon-Charley Rivers National Preserve. Rhythmically layered limestone***** and shale constitute the Calico Bluff Formation (Mississippian and Pennsylvanian). The spectacular folds and faults are evidence of the compressional forces in the earth. The yellow-green layers in the center of the bluff are black shale that has been coated with sulfur, a typically abundant substance in organic shale. Ford Lake Shale is visible once again on the downriver side of Calico Bluff.

G. High above the next bend is a jagged light gray outcrop known as the Limestone Hogback. It is composed of Funnel Creek Limestone (Cambrian). This resistant, siliceous* limestone typically forms massive cliffs.

H. Upstream from the mouth of the Seventymile River, a striking bluff displays vertically oriented rocks. This formation is the Step Conglomerate (Permian), which is composed of mudstone, shale, sandstone, and conglomerate.

I. Barren cliffs downstream from the mouth of the Seventymile River expose sandstone, mudstone, conglomerate, and coal (Cretaceous and Tertiary).

J. Looking toward the Tatonduk River drainage on a clear day, you see a panoramic view of the Ogilvie Mountains. These mountains are composed almost entirely of limestone and dolomite***** (Early Paleozoic).

Map 2

K. Montauk Bluff is a part of the Nation River Formation. On this bluff and the adjacent ridge are exposures of chert*-pebble conglomerate, shale, and fine, olive-gray sandstone. This formation is found extensively throughout this section of the preserve.

L. Graceful arches of Tahkandit Limestone flank the Yukon River on both banks just upriver of the mouth of the Nation River. These beige to very pale orange ridges form the north flank of the Michigan Creek Anticline*. The Tahkandit Limestone, which tends to form massive cliffs, overlies the less resistant mudstone of the Nation River Formation.

Map 3

M. The roar of the turbulent water prepares the traveler for Rock of Ages, a dramatic expression of bedrock withstanding the scour and abrasion of the silt-laden Yukon. The location of Rock of Ages is incorrect on USGS topographic maps. The map provided shows its actual location, which is downstream from the location shown on USGS maps. Extending from the surface of the Yukon River near the left bank, this outcrop is composed mainly of dolomite (Precambrian Tindir Group). Low water in late summer and fall exposes a large part of the outcrop. Rock of Ages is appropriately named because the Tindir Group is the oldest unit in the preserve, and it was deposited before the evolution of shelled fossils.

N. Glenn Shale (Triassic – Cretaceous) is exposed along the Yukon near Glenn Creek, for which it is named. Glenn Shale is predominantly grayish-black carbonaceous***** shale.

O. Directly across from Washington Creek rises Kathul Mountain. Blocky outcrops between grassy slopes and the crest of the mountain are chiefly conglomerate and sandstone. Kathul Graywacke***** forms prominent ridges and extends continuously from Kathul Mountain to the middle and upper reaches of the Kandik River. Fossils indicate marine origin for the Kathul Graywacke (Cretaceous).

Map 4

P. Four miles downriver from the mouth of the Kandik River, Biederman Bluff rises 1,000 feet. The bluff is composed of Biederman Argillite***** (Cretaceous), which exhibits rhythmic bedding of argillite, siltstone, and sandstone. The dark gray and black layers are a few inches to many feet thick.

Q. Downstream from Biederman Bluff, the granitic* mountains of the upper Charley River grace the southern horizon.

R. Chester Bluff is composed of finely layered Biederman Argillite, which is overlain by deposits of a river terrace. These sedimentary deposits are composed of light brown sand and silt and were deposited by the Yukon River when the floodplain was at a higher level. The Yukon subsequently cut down through these deposits and established a floodplain at the present level.

Map 5

S. Biederman Argillite again surfaces where Coal Creek meets the Yukon. An easy one mile hiking trail begins near the mouth of Coal Creek and takes you to the Coal Creek dredge. The dredge was constructed to mine placer* gold deposits. Pick up a self guided dredge tour brochure at the Slaven's Roadhouse or at the dredge. Please exercise caution when walking in and around the dredge. Recreational gold panning in Coal Creek is allowed; however, gold pans and tablespoons are the only tools permitted.

T. Much of the lower section of the Yukon River within the preserve is divided among several volcanic rock sequences providing a considerable array of rock types and features. McGregor Bluff introduces the traveler to the Woodchopper Volcanics. This formation produces prominent bluffs along the river for the next 20 miles.

Map 6

U. The needle-like spires of Takoma Bluff (Precambrian) suggest a medieval castle rising along the Yukon River. Swirling eddies allow the river traveler to examine the thinly layered limestone and dolomite. The needle-like features have developed through dissolution. During this process, water penetrates into vertical fractures and slowly dissolves the bedrock.

V. A few miles downstream from Takoma Bluff a large landslide on private land nearly destroyed a cabin and dammed a major slough in 1983. The down slope movement of unconsolidated material was helped by excessive moisture.

W. The bluffs just downstream from the landslide are composed of rocks known as the Circle Volcanics (Paleozoic and early Mesozoic) and look similar to the Woodchopper Volcanics. They are composed mostly of dark, greenish-gray basalt*****. However, some chert, quartzite*****, and argillite can be found throughout the formation.

Yukon Flats

You now leave Yukon-Charley Rivers National Preserve and enter the easternmost portion of the Yukon-Flats National Wildlife Refuge. The Yukon River can be difficult to navigate through the braided channels of the Yukon-Flats, so be sure to check your river maps.

The flats are composed mainly of silt, floodplain, and river terrace deposits. The village of Circle is located on the west bank of the Yukon approximately 15 miles downstream from the preserve boundary.

Conclusion

The sequence of rocks along the Yukon River demonstrates a relatively intact record of the geologic events over a 600 million year time span. As a river traveler, you have witnessed the erosional power of the Yukon as it exposes older formations and deposits new sediments along its course.

Today geologic processes continue within the Yukon River corridor. The diverse, uniquely beautiful arrays of rock formations along the river provide the visitor with a wealth of information about the geologic past of Eastcentral Alaska.

Glossary

ANTICLINE: A fold in the rock that resembles an arch; the fold is convex upward, and the oldest rocks are in the middle.

ARGILLITE: A rock composed mainly of clay-sized particles, which has been lithified (hardened) to a greater degree than shale.

BASALT: A dark-colored volcanic rock composed of calcium feldspar and pyroxene, and in some cases, olivine.

CARBONACEOUS: Composed of, containing, or yielding carbon.

CHERT: A variety of microcrystalline quartz. Chert may be almost any color. Black chert is flint. Red chert is jasper. Chert may be disseminated throughout a rock or may be in layers or nodules.

CONGLOMERATE: A coarse-grained sedimentary rock composed of rounded fragments cemented in a fine-grained matrix of sand or silt.

CONTINENTAL MARGIN: The region between the shoreline of a continent and the deep ocean basins, including the continental shelf, continental slope, and the continental rise. Also the region where thick granitic continental crust joins thinner basaltic oceanic crust.

DOLOMITE: Calcium-magnesium carbonate. Typically formed by alteration of limestone.

FAULT: A fracture or fracture zone along which there has been movement of the blocks relative to one another parallel to the fracture. A reverse fault is one in which the block above the plane of the fault has moved up relative to the block below the fault. A normal fault is one that the upper block has moved down.

FORMATION: The primary unit of stratigraphy. A formation must be mapable and possess distinguishing characteristics.

GRANITIC: Composed of granite (medium to coarse grained igneous rock consisting of potassium feldspar and quartz).

GRAYWACKE: A sandstone containing quartz, feldspar, and rock fragments in a clay matrix.

GREENSTONE: Volcanic rock, such as an andesite or basalt, that has been metamorphosed by high temperature and pressure.

IGNEOUS: Formed by solidification of magma (molten rock).

LIMESTONE: A sedimentary rock consisting chiefly of calcium carbonate (calcite).

QUARTZITE: A metamorphic rock composed mostly of quartz formed by recrystallization of sandstone.

MARGIN: See continental margin.

MICROFOSSILS: Microscopic fossils such as pollen, spores, or bacteria.

METAMORPHIC ROCK: Formed when igneous, sedimentary, or other metamorphic rocks recrystallize in response to elevated temperature, increased pressure, chemical change, and/or deformation.

MUDSTONE: Rock composed of clay and silt.

PLACER: A surface mineral deposit formed by the mechanical concentration of mineral particles (usually by water). In the preserve, the waters of Coal Creek concentrated the heavier gold in the irregular stream bottom while the lighter minerals were washed downstream.

SEDIMENT: Solid rock, mineral fragments, or plant or animal remains transported and deposited by wind, water, gravity, or ice.

SEDIMENTARY: Formed by accumulation of sediment in water, from air, or by precipitation. Sedimentary rocks are typically horizontally layered or stratified.

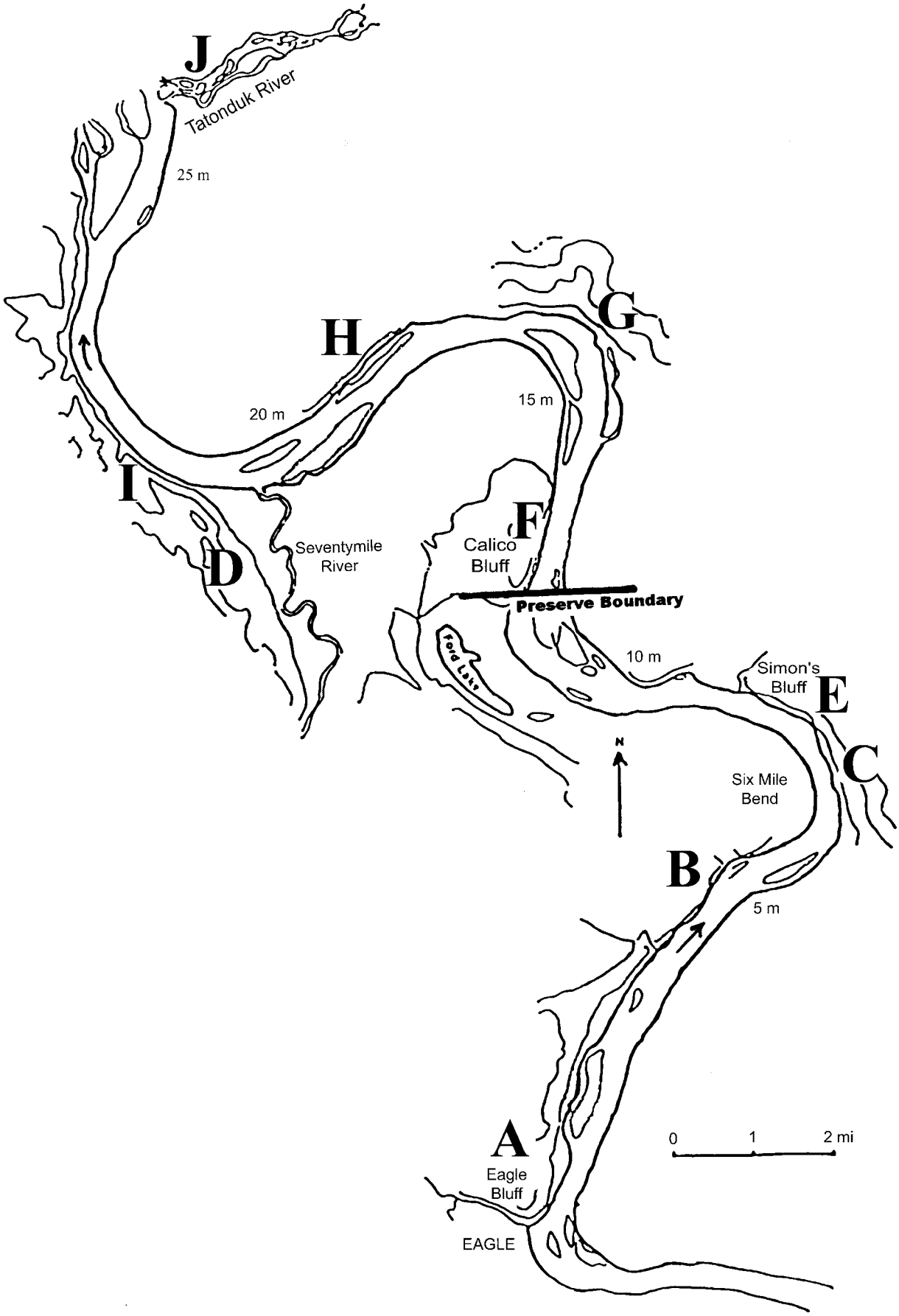
SHALE: A fine grained, sedimentary rock with layered bedding composed of mostly clay minerals.

SILICEOUS: Containing, resembling, relating to, or consisting of silica (a clear crystalline compound, Silicon Dioxide).

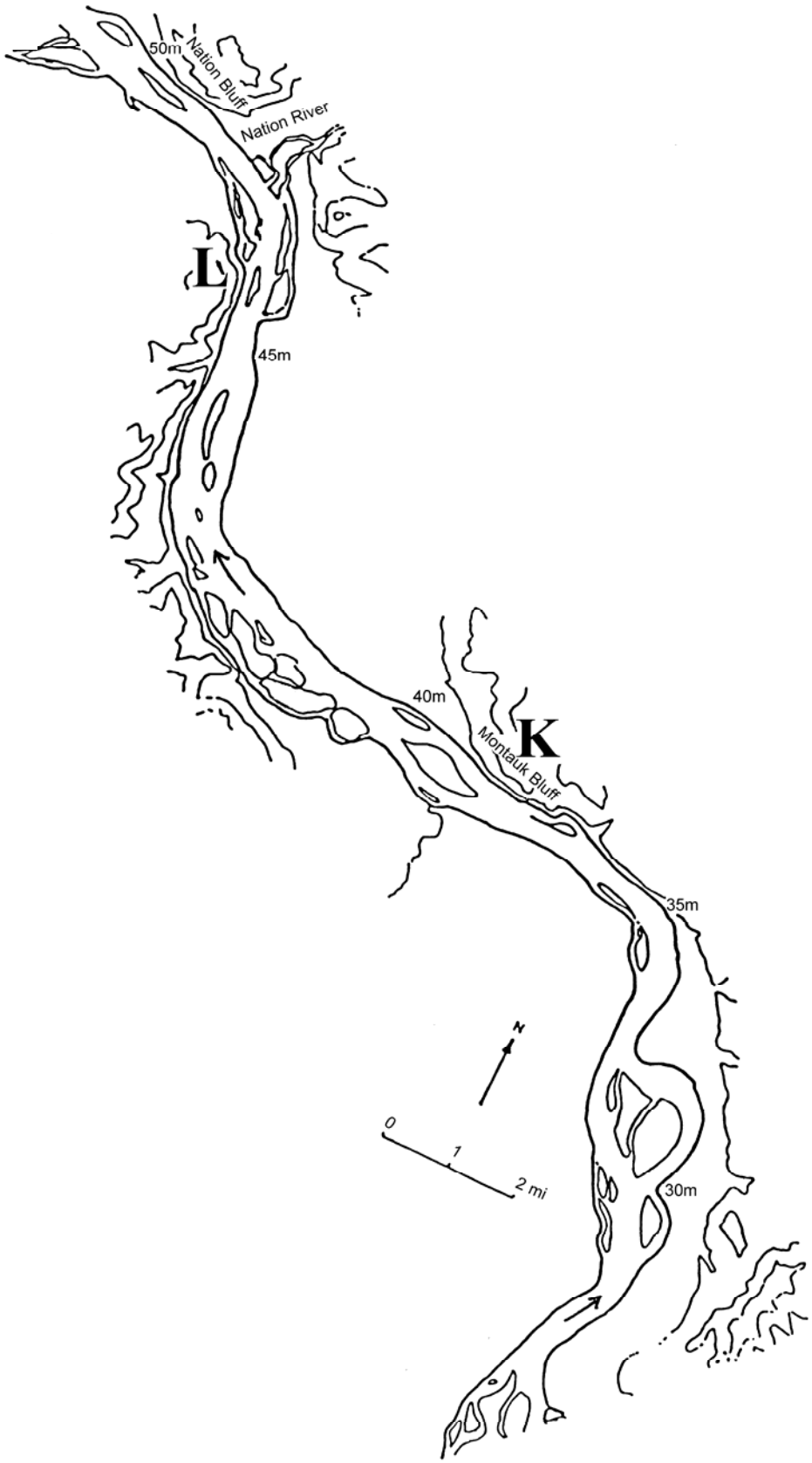
STRIKE-SLIP FAULT: A fault on which the motion is parallel with the direction of a tilted rock surface and is primarily horizontal.

UNMETAMORPHOSED: Unchanged by pressure, heat, or water.

Map 1


J
Tatonduk River
25 m
H
G
20 m
15 m
I
D
Seventymile
River
F
Calico
Bluff
Preserve Boundary
Ford Lkt
10 m
Simon's
Bluff
E
C
N
Six Mile
Bend
B
5 m
A
0
1
2 mi
Eagle
Bluff
EAGLE

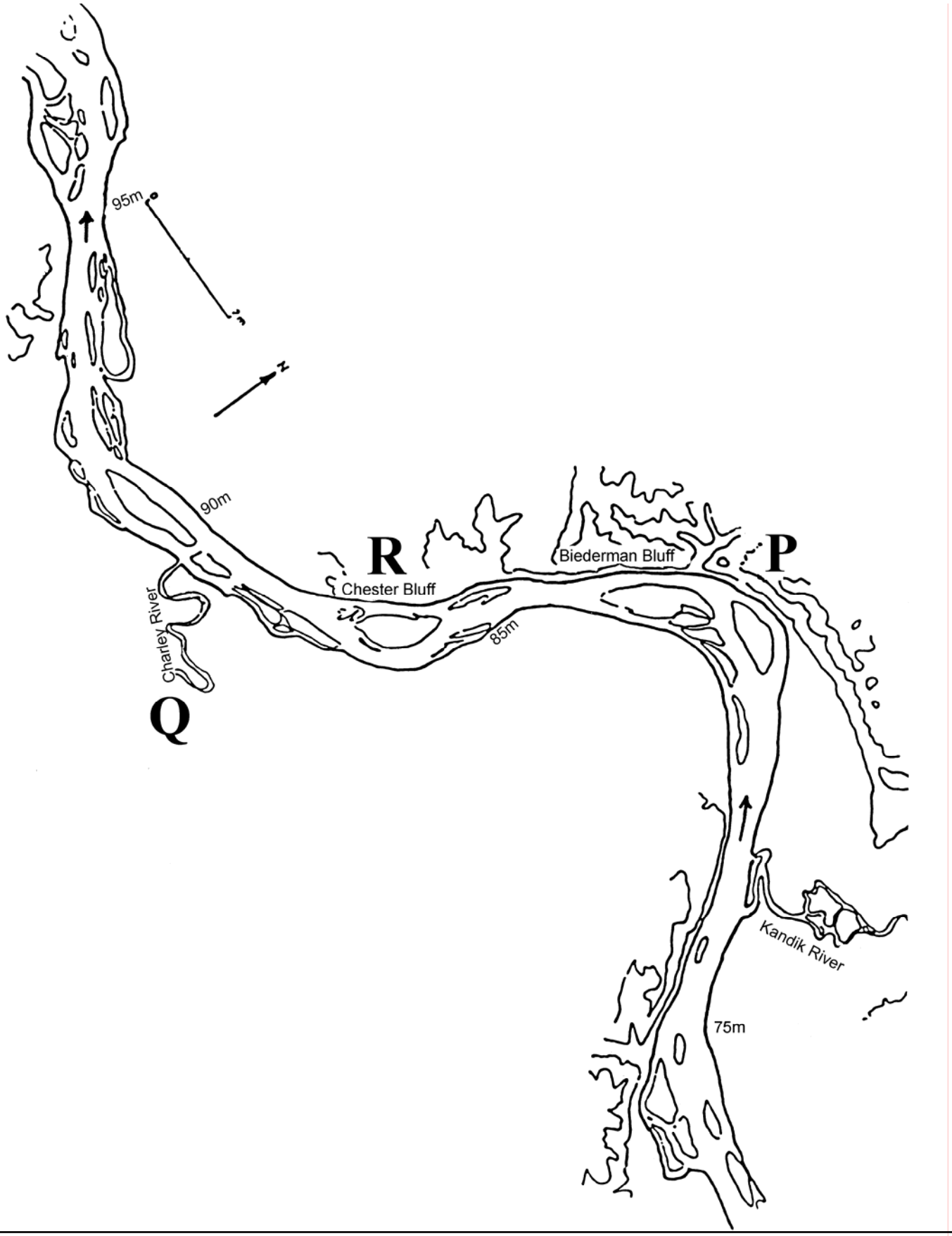
Map 2


50m
Nation Bluff
Nation River
L
45m
40m
K
Montauk Bluff
35m
N
0
1
2 mi
30m

Map 3


Kathul Mountain
O
Washington Creek
70m
N
65m
1
3m
Glenn Creek
N
60m
55m
Rock of Ages Actual Location
M

Map 4


95m
N
90m
R
Biederman Bluff
P
Chester Bluff
Charley River
85m
Q
Kandik River
75m

Map 5


N
115m
Webber Creek
110m
105m
Woodchopper
Roadhouse
0
1
2 km
100m
McGregors
Slavens
Dredge
Coal Creek
Coal Cr. Camp
Placer Mine

Map 6

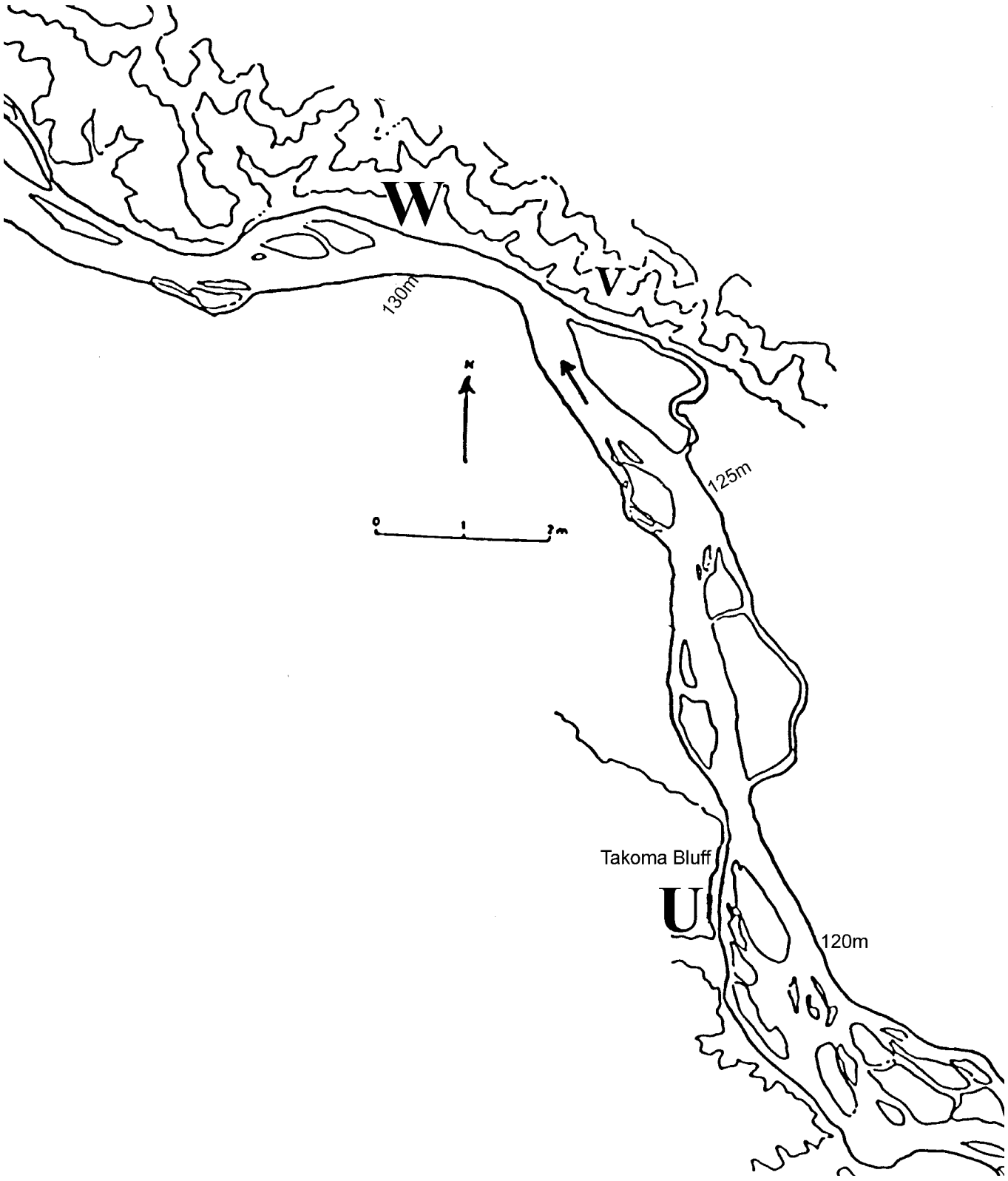
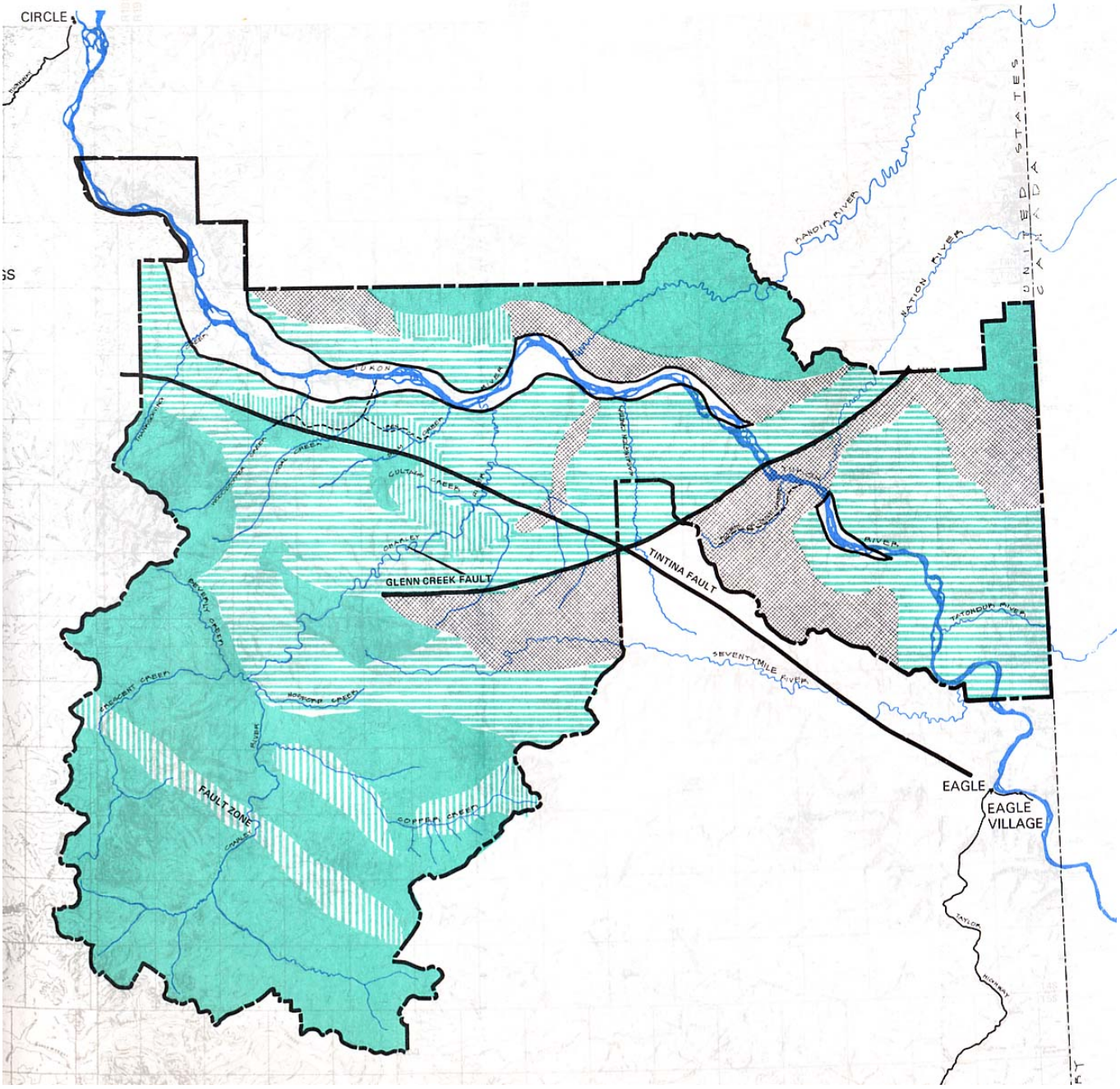


FIG 1. GEOLOGICAL TIME SCALE SHOWING SIGNIFICANT PALEONTOLOGICAL EVENTS AND LOCAL STRATIGRAPHY. PALEONTOLOGICAL EVENTS ARE NOT NECESSARILY EVIDENT IN ALL FORMATIONS. (M.Y. = MILLION YEARS AGO)

ERA	PERIOD	FORMATIONS	PALEONTOLOGY
	Quarternary	Qal flood plain	Homo erectus
CENOZOIC		Qt river terrace	Australopithecus
	Tertiary		Early horses
			Large mammals
65 m.y.}=========	==========	Tks unit	Extinction of dinosaurs
		Kathul Graywacke	
	Cretaceous	Biederman Argillite	
MESOZOIC			
			Early flowering plants
	Jurassic	Glenn Shale	Early birds & mammals
	Triassic		Dinosaurs
248 m.y.}========	==========		Extinction of trilobites
	Permian	Tahkandit Limestone/ Step Conglomerate	
	Pennsylvanian		Early reptiles
		Calico Bluff Formation	
	Mississippian		Coal formation
		Ford Lake Shale	
	Devonian	Nation River Formation	Early trees
PALEOZOIC		McCann Hill Chert	
	Silurian	Road River Formation	Early land plants
	Ordovician		Early fishes
		Hillard Limestone	
	Cambrian	Adams Argillite	
		Funnel Creek Limestone	Shelled fossils
545 m.y.}==========	==========		
		Tinder Group	Early multi-celled Organisms
PRECAMBRIAN			
4.6 b.y.}==========	==========		Formation of Earth

Figure 2



METAMORPHIC ROCK:
SCHISTS, QUARTZ VEINS,
MINOR DEPOSITS OF COPPER, GOLD

SEDIMENTARY ROCK:
SHALE, CARBONACEOUS SHALE,
FOSSILIFEROUS ROCK

SEDIMENTARY AND METAMORPHIC:
LIMESTONE AND DOLOMITES

IGNEOUS ROCK:
GRANODIORITE, ARGILLITE
TONALITE, QUARTZ MONZONITE

ALLUVIAL DEPOSIT:
SAND, SILT, CLAYS,
ORGANIC MATERIAL (PEAT)

NORTH 0 5 10 MILES
0 5 10 KILOMETERS

GEOLOGY

YUKON-CHARLEY RIVERS
NATIONAL PRESERVE

UNITED STATES DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

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