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**CONODONT ANALYSES FROM THE ARCTIC NATIONAL WILDLIFE REFUGE,
NORTHEAST BROOKS RANGE, ALASKA 1990-1993**

by
Andrea P. Krumhardt
Tectonics and Sedimentation Research Group
Geophysical Institute
Department of Geology & Geophysics
University of Alaska

February 1994

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INTRODUCTION

This report contains conodont analyses for samples collected by researchers with the Tectonic and Sedimentation Research Group, Geophysical Institute, and the Department of Geology and Geophysics, University of Alaska Fairbanks and processed during the period 1990 to 1993. These samples were collected from the northeast Brooks Range, Arctic National Wildlife Refuge, and are Mississippian and Pennsylvanian in age. The reports include location, meters above or below significant boundaries, rock type (where available), processing information, faunal list, color alteration index (CAI), biofacies, and age. Samples were processed and identified at the University of Alaska Fairbanks and (or) the U.S. Geological Survey National Center in Reston, Virginia, under the supervision of Dr. Anita G. Harris. All samples are repositied with the U.S. Geological Survey in Reston, Virginia. The reports contained herein are to be considered preliminary and have not been confirmed by the U.S. Geological Survey.

For further information on CAI values, the reader is referred to Epstein and others (1977) and Rejebian and others (1987). Late Mississippian and Early Pennsylvanian biostratigraphy (Figure 1) and biofacies (Figure 2) are based on Krumhardt (1992) and Krumhardt and others (in prep).

STUDY SECTION				CONODONT ZONATION (Baesemann and Lane, 1985)		
SYSTEM	SERIES/ STAGE	FORMATION/ MEMBER	CONODONT ZONE/ FAUNA			
PERMIAN (PART)		ECHOOKA FORMATION				
PENNSYLVANIAN	LOWER ATOKAN	WAHOO LIMESTONE	(262 m)			
	UPPER MORROWAN (AND (OR) LOWER ATOKAN)		1st appearance of <i>I. incurvus</i> ? (246 m)	Unzoned		
			MORROWAN	<i>Idiognathodus</i> Fauna	<i>Idio.</i> <i>ouachitensis</i>	
					<i>Idio. convexus</i>	
					<i>I. klapperi</i>	
	<i>I. sinuosus</i>					
				(177 m)	1st appearance of <i>Pseudostaffella</i> (171 m)	<i>N. bassleri</i>
				<i>minutus</i> Fauna (162 m)	<i>N.</i> <i>symmetricus</i>	
			lower <i>minutus</i> Fauna		<i>Idio. sinuatus-</i> <i>R. minutus</i>	
				(84 m)	<i>noduliferus -</i> <i>primus</i>	<i>D. noduliferus-</i> <i>R. primus</i>
		(~55 m)	1st appearance of <i>G. bulloides</i> (43 m)			
MISSISSIPPIAN (PART)	CHESTERIAN (PART)	UPPER MEMBER	Upper <i>muricatus</i> Subzone (0 m)	Upper <i>R. muricatus</i> Subzone		
		ALAPAH LIMESTONE (PART)				

Figure 1. Conodont zones and faunas recognized in the Wahoo Limestone at the study section compared with the North American middle Carboniferous conodont zonation of Baesemann and Lane (1985). Numbers in parentheses indicate stratigraphic position above base of Wahoo Limestone in the study section. Foraminiferal data from P.L. Brenckle, Amoco Production Co. (written comm., 1991). Generic abbreviations for conodonts are: *D.*, *Declinognathodus*; *I.*, *Idiognathodus*; *Idio.*, *Idiognathoides*; *N.*, *Neognathodus*; *R.*, *Rhachistognathus*. Foraminifers are *Globivalvulina bulloides* and *Pseudostaffella*. From Krumhardt and others (in prep).

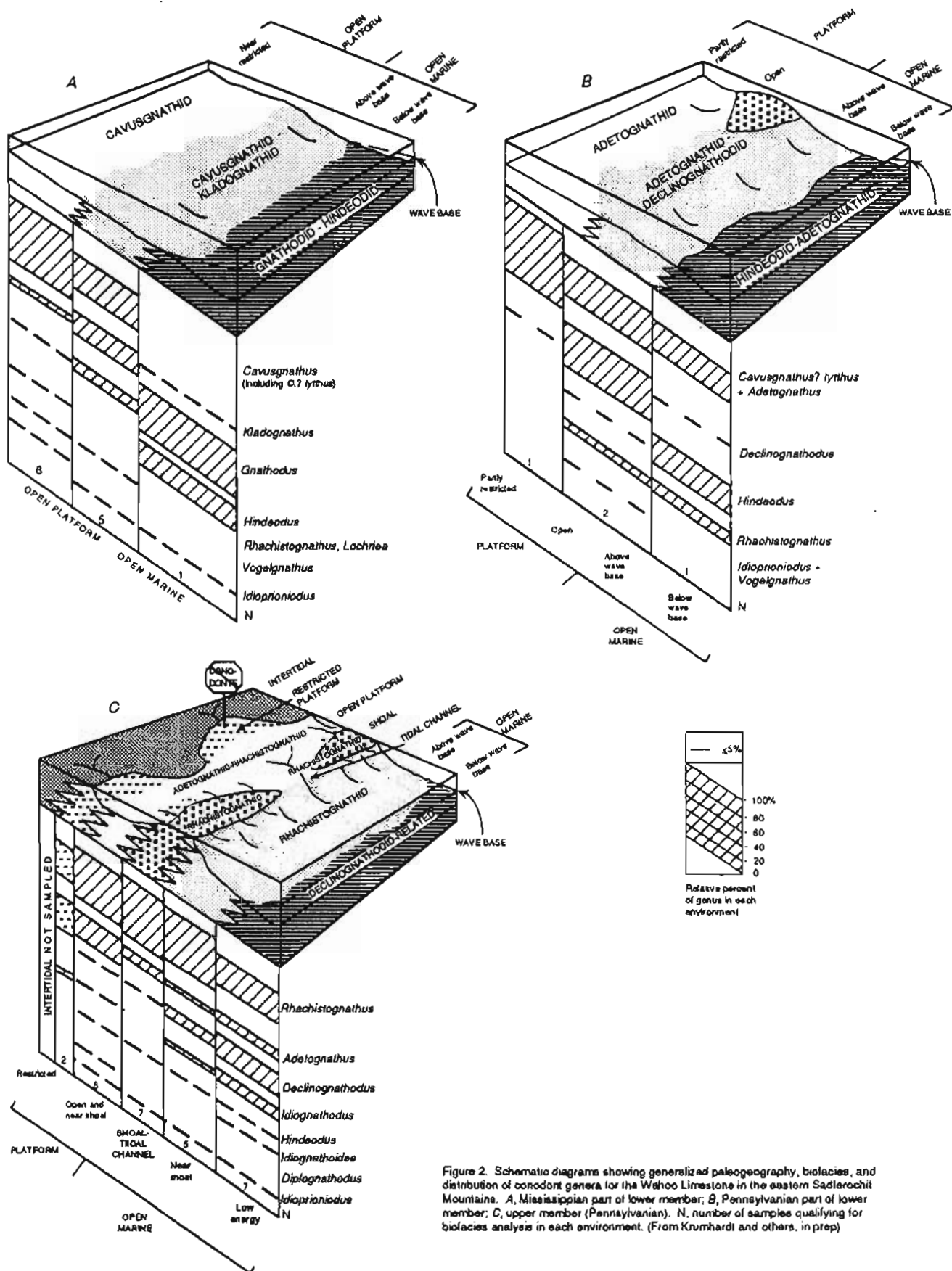


Figure 2. Schematic diagrams showing generalized paleogeography, biofacies, and distribution of conodont genera for the Wahoo Limestone in the eastern Sadlerochit Mountains. A, Mississippian part of lower member; B, Pennsylvanian part of lower member; C, upper member (Pennsylvanian). N, number of samples qualifying for biofacies analysis in each environment. (From Krumhardt and others, in prep)

Aichilik River
69° 23.3'; 143°2.4'
Demarcation Point B-4 Qd.
Reference: Eckstein, 1993
Collector: Mary Eckstein

ME92A is a continuation of a section measured by K.F. Watts (88KWF/UAM #AK-71-M). Watts measured downward from the Permian Echooka Formation and ended at 133 m. Section ME92A continues downward and ME 92A-0.0 = KW88F-133. ME92A is the top part of a composite section that continues with ME92B (Egaksrak River section). Contact between the Alapah and Wahoo Limestones is 22.75 m below the top of ME92A. Lat/Long describes the stratigraphic top of section. Lithologies and depositional environments interpreted by Mary Eckstein.

ME 92A-0.0: Sample collected 22.75 m above the base of the Wahoo Limestone from a medium to light gray pelmatozoan packstone-grainstone, depositional environment indeterminate. 4.6 kg of rock processed (98 g of +20 mesh residue: undissolved lime mud with bryozoan fronds; 5 g of +20-140 mesh residue: heavies--dolomite and weathered pyrite). Sample yielded:

- 1 Pa element *Cavusgnathus unicornis* Youngquist and Miller
- 1 Sa ? element *Kladognathus* sp. indeterminate
- 1 Pa element *Rhachistognathus muricatus* (Dunn)?
- 1 Pa element *Rhachistognathus prolixus* Baesemann and Lane?

Unassigned elements: 8 Pa
Bar, blade, and platform fragments: 28
Other picked: 3 bioclasts

CAI: 6, indicating host rock reached a temperature of at least 350° C
BIOFACIES: indeterminate (too few generically identifiable conodonts)
AGE: Upper *muricatus* Subzone, latest Chesterian (based on underlying sample)

ME92A-6.0: Sample collected 16.75 m above the base of the Wahoo Limestone from a pelmatozoan-bryozoan packstone interpreted to represent an open-marine, above-wave-base depositional environment. 4.4 kg of rock processed (229 +20 mesh residue: undissolved lime mud and lichens; 5 g of +20-140 mesh residue). Sample yielded:

- 1 Pa element *Cavusgnathus unicornis* Youngquist and Miller
- 12 fragments of cavusgnathoids
- Kladognathus* sp. indet.
- 1 P, 1 M, & 1 Sc elements

Bar, blade, and platform fragments: 26
Other picked: 1 gastropod and 1 bryozoan steinkern

CAI: 6, indicating host rock reached a temperature of at least 350° C
BIOFACIES: indeterminate (too few generically identifiable conodonts)
AGE: Upper *muricatus* Subzone (latest Chesterian), based on underlying samples

ME92A-22.2: Sample collected 0.55 m above base of Wahoo Limestone from a peloidal packstone, depositional environment indeterminate. 6.3 kg of rock processed (78 g of +20 mesh residue: undissolved lime mud; 55 g of 20-140 mesh residue: heavies—abundant dolomite and phosphatized grains). Sample yielded:

2 Pa elements *Adetognathus lautus* (Gunnell)
13 Pa elements *Cavusgnathus unicornis* Youngquist and Miller
3 ? elements *Idioproniodus* sp. indeterminate
Kladognathus sp. indeterminate
3 M & 2 Sc elements
3 Pa elements *Rhachistognathus prolixus* Baesemann and Lane
1 Pa element *Rhachistognathus muricatus?* (Dunn)

Unassigned elements: 34 Pa, 1 Pb, 1 M

Bar, blade, and platform fragments: 76

Other picked: 2 bryozoan steinkærns, 4 gastropod steinkærns (all low spiral)

CAI: 5, 5.5, 6, indicating host rock reached a temperature of at least 350° C

BIOFACIES: cavusgnathid, kladognathid, and rhachistognathid: shallow, normal marine, probably open-platform to near-restricted depositional environment.

AGE: Upper *muricatus* Subzone (latest Chesterian)

ME92A-24: Sample collected 1.25 m below the base of the Wahoo Limestone from the upper Alapah Limestone from a peloidal, spiculitic packstone interpreted to represent a restricted-platform depositional environment. 5.4 kg of rock processed (666 +20 mesh residue: undissolved lime mud; 54 g of 20-140 mesh residue: heavies--abundant dolomite and weathered pyrite) and yielded:

1 Pa element *Adetognathus lautus* (Gunnell)
1 Pa element *Cavusgnathus unicornis* Youngquist and Miller

Bar, blade, and platform fragments: 21

CAI: 6 (chiefly), 6.5(rare), indicating host rock reached a temperature of at least 440° C

BIOFACIES: indeterminate (too few generically identifiable conodonts)

AGE: Upper *muricatus* Subzone (latest Chesterian)

ME92A-66: Sample collected 43.25 m below the base of the Wahoo Limestone from the upper Alapah Limestone from a peloidal, spiculitic packstone interpreted to represent a restricted-platform depositional environment. 6.2 kg of rock processed (1.1 kg of +20 mesh residue: silicified and laminated mudstone and chert fragments; 70 g of 20-140 mesh residue: heavies--common fluorite, abundant dolomite and bioclasts). Elements have extreme sugary texture and some have healed fractures. Sample yielded:

2 Pa elements *Adetognathus lautus* (Gunnell)
1 Pa element *Hindeodus* sp. indet.

Unassigned elements: 4 Pa, 2 Pb

Bar, blade, and platform fragments: 27

Other picked: 2 fluorite grains, 2 bioclasts

CAI: 5.5-6, indicating host rock reached a temperature of at least 350° C.

BIOFACIES: indeterminate (too few generically identifiable conodonts)

AGE: Upper *muricatus* Subzone (latest Chesterian)

ME92A-103: Sample collected 80.25 m below the base of the Wahoo Limestone from the upper Alapah Limestone from a pelmatozoan grainstone with micritized grains interpreted to represent an open-platform depositional environment. 6.4 kg of rock processed (75g +20 mesh residue: chert nodule fragments; 20g of 20-140 mesh residue: heavies--abundant ichthyoliths, bioclasts and common pyrite and dolomite). All elements have extreme sugary texture. Sample yielded:

5 Pa elements *Cavusgnathus unicornis* Youngquist and Miller

3 Pa elements *Cavusgnathus? tyththus* (Brown and Rexroad), (2 g and 1 b morphotypes)

1 Pa element *Adetognathus lautus* (Gunnell)?

Unassigned elements: 2 Pa, 1 M

Bar, blade, and platform fragments: 7

Other picked: 3 bioclasts, 7 ichthyoliths

CAI: 6 (chiefly), 350° C, indicating host rock reached a temperature of at least 350° C.

BIOFACIES: indeterminate (too few generically identifiable conodonts), but probably from a near-restricted depositional environment.

AGE: Upper *muricatus* Subzone (latest Chesterian)

Egaksrak River
Demarcation Point B-4
69° 23.9', 142° 51.2'
Reference: Eckstein, 1993
Collector: Mary Eckstein

ME92B was measured upsection beginning at nearly the highest elevation along a N-S ridge in a recrystallized mudstone/wackestone with orange and gray chert and abundant calcite vugs and is a continuation of a section started by Watts (88KWC/UAM# AK-21-M, USGS colln. 30213- & 30214-PC). Meterage follows that of Watts. Section consists entirely of Alapah Limestone. This is the lower part of a composite section that begins with ME92A (Aichilik River). Assuming base of section equals base of Lisburne Group (and base of Alapah Limestone) which begins with 13 m of buff colored dolomitic limestone followed by 109 m of talus slope. It is possible, however, that the buff colored dolomitic limestone and talus slope may actually be the Kayak Formation! Base of continuously exposed Lisburne begins at 122.3 m above the base of section. Lithologies and depositional environments interpreted by Mary Eckstein.

ME92B-0.0: Sample collected at base of Alapah Limestone from a dolostone with no recognizable grains, depositional environment indeterminate. 7.3 kg of rock processed (2.3 kg of +20 mesh residue: undissolved dolomitized lime mud; 880 g of 20-140 mesh residue. Sample was sieved through +80 mesh and only partially run in heavies due to large amount of dolomite) and yielded:

9 Pa elements of *Bispathodus utahensis* Sandberg and Gutschick
1 Pa element *Cavusgnathus unicornis* Youngquist and Miller
2 M elements *Kladognathus?* sp. indeterminate
2 fragments of *Synclidognathus* sp. indeterminate

Bar, blade, and platform elements: 24
Other picked: 1 tetrahedral mineral grain and 1 bioclast

CAI: 5.5-6, indicating host rock reached a temperature of at least 350° C
BIOFACIES: Indeterminate (too few generically identifiable conodonts). The bispathodids may indicate a deeper water, normal marine environment.
AGE: early Osage to late Merimecian

ME92B-125: Sample collected 125 m above base of Alapah Limestone from an intraclastic grainstone with algae and peloids interpreted to represent an open- to restricted-platform depositional environment. 6.1 kg of rock processed (27 g of +20 residue: black silicified mud with bioclasts (bryozoans and brachiopod fragments); 8 g of 20 - 140 mesh residue: heavies--indeterminate steel-gray colored mineral grains and minor dolomite and pyrite. During acid processing sample emitted a rotten egg odor and was very oily.

NO CONODONTS WERE RECOVERED

ME92B-532: Sample collected 532 m above the base of the Alapah Limestone from a bryozoan-pelmatozoan packstone interpreted to represent an open-platform depositional environment. 6 kg of rock processed (57 g of +20 residue: undissolved lime mud and silicified crinoid ossicles; 35 g of 20-140 mesh residue: Heavies--small amount of dolomite, pyrite, and fluorite) and yielded:

- 6 Pa elements *Cavusgnathus unicornis* Youngquist and Miller
- 5 Pa fragments of cavusgnathoids
- 4 Pa elements *Hindeodus* sp. indet.
- 2 Sc elements *Kladognathus* sp.
- Vogelgnathus postcampbelli* (Austin and Husri)
- 1 Pa & 1 M elements

Unassigned elements: 2 Pb, 3 M, 1 Sb

Bar, blade, and platform fragments: 40

Other picked: 1 ichthyolith, 1 fluorite grain, 1 sponge spicule, 2 gastropod steinkerns

CAI: 5.5(rare) - 6 (common), indicating host rock reached a temperature of at least 350° C

BIOFACIES: indeterminate (too few generically identifiable elements). Possibly open-platform to near-restricted depositional environment.

AGE: no older than *monoceras* Zone (late Chesterian).

ME 92B-548: Sample collected 548 m above the base of the Alapah Limestone from a pelmatozoan packstone with fecal pellets interpreted to represent a restricted-platform depositional environment. 6.4 kg of rock processed (287 g of +20 residue: medium gray silicified lime mud with minor bryozoan fronds; 70 g of 20 - 140 mesh residue: heavies--abundant weathered pyrite, rare phosphatized bioclasts). All elements have a sugary texture. Sample yielded:

- 1 Pa element *Adetognathus lautus* (Gunnell)
- 5 Pa elements *Cavusgnathus unicornis* Youngquist and Miller
- 1 Pa element *Hindeodus minutus* (Ellison)
- 1 Pa element *Hindeodus* sp. indet.
- Kladognathus* sp. indet.
- 2 Sa & 1 Sc elements
- 2 Pa elements *Vogelgnathus postcampbelli* (Austin and Husri)
- 1 Pb element *Vogelgnathus* sp.?

Unassigned elements: 8 Pa

Bar, blade, and platform fragments: 18

Other picked: 1 ichthyolith, 1 fish scale, 3 indeterminate fragments

CAI: 6, indicating host rock reached a temperature of at least 350° C

BIOFACIES: indeterminate (too few generically identifiable elements). Probably open-platform to near-restricted depositional environment.

AGE: Upper *muricatus* Subzone (latest Chesterian)

ME 92B-567.5: Sample collected 567.5 m above the Alapah Limestone from a micritized pelmatozoan-bryozoan grainstone interpreted to represent a shoal depositional environment. 6.7 kg of rock processed (3 g of +20 residue: silicified crinoid ossicles and grains and lichens; 6 g of 20 - 140 mesh residue: Heavies—abundant dolomite, common pyrite, and rare flourite). All elements have a sugary texture, most elements show abrasion. Sample yielded:

12 Pa elements *Adetognathus lautus* (Gunnell)
31 Pa elements *Cavusgnathus unicornis* Youngquist and Miller
4 Pa elements *Gnathodus girtyi girtyi* Hass
6 Pa elements *Gnathodus girtyi simplex* Dunn
1 M element *Gnathodus* sp. indet.
6 Pa elements *Hindeodus minutus* (Ellison)
4 Pa elements *Hindeodus* sp. indet.
Kladognathus sp. indet.
2 Sa & 1 Sc elements
1 Pa element *Lochriea commutata* (Branson and Mehl)
2 Pa elements *Vogelgnathus campbelli* (Rexroad)

Unassigned: 88 Pa, 8 Pb, 15 M, 2 Sb?
Bar, blade, and platform fragments: 206
Other picked: 1 ichthyolith, 1 flourite grain

CAI: 6, indicating host rock reached a temperature of at least 350° C
BIOFACIES: mixed (cavusgnathid, adetognathid, hindeodid, gnathodid); all elements are very small, may represent a winnow from a shallow marine, normal- to near-restricted depositional environment.
AGE: Upper *muricatus* Subzone (latest Chesterian)

ME 92B-587.6: Sample collected 587.6 meters above the Alapah Limestone from a cryptalgal boundstone interpreted to represent an intertidal depositional environment. 6.3 kg of rock processed (149 g of +20 mesh residue: undissolved lime mud; 24 g of 20-140 mesh residue; heavies: abundant phosphatized grains, dolomite, minor flourite). 7 trays picked out of a large amount of heavy residue in which no bioclasts were noted:

NO CONODONTS WERE RECOVERED.

ME92B-618: Sample collected 618 m above base of Alapah Limestone from a peloidal, spiculitic packstone interpreted to represent a restricted-platform depositional environment. 6.9 kg of rock processed (900 g of +20 mesh residue: mud with silicified nodules; 105 g of 20-140 mesh residue: heavies—abundant dolomite with common flourite and weathered pyrite) and yielded:

2 Pa elements *Cavusgnathus unicornis* Youngquist and Miller
Hindeodus minutus (Ellison)
1 Pa & 1 Sb elements
1 M element *Kladognathus* sp. indeterminate

Unassigned elements: 1 Pa, 2 Pb
Bar, blade, and platform fragments: 2
Other picked: 1 flourite grain

CAI: 6 (bleached)
BIOFACIES: indeterminate (too few generically identifiable conodonts)
AGE: Upper *muricatus* Subzone (latest Chesterian) (based on adjacent samples)

ME92B-648: Sample collected 648 m above the base of the Alapah Limestone from a peloidal packstone interpreted to represent a restricted-platform depositional environment. 6.5 kg of rock processed (187 g of +20 mesh residue: light gray dolomitized lime mud; 60 g of +20-140 mesh residue: heavies--abundant phosphatized grains/bioclasts?). All elements have extreme sugary texture and some are bleached indicating increased hydrothermal activity at this level. Sample yielded:

2 Pa *Adetognathus lautus* (Gunnell)
3 Pa *Cavusgnathus unicornis* Youngquist and Miller
3 Pa *Hindeodus* sp. indeterminate
Kladognathus sp. indeterminate
1 P, 2 M

Unassigned elements: 6 Pa, 3 Pb, 4 M, 1 Sc
Bar, blade, and platform fragments: 60
Other picked: 3 fluorite grains

CAI: 5.5-6, indicating host rock reached a temperature of at least 350° C
BIOFACIES: Indeterminate
AGE: Upper *muricatus* Subzone (latest Chesterian)

ME 92B-669.5: Sample collected 669.5 m above the Alapah Limestone from a peloidal, spiculitic packstone interpreted to represent a restricted-platform depositional environment. 6.8 kg of rock processed (1.4 kg of +20 mesh residue and 153 g of 20-140 mesh residue: heavies--dolomite and pyrite). All elements have extreme sugary texture. Sample yielded:

4 Pa elements *Adetognathus lautus* (Gunnell)
4 Pa elements *Cavusgnathus unicornis* Youngquist and Miller
14 Pa elements *Vogelgnathus postcampbelli* (Austin and Husri)

Unassigned elements: 8 Pa, 4 M, 2 Sa, 1 Sb
Bar, Blade, and platform fragments: 132

CAI: 6, indicating host rock reached a temperature of at least 350° C
BIOFACIES: vogelgnathid, restricted- to near-restricted depositional environment
AGE: upper *muricatus* Subzone (latest Chesterian)

ME 92B-692: Sample collected 692 m above the Alapah Limestone from a pelmatozoan-bryozoan grainstone with minor fecal pellets interpreted to represent an open-marine depositional environment. 6.3 kg of rock processed (0g of +20 mesh residue and 6 g of 20-140 mesh residue: heavies--pyrite and minor phosphatized bioclasts). All elements have a sugary texture. Sample yielded:

1 Pa element *Adetognathus lautus* (Gunnell)
7 Pa elements *Cavusgnathus unicornis* Youngquist and Miller
1 Pa element *Gnathodus girtyi simplex* Dunn
Kladognathus spp. indet.
1 P, 1 M & 1 Sc elements
1 Pa element *Rhachistognathus muricatus* (Dunn)

Unassigned elements: 16 Pa
Bar, Blade, and platform fragments: 44
Other picked: 2 gastropod steinkerns, 1 fish scale, 1 brachiopod fragment

CAI: 6, indicating host rock reached a temperature of at least 350° C
BIOFACIES: indeterminate (too few generically identifiable elements). Probably open-platform to near-restricted depositional environment.
AGE: Upper *muricatus* Subzone (latest Chesterian)

North Bathtub Ridge
Demarcation Point A-3 Qd.
69° 8.7', 142° 18.2'
Reference: Eckstein, 1993
Collector: Mary Eckstein

ME92C was measured upsection along top of ridge with the basal 15 meters offset to the northwest of the main ridge. The section begins with an outcrop of dark gray dolomitic skeletal wackestone with abundant black replacement chert nodules and bands that are exposed in the middle of gently sloping talus. Base of section is base of Lisburne Group (and base of Alapah Limestone). The contact between the Wahoo and Alapah Limestones consists of a transitional unit from 560 to 935 m. The highest exposed Wahoo Limestone is at 1219 m followed by 30 m of Lisburne rubble. The contact between the Wahoo and Echooka is at 1249 m. Lat/long is for base of section. Lithologies and depositional environments interpreted by Mary Eckstein.

ME92C-31.5: Sample collected 31.5 m above base of Alapah Limestone from a recrystallized, dolomitized, bioturbated cherty limestone, depositional environment indeterminate. 7.4 kg of rock processed (950 g of +20 residue: chert nodules and coarse undissolved limestone; 195 g of 20-140 mesh residue: heavies--large amount of dolomite with abundant ichthyoliths and other phosphatized bioclasts). Picked 10 trays of +80 mesh heavies 100%, remaining unpicked. Sample yielded:

23 Pa elements *Bispathodus utahensis* Sandberg and Gutschick
Idioproniodus sp. indet.
4 Sa & 4 Sc elements
Kladognathus sp. indet.
2 P, 4 M, 3 Sa & 12 Sc elements
2 S elements *Syncladognathus geminus* (Hinde)

Unassigned elements: 11 M, 1 Sc
Bar, blade, and platform fragments: 99
Other picked: 14 ichthyoliths, 11 bioclasts, 1 ostracode

BIOFACIES: Postmortem transport from or within the bispathodid-kladognathid biofacies--relatively deep water, normal marine.

CAI: 4, 5.5, 6, indicating host rock reached a temperature of at least 350° C

AGE: early Osagean to late Meramecian

ME92C-120.5: Sample collected 120.5 m above base of Alapah Limestone from a dolostone. Depositional environment indeterminate. 5.6 kg of rock processed (274 g of +20 mesh residue: undissolved mud and chert nodules; 334 g of 20- +180 mesh residue: heavies--abundant dolomite, phosphatized bioclasts and pyrite). Picked +80 fraction 100%. Sample yielded:

4 Pa elements *Cavusgnathus unicornis* Youngquist and Miller
Kladognathus sp. indet.
1 P, 1 Sa & 1 Sc elements

Unassigned elements: 1 Pa
Bar, blade, and platform fragments: 9
Other picked: 3 ichthyoliths, 1 bioclast

CAI: 5-6, indicating host rock reached a temperature of at least 350° C

BIOFACIES: indeterminate (too few generically identifiable elements)

AGE: late Meramecian to early Chesterian

ME92C-157: Sample collected 157 m above base of Alapah Limestone from a peloidal packstone interpreted to represent a restricted-platform depositional environment. 6.7 kg of rock processed (245g of +20 mesh residue: light grey silicified mud, no chert; 16 g of 20-140 mesh residue: heavies--1/2 tray dolomite and minor pyrite with minor bioclasts) and yielded:

14 Pa elements *Hindeodus cristulus* (Youngquist and Miller)
Hindeodus sp. indet.
2 M, 1 Sb & 1 Sc elements
1 Sa element *Kladognathus tenuis* (Bransen and Møhl)
1 S element *Synclidognathus liberatus?* (Varker)

Bar, blade, and platform fragments: 24
Other picked: 1 ichthyolith

CAI: 4.5, indicating host rock reached a temperature of at least 300° C.

BIOFACIES: Postmortem transport from within or from the hindeodid biofacies- relatively shallow water with possible variable salinities--restricted to near-restricted depositional environment.

AGE: late Meramecian to early Chesterian

ME92C-215: Sample collected 215 m above the base of the Alapah Limestone from a skeletal packstone-grainstone with minor bryozoans, echinoderms, foraminiferans, ostracodes, coral fragments and fecal pellets interpreted to represent an open-platform depositional environment. 6.5 kg of rock processed (422 g of +20 mesh residue: black chert nodule fragments, undissolved carbonate and minor crinoid fragments; 66 g of 20-140 mesh residue: heavies--abundant dolomite with rare bioclasts and pyrite) and yielded:

2 Pa elements *Cavusgnathus unicornis* Youngquist and Miller
2 Pa elements *Hindeodus* sp. indeterminate
Kladognathus sp. indeterminate
1 Sa? & 1 Sc elements
Synclidognathus liberatus? (Varker)
1 Pa, 1 Pb & 7 S elements

Unassigned elements: 1 Pb
Bar, blade, and platform fragments: 18
Other picked: 1 ichthyolith, 1 brachiopod fragment

CAI: 5, 5.5, 6, indicating host rock reached a temperature of at least 350° C.

BIOFACIES: Indeterminate

AGE: late Meramecian to early Chesterian

ME 92C-276: Sample collected 276 meters above the base of the Alapah Limestone from a plematozoan packstone interpreted to represent an open-platform depositional environment. 6.2 kg of rock processed (0 g +20 mesh residue; 45 g +20-240 mesh residue: Heavies--abundant dolomite). Picked +80 mesh fraction 100%. Sample yielded:

Synclidognathus geminus (Hinde)
1 Pa & 2 S elements
1 Pa element *Hindeodus cristula* (Youngquist and Miller)

Bar, blade, and platform fragments: 1

CAI: 5.5, indicating host rock reached a temperature of at least 300° C

BIOFACIES: indeterminate (too few generically identifiable elements)

AGE: late Meramecian to early Chesterian

ME92C-311: Sample collected 311 m above the base of the Alapah Limestone from a peloidal packstone interpreted to represent a restricted-platform depositional environment. 6.9 kg of rock processed (429 g of +20 mesh residue: undissolved lime mud with bioclast fragments including corals; 38 g of 20-140 mesh residue: heavies--abundant dolomite). Picked +80 fraction 100%.

NO CONODONTS WERE RECOVERED

ME92C-345: Sample collected 345 m above base of Alapah Limestone from a peloidal-skeletal packstone interpreted to represent an open- to restricted-platform depositional environment. 6.6 kg of rock processed (354 g of +20 mesh residue: lime mud, black, and oily; 20-140 mesh residue: heavies--abundant dolomite and minor phosphatized bioclasts). Picked +80 mesh fraction 100%. Sample yielded:

1 Pa element *Cavusgnathus unicornis* Youngquist and Miller
Syncladognathus geminus (Hinde)
5 Pa & 4 S elements

Other picked: 2 fluorite grains, 3 ichthyoliths

CAI: 5.5, indicating host rock reached a temperature of at least 300° C

BIOFACIES: indeterminate (too few generically identifiable conodonts)

AGE: late Meramecian to early Chesterian

ME92C-391: Sample collected 391 m above the base of the Alapah Limestone, no lithology data available. 5.2 kg of rock processed (251 g of +20 mesh residue: undissolved lime mud with silicified crinoid and other bioclasts; 21 g of 20-140 mesh residue: heavies--abundant dolomite and minor indeterminate bioclasts). Picked +80 fraction 100%, +80-140 not picked.

NO CONODONTS WERE RECOVERED

ME92C-457.5: Sample collected 457.5 m above base of Alapah Limestone from a peloidal wackestone-grainstone with minor superficial ooids and ostracodes interpreted to represent a restricted-platform, near-shoal depositional environment. 6.2 kg of rock processed (3 g of +20 residue: undissolved lime mud and silicified crinoid ossicles and stems; 3 g of 20-140: heavies--small amount [1 tray] of dolomite and pyrite and minor phosphatized bioclasts). Sample produced oily residue during acid baths and yielded:

4 Pa elements *Cavusgnathus unicornis* Youngquist and Miller

Unassigned elements: 2 Pa

Bar, blade, and platform fragments: 3

Other picked: 2 ichthyoliths

CAI: 5.5-6, indicating host rock reached a temperature of at least 350° C

BIOFACIES: indeterminate (too few generically identifiable elements)

AGE: late Meramecian to early Chesterian (based on adjacent samples)

ME92C-523.5: Sample collected 523.5 m above the base of the Alapah Limestone from a peloidal skeletal packstone interpreted to represent an open- to restricted-platform depositional environment. 6 kg of rock processed (0 g of +20 mesh residue, 19 g of +20-140 mesh residue: heavies--dolomite, pyrite, and rare phosphatized bioclasts) and yielded:

1 Pa element *Cavusgnathus unicornis* Youngquist and Miller

Bar, blade, and platform fragments: 1
Other picked: 1 ichthyolith

CAI: 5.5, indicating host rock reached a temperature of at least 300° C
BIOFACIES: indeterminate (too few generically identifiable elements)
AGE: late Meramecian to early Chesterian (based on adjacent samples)

ME92C-544: Sample collected 544 m above the base of the Alapah Limestone from a peloidal packstone with minor bryozoans, echinoderms, brachiopods, foraminiferans, ostracodes interpreted to represent an open- to restricted-platform depositional environment. 6.2 kg of rock processed (787g of +20 mesh residue: dark gray to black silicified mud, no bioclasts noted; 155 g of 20-140 mesh residue: heavies--abundant phosphatized bioclasts and ichthyoliths, minor dolomite and pyrite) and yielded:

2 Pa elements *Cavusgnathus unicornis* Youngquist and Miller
3 Pa elements *Hindeodus* sp. indeterminate
Kladognathus sp.
1 P, 2 M & 8 Sc elements
Syncladognathus geminus (Hinde)
4 Pa & 27 S elements

Unassigned elements: 1 M
Other picked: 7 ichthyoliths, 1 spicule?, 1 foraminiferan steinkern

CAI: 5.5, 6, indicating host rock reached a temperature of at least 350° C.
BIOFACIES: syncladognathid-kladognathid, relatively shallow, normal marine depositional environment.
AGE: late Meramecian to early Chesterian

ME92C-601: Sample collected 648 m below base of Echooka Formation and 601 m above base of Alapah Limestone and 41 m above the base of the transitional unit between the Alapah and Wahoo Limestones from a pelmatozoan grainstone interpreted to represent an open-platform depositional environment. 5.9 kg of rock processed (6 g of +20 mesh residue; lime mud; 20 g of 20-140 mesh residue; Heavies--2 trays of weathered pyrite and rounded phosphatized bioclasts including sponges? and bryozoans). All elements have a sugary texture. Sample yielded:

5 Pa elements *Cavusgnathus unicornis* Youngquist and Miller
Kladognathus sp. indet.
1 Sa & 1 Sc elements
1 S element *Syncladognathus geminus* (Hinde)?
1 Pa element *Vogelgnathus postcampbelli* (Austin and Husri)

Bar, blade, and platform fragments: 19
Other picked: 2 gastropod steinkerns, 2 foraminiferan steinkerns, 2 ichthyoliths

CAI: 5.5-6, indicating host rock reached a temperature of at least 350° C
BIOFACIES: indeterminate (too few generically identifiable elements). Possibly open-platform to near-restricted depositional environment.
AGE: late Meramecian to early Chesterian if *Syncladognathus* identification is correct. If not, then late Meramecian to Chesterian.

ME92C-663.5: Sample collected 663.5 m above the base of the Alapah Limestone and 103.5 m above the base of the transitional unit between the Alapah and Wahoo Limestones from an intraclastic skeletal packstone interpreted to represent an open-platform depositional environment. 6.3 kg of rock processed (0 g of +20 mesh residue; 4 g of 20-140 mesh residue: heavies--abundant bioclasts and pyrite) and yielded:

Cavusgnathus unicornis Youngquist and Miller
5 Pa & 1 M elements
1 Pa element *Hindeodus* sp. indeterminate
1 Sc element *Kladognathus* sp. indeterminate

Unassigned elements: 12 Pa, 5 Pb, 1 M
Bar, blade, and platform fragments: 111
Other picked: 2 bioclasts, 2 gastropod steinkerns (1 high and 1 low spiral)

CAI: 6, indicating host rock reached a temperature of at least 350° C
BIOFACIES: indeterminate (too few generically identifiable elements). Possibly open-platform to near-restricted depositional environment.
AGE: late Meramecian to Chesterian

ME92C-712: Sample collected 712 m above the base of the Alapah Limestone, and 152 m above the base of the transitional unit to the Wahoo Limestone from a bryozoan-pelmatozoan packstone-grainstone interpreted to represent an open-platform depositional environment. 6 kg of rock processed (60 g of +20 residue: chert nodule fragments; 13 g of 20-140 mesh residue: heavies--abundant weathered pyrite and phosphatized bioclasts). Sample yielded:

23 Pa elements *Cavusgnathus unicornis* Youngquist and Miller
20 Pa fragments of cavusgnathoids
Hindeodus minutus (Ellison)
2 Pa, 1 Pb?, and 1 Sb elements
2 Pa elements *Hindeodus* sp. indeterminate
Kladognathus tenuis (Branson and Mehl)
1 M, 1S? elements
Kladognathus sp. indeterminate
1 Sa, 2 Sc elements

Unassigned elements: 4 m elements
Bar, blade, and platform fragments: 102
Other picked: 2 ichthyoliths, 1 gastropod steinkern

CAI: 4.5, 5.5, 6 (chiefly), indicating host rock reached a temperature of at least 350° C
BIOFACIES: cavusgnathid: shallow, normal marine, open-platform to near restricted depositional environment.
AGE: late Chesterian (no older than *monoceras* Zone)

ME92C-768: Sample collected 768 m above the base of the Alapah Limestone and 208 meters above the base of the transitional unit between the Alapah and Wahoo Limestones from a bryozoan packstone interpreted to represent an open-marine, below-wave-base depositional environment. 6.4 kg of rock processed (819 g of +20 mesh residue: chert nodule fragments and minor undissolved carbonate; 40 g of 20-140 mesh residue: heavies--abundant phosphatized bioclasts and minor pyrite) and yielded:

Cavusgnathus unicornis Youngquist and Miller
23 Pa (juveniles and adults), 1 Pb, 1 M, 1 Sa, and 1 Sc elements
15 Pa fragments of cavusgnathoids
Hindeodus minutus (Ellison)
12 Pa, 4 Pb, 1 M, and 1 Sb elements
Kladognathus sp. indeterminate
2 P, 2 M, and 2 Sc elements
1 Pa *Rhachistognathus prolixus* Baesemann and Lane
2 S elements *Syncladognathus?* (Redeposit?)
1 Pa *Vogelgnathus campbelli* Norby and Rexroad

Unassigned elements: 5 Pa, 2 M
Bar, blade, and platform fragments: 165
Other picked: 6 foraminiferan and 5 gastropod steinkerns

CAI: 5.5-6, indicating host rock reached a temperature of at least 350° C
BIOFACIES: postmortem transport within or from the cavusgnathid-hindeodid biofacies, shallow marine, open platform to near restricted.
AGE: no older than the *monoceras* Zone to latest Chesterian

ME 92C-776: Sample collected 473 meters below Echooka Formation and 776 m above base of the Alapah Limestone from a bryozoan packstone, depositional environment indeterminate. 6.7 kg of rock processed (64 g of +20 mesh residue: undissolved lime mud; 2 g of 20-140 mesh residue; heavies: bioclasts, weathered pyrite, minor dolomite) and yielded:

2 Pa elements *Cavusgnathus unicornis* Youngquist and Miller
1 Pb element *Idioproniodus* cf. *I. healdi* (Roundy)
1 Pb element *Idioproniodus* sp. indet.
1 indeterminate element *Kladognathus* sp.
1 Pa element *Rhachistognathus muricatus* (Dunn)
1 Pa element *Rhachistognathus prolixus* Baesemann and Lane
2 Pa elements rhachistognathids?

Unassigned elements: 2 Pa
Bar, blade, and platform fragments: 31
Other picked: 2 bioclasts

CAI: 5.5-6, indicating host rock reached a temperature of at least 350° C
BIOFACIES: indeterminate (too few generically identifiable elements). Identified elements suggest shallow, moderate to high energy, normal-marine depositional environment.
AGE: *muricatus* Zone (late Chesterian)

ME92C-842: Sample collected 842 m above base of Alapah Limestone in transitional unit between the Alapah and Wahoo Limestones. No lithologic data available. 5.8 kg of rock processed (239 g +20 mesh residue: chert nodule fragments and undissolved carbonate; 12 g of +20-140 mesh residue: heavies-- 1 tray of weathered pyrite and minor dolomite).

38 Pa elements *Cavusgnathus unicornis* Youngquist and Miller
33 cavusgnathoids
Hindeodus minutus (Ellison)
3 Pa elements, 1 M element
Kladognathus sp. indeterminate
1 M element, 1 Sa element, 1 Sc element
3 Pa elements *Vogelgnathus postcampbelli* (Austin and Husri)

Unassigned elements: 2 Pb, 5 M (4 morphotypes)
Bar, blade, and platform fragments: 52

CAI: 6, indicating host rock reached a temperature of at least 350° C
BIOFACIES: Postmortem transport within or from the cavusgnathid biofacies-- relatively shallow water, normal-marine, near-restricted depositional environment.
AGE: *muricatus* Zone (latest Chesterian) based on adjacent samples.

ME92C-900: Sample collected 349 meters below Echooka Formation and 900 m above base of Alapah Limestone from a laminated, micritized, bryozoan-pelmatozoan grainstone interpreted to represent a shoal depositional environment. 6.8 kg of rock processed (630 g of +20 mesh residue: chert nodules and undissolved lime mud; 24 g of 20-140 mesh residue: heavies--abundant phosphatized bioclasts including bryozoans, sponges?, and echinoderm spines and minor pyrite). All elements have sugary texture and are water worn. Sample yielded:

12 Pa elements *Cavusgnathus unicornis* Youngquist and Miller (juveniles and adults)
2 Pa elements *Gnathodus girtyi girtyi* Hass (some transitional to *Declinognathodus noduliferus*)
1 Pa element *Gnathodus girtyi simplex* Dunn
1 ? element *Idioproniodus* sp. indeterminate
Kladognathus sp.
2 P? & 2 Sc elements
4 Pa elements *Rhachistognathus prolixus* Baesemann and Lane?

Unassigned elements: 32 Pa, 2 Pb (2 morphotypes), 3 M (3 morphotypes), 1 Sa, 1 Sb
Bar, blade, and platform fragments: 374
Other picked: 1 foraminiferan steinkern, 1 gastropod steinkern, 2 gastropod axis fragments

CAI: 4.5, 5.5, & 6 (chiefly), indicating host rock reached a temperature of at least 350° C
BIOFACIES: Mixed (cavusgnathid, hindeodid, kladognathid, rhachistognathid) possibly near-restricted to open-platform, shallow, normal-marine depositional environment.
AGE: *muricatus* Zone (late Chesterian) (based on underlying sample)

ME92C-974.5: Sample collected 274.5 meters below the Echooka Formation and 974.5 m above base of Alapah Limestone from a pelmatozoan packstone interpreted to represent an open-marine, below wave base depositional environment. 6.2 kg of rock processed (53 g of +20 residue: undissolved lime mud; 18 g of 20-140 mesh residue; heavies: abundant pyrite, minor dolomite) and yielded:

26 Pa elements *Cavusgnathus unicornis* Youngquist and Miller (juveniles and adults)
11 Pa elements *Gnathodus girtyi girtyi* Hass (some transitional to *Declinognathodus noduliferus*)
2 Pa elements *Gnathodus girtyi simplex* Dunn
13 Pa elements *Gnathodus girtyi* subspp. (12 juveniles)
1 ? element *Idioproniodus* sp. indet.
Kladognathus sp. indet.
1 M, 2 Sa, 1 Sb & 6 Sc elements
2 M elements *Kladognathus?* sp.
6 Pa elements *Rhachistognathus muricatus* (Dunn)
24 Pa elements *Vogelgnathus postcampbelli* (Austin and Husri)
Vogelgnathus? sp. indeterminate
1 Pb? & 1 M elements

Unassigned elements: 32 Pa, 1 Pb
Bar, blade, and platform fragments: 155
Other picked: 6 ichthyoliths, 2 bioclasts

CAI: 4 & 6 (chiefly), 5.5 (rare), indicating host rock reached a temperature of at least 350° C
BIOFACIES: post mortem transport from within or from the cavusgnathid-gnathodid-vogelgnathid biofacies: moderate to low energy, normal marine, possibly "lagoonal" depositional environment.
AGE: *muricatus* Zone (late Chesterian). The transitional nature of some of the gnathodids to Pennsylvanian declinognathodids suggests a very latest Chesterian age.

ME92C-1026: Sample collected from a bryozoan (fenestrate and ramose) packstone 223 m below Echooka Formation and 1026 m above base of Alapah Limestone from a fenestrate bryozoan packstone with fecal pellets interpreted to represent an open-marine, below-wave-base depositional environment. 7.5 kg of rock processed (115 g of +20 residue: chert nodule fragments and minor silicified crinoid ossicles; 57 g of 20-140 mesh residue; heavies--abundant pyrite and dolomite). All elements have a sugary texture. Sample yielded:

3 Pa elements *Cavusgnathus unicornis* Youngquist and Miller
13 Pa elements *Gnathodus girtyi girtyi* Hass
9 Pa elements *Gnathodus girtyi simplex* Dunn (all juveniles)
7 Pa ? elements *Gnathodus* sp. indeterminate
Kladognathus sp.
1 M, 1 Sa & 1 Sc elements
Vogelgnathus postcampbelli (Austin and Husri)
195 Pa (including some juveniles), 1 Sb & 2 Sc elements

Unassigned elements: 4 Pa, 2 Pb, 4 M(2 morphotypes), 1 Sb, 1 Sc
Bar, blade, and platform fragments: 132
Other picked: 2 brach fragments, 1 sponge spicule, 1 gastropod, 1 pyritized bioclast, 1 coral? fragment, 4 pyritized allochems

CAI: 3-6, indicating host rock reached a temperature of at least 350° C
BIOFACIES: postmortem transport from within or from the vogelgnathid biofacies. Elsewhere (Purnell and von Bitter, 1992) vogelgnathids have been associated with restricted marine deposits. The rock type and presence of gnathodids however, suggest a relatively deeper, normal-marine depositional environment. The small elements of the vogelgnathids could have been easily winnowed into deeper water.
AGE: *muricatus* Zone, late Chesterian (based on underlying sample)

ME92C-1093: Sample collected 156 meters below Echooka Formation and 1093 m above the base of the Alapah Limestone from a bryozoan grainstone interpreted to represent an open-marine, above-wave-base depositional environment. 6.6 kg of rock processed (6 g of +20 residue: silicified crinoid fragments and chert nodule fragments; 10 g of 20-140 mesh residue: heavies--abundant weathered pyrite, minor phosphatized bioclasts). All elements have a sugary texture. Sample yielded:

- 1 Pa element *Declinognathodus noduliferus noduliferus* (Ellison and Graves) transitional from *Gnathodus girtyi girtyi* Dunn)
- 3 Pa elements *Cavusgnathus? tyththus* Brown and Rexroad (2 α morphs, 1 β morph)
- 6 Pa elements *Rhachistognathus muricatus* (Dunn)
- 5 Pa elements *Vogelgnathus postcampbelli* (Austin and Husri)

Unassigned elements: 2 PaBar, blade, and platform fragments: 22
Other picked: 6 fish scales, 1 bioclast

CAI: 6, indicating host rock reached a temperature of at least 350° C
BIOFACIES: indeterminate (too few generically identifiable elements)
AGE: *noduliferus-primus* Zone, (early Morrowan). The transitional nature of the declinognathodid from the Mississippian gnathodid forms suggests a very earliest Pennsylvanian age.

ME92C-1123: Sample collected 126 meters below the Echooka Formation and 1123 m above base of Alapah Limestone from a bryozoan grainstone interpreted to represent an open-marine, above wave base depositional environment. 6.3 kg of rock processed (3 g of +20 mesh residue: silicified crinoid ossicles, < 0.25 in; 17 g of 20-140 mesh residue: heavies--2 trays of abundant pyrite, minor dolomite, and rare phosphatized bioclasts) and yielded:

REDEPOSITED MISSISSIPPIAN CONODONTS: 1 Pa element *Lochriea commutata* (Branson and Mehl)

CAI: 6, indicating host rock reached a temperature of at least 350° C
BIOFACIES: indeterminate (too few generically identifiable elements)
AGE: early Morrowan based on adjacent samples

ME92C-1144: Sample collected 105 meters below the Echooka Formation and 1144 m above the base of the Alapah Limestone from a bryozoan grainstone interpreted to represent an open-marine, above wave base depositional environment. 5.5 kg of rock processed (295 g of +20 mesh residue: small crinoid ossicles and undissolved lime mud; 77 g of 20-140 mesh residue: heavies--pyrite, hematite?, abundant dolomite, and rare fluorite) and yielded:

- 2 Pa elements *Cavusgnathus? tyththus* Brown and Rexroad
- 3 Pa elements *Rhachistognathus muricatus* (Dunn)
- 2 Pa elements *Rhachistognathus websteri* Baesemann and Lane

Bar, blade, and platform fragments: 5
Other picked: 1 fluorite grain

CAI: 6, indicating host rock reached a temperature of at least 350° C.
BIOFACIES: indeterminate (too few generically identifiable elements)
AGE: early Morrowan (*noduliferus-primus* Zone to lower *minutus* Fauna). *R. websteri* is restricted to the early Morrowan (Baesemann and Lane, 1985).

ME92C-1219: Sample is from highest exposed Wahoo Limestone in section and 30 m below contact with Echooka Formation and 1219 m above base of Alapah Limestone from a byrozoan-pelmatozoan grainstone interpreted to represent an open-marine, above wave base depositional environment. 5.7 kg of rock processed (315 g of +20 mesh residue: chert nodules and undissolved lime mud with bryozoan fronds; 224 g of 20-140 mesh residue: heavies--phosphatized bioclasts, weathered pyrite, dolomite, and rare flourite) and yielded:

- 11 Pa elements *Declinognathodus noduliferus japonicus* (Igo and Kolke)
- 15 Pa elements *Declinognathodus noduliferus noduliferus* (Ellison and Graves)
- 1 Pa? element *Idioproniodus* sp. indeterminate
- 1 Pa element *Rhachistognathus minutus declinatus* Baesemann and Lane
- 1 Pa element *Rhachistognathus minutus havlenai* Baesemann and Lane
- 1 Pa element *Rhachistognathus minutus* subspp. indet.
- 1 Pa element *Rhachistognathus muricatus* (Dunn)

Unassigned elements: 7 Pa, 1 Pb

Bar, blade, and platform fragments: 44

Other picked: 4 bioclasts, 2 flourite grains

CAI: 4, 6, indicating host rock reached a temperature of at least 350° C

BIOFACIES: postmortem transport from within or from the declinognathodid biofacies (low to moderate energy, normal marine, relatively deeper water).

AGE: no older than the *minutus* Fauna (lower Morrowan to early Atokan)

Marsh Fork

Mt. Michelson A-4 Qd.

NW 1/4, Sec. 3, T.4S., R. 26E. and SE 1/4, Sec. 33, T.3S., R. 26E.,

Reference: Morgan, 1992

Collector: Sue Morgan

SKM 91B is a limited section that starts in the upper Wahoo Limestone at the first impassable cliff. Most of the Wahoo in this area is extensively faulted and folded. Only 60 m of upper Wahoo was measured. Contact with the sub-Echooka unconformity is covered, but placed at the first orange-weathering sandstone float on the saddle.

SKM 91B-9.0: This sample was collected 9 m above the base of section and 51 m below the base of the Echooka Formation. Sample processed at USGS, Reston, Va., and picked and identified at the University of Alaska Fairbanks. Heavies: mag--pyrite; nonmag--dolomite, pyrite, and hematite. Conodont elements have sugary texture, some are squashed.

17 Pa elements *Declinognathodus noduliferus noduliferus* (Ellison and Graves)

1 Pa element *Declinognathodus noduliferus japonicus* (Igo and Koike)

7 Pa elements *Declinognathodus* subsp. indeterminate

Bar, blade, and platform fragments: 2

CAI: 5.5, 6, indicating host rock reached a temperature of 350°C

BIOFACIES: post mortem transport from within or adjacent declinognathodid biofacies: normal marine, relatively deep water, possibly below wave base.

AGE: Pennsylvanian, Morrowan to early Atokan

Pogopuk River
Mt. Michelson A-5
69° 7.6' 146° 26.0'
Reference: Morgan, 1992
Collector: Sue Morgan

SKM91C starts in the lower member of the Wahoo Limestone exposed in the creek bed. No Alapah Limestone is exposed. The contact between the upper and lower members of the Wahoo Limestone is at about 260 m (personal commun., K. Watts, 1993; S. Morgan originally put the boundary at 82m). The Wahoo Limestone is in sharp contact with the overlying Echooka Formation, above which is a moss-covered saddle and talus slope. First outcrop of Echooka is at 324 m above the base of section and consists of rust-colored dark gray sandstone. Unless otherwise noted, all samples processed at USGS, Reston, Va., and picked at the University of Alaska Fairbanks.

SKM91C-10 (USGS colln. 31824-PC): Sample collected from the lower member of the Wahoo Limestone, 299.5 m below the base of the Echooka Formation, from a thick- to medium-bedded bryozoan packstone/wackestone. Sample picked at USGS, Reston. 6.1 kg of rock processed (20 g of +20 mesh residue and 30g of 20-200 mesh residue) and yielded:

69 Pa elements of *Declinognathodus noduliferus japonicus* (Igo and Koike)
3 Pa elements of *Hindeodus minutus* (Ellison)
1 Pa element of *Rhachistognathus prolixus* Baesemann and Lane
11 Pa elements of *Vogelgnathus postcampbelli* (Austin and Husri)

Unassigned elements: 3 Pb and 5 Sc (morphotypes)
Bar, blade, and platform fragments: 56
Other picked: 2 Ichthyoliths

CAI: 5 (1%), 5.5(50%), 6 (40%), and 6.5 and 7 (9%), indicating host rock reached a temperature of at least 450° C.
BIOFACIES: declinognathodid: normal marine, relatively shallow to moderate depth platform or shelf.
AGE: *noduliferus-primus* Zone, probably low in zone if *Vogelgnathus campbelli* is indigenous and not redeposited.

SKM91C-21: Sample collected from the lower member of the Wahoo Limestone, 288.5 m below base of Echooka Formation. Heavies--1 tray of pyrite and minor dolomite.

5 Pa elements *Declinognathodus noduliferus japonicus* (Igo and Koike) (1 juvenile)
1 Pa element *Declinognathodus noduliferus japonicus* (Igo and Koike)
(transitional from *Gnathodus girtyi simplex* Dunn)

Bar, blade, and platform fragments: 7
Other: 1 bioclasts

CAI: 5.5, 6, indicating host rock reached a temperature of at least 350° C
BIOFACIES: indeterminate (too few generically identifiable conodonts): normal marine, shallow water.
AGE: *noduliferus-primus* Zone (early Morrowan)

SKM91C-31: Sample collected from the lower member of the Wahoo Limestone, 278.5 m below base of Echooka Formation. Heavies—pyrite and minor dolomite.

5 Pa elements *Declinognathodus noduliferus japonicus* (Igo and Koike) (transitional from *Gnathodus girtyi simplex* Dunn)

Bar, blade, and platform fragments: 17

CAI: 6, indicating host rock reached a temperature of at least 350° C

BIOFACIES: indeterminate (too few generically identifiable conodonts): normal marine, shallow water

AGE: *noduliferus-primus* Zone (early Morrowan)

SKM91C-40: Sample collected from the lower member of the Wahoo Limestone, 269.5 m below base of Echooka Fm. Heavies: pyrite and dolomite.

Declinognathodus noduliferus noduliferus (Ellison and Graves)

10 Pa elements, 1 M element

10 Pa elements *Rhachistognathus muricatus* (Dunn)

1 Pa element *Vogelgnathus postcampbelli* (Austin and Husri)

Unassigned elements: 1 Pb

Bar, blade, and platform fragments: 23

CAI: 4.5, 5.5, 6 (chiefly), indicating host rock reached a temperature of at least 350° C

BIOFACIES: declinognathodid-rhachistognathid; moderate to high energy, normal, open marine, probably seaward side of shoal apron.

AGE: *noduliferus-primus* Zone (early Morrowan)

SKM91C-51: Sample collected from the lower member of the Wahoo Limestone, 258.5 m below base of Echooka Fm. 6.2 kg of rock processed (20 g of +20 mesh residue: silicified crinoid ossicles; 69 g of 20-140 mesh residue; heavies: pyrite, minor dolomite). Sample processed at the University of Alaska Fairbanks.

1 Pa element *Hindeodus?* sp. indeterminate

1 Sc element *Kladognathus* spp.

1 Pa element *Rhachistognathus muricatus* (Dunn)

Bar, blade, and platform fragments: 6

CAI: 6, indicating host rock reached a temperature of at least 350° C

BIOFACIES: indeterminate (too few generically identifiable conodonts): normal marine, shallow water.

AGE: *noduliferus-primus* Zone (early Morrowan)

SKM91C-79 (USGS colln. 31825-PC): Sample collected from a thick to medium bedded crinoidal grainstone that grades upward into bioclastic packstone, packstone/wackestone, and finally dolomitic wackestone; lithofacies appear to be arranged in fining-upward sequences, lower member of the Wahoo Limestone, 245 m below the base of the Echooka Formation. Sample picked at USGS, Reston. 5.9 kg of rock processed (320 g of +20 mesh residue and 61 g of 20-200 mesh residue) and yielded:

2 Pa elements of *Rhachistognathus muricatus* Dunn

1 indeterminate bar fragment

CAI: 5.5 and 6, indicating host rock reached a temperature of at least 350° C

BIOFACIES: indeterminate (too few generically identifiable conodonts); shallow water, relatively high-energy, normal-marine depositional environment (sample probably from grainstone).

AGE: *noduliferus-primus* Zone (early Morrowan)

SKM 91C-90: Sample collected from the lower member of the Wahoo Limestone, 219.5 m below the base of the Echooka Formation. Sample picked at USGS, Reston, Va.

- 1 Pa element *Cavusgnathus? tythus* Brown and Rexroad
- 8 Pa elements *Declinognathodus noduliferus noduliferus* (Ellison and Graves)
- 1 Pa element *Gnathodus girtyi simplex* Dunn
- 1 Pa element *Hindeodus* sp. Indeterminate
- 2 Sc elements *Kladognathus* spp.
- 2 Pa elements *Rhachistognathus muricatus* (Dunn)

Unassigned elements: 5 Pa, 4 Pb, 1 M, 2 Sc
Bar, blade, and platform fragments: 21

CAI: 5-6.5, indicating host rock reached a temperature of 440° C
BIOFACIES: indeterminate
AGE: *noduliferus-primus* Zone (early Morrowan)

SKM91C-112.5: Sample collected from the lower member of the Wahoo Limestone, 197 m below base of Echooka Formation. Heavies: weathered pyrite and dolomite. All specimens have extreme sugary texture.

- 8 Pa elements *Declinognathodus noduliferus noduliferus* (Ellison and Graves)
- Kladognathus* spp.
- 1 M element and 1 Sc element
- 6 Pa elements *Rhachistognathus muricatus* (Dunn)

Unassigned elements: 1 Pa
Bar, blade, and platform fragments: 18

CAI: 6, indicating host rock reached a temperature of at least 350° C
BIOFACIES: indeterminate (too few generically identifiable conodonts): normal marine, probably seaward of shoal apron
AGE: *noduliferus-primus* Zone to lower *minutus* Fauna (Morrowan)

SKM91C-122: Sample collected from the lower member of the Wahoo Limestone, 187.5 m below the base of the Echooka Formation. Heavies: abundant dolomite and pyrite.

- 1 Pa element *Adetognathus lautus* (Gunnell)
- 1 Pa element *Hindeodus* sp. indeterminate
- 1 Pa element *Rhachistognathus muricatus* (Dunn)
- 1 Pa element *Rhachistognathus websteri* Baesemann and Lane

Unassigned elements: 4 Pa, 1 Pb, 1 Sa
Bar, blade, and platform elements: 20

CAI: 4, 6, indicating host rock reached a temperature of at least 350° C
BIOFACIES: indeterminate (too few generically identifiable conodonts): normal marine, shallow water.
AGE: *noduliferus-primus* Zone to lower *minutus* Fauna (Morrowan)

SKM91C-132: Sample collected from the lower member of the Wahoo Limestone, 177.5 m below the base of the Echooka Formation. Heavies: dolomite and pyrite.

2 Pa elements *Declinognathodus noduliferus japonicus* (Igo and Koike) (1 juvenile)

Bar, blade, and platform fragments: 8

CAI: 6, indicating host rock reached a temperature of at least 350° C.

BIOFACIES: indeterminate (too few generically identifiable conodonts): normal marine, shallow water.

AGE: *noduliferus-primus* Zone to lower *minutus* Fauna (Morrowan)

SKM92C-142: Sample collected from the lower member of the Wahoo Limestone, 167.5 m below the base of the Echooka Formation. Heavies: abundant phosphatized flakes with pyrite coating.

NO CONODONTS WERE RECOVERED

SKM91C-152: Sample collected from the lower member of the Wahoo Limestone, 157.5 m below base of Echooka Formation. Heavies: Pyrite, dolomite, and phosphatized bioclasts.

4 Pa elements *Adetognathus lautus* (Gunnell)
2 Pa elements *Gnathodus defectus* Dunn
1 Sb element *Idioproniodus* spp.
20 Pa elements *Rhachistognathus muricatus* (Dunn)
2 Pa elements *Rhachistognathus websteri* Baesemann and Lane

Unassigned elements: 27 Pa, 1 Pb

Bar, blade, and platform fragments: 72

Other picked: steinkerns: 2 foram, 9 gastropod, 4 bryozoan; 1 archemides screw fragment, 1 ichthyolith, 1 bioclast

CAI: 5.5, indicating host rock reached a temperature of at least 300° C

BIOFACIES: postmortem transport within or from the rhachistognathid biofacies (relatively high energy, normal marine)

AGE: *noduliferus-primus* Zone to lower *minutus* Fauna (Morrowan)

SKM91C-163: Sample collected from the lower member of the Wahoo Limestone, 146.5 m below base of Echooka Formation. Heavies: Abundant pyrite (cubes, multiple cubes, and weathered) and common bioclasts.

3 ? elements *Idioproniodus* sp. indeterminate
19 Pa elements *Declinognathodus noduliferus japonicus* (Igo and Koike) (9 juveniles)
15 Pa elements *Declinognathodus noduliferus noduliferus* (Ellison and Graves) (7 juveniles)
10 Pa elements *Declinognathodus noduliferus* spp. indet. (4 juveniles)

Unassigned elements: 3 Pb (2 morphotypes), 3 M (3 morphotypes)

Bar, blade, and platform fragments: 87

Other: 3 pyrite cubes, 1 pyrite rosette

CAI: 5.5-7, indicating host rock reached a temperature of at least 400° C

BIOFACIES: post mortem transport from within or adjacent declinognathodid biofacies; normal marine, relatively deep water.

AGE: *noduliferus-primus* Zone to lower *minutus* Fauna (Morrowan)

SKM91C-175.5: Sample collected from the lower member of the Wahoo Limestone, 134 m below base of Echooka Formation. 5.1 kg of rock processed (40 g of 20 mesh residue: silicified brach fragments; 33 g of 20-140 mesh residue; heavies: Pyrite, dolomite, and abundant phosphatized bioclasts).

- 1 Pa element *Adetognathus lautus* (Gunnell)
- 1 ? element *Idioproniodus* spp. indeterminate
- 2 Pa elements *Rhachistognathus minutus minutus* (Higgins and Bouckear)?
- 34 Pa elements *Rhachistognathus muricatus* (Dunn)
- 1 Pa element *Rhachistognathus websteri* Baesemann and Lane
- 2 Pa elements *Rhachistognathus* sp. indeterminate (juveniles)

Unassigned elements: 9 Pa

Bar, blade, and platform fragments: 10

Other: steinkerns: 2 gastropod, 1 bryozoan, 1 ostracode, 9 ichthyoliths, 2 bones, 1 fluorite grain

CAI: 5.5-6, indicating host rock reached a temperature of at least 350° C

BIOFACIES: post mortem transport from within or adjacent rhachistognathid biofacies (relatively high energy, normal marine)

AGE: lower *minutus* Fauna (Morrowan)

SKM91C-187: Sample collected from the lower member of the Wahoo Limestone, 154.5 m below the base of the Echooka Formation. Heavies: Mag--pyrite, dolomite, and phosphatized bioclasts; Non-mag--abundant phosphatized bioclasts including bryozoans, gastropods, ichthyoliths, ostracodes, and foraminifera. Good preservation of some elements.

- 5 Pa elements *Gnathodus defectus* Dunn
- Idioproniodus conjunctus* (Gunnell)
- 1 Pa, 3 Pb, 1 M, 4 Sa, 1 Sb, 3 Sc elements
- 2 Pa elements *Rhachistognathus minutus havlenai* Baesemann and Lane
- 3 Pa elements *Rhachistognathus minutus minutus* Baesemann and Lane
- 59 Pa elements *Rhachistognathus muricatus* (Dunn)
- 15 Pa elements *Rhachistognathus websteri* Baesemann and Lane

Unassigned elements: 2 M (2 morphotypes)

Bar, blade, and platform elements: 121

Other picked: 1 fluorite grain, 1 pyrite cube, 2 ichthyoliths, 1 fish bone, steinkerns (2 ostracodes, 2 bryozoans, 2 foraminiferans, 6 gastropods).

CAI: 5.5-6 (chiefly), 7 (rare), indicating host rock reached at least 350° C

BIOFACIES: postmortem transport from within or adjacent rhachistognathid biofacies. Normal-marine, shallow, high-energy depositional environment.

AGE: lower *minutus* Fauna (Morrowan)

SKM91C-198: Sample collected from the lower member of the Wahoo Limestone, 111.5 m below base of Echooka Formation. Heavies--nonmag: abundant phosphatized bioclasts, gastropods and minor dolomite; mag: weathered pyrite and dolomite.

- 2? elements *Idioproniodus* spp. indeterminate
- 9 Pa elements *Rhachistognathus muricatus* (Dunn)
- 2 Pa elements *Gnathodus defectus* Dunn

Unassigned elements: 2 Pa

Bar, blade, and platform fragments: 19

Other: steinkerns: 5 gastropod, 1 foraminiferan

CAI: 5.5-6, indicating host rock reached a temperature of at least 350° C

BIOFACIES: indeterminate (too few generically identifiable conodonts): normal marine, shallow water.

AGE: lower *minutus* Fauna (Morrowan)

SKM91C-209: Sample collected from the lower member of the Wahoo Limestone, 100.5 m below the base of the Echooka Formation. Heavies: dolomite and pyrite.

- 1 Pa element *Gnathodus defectus* Dunn (juvenile)
- 1 Pa element *Rhachistognathus muricatus* (Dunn)

Unassigned elements: 1 M
Bar, blade, and platform fragments: 24
Other picked: 1 fish tooth

CAI: 5.5-6, indicating host rock reached a temperature of at least 350° C
BIOFACIES: indeterminate (too few generically identifiable conodonts)
AGE: lower *minutus* Fauna (Morrowan)

SKM91C-219: Sample collected from the lower member of the Wahoo Limestone, 90.5 m below base of Echooka Formation. 5.1 kg of rock processed (0 g of 20 mesh residue, 14 g of 20-140 mesh residue; heavies: pyrite and abundant phosphatized bioclasts).

- 6 Pa elements *Adetognathus lautus* (Gunnell)
- 1 Pa element *Hindeodus* sp. indeterminate
- 2 ? elements *Idiopriodontus* spp. indeterminate
- 18 Pa elements *Rhachistognathus minutus* subspp.
- 15 Pa elements *Rhachistognathus muricatus* (Dunn)
- 2 Pa elements *Rhachistognathus websteri* Baesemann and Lane
- 1 Pa element transitional between *Gnathodus girtyi girtyi* Hass and *Declinognathodus noduliferus noduliferus* (Ellison and Graves)

Unassigned elements: 10 Pa
Bar, blade, and platform fragments: 54
Other: steinkerns: 9 gastropod, 4 bryozoan, 1 foraminifer, 3 ichthyoliths, 2 bones

CAI: 5.5 (chiefly)-6, indicating host rock reached a temperature of at least 350° C
BIOFACIES: postmortem transport from within or adjacent rhachistognathid biofacies (relatively high-energy, normal-marine depositional environment)
AGE: lower *minutus* Fauna (Morrowan)

SKM 91C-229.5: Sample collected from the lower member of the Wahoo Limestone, 80 m below base of Echooka Formation. Sample processed and picked at USGS, Reston, Va.

- 1 Pa element *Declinognathodus noduliferus noduliferus* (Ellison and Graves)
- 3 Pa element *Rhachistognathus minutus havlenai* Baesemann and Lane

Unassigned elements: 1 Pa
Bar, blade, and platform fragments: 2
Other picked: 1 ichthyolith

CAI: 5.5-6, indicating host rock reached a temperature of at least 350° C
BIOFACIES: indeterminate (too few generically identifiable conodonts): normal marine, shallow water
AGE: *minutus* Fauna (Morrowan) to lower Atokan

SKM91C-237: Sample collected from the lower member of the Wahoo Limestone, 72.5 m below base of Echooka Formation. 7.4 kg of rock processed (900 g of 20 mesh residue, 159 g of 20-140 mesh residue: cherty, sandy material: heavies--weathered pyrite, abundant dolomite and bioclasts). Sample yielded:

Bar, blade, and platform fragments: 6

Other: bryozoan steinkerns

CAI: 5.5, indicating host rock reached a temperature of at least 300° C

BIOFACIES: indeterminate (too few generically identifiable conodonts)

AGE: *minutus* Fauna (Morrowan) to lower Atokan (based on adjacent samples)

SKM91C-309.5: Sample collected from the highest outcrop of the upper member of the Wahoo Limestone immediately below base of Echooka Formation. Heavies--mag: abundant dolomite and pyrite; nonmag: dolomite with a rusty ilmonite coating.

1 Pa element *Adetognathus lautus* (Gunnell)

1 Pa element *Idlognathodus* sp. indet. (juvenile)

1 Pb? element *Idioprioniodus* sp. indet.

3 Pa elements *Rhachistognathus minutus declinatus* Baesemann and Lane

2 Pa elements *Rhachistognathus minutus havlenai* Baesemann and Lane

1 Pa element *Rhachistognathus minutus minutus* (Higgins and Bouckert)

Unassigned elements: 11 Pa

Bar, blade, and platform fragments: 36

Other: 1 bryozoan steinkern, 1 bioclast

CAI: 4.5-5 indicating host rock reached a temperature of at least 300° C

BIOFACIES: indeterminate (too few generically identifiable conodonts): normal marine, shallow, probably high energy depositional environment

AGE: *Idiognathodus* Fauna (late Morrowan to early Atokan)

Wahoo Lake
Sagaviniitok A-1 Qd.
69° 1.4', 147° 0.1
Reference: Morgan, 1992
Collector: Sue Morgan

Measured section **SKM91D** starts within the Alapah Limestone above a rubble slope on a tundra covered saddle; section starts at first good outcrop down-dip from saddle. Section contains 70 m of Alapah that is transitional to the Wahoo. Contact between the lower and upper Wahoo is at 239 m above base of section. Sub-Echooka unconformity is at 469 m above base of section and is an abrupt planar contact. The Echooka Formation consists of dark gray sandstone and appears to be brecciated. Unless otherwise noted, all samples processed at USGS Reston, Va., and picked at the University of Alaska Fairbanks.

SKM 91D-30: Sample collected from the Alapah Limestone, 40 m below the base of the transitional unit and 439 meters below base of Echooka Fm. Heavies: non-mag: abundant dolomite, common bioclasts; mag: abundant weathered pyrite and minor dolomite.

21 bar and blade fragments, possibly including an Sa element of *Hindeodus* spp.

CAI: 6, indicating host rock reached a temperature of at least 350° C
BIOFACIES: indeterminate (no generically identifiable conodonts)
AGE: no older than Mississippian

SKM 91D-70: Sample collected from the uppermost Alapah Limestone, 399 meters below base of Echooka Formation. Sample picked at USGS, Reston and yielded:

11 Pa elements *Cavusgnathus* sp. indeterminate
1 Pa element *Cavusgnathus? tythus* Brown and Rexroad
3 indeterminate elements of *Idioproniodus* spp. indeterminate
Kladognathus sp. indeterminate
1 Sc element, 7 indeterminate elements

Bar, blade, and platform fragments: 21

CAI: 5.5-6, indicating host rock reached a temperature of at least 350° C
BIOFACIES: cavusgnathid-kladognathid. Relatively shallow, moderate- to high-energy open marine to open-platform depositional environment.
AGE: late Meramecian to Chesterian (Late Mississippian)

SKM92D-70.8 (USGS colln. 31826-PC): Sample collected 2.8 m above the base of the Wahoo Limestone from a thick- to medium-bedded crinoidal grainstone containing faint laminations. Sample picked and identified by A.G. Harris, USGS, Reston. 5.7 kg of rock processed (10 g of +20 mesh residue and 622 g of 20-200 mesh residue) and yielded:

2 Pa elements of *Cavusgnathus? tythus* Brown and Rexroad
4 Pa element fragments of cavusgnathoids
2 Pa elements of *Gnathodus girtyi girtyi* Hass
1 Pa element of *Gnathodus* aff. *G. girtyi* Hass
Hindeodus sp. indeterminate
2 Pa fragments and 1 Sc element
5 Pa elements of *Rhachistognathus muricatus* (Dunn)

Bar, blade, and platform fragments: 4

CAI: chiefly 6 and lesser 5.5 and 7, indicating host rock reached a temperature of at least 400° C
BIOFACIES: Indeterminate (too few conodonts and too many genera: postmortem mixing and transport). Relatively shallow-water, normal-marine depositional environment.
AGE: *Rhachistognathus muricatus* Zone (very latest Chesterian)

SKM 91D-124: Sample collected above the base of the lower Wahoo Limestone and 345 m below the Echooka Formation. Heavies: dolomite, pyrite, and bioclasts? Sample yielded:

3 Pa elements *Cavusgnathus unicornis* Youngquist and Miller
Hindeodus sp. indeterminate
6 Pa elements and 1 Sb element
Kladognathus sp. indeterminate
1 P element, 1 M element, 1 Sa element, and 2 Sc elements

Unassigned elements: 1 Pa, 1 M, 3 Sb
Bar, blade, and platform fragments: 32

CAI: 5.5-6, indicating host rock reached a temperature of at least 350° C

BIOFACIES: Indeterminate (too few generically identifiable conodonts): normal marine to near restricted, shallow water.

AGE: late Meramecian to Chesterian

SKM91D-135 (USGS colln. 31827-PC): from lower member of the Wahoo Limestone 67 m above the base and 334 m below base of Echooka Formation and 135 m above base of measured section that starts within the Alapah Limestone. The sample is from a medium-bedded packstone/wackestone containing possible ooids and dark-gray to black chert nodules; inferred to represent shoal depositional environment. Sample picked at USGS, Reston. 6.5 kg of rock processed (20 g of +20 mesh residue and 71 g of 20-200 mesh residue) and yielded:

9 Pa elements (some robust complete specimens) *Cavusgnathus unicornis*
Youngquist and Miller
17 Pa element fragments of cavusgnathoids
1 Pa element fragment *Gnathodus* aff. *G. girtyi simplex* Dunn
Kladognathus sp. indeterminate
3 Sb and 2 Sc element fragments

Unassigned elements: 4 M (2 morphotypes)
Bar, blade, and platform fragments: 39
Other: 2 phosphatized gastropod steinkerns

CAI=4.5 and 5.5-6: indicating the host rock reached at least 250°-300°C; the range in CAI value within the sample indicates hydrothermal activity.

BIOFACIES: cavusgnathid: open-platform to possibly near restricted depositional environment.

The heavy-mineral concentrate consists almost solely of phosphatized bioclast steinkerns of, in order of decreasing abundance: gastropods (chiefly low-spined), ramose bryozoans, ostracodes, spines, pelmatozoans.

AGE: *Rhachistognathus muricatus* Zone (late Chesterian) (on the basis of underlying collections)

SKM 91D-145: Sample collected 77 m above the base of the lower member of the Wahoo Limestone and 324 meters below the base of the Echooka Formation. 7.1 kg of rock processed (20 g +20 mesh residue: chiefly lichens!, 27 g of 20-140 mesh; heavies: dolomite, abundant weathered pyrite).

8 Pa elements *Cavusgnathus unicornis* Youngquist and Miller
2 Pa elements *Gnathodus girtyi simplex* Dunn
2 Sc elements *Kladognathus* sp. indet.

Unassigned elements: 21 Pa, 1 M
Bar, blade, and platform fragments: 48
Other: 2 ichthyoliths, 1 brachiopod fragment

CAI: 5-5.5 (minor), 6, indicating host rock reached a temperature of at least 350° C

BIOFACIES: indeterminate

AGE: *Rhachistognathus muricatus* Zone (late Chesterian) (on the basis of underlying collections)

SKM92D-155 (USGS colln. 31828-PC): Sample collected 87 m above the base of the lower member of the Wahoo Limestone. Thick to medium bedded crinoidal packstone/wackestone to packstone, containing abundant grey chert. Sample picked at USGS, Reston. 7.1 kg of rock processed (20 g of +20 mesh residue and 14 g of 20-200 mesh residue) and yielded:

- 1 Pa element of *Adetognathus lautus* (Gunnell)
- 10 Pa elements of *Cavusgnathus unicornis* Youngquist and Miller
- 7 Pa fragments of cavusgnathoids
- Hindeodus* aff. *H. minutus* (Ellison)
- 2 Pa and 4 Pb elements
- Kladognathus* sp. indeterminate
- 2 Sa, 5 Sb, and 1 Sc elements

Unassigned elements: 5 Pb (2 morphotypes), 6 M (3 morphotypes), 1 Sb, 4 Sc (2 morphotypes)

Bar, blade, and platform fragments: 49

Other: ichthyoliths and phosphatized gastropod and foraminiferan steinkerns

CAI: 5.5 and 6 indicating host rock reached at least 350° C

BIOFACIES: postmortem transport within or from the cavusgnathid biofacies; shallow- to moderate-depth, probably normal-marine depositional environment.

AGE: Upper *muricatus* Subzone (very latest Chesterian)

SKM D-165: Sample collected from 97 m above the base of the lower member of the Wahoo Limestone and 304 m below the contact with the Echooka Formation. Heavies: abundant dolomite, bioclasts, and pyrite.

- 5 Pa elements *Adetognathus lautus* (Gunnell)
- 41 Pa elements *Cavusgnathus unicornis* Youngquist and Miller
- 3 Pa fragments of cavusgnathoids
- 3 Pa elements *Gnathodus girtyi girtyi* Hass
- 1 Pa element *Gnathodus girtyi simplex* Dunn
- Hindeodus minutus* (Ellison)
- 12 Pa, 5 Pb, 1 M, 1 Sa, and 2 Sb elements
- Kladognathus* sp.
- 1 P, 1 M, and 6 Sc elements
- 1 Pa element *Vogelgnathus campbelli* (Rexroad)?

Unassigned elements: 5 Pb, 8 M, 2 Sc

Bar, blade, and platform fragments: 202

Other: 4 gastropod steinkerns, 1 fish scale

CAI: 5-6.5, indicating host rock reached a temperature of at least 440° C

BIOFACIES: postmortem transport from within or adjacent cavusgnathid-hindeodid biofacies. Near-restricted to open platform depositional environment.

AGE: Upper *muricatus* Subzone, latest Chesterian

SKM 91D-175: Sample collected from 107 m above the base of the lower Wahoo Limestone, 304 m below contact with overlying Echooka Formation. Heavies: abundant weathered pyrite, common dolomite, minor pyrite cubes and common bioclasts. Elements have sugary texture, healed fractures and tectonically beat up. Sample yielded:

1 Pa element *Adetognathus lautus* (Gunnell)
3 Pa elements *Cavusgnathus unicornis* Youngquist and Miller
1 Pa element *Gnathodus girtyi girtyi* Hass
3 Pa elements *Hindeodus* sp. indeterminate
Kladognathus sp. indeterminate
2 P, 2 M and 2 Sa elements

Unassigned elements: 9 Pa, 1 M
Bar, blade, and platform fragments: 65
Other: 2 gastropod steinkerns

CAI: 5.5-6.5, indicating host rock reached a temperature of at least 400° C
BIOFACIES: indeterminate (too few generically identifiable conodonts): normal marine to near restricted, shallow water.
AGE: Upper *muricatus* Subzone, latest Chesterian

SKM 91D-189: Sample collected 121 m above the base of the Wahoo Limestone and 280 below the base of the Echooka Formation. Heavies: small amount of dolomite and pyrite with minor bioclasts. Sample yielded:

9 Pa elements *Cavusgnathus unicornis* Youngquist and Miller
1 Pa element *Hindeodus*? sp. indeterminate
Kladognathus sp.
1 P?, 3 M, and 1 Sa elements

Unassigned elements: 5 Pa
Bar, blade, and platform fragments: 9
Other picked: 2 bioclasts

CAI: 5.5-6, indicating host rock reached a temperature of at least 350° C
BIOFACIES: indeterminate (too few generically identifiable conodonts), however, conodonts suggest normal marine to near restricted, shallow water.
AGE: Upper *muricatus* Subzone, latest Chesterian, based on underlying samples.

SKM 91D-204: Sample collected 136 m above the base of the Wahoo Limestone and 265 meters below the base of the Echooka Formation. 6.6 kg of rock processed (10 g +20 mesh residue: undissolved carbonate mud; 82 g 20-140 mesh; heavies: abundant phosphatized bioclasts, dolomite). Sample yielded:

1 Pa element *Gnathodus defectus* Dunn
Kladognathus sp. indeterminate
1 P, 3 M, 2 Sa, and 1 Sc elements

Unassigned elements: 1 Pa
Bar, blade, and platform fragments: 31
Other picked: 8 gastropod steinkerns, 4 bryozoan steinkerns, 4 bioclasts

CAI: 5.5 (chiefly), 6 (minor), indicating host rock reached a temperature of at least 350° C
BIOFACIES: indeterminate (too few generically identifiable elements)
AGE: Upper *muricatus* Subzone, latest Chesterian, based on underlying sample.

SKM 91D-220: Sample collected 152 m above the base of the lower member of the Wahoo Limestone, 249 m below the base of the Echooka Formation. Heavies: pyrite, dolomite, common doubly terminated pyrite. Elements have extreme sugary texture. Sample yielded:

- 1 Pa element *Gnathodus girtyi simplex* Dunn
- 3 indeterminate elements *Idioproniodus* sp. indeterminate
- 1 Pa element *Rhachistognathus prolixus* Baesemann and Lane
- 8 Pa elements *Vogelgnathus postcampbelli* (Austin and Husri)

Unassigned elements: 2 Pb, 1 Sa
Bar, blade, and platform fragments: 58

CAI: 6-6.5, indicating host rock reached a temperature of at least 440° C
BIOFACIES: indeterminate (too few generically identifiable conodonts)
AGE: Upper *muricatus* Subzone, latest Chesterian, based on underlying sample.

SKM 91D-235: Sample collected 167 m above the base of the lower member of the Wahoo Limestone and 234 meters below base of Echooka Formation. Sample picked at USGS, Reston, and yielded:

- 8 Pa elements *Cavusgnathus unicornis* Youngquist and Miller
- cavusgnathoid fragments
- 3 Pa and 1 Sb elements
- 2 Pa elements *Hindeodus* sp. indet.
- Kladognathus* sp. indeterminate
- 1 Sa, 1 Sc elements

Unassigned elements: 1 M
Bar, blade, and platform fragments: 12

CAI: 6-7, indicating host rock reached a temperature of at least 490° C
BIOFACIES: Indeterminate (too few generically identifiable conodonts), however, conodonts suggest normal marine to near restricted, shallow water.
AGE: Upper *muricatus* Subzone, latest Chesterian, based on underlying samples.

SKM 91D-249.5: Sample collected from 181.5 m above the base of the lower Wahoo Limestone and 10 m above the base of the upper Wahoo Limestone, and 219.5 meters below the base of the Echooka Formation. 6.2 kg of rock processed (40 g of +20 mesh residue: undissolved lime mud; 104 g 20-140 mesh residue: heavies--pyrite and abundant dolomite.) Sample yielded:

- 24 Pa elements *Gnathodus girtyi simplex* Dunn
- 1 Pa element *G. g. simplex* Dunn transitional to *Declinognathodus noduliferus*
- noduliferus* (Ellison and Graves)
- Kladognathus* sp. indeterminate
- 1 M and 1 Sc elements
- Idioproniodus* sp. indeterminate
- 2 Pa, 3 Pb, 4 Sa, 4 Sb, 1 Sc, and 3 indeterminate elements
- 8 Pa elements *Rhachistognathus muricatus* (Dunn)
- 5 Pa elements *Rhachistognathus primus* Dunn?

Unassigned elements: 5 Pa
Bar, blade, and platform fragments: 106
Other: 5 bryozoan steinkerns, 6 bioclasts, 3 ichthyoliths, 1 bone

CAI: 6 (chiefly), 7 (rare), 5 (minor), 5.5 (common), indicating host rock reached a temperature of at least 490° C
BIOFACIES: postmortem transport from within or adjacent gnathodid-idioproniodid biofacies (normal marine, relatively deeper open marine depositional environments, moderate to low energy)
AGE: Upper *muricatus* Subzone, latest Chesterian.

SKM91D-264.5 (USGS colln. 31829-PC): Sample collected ~25 m above the base of the upper member of the Wahoo Limestone from a thick- to medium-bedded wackestone containing lenses of packstone and ramose and fenestrate bryozoans, and brachiopods; uncommon small gray chert nodules. Sample picked at USGS, Reston. 6.2 kg of rock processed (240 g of +20 mesh residue and 57 g of 20-200 mesh residue) and yielded:

- 3 Pa elements *Cavusgnathus unicornis* Youngquist and Miller
- 2 Pa elements *Gnathodus girtyi girtyi* Hass
- 4 Pa elements *Gnathodus girtyi simplex* Dunn
- 1 Pa element *Hindeodus* sp. indeterminate
- 1 M element *Kladognathus* sp. indeterminate
- 1 Pa element *Vogelgnathus postcampbelli* (Austin and Husri)

Bar, blade, and platform fragments: 25
Other picked: 2 phosphatized gastropod steinkerns

CAI: 5.5, 6.5, and rare 7
BIOFACIES: indeterminate (too few generically identifiable conodonts and very mixed); normal-marine depositional environment.
AGE: Upper *muricatus* Subzone, latest Chesterian

SKM 91D-279.5: Sample collected from the upper member of the Wahoo Limestone, 189.5 m below the base of the Echooka Formation. Heavies: phosphatized bioclasts, ichthyoliths, dolomite, pyrite, and hematite?

- 18 Pa elements *Cavusgnathus? tythus* Brown and Rexroad (7 α , 11 β , 8 γ morphotypes)
- 1 Pa element *Gnathodus bilineatus bilineatus* (Roundy)
- 7 Pa elements *Gnathodus girtyi girtyi* Hass
- 7 Pa elements *Gnathodus girtyi simplex* Dunn
- 1 M element *Gnathodus* sp. indeterminate
- Hindeodus* sp. indeterminate
- 7 Pa and 1 Sa elements
- 7 Pa elements *Rhachistognathus muricatus* (Dunn)
- 2 Pa elements *Rhachistognathus websteri* Baesemann and Lane
- 1 Pa element *Rhachistognathus prolixus* Baesemann and Lane
- Vogelgnathus postcampbelli* (Austin and Husri)
- 67 Pa, 1 Pb, and 1 M element

Unassigned elements: 25 Pa, 6 Pb, 1 M, 2 Sc
Bar, blade, and platform fragments: 161

CAI: 6-7 indicating host rock reached a temperature of at least 490° C
BIOFACIES: post mortem transport from within or adjacent vogelgnathid-cavusgnathid biofacies: restricted to near restricted open-platform depositional environment
AGE: Upper *muricatus* Subzone, latest Chesterian

SKM91D-295 (USGS colln. 31830-PC): Sample collected ~55 m above base of upper member of the Wahoo Limestone from a massive to thick-bedded bryozoan wackestone grading into a packstone/grainstone, intercalated with dolostone and containing lenses of packstone and grainstone throughout and bioclasts and genestrate bryozoans. Picked at USGS, Reston. 7.4 kg of rock processed (220 of +20 mesh residue and 39 g of 20-200 mesh residue) and yielded:

100 Pa elements of *Declinognathodus noduliferus japonicus* (Igo and Koike)
3 juvenile Pa elements of *Gnathodus girtyi simplex* (Dunn)
1 M element *Gnathodus* sp. indeterminate
42 gnathodontid Pa element fragments
Hindeodus sp. indeterminate
2 Pa (fragments), 2 Sb, and 1 Sc elements
7 Pa elements *Vogelgnathus postcampbelli* (Austin and Husri)

Unassigned elements: 1 Pb, 3 M
Bar, blade, and platform fragments: 84

CAI: Chiefly 7, minor 6 and 6.5, indicating host rock reached a temperature of at least 490° C
BIOFACIES: declinognathodid; open-marine, above wave base (virtually all ramiform elements have been winnowed away) depositional environment.
AGE: *Declinognathodus noduliferus-Rhachistognathus primus* Zone, probably lower part of zone (very earliest Morrowan)

SKM91D-316 (USGS colln. 31831-PC): Sample collected ~77 m above base of upper member of the Wahoo Limestone. Massive, cliff-forming crinoidal bioclast packstone/grainstone. Picked at USGS, Reston. 7.2 kg of rock processed (200 g of +20 mesh residue and 143 g of 20-200 mesh residue) and yielded:

4 Pa elements of *Cavusgnathus? tythus* Brown and Rexroad

Unassigned elements: 6

CAI: 5.5-6.5, indicating host rock reached a temperature of at least 400° C
BIOFACIES: indeterminate; probably normal-marine depositional environment
AGE: *Declinognathodus noduliferus-Rhachistognathus primus* Zone, probably lower part of zone (very earliest Morrowan)

SKM91D-346: Sample collected from the upper member of the Wahoo Limestone, 123 m below the base of the Echooka Formation. Heavies: abundant pyrite, common dolomite and minor hematite. Elements have a sugary texture and healed fractures.

1 Sc element *Kladognathus* sp. indeterminate (Redeposit)

Bar, blade, and platform fragments: 1

CAI: 6, indicating host rock reached a temperature of at least 350° C
BIOFACIES: indeterminate (too few generically identifiable conodonts)
AGE: Early Pennsylvanian (early Morrowan), probably *noduliferus-primus* Zone to lower *minutus* Fauna, based on adjacent samples.

SKM 91D-400: Sample collected from the upper member of the Wahoo Limestone, 69 m below base of Echooka Fm. Sample picked at USGS, Reston, Va.

- 1 Pa element fragments of cavusgnathoids
- 1 Pa element *Gnathodus defectus* Dunn
- 1 M element *Gnathodus* sp. indet.
- 4 Pa elements *Hindeodus* sp. indet.
- 26 Pa elements *Rhachistognathus websteri* Baesemann and Lane

Unassigned elements: 2 Pb, 1M

Bar, blade, and platform fragments: 27

Other picked: 4 ichthyoliths

BIOFACIES: postmortem transport from within or from the rhachistognathid biofacies; normal-marine, relatively high energy; most elements are small and complete suggesting a possible winnow.

Depositional environment may be open-marine side of shoal.

AGE: Early Pennsylvanian (early Morrowan), probably *noduliferus-primus* Zone to lower *minutus* Fauna.

CAI=7 indicating host rock reached at least 490°C. The conodonts are very well preserved suggesting a rapid thermal event.

Jago Stock
Demarcation Point B-5 Qd.
Reference: Peapples, 1993
Collector: Palge Peapples

CS5-01: Sample collected 100 feet above base of Lisburne Group from the Alapah Limestone. Demarcation Point B-5 Qd., T.2S., R.36E., Sec.18, lat. 69° 16' N., long. 143° 32'W, elevation 5210 ft. 5.4 kg of rock processed (641 g of +20 mesh residue; lime mud with thin quartz veins; 50 g of +20-140 mesh residue: heavies--weathered pyrite, hematite?, and abundant dolomite and minor phosphatized grains, no bioclasts noted) Sample sieved to +80 and picked 100%, picked two trays +80-140, all fine-grained dolomite.

NO CONODONTS WERE RECOVERED

CS5-02: Sample collected 50 feet above base of Lisburne Group, same location as above, 5160 ft. elevation.

1 Pa element of a mestognathid morphotype
4 fragments

CAI: 5.5, indicating host rock reached a temperature of at least 300° C

BIOFACIES: indeterminate

AGE: indeterminate, possibly early Mississippian

CS14-01: Sample also collected 50 feet above base of Lisburne Group, same location as above. 5.7 kg of rock processed (119 g of +20 mesh residue; siliceous flakes and undissolved lime mud; 42 g of +20-140 mesh residue: heavies--abundant dolomite, pyrite, and hematite, no bioclasts noted) Sample sieved to +80 and picked 100%, picked one tray +80-140.

NO CONODONTS WERE RECOVERED

CS8-6-01: Sample collected from the uppermost Wahoo Limestone, just below the contact with the Echooka Formation. Demarcation Point B-5 Qd., T.2S., R.36 E., sec. 8, lat 69° 17'N., long. 143°29'W., 5145 ft. elevation. 6.8kg of rock processed (18 g of +20 mesh residue: silicified mud flakes; 473 g of +20-140 mesh residue: heavies--abundant pyrite, hematite, dolomite and minor phosphatized grains). Sample sieved through +80 mesh screen; this portion picked 100%. Elements are crumpled, have healed fractures, extreme sugary texture, and are water worn. Sample yielded:

3 Pa elements *Declinognathodus noduliferus japonicus* (Igo and Koike)
Idioprioniodus sp. indeterminate
1 Pb, and 1? elements
1 fragment of an idiognathodid?

Unassigned elements: 6 Pa

Bar, blade, and platform fragments: 44

Other picked: 2 bioclasts

CAI: 5.5-6, indicating host rock reached a temperature of at least 350° C

BIOFACIES: indeterminate, (too few generically identifiable genera), but declinognathodids indicate slightly deeper water

AGE: Morrowan to early Atokan (Early Pennsylvanian)

CS8-6-02: Sample collected from the uppermost Wahoo Limestone, 40 below the contact with the Echooka Formation, same location as CS8-6-01, 5105 ft. elevation. 5.1 kg of rock processed (110 g of +20 mesh residue: sheared? silicified mud flakes and quartz grains; 486 g of +20-140 mesh residue: heavies--abundant pyrite, hematite, dolomite and minor fluorite). 10 trays picked 100%, sieved to +60 and picked 100%. Elements have sugary texture. Sample yielded:

Unassigned elements: 1 Pa

Bar, blade, and platform fragments: 4

CAI: 6, indicating host rock reached a temperature of at least 350° C

BIOFACIES: indeterminate (no generically identifiable elements)

AGE: indeterminate but probably Morrowan to early Atokan (Early Pennsylvanian) based on overlying sample

CS8-7-01: Sample collected from the lowermost Wahoo Limestone just above the contact with the Alapah Limestone. Demarcation Point B-5 Qd., T.2S., R.36E., sec. 8, lat 69° 17"N., long 143° 29"W., 4500 ft. elevation. 5 kg of rock processed (390 g of +20 mesh residue: silicified lime mud, no bioclasts noted; 195 g of +20-140 mesh residue: heavies--2 trays phosphatized grains and bioclasts). Elements have extreme sugary texture. Sample yielded:

1 Pa element *Gnathodus girtyi simplex* Dunn? (juvenile)

5 Pa elements *Vogelgnathus postcampbelli* (Austin and Husri)

Bar, blade, and platform fragments: 22

CAI: 5-5.5 indicating host rock reached a temperature of at least 300° C

BIOFACIES: Indeterminate (too few generically identifiable conodonts)

AGE: Upper *muricatus* Subzone (latest Chesterian, Late Mississippian), based on sample CS8-7-02

CS8-7-02: Same stratigraphic position and location as CS8-7-01. 14.8 kg of rock processed (148 g of +20 mesh residue: undissolved lime mudstone; 22 g of +20-140 mesh residue: heavies--abundant dolomite, pyrite, and hematite.) Most elements have extreme sugary texture, some have healed fractures and are contorted. Sample yielded:

2 S elements apatognathid forms (may be redeposit)

1 Pa element *Adetognathus lautus* (Gunnell)

1 Pa element *Cavusgnathus? tythus* (Brown and Rexroad)

3 Pa elements *Gnathodus bilineatus* (1 G. b. *bilineatus*)

2 Pa elements *Gnathodus defectus* Dunn

14 Pa elements *Gnathodus girtyi simplex* Dunn

6 Pa elements *Hindeodus?* sp. indeterminate

1 M *Idioprioniodus* sp. indeterminate

2 Pa elements *Lochrlea commutata* (Branson and Mehl)

2 Pa elements *Rhachistognathus muricatus* (Dunn)

Unassigned elements: 39 Pa

Bar, blade, and platform fragments: 323

CAI: 5.5, 6 (chiefly), indicating host rock reached a temperature of at least 350° C

BIOFACIES: gnathodid biofacies. Relatively deeper normal marine, moderate- to low-energy depositional environment. Most elements are relatively small--sample may represent a winnow.

AGE: Upper *muricatus* Subzone (latest Chesterian, Late Mississippian)

CS-8-7-03: Sample collected from the uppermost Alapah Limestone, just below the contact with the Wahoo Limestone, same location as CS8-7-01 and CS8-7-02. 5.1 kg of rock processed (0 g of +20 mesh residue; 15g of +20-140 mesh residue: heavies--rounded phosphatized bioclasts and weathered pyrite). All elements have sugary texture and are water worn. Sample yielded:

- 1 Pa element *Gnathodus girtyi girtyi* Hass
- 1 Pb? element *Idiocrioniodus* sp. indeterminate

Bar, blade, and platform fragments: 20
Other picked: 1 low-spiral gastropod steinkern

CAI: 6, indicating host rock reached a temperature of at least 350° C
BIOFACIES: indeterminate (too few generically identifiable conodonts)
AGE: late Meramecian to Chesterian (Late Mississippian), but probably Upper *muricatus* Subzone (latest Chesterian, Late Mississippian) based on CS8-7-02.

CS-8-7-04: Sample collected from same stratigraphic position and location as CS8-7-03. 5.6 kg of rock processed (36 g of +20 mesh residue: gray to dark gray lime mud; 74 g of +20-140 mesh residue: heavies--phosphatized grains). All elements have extreme sugary texture and were difficult to detect from other phosphatized grains. Sample yielded:

- 1 Pa element *Gnathodus bilineatus* subsp. indeterminate

Unassigned elements: 1 Pa
Bar, blade, and platform fragments: 37

CAI: 5.5, indicating host rock reached a temperature of at least 300° C
BIOFACIES: indeterminate (too few generically identifiable conodonts)
AGE: late Meramecian to Chesterian (Late Mississippian) but probably Upper *muricatus* Subzone (latest Chesterian, Late Mississippian) based on CS8-7-02.

Fourth Range

Mt. Michelson B-3 Qd.

Reference: Meterage follows that of Gruzlovic measured section AK-13-M (Gruzlovic, 1991)

Collector: Andrea Krumhardt

AK90A-6: Sample collected 6 m below base of Alapah Limestone from the Kayak. 5.6 kg of rock processed (700g +20 mesh and 295g 20-140 mesh insoluble residue).

NO CONODONTS WERE RECOVERED

AK90A-8: Sample collected 4 m below base of Alapah Limestone from the Kayak. 6.5 kg of rock processed (20g +20 mesh and 71g 20-140 mesh insoluble residue).

NO CONODONTS WERE RECOVERED

AK90A-12: Sample collected immediately below base of Alapah Limestone from the Kayak. 6.4 kg of rock processed (235g 20-140 mesh insoluble residue: heavies--black, phosphatized sediment and rare bioclasts (ichthyoliths). Only half of 20-140 residue run in heavies.

NO CONODONTS WERE RECOVERED

AK90A-16: Sample collected 4 m above base of Alapah Limestone. 6.8 kg of rock processed (0g +20 mesh and 4g 20-140 mesh insoluble residue).

NO CONODONTS WERE RECOVERED

AK90A-20.5: Sample collected 8.5 m above base of Alapah Limestone. 5.5 kg of rock processed (40g +20 mesh and 3g 20-140 mesh insoluble residue). Sample yielded:

3 indet. bar, blade, and platform fragments
12 ichthyolith fragments?

CAI: indeterminate

BIOFACIES: indeterminate

AGE: indeterminate

AK90A-24.5: Sample collected 12.5 m above base of Alapah Limestone. 6.8 kg of rock processed (16 g of 20-140 mesh insoluble residue). Sample yielded:

Syncladognathus sp.
1 Pa and 1 S elements

CAI: 5.5, indicating host rock reached a temperature of at least 300° C

BIOFACIES: indeterminate

AGE: Osagean to lower Chesterian

AK90A-40: Sample collected 28 m above base of Alapah Limestone. (23g 20-140 mesh insoluble residue). Sample yielded:

8 Pa elements *Cavusgnathus unicornis* Youngquist and Miller

Unassigned elements: 1 Sb?

Bar, blade, and platform fragments: 6

BIOFACIES: indeterminate

CAI: 5.5, indicating host rock reached a temperature of at least 300° C

AGE: upper Meramecian to lower Chesterian

AK90A-46: Sample collected 34 m above base of Alapah Limestone and 258 m below base of Wahoo Limestone. (56 g 20-140 mesh insoluble residue). Sample yielded:

- 1 Pa element *Cavusgnathus unicornis* Youngquist and Miller
- 1 S element *Synclydagnathus?* sp.

Bar, blade, and platform fragments: 1

BIOFACIES: Indeterminate

CAI: 5.5-6, indicating host rock reached a temperature of at least 350° C

AGE: upper Meramecian to lower Chesterian

AK90A-51: Sample collected 39 m above base of Alapah Limestone and 253 m below base of Wahoo Limestone. Sample yielded:

40 hydraulically rounded conodont fragments

Other picked: 2 bioclasts, 2 gastropod steinkerns, 4 foraminiferan steinkerns

BIOFACIES: indeterminate

CAI: Indeterminate

AGE: late Meramecian to Chesterian

AK90A-56: Sample collected 44 m above base of Alapah Limestone and 248 m below base of Wahoo Limestone. (72g 20-140 mesh insoluble residue; heavies--abundant rounded allochems, mainly bioclasts). Picked +80 fraction 100%, rest partial. Extreme hydraulic abrasion and healed fractures. Sample yielded:

- 9 Pa elements *Cavusgnathus unicornis* Youngquist and Miller
- Kladognathus* sp. indet.
- 1 M and 1 Sc elements
- 10 Pa fragments of cavusgnathoids
- 3 Pa fragments of rhachistognathids

Bar, blade, and platform fragments: 119

Other picked: 1 gastropod, 2 foram steinkerns, 1 bioclast, 1 gastropod steinkern

CAI: 5.5-6, indicating host rock reached a temperature of at least 350° C

BIOFACIES: indeterminate (too few generically identifiable conodonts)

AGE: late Meramecian to Chesterian

AK90A-59: Sample collected 47 m above base of Alapah Limestone and 245 m below base of Wahoo Limestone. 6.9 kg of rock processed (20 g of 20-140 mesh residue: heavies-weathered pyrite, pyritized and phosphatized bioclasts, and abundant ichthyoliths). Sample yielded:

1 Pa element *Adetognathus lautus* (Gunnell)
2 Pa elements *Cavusgnathus unicornis* Youngquist and Miller
22 Pa elements *Hindeodus cristulus* ?(Youngquist and Miller)
Kladognathus sp. indeterminate
1 P, 1 M, and 4 Sc elements
Syncladognathus spp.
34 Pa and 23 S elements

Unassigned elements: 2 Pb

Bar, blade, and platform fragments: 160

Other picked: 3 bioclasts, 1 pyrite cube and 17 ichthyoliths

CAI: 4.5, 5 (chiefly), and 5.5, indicating host rock reached a temperature of at least 300° C

BIOFACIES: postmortem transport within or from syncladognathid-hindeodid biofacies: shallow, normal-marine to near-restricted depositional environment

AGE: Upper *muricatus* Subzone (latest Chesterian)

AK90A-74: Sample collected 62 m above base of Alapah Limestone and 230 m below base of Wahoo Limestone. 7.1 kg of rock processed (20g +20 mesh and 71g 20-140 mesh insoluble residue; heavies: dolomite and pyrite with micrite cement). Sample yielded:

1 kladognathid fragment

CAI: 5, indicating host rock reached a temperature of at least 300° C

BIOFACIES: indeterminate

AGE: Upper *muricatus* Subzone, latest Chesterian

AK90A-81: Sample collected 69 m above base of Alapah Limestone and 223 m below base of Wahoo Limestone. 7.7 kg of rock processed (10g 20-140 mesh insoluble residue). Sample yielded:

Cavusgnathus unicornis Youngquist and Miller
53 Pa and 1 Sc elements
6 Pa elements *Gnathodus girtyi girtyi* Hass
Kladognathus sp.
2 P, 12 M, 5 Sa, and 22 Sc elements
2 Pa elements *Lochreia commutata* (Branson and Mehl)

Unassigned elements: 36 Pa, 1 juvenile Pa, 11 Pb

Bar, blade, and platform fragments: 463

CAI: 5.5-6, indicating host rock reached a temperature of at least 350° C

BIOFACIES: postmortem transport within or from the cavusgnathid-kladognathid biofacies: open platform to open marine, moderate- to high-energy depositional environment.

AGE: Upper *muricatus* Subzone, latest Chesterian

AK90A-96: Sample collected 84 m above the base of the Alapah Limestone and 208 m below the base of the Wahoo Limestone. Sample yielded:

5 Pa elements *Cavusgnathus unicornis* Youngquist and Miller
2 Pa elements *Gnathodus girtyi* subsp. indeterminate (elements are hydraulically worn)
Kladognathus sp. indeterminate
1 M and 1 Sc elements

Unassigned elements: 3 Pa
Bar, blade, and platform fragments: 10

CAI: 5.5, 6, indicating host rock reached a temperature of at least 350° C
BIOFACIES: indeterminate
AGE: upper *muricatus* Subzone, latest Chesterian

AK90A-105: Sample collected 93 m above base of Alapah Limestone and 199 m below base of Wahoo Limestone. 5.5 kg of rock processed (90 g +20 mesh and 22 g 20-140 mesh insoluble residue: heavies--phosphatic grains, phosphatized bioclasts, and minor dolomite and weathered pyrite). All elements show extreme hydraulic wear. Sample yielded:

1 Pa fragment *Cavusgnathus unicornis* Youngquist and Miller
1 Pa *Rhachistognathus muricatus* Dunn

Unassigned elements: 9 Pa
Bar, blade, and platform fragments: 22

CAI: 6, indicating host rock reached a temperature of at least 350° C
BIOFACIES: indeterminate
AGE: Upper *muricatus* Subzone, latest Chesterian

AK90A-115: Sample collected 103 m above base of Alapah Limestone and 189 m below base of the Wahoo Limestone. 4.3 kg of rock processed and yielded:

1 Pa element *Cavusgnathus unicornis* Youngquist and Miller
1 Pa element *Hindeodus* sp. indeterminate
Kladognathus sp. indeterminate
1 P and 1 M elements

Unassigned elements: 1
Bar, blade, and platform fragments: 26
Other picked: 1 bioclast, 3 ichthyoliths

CAI: 4, 5.5, and 6, indicating host rock reached a temperature of at least 350° C
BIOFACIES: indeterminate
AGE: Upper *muricatus* Subzone, latest Chesterian

AK90A-151: Sample collected 139 m above base of Alapah Limestone and 153 m below base of Wahoo Limestone. 6 kg of rock processed (370g +20 mesh and 73g 20-140 mesh insoluble residue; flourite common in heavies). Sample yielded:

23 Pa elements *Cavusgnathus unicornis* Youngquist and Miller
1 Pa element *Hindeodus minutus* (Ellison)
1 Pa element *Hindeodus* sp. indeterminate
Kladognathus sp.
6 P, 9 M, and 15 Sc elements

Unassigned elements: 15 Pa, 5 Pb (5 morphotypes), 2 M

Bar, blade, and platform fragments: 119

Other picked: 2 grains flourite, 2 coral? fragments, 1 brach fragment.

CAI: 5.5 and 6, indicating host rock reached a temperature of at least 350° C

BIOFACIES: cavusgnathid: normal marine, moderate to high energy, may be shoreward of some barrier.

AGE: Upper *muricatus* Subzone, latest Chesterian

AK90A-170: Sample collected 158 m above base of Alapah Limestone and 134 m below base of Wahoo Limestone. 6.8 kg of rock processed (410 g +20 mesh and 26 g 20-140 mesh insoluble residue; heavies-phosphatized bioclasts, dolomite and weathered pyrite). Sample yielded:

11 Pa elements *Cavusgnathus unicornis* Youngquist and Miller
Hindeodus minutus (Ellison)
1 Pa, 1 M, 1 Sa, 1 Sb, and 1 Sc elements
Kladognathus sp.
3 P and 1 Sb elements

Unassigned elements: 2 Pa, 2 Pb, 2 M

Bar, blade, and platform fragments: 74

CAI: 6, indicating host rock reached a temperature of at least 350° C

BIOFACIES: cavusgnathid-hindeodid: normal marine to near restricted, moderate to high energy, may be shoreward of some barrier.

AGE: Upper *muricatus* Subzone, latest Chesterian

AK90A-179: Sample collected 167 m above base of Alapah Limestone and 125 m below base of Wahoo Limestone. 6 kg of rock processed (0g +20 mesh and 92g 20-140 mesh insoluble residue). Sample yielded:

2 Pa elements *Cavusgnathus unicornis* Youngquist and Miller
1 Sa? element *Gnathodus?* sp.
1 Pa element *Hindeodus* sp. indeterminate
Kladognathus sp.
1 P, 1 M, 1 Sa, and 1 Sc (juvenile) elements
1 Pa element *Vogelgnathus?* sp.

Unassigned elements: 3 Pa, 2 Pb, 1 Sc

Bar, blade, and platform fragments: 24

Other picked: 2 bioclasts

CAI: 5.5-6, indicating host rock reached a temperature of at least 350° C

BIOFACIES: indeterminate (too few generically identifiable elements)

AGE: Upper *muricatus* Subzone, latest Chesterian

AK90A-185: Sample collected 173 m above base of Alapah Limestone and 119 m below base of Wahoo Limestone. kg of rock processed (g +20 mesh and g 20-140 mesh insoluble residue). Sample yielded:

- 9 Pa fragments of *cavusgnathoids*
- 4 Pa elements *Cavusgnathus unicornis* Youngquist and Miller
- 2 Sa elements *Kladognathus* sp. indeterminate
- 1 Pa element of *Vogelgnathus campbelli* (Rexroad)

Unassigned elements: 2 Sa

Bar, blade, and platform fragments: 61

CAI: 5.5-6, indicating host rock reached a temperature of at least 350° C

BIOFACIES: indeterminate (too few generically identifiable elements)

AGE: Upper *muricatus* Subzone, latest Chesterian

AK90A-188: Sample collected 176 m above the base of the Alapah Limestone and 116 m below the base of the Wahoo Limestone. 6.2 kg of rock processed and yielded:

- 5 Pa elements *Cavusgnathus unicornis* Youngquist and Miller
- 1 M element *Idioproniodus conjunctus* (Gunnell)
- Vogelgnathus* sp.
- 1 Pa and 1 Sb elements

Bar, blade, and platform fragments: 15

CAI: 6, indicating host rock reached a temperature of at least 350° C

BIOFACIES: indeterminate (too few generically identifiable elements)

AGE: Upper *muricatus* Subzone

AK90A-207: 97 m below base of Wahoo Limestone and 195 above base of Alapah Limestone. Dolomitized spiculitic wackestone. 5.8 kg of rock processed (110g +20 mesh and 42g 20-140 mesh insoluble residue). Common anhedral purple fluorite in heavies. Conodonts have sugary texture. Sample yielded:

- Cavusgnathus unicornis* Youngquist & Miller (All sizes, complete elements)
- 36 Pa and 4 Pb elements
- 4 Pa fragments of *cavusgnathoids*
- Kladognathus* sp. indet.
- 1 M, 4 Sb, 4 Sc and abundant large bar fragments
- Hindeodus minutus* (Ellison)
- 9 Pa, 1 Pb and 3 Sb elements

Unassigned elements: 2Pb, 4M

Bar, blade, and platform fragments: 63

CAI: 5-5.5(common), 6, indicating host rock reached a temperature of at least 350° C

BIOFACIES: *Cavusgnathid* with postmortem admixture from *kladognathid* biofacies. Warm, relatively shallow, partly restricted shallow marine.

AGE: Upper *muricatus* Subzone, latest Chesterian

AK90A-223: Sample collected 211 m above base of Alapah Limestone and 81 m below base of Wahoo Limestone from a spiculitic wackestone with pelmatozoan fragments. 7.1 kg of rock processed (1.08 kg +20 mesh and 42g 20-140 mesh insoluble residue). Sample yielded:

3 Pa fragments *Bispathodus?* sp. indeterminate
27 Pa elements *Cavusgnathus unicornis* Youngquist & Miller
20 Pa cavusgnathoid fragments
1 Pa element *Gnathodus girtyi simplex* Dunn
5 Pa elements *Hindeodus minutus* (Ellison)
Kladognathus sp. indet.
1 M and 5 Sc elements
3 Pa elements *Rhachistognathus prolixus* Baesemann & Lane
2 Pa elements *Vogelgnathus postcampbelli* (Austin & Husri)

Unassigned elements: 5 Pb, 3 M, 1 Sb and 4 Sc elements
Bar, blade and platform fragments: 40
Other picked: abundant ichthyoliths

CAI= 4.5-5.5, indicating host rock reached a temperature of at least 300° C
BIOFACIES: cavusgnathid with admixture from adjacent biofacies; normal marine, shallow water depositional environment.
AGE: Upper *muricatus* Subzone, latest Chesterian

AK90A-230: Sample collected 218 m above the base of the Alapah Limestone and 74 m below the base of the Wahoo Limestone. 6.8 kg of rock processed (200 g +20 mesh residue: undissolved carbonate; 37 g 20-200 mesh residue). Sample yielded:

34 Pa elements *Cavusgnathus unicornis* Youngquist and Miller
12 Pa cavusgnathoid fragments
5 Pa elements *Hindeodus minutus* (Ellison)
Idioproniodus sp.
1 Pb, 1M, and 1 S? elements
Kladognathus sp.
2 M, 32 Sa, and 6 Sc elements
1 Pa *Lochriea* sp.?

Unassigned elements: 2 Pb
Bar, blade, and platform fragments: 34
Other picked: 12 ichthyoliths, 1 phosphatized brachiopod valve, and 1 bioclast

CAI: 5.5 (chiefly), 6, indicating host rock reached a temperature of at least 350° C
BIOFACIES: postmortem transport within or from the cavusgnathid-kladognathid biofacies: shallow, normal marine, moderate- to high-energy depositional environment.
AGE: Upper *muricatus* Subzone, latest Chesterian

AK90A-237: Sample collected 225 m above the base of the Alapah Limestone and 67 m below the base of the Wahoo Limestone. 5.5 kg of rock processed (800 g of +20 mesh residue: silicified grains; 11 g of 20-200 mesh residue). Sample yielded:

4 Pa elements *Gnathodus girtyi simplex* Dunn

Unassigned elements: 1Pa
Bar, blade, and platform fragments: 11

CAI: 4, 6, indicating host rock reached a temperature of at least 350° C
BIOFACIES: indeterminate (too few generically identifiable elements)
AGE: Upper *muricatus* Subzone, latest Chesterian

AK90A-251: Sample collected 239 m above base of Alapah Limestone and 53 m below the base of the Wahoo Limestone. 5.9 kg of rock processed (300 g of +20 mesh residue: undissolved lime mud; 20 g of 20-200 mesh residue). Sample yielded:

- 8 Pa elements *Adetognathus lautus* (Gunnell)
- 1 Pa element *Cavusgnathus unicornis* Youngquist and Miller
- 4 Pa elements *Gnathodus girtyi simplex* Dunn
- 2 Pa elements *Hindeodus minutus* (Ellison)
- 9 Pa elements *Hindeodus* sp. indeterminate
- 4 Pa elements *Rhachistognathus prolixus* Baesemann and Lane

Unassigned elements: 17 Pa (mostly cavusgnathoids), 3 Pb, 5 M (2 morphotypes), and 3 Sa (2 morphotypes) elements.

Bar, blade, and platform elements: 88

Other picked: 2 flourite grains, 2 pyritized sponge spicules, 1 pyritized bioclast

CAI: 5.5, 6, indicating host rock reached a temperature of at least 350° C

BIOFACIES: hindeodid to adetognathid to mixed. May represent a normal-marine to near-restricted depositional environment with mixing from higher energy (rhachistognathids) and lower energy (gnathodids) biofacies.

AGE: Upper *muricatus* Subzone, latest Chesterian

AK90A-260: Sample collected 248 m above base of Alapah Limestone and 44 m below base of Wahoo Limestone. 6.4 kg of rock processed (100g +20 mesh and 12g 20-140 mesh insoluble residue; abundant flourite in heavy residue). Conodont elements have a very sugary texture. Sample yielded:

- 3 Pa elements *Adetognathus lautus* (Gunnell)
- 2 Pa elements *Gnathodus girtyi* subsp. indet. (juveniles)

Unassigned elements: 3 Pa, 2 M, 2 Sb?

Bar, blade, and platform fragments: 32

Other picked: flourite grains

CAI: 5.5-6, indicating host rock reached a temperature of at least 350° C

BIOFACIES: indeterminate (too few generically identifiable elements)

AGE: Upper *muricatus* Subzone, latest Chesterian

AK90A-270: Sample collected 258 m above base of Alapah Limestone and 34 m below base of Wahoo Limestone. 6.4 kg of rock processed (760 g +20 mesh and 40 g 20-140 mesh insoluble residue; abundant phosphatized bioclasts in heavy residue). Sample yielded:

- 3 Pa elements *Adetognathus lautus* (Gunnell)
- 3 Pa elements *Gnathodus girtyi simplex* Dunn
- 1 ? element *Idioproniodus* sp. indeterminate
- 1 M element *Kladognathus* sp.
- 2 Pa elements *Lochriea commutata* (Branson and Mehl)
- 1 Pa element *Vogelgnathus postcampbelli* (Austin and Husri)
- 1 Pa element *Rhachistognathus prolixus*? Baesemann and Lane

Unassigned elements: 3 Pa, 1 M, 1 Sa, 2 Sb, 1 Sc

81 indet. bar, blade, and platform fragments

Other: 2 flourite grains, 3 sponge spicules, 2 gastropod steinkerns, 2 ichthyoliths, 1 ostracode, 1 brach frag.

CAI: 6 (chiefly), 6.5

BIOFACIES: indeterminate (too few generically identifiable elements)

AGE: Upper *muricatus* Subzone, latest Chesterian

AK90A-286: Sample collected 274 m above base of Alapah Limestone and 18 m below base of Wahoo Limestone. 7.2 kg of rock processed (220g +20 mesh and 61g 20-140 mesh insoluble residue). Sample yielded:

Unassigned elements: 1 Pa, 2 Pb, 3 M, 1 Sa

Bar, blade, and platform fragments: 12

Other picked: 2 bryozoan steinkerns, 1 sponge spicule

CAI: 6, indicating host rock reached a temperature of at least 350° C

BIOFACIES: indeterminate

AGE: Upper *muricatus* Subzone, latest Chesterian

AK90A-296: Sample collected 8 m below base of Wahoo Limestone and 284 above base of Alapah Limestone from a dolomitized spiculitic mudstone. 6.1 kg of rock processed (810 g +20 mesh and 67 g 20-140 mesh residue). Conodonts have sugary texture. Identifiable forms are complete.

Cavusgnathus unicornis Youngquist & Miller

5 Pa and 1 Sb elements

Hindeodus minutus (Ellison)

1Pa, 3 Sa, and 1 Sc elements

1 Sc element *Kladognathus* sp. indet.

Unassigned elements: 3 M

Bar fragments: 20

CAI: 5-6,(6 common), indicating host rock reached a temperature of at least 350° C

BIOFACIES: indeterminate (too few generically identifiable elements)

AGE: Upper *muricatus* Subzone, latest Chesterian

AK90A-303.5: Sample collected 291.5 m above base of the Alapah Limestone and 0.5 m below base of Wahoo Limestone. 5.1 kg of rock processed (560 g +20 mesh residue; 46g of 20-140 mesh residue, heavy mineral concentrate which consisted of phosphatized bryozoans and gastropods)

NO CONODONTS WERE RECOVERED.

AK90A-304: Sample collected from base of Wahoo Limestone. (6.2 kg of rock processed: 600 g of +20 residue, mostly chert nodules; 24 g of 20-140 mesh residue)

NO CONODONTS WERE RECOVERED

AK90A-316: Sample collected 304 m above base of the Alapah Limestone and 12 m above base of lower Wahoo Limestone. 6.5kg of rock was processed (0g +20 mesh and 27g 20-140 mesh insoluble residue). Sample yielded:

1 Pa element *Cavusgnathus unicornis* Youngquist & Miller

1 Pa fragment of a cavusgnathid

1 Pa element *Gnathodus girtyi girtyi* Hass

1 Pa element *Gnathodus girtyi simplex* Dunn

1 ? element *Idioploniodus* sp.

Bar, blade and platform fragments: 4

CAI=6, indicating host rock reached a temperature of at least 350° C

BIOFACIES: indeterminate (too few generically identifiable elements)

AGE: Upper *muricatus* Subzone, latest Chesterian

AK90A-327: Sample collected 23 m above base of Wahoo Limestone. Mamet Zone 18. 6.1 kg of rocks processed (170 g of +20 mesh; 29 g of 20-140 mesh residue). Sample yielded:

2 Pa elements *Cavusgnathus? tyttus* Brown & Rexroad (2 morphotypes)
95 Pa elements *Cavusgnathus unicornis* Youngquist & Miller
43 Pa cavusgnathoid fragments
4 Pa elements *Gnathodus girtyi girtyi* Hass
7 Pa elements *Gnathodus girtyi simplex* Dunn
1 Pa element *Hindeodus minutus* (Ellison)
1 Pa element *Hindeodus* sp. indet.
Kladognathus sp. indet.
1 M & 7 Sc elements
7 Pa elements *Rhachistognathus muricatus* (Dunn)
4 Pa elements *Vogelgnathus postcampbelli* (Austin & Husri)

Unassigned elements: 15 Pb, 9 M, 3 Sa, 2 , and 2 Sc
Bar, blade, and platform fragments: +150

CAI=5-7, 6 common, indicating host rock reached a temperature of at least 490° C
BIOFACIES: cavusgnathid biofacies with admixture from adjacent biofacies; shallow, probably normal marine.
AGE: Upper *muricatus* Subzone, latest Chesterian

AK90A-337: Sample collected 33 m above base of Wahoo Limestone. Mamet Zone 18. 5.9 kg of rock processed: (0 g of +20 mesh residue; 13 g of 20-140 mesh residue) Sample yielded:

20 Pa elements *Cavusgnathus unicornis* Youngquist & Miller
17 Pa elements cavusgnathoid fragments
10 Pa elements *Gnathodus girtyi girtyi* Hass
7 Pa elements *Gnathodus girtyi simplex* Dunn
Kladognathus sp.
2 M, 1 Sa, 2 Sb, and 2 Sc elements
7 Pa elements *Rhachistognathus muricatus* (Dunn)
2 Pa elements *Vogelgnathus postcampbelli* (Austin & Husri)

Unassigned elements: 1 Pb
Bar, blade, and platform fragments: 95

CAI= minor 5, common 5.5 and minor 6.5, indicating host rock reached a temperature of at least 440° C
BIOFACIES: postmortem transport within or from the cavusgnathid-gnathodid biofacies. Shallow, normal marine depositional environment.
AGE: Upper *muricatus* Subzone, latest Chesterian

AK90A-347: Sample collected 43 m above base of Wahoo Limestone. Mamet Zone 18. (6.2 kg of rock processed: 500 g of +20 mesh residue; 69 g of 20-140 mesh residue). Sample yielded:

8 Pa elements *Gnathodus girtyi simplex* Dunn
Hindeodus minutus (Ellison)
5 Pa and 1 Sb elements
3 elements *Idioproniodus* sp.
Kladognathus sp. indet.
1M, 2Sb, and 1Sc elements
6 Pa elements *Vogelgnathus postcampbelli* (Austin & Husri)

Unassigned elements: 3 Pb (2 morphotypes), 1 M
Bar, blade, and platform elements: 65

CAI= 4.5 (common), 5.5-6 (abundant), 6.5-7 (common), indicating host rock reached a temperature of at least 490° C

BIOFACIES: postmortem hydraulic mixture-- no two components make up 70% of faunule; normal marine, relatively shallow.

AGE: Upper *muricatus* Subzone, latest Chesterian

AK90A-350: Sample collected 46 m above base of Wahoo Limestone. Mamet Zone 18. (5.7 kg of rock processed: 200 g of +20 mesh residue; 88 g of 20-140 mesh residue). Sample yielded:

14 Pa elements *Gnathodus girtyi simplex* (Dunn)
1 Pa element *Gnathodus girtyi girtyi* Hass
10 Pa elements *Vogelgnathus postcampbelli* (Austin & Husri)
Hindeodus minutus (Ellison)
3 Pa and 6 Sb elements

Unassigned elements: 2 Pb (2 morphotypes), 6 M (3 morphotypes)
Bar, blade, and platform fragments: 75

CAI: chiefly 4.5 and 5.5-6, and lesser 6.5 and 7 indicating host rock reached a temperature of at least 490° C

BIOFACIES: postmortem transport within or from the gnathodid-vogelgnathid biofacies. Relatively shallow, normal marine depositional environment.

AGE: Upper *muricatus* Subzone, latest Chesterian

AK90A-353: Sample collected 49 m above base of Wahoo Limestone. (6.1 kg of rock processed: 90 g of +20 mesh residue; 28 g of 20-140 mesh residue). Assigned to Zone 18. Sample yielded:

1 Pa cavusgnathoid fragment
26 Pa elements *Gnathodus girtyi girtyi* Hass
15 Pa elements *Gnathodus girtyi simplex* (Dunn)
Hindeodus minutus (Ellison)
5 Pa, 3 M, 1 Sb, and 1 Sc elements
Kladognathodus sp.
1 M, 2 Sb, and 1 Sc elements
Vogelgnathus postcampbelli (Austin & Husri)
135 Pa and 1 Sc? elements

Unassigned Elements: 1 Pb, 1 Sc

Bar, blade, and platform fragments: 166

CAI: 5.5 (minor), 6 (common), 6.5-7 (abundant), 8 (rare), indicating host rock reached a temperature of at least 600° C

BIOFACIES: Postmortem transport within or from the vogelgnathid biofacies. Relatively shallow, normal-marine to near restricted depositional environment. Alternatively, the relatively high number of gnathodids may indicate that the small elements of *Vogelgnathus* may have been winnowed into deeper waters.

AGE: late Chesterian, upper *muricatus* Subzone (based on underlying samples)

AK90A-355: Sample collected 51 m above base of Wahoo Limestone. (6.5 kg of rock processed: 30 g of +20 mesh residue; 13 g of 20-140 mesh residue). Not zoned by Mamet, but immediately above rocks assigned to Zone 18. Sample yielded:

23 Pa elements *Gnathodus girtyi girtyi* Hass
5 Pa elements *Gnathodus girtyi simplex* Dunn
Vogelgnathus postcampbelli (Austin & Husri)
60 Pa and 1 Pb elements
Kladognathus sp.
1 Sc and 1 M elements
Hindeodus minutus (Ellison)
2 Pa and 1 Sb elements

Unassigned Elements: 3M, 1 Pb, 1 Sc

Bar, blade and platform fragments: 55

CAI: chiefly 5.5-6.5, indicating host rock reached a temperature of at least 360° C

BIOFACIES: Postmortem transport within or from the vogelgnathid-gnathodid biofacies. Shallow, normal marine. The small elements of *Vogelgnathus* are easily winnowed out of their biofacies. Elsewhere (Purnell and von Bitter, 1991), vogelgnathids are found in sediments deposited in restricted-marine environments.

AGE: Upper *muricatus* Subzone, latest Chesterian

AK90A-364: Sample collected 60 m above base of Wahoo Limestone. (7.1 kg of rock processed: 190 g of +20 mesh residue; 54 g of 20-140 mesh residue). Not zoned by Mamet. Sample yielded:

1 Pb element *Gnathodus defectus* Dunn
1 Pa element *Gnathodus girtyi simplex* Dunn
1 Pa cavusgnathoid fragment

Bar, blade, and platform fragments: 4

CAI: 5.5-6, indicating host rock reached a temperature of at least 350° C

BIOFACIES: Indeterminate

AGE: Upper *muricatus* Subzone, latest Chesterian

AK90A-366: Sample collected 62 m above base of Wahoo Limestone. (5.8 kg of rock processed: 20g of +20 mesh residue; 1 g of 20-140 mesh residue). Sample yielded:

2 M elements *Kladognathus* sp. Indeterminate

Bar, blade and platform fragments: 4

CAI: Indeterminate

BIOFACIES: indeterminate (too few generically identifiable elements)

AGE: Upper *muricatus* Subzone, latest Chesterian

AK90A-369: Sample collected 65 m above base of Wahoo Limestone. 6.5 kg of rock was processed (200 g +20 mesh and 233 g 20-140 mesh insoluble residue). Sample yielded:

15 Pa elements *Gnathodus bilineatus bilineatus* Roundy

1 Pa element *Gnathodus girtyi girtyi* Hass

3 Pa elements *Hindeodus minutus* Ellison

2 M elements *Kladognathus* sp. indet.

3 Pa elements *Lochriea commutata* (Branson and Mehl)

Unassigned elements: 5 Pa, 1 Pb, 2 Sb, and 1 Sc elements

Bar, blade and platform fragments: 12

CAI: 4.5 and 6, indicating host rock reached a temperature of at least 350° C

BIOFACIES: gnathodid to mixed biofacies; shallow to moderate depth, normal marine.

AGE: Upper *muricatus* Subzone, latest Chesterian

AK90A-372.5: Sample collected 68.5 m above base of Wahoo Limestone., Gruzlovic noted significant compactions at this interval. According to Carlson (1989) there is a subaerial exposure surface at about 375 m. This exposure surface could have provided a channelway for movement of hydrothermal solutions and a zone along which strain could be concentrated. Fluids moving through the carbonate succession could have carried younger conodonts (**stratigraphic leak**) downward to this level. 6.6 kg of rock (2.1 kg of +20 mesh and 225 g 20-140 mesh insoluble residue). Elements fractured and plastically deformed. Sample yielded:

1 Pa element *Declinognathodus noduliferus japonicus* (Igo and Koike)

1 Pa element *Declinognathodus noduliferus noduliferus* (Ellison and Graves)

3 Pa elements *Gnathodus girtyi simplex* Dunn--**REDEPOSITED**

2 Pa elements *Gnathodus girtyi girtyi* Hass--**REDEPOSITED**

Hindeodus minutus (Ellison)

3 Pa and 1 Sb elements

1 Pa element *Idlognathodus* sp.

10 ? elements *Idioproniodus conjunctus* (Gunnell)

9 Sc elements *Kladognathus* sp.--**REDEPOSITED**

Unassigned elements: 1 Pb

Bar, blade and platform fragments: 46

CAI: 5-6.5, chiefly 5.5 to 6, indicating host rock reached a temperature of at least 350° C

BIOFACIES: postmortem hydraulic mixing of several biofacies and ages.

AGE: No older than early late Morrowan. Conodonts that do not range above this level are redeposited.

AK90A-374 : Sample collected 70 m above base of lower Wahoo Limestone. (5.9 kg of rock processed: 200 g +20 mesh residue; 40 g 20-140 mesh insoluble residue). Specimens are squashed, stretched, mashed, and hydrothermally altered. Sample yielded:

- 8 Pa elements *Declinognathodus noduliferus japonicus* (Igo and Koike)
- 6 Pa elements *Cavusgnathus? tyththus* Brown and Rexroad (2 α , 1 β , morphotype, other 4?) **Redeposited**
- 2 Pa elements *Hindeodus* sp. indeterminate
- 1 Pa element *Rhachistognathus muricatus* (Dunn)

Bar, blade, and platform fragments: 9

CAI: 6.5, 7, 8. CAI values of 6-8 cannot be used to assess temperatures of hydrothermally altered rocks (Rejeblan and others, 1987)

BIOFACIES: indet. Postmortem hydraulic mixing of several biofacies and ages.

AGE: No older than early late Morrowan. Conodonts that do not range above this level are redeposited; all others are indigenous

AK90A-375: Sample collected 71 m above base of lower Wahoo Limestone. (5.3 kg of rock processed: 220 g +20 mesh residue; 220 g 20-140 mesh insoluble residue). Sample yielded:

- 10 Pa elements *Declinognathodus noduliferus japonicus* (Igo and Koike)
- 3 Pa elements *Cavusgnathus? tyththus* Brown and Rexroad **Redeposited**
- Hindeodus* sp. indet.
- 1 Pa and 1 Sa elements
- 11 cavusgnathoid Pa fragments
- 1 Pa element *Vogelgnathus postcampbelli* (Austin & Husri) **Redeposited**

Unassigned elements: 2 Sb, 1 Sc

31 indet. bar, blade, and platform fragments

CAI: 5.5-6.5 (chiefly 6.5), indicating host rock reached a temperature of at least 440° C

BIOFACIES: indeterminate Postmortem hydraulic mixing of several biofacies and ages.

AGE: No older than early late Morrowan. Conodonts that do not range above this level are redeposited; all others are indigenous.

AK90A-376: Sample collected 72 m above base of lower Wahoo Limestone. (6.7 kg of rock processed: 400 g +20 mesh residue; 178 g 20-140 mesh insoluble residue). Sample yielded:

- 1 Pa element *Cavusgnathus? tyththus* Brown and Rexroad **Redeposited**
- 38 Pa elements *Declinognathodus noduliferus japonicus* (Igo and Koike)
- 1 Pa element *Gnathodus girtyi girtyi* Hass **Redeposited**
- Hindeodus* aff. *H. minutus* (Ellison)
- 4 Pa, 1 Pb, 1 Sa, & 5 Sb
- 2 Pa elements *Vogelgnathus postcampbelli* (Austin & Husri) **Redeposited**
- 1 cavusgnathid Pa fragment

Unassigned elements: 3 Pb (2 morphotypes), 2 M, 1 Sa

Bar, blade, and platform fragments: 25

CAI: 5.5-6.5 (chiefly 5.5), indicating host rock reached a temperature of at least 440° C

BIOFACIES: indeterminate. Postmortem hydraulic mixing of several biofacies and ages.

AGE: No older than early late Morrowan. Conodonts that do not range above this level are redeposited; all others are indigenous.

AK90A-378: Sample collected 74 m above base of Wahoo Limestone. (5.9 kg of rock processed: 860g of +20 residue, mostly siliceous flakes and undissolved lime mud; 187 g of 20-140 mesh residue). Sample yielded:

- 1 Pa element *Cavusgnathus? tythius?* Brown and Rexroad **Redeposited**
- 60 Pa elements *Declinognathodus noduliferus japonicus* (Igo and Koike)
- 1 Pa element *Hindeodus minutus*(Ellison)
- 2 ? elements *Idioproniodus* sp. indet.
- 1 Sc element *Kladognathus* sp. indet. **REDEPOSITED**
- 30 Pa elements *Vogelgnathus postcampbelli* (Austin & Husri) **Redeposited**

Unassigned elements: 3 Pa, 6 Pb, Sa
Bar, blade, and platform fragments: 102

CAI: 4, 4.5, 6, 6.5, indicating host rock reached a temperature of at least 440° C.
BIOFACIES: Indeterminate. Postmortem hydraulic mixing of several biofacies and ages.
AGE: No older than early late Morrowan. Conodonts that do not range above this level are redeposited; all others are indigenous.

AK90A-381.5: Sample collected 77.5 m above base of Wahoo Limestone. (4.9 Kg of rock processed, 800 g +20 residue; 52 g 20-140 mesh residue). Sample yielded:

- 1 Pa element *Adetognathus lautus?* (Gunnell)
- 65 Pa elements *Declinognathodus noduliferus japonicus* (Igo and Koike)
- 10 Pa elements *Vogelgnathus postcampbelli* (Austin & Husri) **Redeposited**

Unassigned elements: 3 Pa, 1 Pb and 5 Sc
Bar, blade and platform fragments: 38

CAI=4.5-6.5, chiefly 6 or greater, indicating host rock reached a temperature of at least 440 ° C
BIOFACIES: Indeterminate Postmortem hydraulic mixing of several biofacies and ages.
AGE: No older than early late Morrowan. Conodonts that do not range above this level are redeposited; all others are indigenous.

AK90A-382.5: Sample collected 78.5 m above base of Wahoo Limestone. (6.3 Kg of rock processed, 510 g +20 residue; 85 g 20-140 mesh residue). Sample yielded:

- 87 Pa elements *Declinognathodus noduliferus japonicus* (Igo and Koike) (full range of small juveniles to adults)
- 2 Pa elements *Vogelgnathus postcampbelli* (Austin & Husri) **Redeposited**
- 3 Pa elements *Rhachistognathus muricatus*Dunn)
- 1 Pa element *C.? tythius* Brown and Rexroad **Redeposited**
- Hindeodus minutus*(Ellison)
- 5 Pa, 3 M, and 1 Sc elements
- 8 Pa cavusgnathoid fragments

Unassigned Elements: 3 Pb, 2 M, 1 Sa, 3 Sc
Bar, blade, and platform fragments: 105

CAI=4.5 (minor), 5.5-6.5(common), indicating host rock reached a temperature of at least 440° C
BIOFACIES: indeterminate. Postmortem hydraulic mixing of several biofacies and ages.
AGE: No older than early late Morrowan. Conodonts that do not range above this level are redeposited; all others are indigenous.

AK90A-383.5: Sample collected 79 m above the base of the Wahoo Limestone. (6.1 kg of rock processed; 120 g +20 mesh residue; 47 g of 20-140 mesh residue). Sample yielded:

116 Pa elements *Declinognathodus noduliferus japonicus* (Igo and Koike)
2 Pa elements *Declinognathodus noduliferus noduliferus* (Ellison and Graves)
12 Pa elements *Declinognathodus lateralis* (Higgins and Bouckaert)
1 Pa element *C. ? tythus* (Brown and Rexroad)
2 Pa elements *Adetognathus lautus* (Gunnell)
6 Pa elements *Vogelgnathus postcampbelli* (Austin & Husri) **Redeposited**
1 Pa element *Rhachistognathus muricatus* Dunn
Hindeodus minutus (Ellison)
7 Pa, 1 Pb, 1 M, and 3 Sc elements
1 Sc *Kladognathus* sp. indet. **Redeposited**

Unassigned Elements: 26 Pa gnathodid and cavusgnathid frags, 5 Pb, 1M, 1 Sc, 1Sb

Bar, blade, and platform fragments: 136

CAI=5 (minor), 5.5-6 (abundant), 6.5 (rare), indicating host rock reached a temperature of at least 440° C
BIOFACIES: indeterminate. Postmortem hydraulic mixing of several biofacies and ages.
AGE: No older than early late Morrowan. Conodonts that do not range above this level are redeposited; all others are indigenous.

AK90A-385: Sample collected 81 m above base of Wahoo Limestone. (6 Kg of rock processed, 100 g +20 residue; 18 g 20-140 mesh residue). Sample yielded:

14 Pa elements *C. ? tythus* Brown and Rexroad (a morphotype) **Redeposited**
6 Pa elements *C. ? tythus* Brown and Rexroad (g morphotype) **Redeposited**
3 Pa elements *Declinognathodus noduliferus noduliferus* (Ellison and Graves)
15 Pa elements *Declinognathodus noduliferus japonicus* (Igo and Koike)
3 Pa elements *Hindeodus minutus* (Ellison)
13 Pa elements *Rhachistognathus muricatus* Dunn
1 Sc element *Kladognathus* sp. **Redeposited**

Unassigned Elements: 4 Pb, 2 M, 1 Sb

Bar, blade and platform fragments: 57

CAI=5.5-6.5, indicating host rock reached a temperature of at least 440° C
BIOFACIES: indet. Postmortem hydraulic mixing of several biofacies and ages.
AGE: No older than early late Morrowan. Conodonts that do not range above this level are redeposited; all others are indigenous.

AK90A-388: Sample collected 84 m above base of Wahoo Limestone. (6 kg of rock processed, 100 g +20 residue; 18 g 20-140 mesh residue). Sample yielded:

2 Pa elements *C. ? tythus* Brown and Rexroad (a morphotype) **Redeposited**

Unassigned elements: 2Pb

CAI=5.5, indicating host rock reached a temperature of at least 300° C
BIOFACIES: indeterminate Postmortem hydraulic mixing of several biofacies and ages.
AGE: No older than early late Morrowan. Conodonts that do not range above this level are redeposited; all others are indigenous.

AK90A-390: Sample collected 86 m above base of Wahoo Limestone. (5.4 kg of rock processed, 102g +20 residue; 18 g 20-140 mesh residue). Sample yielded:

17 Pa elements *Declinognathodus noduliferus japonicus* (Igo and Koike)
1 Pa element *C. ? tythrus* Brown and Rexroad(a morphotype) **Redeposited**
1 Sc element *Kladognathus* sp. **Redeposited**
1 Pa element *Rhachistognathus muricatus* (Dunn)
1 Pa element *Hindeodus minutus*(Ellison)

Unassigned Elements: 3 Pb (2 morphotypes), 1 M
Bar, blade, and platform fragments: 38

CAI=5.5-6.5, indicating host rock reached a temperature of 440° C.
BIOFACIES: indeterminate. Postmortem hydraulic mixing of several biofacies and ages.
AGE: No older than early late Morrowan. Conodonts that do not range above this level are redeposited; all others are indigenous.

AK90A-398: Sample collected 94 m above base of Wahoo Limestone. Foram Zone 20. 6.1 kg of rock processed (20 g +20 mesh and 53 g 20-140 mesh insoluble residue). A few specimens deformed. Sample yielded:

3 Pa elements *Cavusgnathus ? tythrus* Brown & Rexroad **Redeposited**
7 Pa elements *Declinognathodus noduliferus japonicus ?* (Igo and Koike)
Hindeodus sp. indeterminate.
1 Pa and 1 Sa elements
3 Pa *Idiognathodus* sp. indeterminate
1 Pa element *Gnathodus bilineatus* (Roundy) **REDEPOSITED**
6 Pa elements *Gnathodus girtyi girtyi* Hass **REDEPOSITED**
Kladognathus sp. indeterminate **REDEPOSITED**
1 M, 1 Sb, and 4 Sc elements
10 Pa elements *Rhachistognathus muricatus* (Dunn)
1 Pa element *R. websteri* Baesemann and Lane
1 Pa element *R. primus* Dunn

Unassigned elements: 1 Pb
Bar, blade and platform fragments: 41

CAI: 5.5-6.5, indicating host rock reached a temperature of at least 440° C
BIOFACIES: Hydraulic mixing of biofacies and ages.
AGE: No older than early late Morrowan. Conodonts that do not range above this level are redeposited; all others are indigenous.

AK90A-411: Sample collected 107 m above base of lower Wahoo Limestone and 27.5 m above base of upper member of Wahoo Limestone. (5.6 kg of rock processed: 200 g +20 mesh residue; 31 g 20-140 mesh insoluble residue). Sample yielded:

- 1 Pa element *Adetognathus* aff. *A. lautus* (Gunnell)
- 32 Pa cavusgnathoid fragments
- 2 Pa elements *Cavusgnathus*? aff. *C.?* *tytthus* Brown & Rexroad **Redeposited**
- 25 Pa elements *Cavusgnathus*? *tytthus* (α morphotype) Brown and Rexroad **Redeposited**
- 10 Pa elements *Cavusgnathus*? *tytthus* (β morphotype) Brown and Rexroad **Redeposited**
- 1 Pa element *Cavusgnathus*? *tytthus* (γ morphotype) Brown and Rexroad **Redeposited**
- 20 Pa elements *Declinognathodus noduliferus noduliferus* (Ellison and Graves)
- 1 Pa element *Declinognathodus noduliferus japonicus* (Igo and Kolke)
- 2 Pa elements *Hindeodus minutus* (Ellison)
- 5 Pa fragments *Hindeodus* sp. indeterminate.
- Kladognathus* sp. indet. **Redeposited**
- 1 Pb and 3 Sc elements
- 35 Pa elements *Rhachistognathus muricatus* (Dunn)

Unassigned elements: 2 Pb (2 morphotypes), 3 M
Bar, blade, and platform fragments: 30

CAI: 4.5 and 6, indicating host rock reached a temperature of at least 350° C

BIOFACIES: Hydraulic mixing of biofacies and ages.

AGE: No older than early late Morrowan. Conodonts that do not range above this level are redeposited; all others are indigenous.

AK90A-421: Sample collected 117 m above base of Wahoo Limestone and 39 m above base of upper member of Wahoo Limestone. (5.8 kg of rock processed: 360 g of +20 residue; 249 g of 20-140 mesh residue). Sample yielded:

- 33 Pa elements *Rhachistognathus muricatus* (Dunn)
- 1 Pa element *Rhachistognathus primus* Dunn
- 3 Pa elements *Rhachistognathus websteri* Baesemann & Lane

Bar, blade, and platform fragments: 23

CAI: 5.5-6, indicating host rock reached a temperature of at least 350° C

BIOFACIES: Hydraulic mixing of biofacies and ages.

AGE: No older than early late Morrowan. Conodonts that do not range above this level are redeposited; all others are indigenous.

AK90A-430: Sample collected 126 m above base of Wahoo Limestone and 48 m above base of upper member of Wahoo Limestone. 5.9 kg of rock processed (0 g of +20 residue; 28 g of 20-140 mesh residue). Only 100-140 mesh picked. Sample yielded:

- 7 Pa elements *Adetognathus lautus* (Gunnell)
- 1 Pa element *Gnathodus defectus* Dunn **REDEPOSITED**
- 2 Pa elements *Gnathodus girtyi simplex* Dunn **REDEPOSITED**
- 1? elements *Idioproniodus* sp.
- 4 Pa elements *Rhachistognathus minutus* subspp. indet.
- 1 Pa element *Rhachistognathus minutus havlena* Baesemann & Lane
- 104 Pa elements *Rhachistognathus muricatus* (Dunn)
- 2 Pa elements *Rhachistognathus primus* Dunn **Redeposited**
- 10 Pa elements *Rhachistognathus websteri* Baesemann & Lane **Redeposited**

Unassigned Elements: 18 Pa cavusgnathoid and rhachistognathid fragments.
Bar, blade, and platform fragments: 49

CAI: 5 (very rare), 5.5-6 (chiefly), 6 (rare), indicating host rock reached a temperature of at least 350° C
BIOFACIES: Hydraulic mixing of biofacies and ages.

AGE: No older than early late Morrowan. Conodonts that do not range above this level are redeposited; all others are indigenous.

AK90A-438: Sample collected 134 m above base of Wahoo Limestone and 55 m above base of upper member of Wahoo Limestone. (6.7 kg of rock processed: 310g +20 mesh residue; 179 g 20-140 mesh residue). Sample yielded:

- 1 Pa element *Cavusgnathus? tythus* Brown & Rexroad **Redeposited**
- 2 Pa elements *Gnathodus defectus* Dunn **Redeposited**
- 1? element *Idioproniodus* sp.
- 12 Pa elements *Rhachistognathus muricatus* (Dunn)
- 1 Pa element *Rhachistognathus primus* Dunn **Redeposited**

Unassigned elements: 3 Pa, 2 Pb and 1 Sb
Bar, blade, and platform fragments: 17

CAI=5.5-6, indicating host rock reached a temperature of at least 350° C

BIOFACIES: Hydraulic mixing of biofacies and ages.

AGE: No older than early late Morrowan. Conodonts that do not range above this level are redeposited; all others are indigenous.

AK90A-446: Sample collected 143 m above base of Wahoo Limestone and 42 m above base of upper member of Wahoo Limestone. (6 kg of rock processed: 120 g +20 mesh residue; 51 g 20-140 mesh). Sample yielded:

- 13 Pa elements *Adetognathus lautus* (Gunnell)
- 7 Pa fragments of cavusgnathoids
- 1 Pa element *Declinognathodus noduliferus* (Ellison & Graves) subsp. indet. (waterworn)
- 13 Pa elements *Rhachistognathus minutus declinatus* Baesemann and Lane
- 13 Pa elements *Rhachistognathus minutus havlenai* Baesemann and Lane
- 10 Pa elements *Rhachistognathus minutus minutus* (Higgins & Bouckaert)
- 9 Pa elements *Rhachistognathus muricatus* (Dunn)
- 6 Pa fragments rhachistognathids

Bar, blade, and platform fragments: 17

Other picked: Phosphatized steinkerns of gastropods, foraminifers, and bryozoans. Also ichthyoliths.

CAI=4.5, 6, indicating host rock reached a temperature of at least 350° C

BIOFACIES: rhachistognathid; shallow water, relatively high energy, normal marine depositional environment. Postmortem transport within or from biofacies.

AGE: Pennsylvanian (late Morrowan-Atokan)

AK90A-459: Sample collected 156 m above base of Wahoo Limestone and 65 m above base of upper member of Wahoo Limestone. (6.5 kg of rock processed: 380 g +20 residue; 318 g of 20-140 mesh residue). Sample yielded:

- 2 Pa elements *Declinognathodus noduliferus noduliferus* (Ellison & Graves)

Unassigned elements: 1 Pa

Bar, blade and platform fragments: 4

Other picked: gastropod, foram, and bryozoan steinkerns

CAI=4.5, indicating host rock reached a temperature of at least 300° C

BIOFACIES: indeterminate

AGE: Morrowan-early Atokan

AK90A-471: Sample collected 167 m above base of Wahoo Limestone., 6 kg of rock processed: 170 g +20 mesh residue; 40 g 20-140 mesh. Sample yielded:

- 26 Pa elements *Declinognathodus noduliferus japonicus* (Igo and Koike) (complete to broken elements)
- 1 Pa element *Gnathodus defectus* Dunn **Redeposited**
- 3 Pa elements *Idiognathodus* sp. indet. fragments
- 2? elements *Idioproniodus* sp. indet.
- 1 Pa element *Rhachistognathus minutus* subsp. indet. (juvenile)

Bar, blade, and platform fragments: 21

Other picked: ichthyoliths

CAI: 4.5, indicating host rock reached a temperature of at least 300° C

BIOFACIES: Declinognathodid biofacies. Normal open marine, probably ocean side of barrier.

AGE: *Idiognathodus* Fauna; Morrowan-early Atokan

AK90A-480: Sample collected 176 m above base of Wahoo Limestone and m above base of upper member of Wahoo Limestone. (6. kg of rock processed: 40 g +20 residue; 11 g of 20-140 mesh residue). Sample yielded:

- 1 Pa element *Adetognathus lautus* (Gunnell)
- 1 Pa element *Declinognathodus noduliferus japonicus* (Igo and Koike)
- 1 Pa element *Rhachistognathus minutus* (Higgins & Bouckaert) subsp. indet.
- 1 Pa element *Rhachistognathus muricatus* (Dunn)

Bar, blade and platform fragments: 12

CAI: 4.5 (rare), 5.5-6.5 (common), indicating host rock reached a temperature of at least 440° C

BIOFACIES: Indeterminate

AGE: Morrowan-early Atokan

AK90A-485: Sample collected 181 m above base of Wahoo Limestone and 65 m above base of upper member of Wahoo Limestone. (6.1 kg of rock processed: 110 g +20 residue; 43 g of 20-140 mesh residue). Sample yielded:

- 4 Pa elements *Adetognathus lautus* (Gunnell) (1 is *A. spathus*)
- 4 Pa elements *Rhachistognathus minutus declinatus* Baesemann and Lane

Unassigned elements: 1 Sa

CAI=4.5-5, indicating host rock reached a temperature of at least 300° C

BIOFACIES: Indeterminate

AGE: Morrowan-early Atokan

AK90A-490: Sample collected 187 m above base of lower Wahoo Limestone and 96 m above base of upper member of Wahoo Limestone. (5.4 kg of rock processed: 100 g +20 mesh residue; 74 g 20-140 mesh residue). Sample yielded:

- 19 Pa elements *Declinognathodus noduliferus noduliferus* (Ellison and Graves)
- 4 Pa elements *Declinognathodus noduliferus japonicus* (Igo and Koike)
- 2 Pa elements *diognathodus* aff. *I. incurvus*
- 34 Pa elements *Idiognathodus* sp. indet.
- 2 ? elements *Idioproniodus* sp. indet.
- 10 Pa gnathodont fragments

Unassigned elements: 1 Pb

Bar, blade, and platform fragments: 42

Other picked: rare ichthyoliths

CAI: 4.5 & 6, indicating host rock reach a temperature of 350° C

BIOFACIES: postmortem transport within the cavusgnathid?-rhachistognathid-declinognathodid biofacies; normal marine, relatively shallow water depositional environment.

AGE: no older than early Atokan, could be early Atokan

Eastern Sadlerochit Mountains

Mt. Michelson C-1 Qd.

SE1/4 SW1/4, SEC. 5 T.3N., R.30E. to NW1/4, SEC. 8, T.3N., R.30E.

Reference: Krumhardt, 1992

Collector: Andrea Krumhardt

Samples **AK92 5, 7** were collected at the main section in the eastern Sadlerochit Mountains (Krumhardt 1992) in an attempt to better define the Mississippian Pennsylvanian boundary.

AK92-7: Sample collected 1 meter below red and gray chert-bearing interval from a bryozoan-pelmatozoan grainstone, 54m above base of lower member of Wahoo Limestone. (Heavies--abundant pyrite and minor phosphatized bioclasts and hematites?) Sample yielded:

Gnathodus girtyi simplex Dunn
10 Pa (adults and juveniles), and 1 M elements
Hindeodus sp. indeterminate
1 Pa and 1 Pb elements
1 cavusgnathoid fragment

Unassigned elements: 2 Pa

Bar, blade, and platform fragments: 28

CAI: 4, 6(chiefly), indicating host rock reached a temperature of at least 350° C

BIOFACIES: indeterminate (too few generically identifiable elements) but conodonts suggest relatively deeper water, normal-marine depositional environment.

AGE: Upper *muricatus* Subzone, latest Chesterian (based on previous samples, Krumhardt, 1992)

AK92-5: Sample collected 0.1 meter below red and gray chert-bearing interval from a bryozoan-pelmatozoan grainstone, 54.9 m above base of lower member of Wahoo Limestone. 4.3 kg of rock processed (9 g of +20 mesh residue: chert fragments, brachiopod fragments and crinoid ossicles; 20 g of 20-140 mesh residue: heavies--abundant pyrite with dolomite rhombs) Sample yielded:

5 Pa elements *Gnathodus girtyi girtyi* Hass
1 Pb? element *Idioprioniodus* sp. indeterminate
1 M element *Kladognathus* sp. indeterminate
2 Pa elements *Lochriea commutata* (Branson and Mehl)

Bar, blade, and platform fragments: 34

CAI: 6, 6.5, indicating host rock reached a temperature of at least 440° C

BIOFACIES: indeterminate (too few generically identifiable elements) but conodonts suggest relatively deeper water, normal-marine depositional environment.

AGE: Upper *muricatus* Subzone, latest Chesterian (based on previous samples, Krumhardt, 1992)

Samples **AK90C 1-3** and **AK92 1-4** were collected approximately 100 meters from the main section measured for Krumhardt (1992) in an attempt to better define the Mississippian Pennsylvanian boundary in the eastern Sadlerochit Mountains.

AK90C-1: Top of bryozoan-pelmatozoan skeletal grainstone immediately below red and gray chert-bearing interval, approximately 55 m above base of lower member of Wahoo Limestone. (5.8 kg of rock processed; 473 g of +20 mesh residue; 69g of 20-140 mesh residue). Sample yielded:

- 3 Pa elements *Declinognathodus noduliferus japonicus* (Igo & Koike)
- 21 Pa elements *Cavusgnathus? tyththus* Brown & Rexroad (3 morphotypes)
- 1 juvenile Pa element *Rhachistognathus* aff. *R. muricatus* (Dunn)
- 14 Pa fragments cavusgnathoids
- 3 Pb element fragments of *Cavusgnathus? tyththus* Brown & Rexroad

Bar, blade and platform elements: 14

CAI=4, 4.5 & 6, indicating host rock reached a temperature of at least 350° C

BIOFACIES: *Cavusgnathus? tyththus* biofacies--ramiform elements have been winnowed out. Shallow-, moderate-energy, probably open lagoon.

AGE: Lower *noduliferus-primus* Zone, earliest Pennsylvanian

AK90C-2: From middle part of peloidal, spiculitic wackestone containing red and gray chert, approximately 55.5 m above base of lower member of Wahoo Limestone. (5.8 kg of rock processed: 120 g of +20 mesh residue; 59g of 20-140 mesh residue). Sample yielded:

- 3 Pa *Cavusgnathus? tyththus* Brown & Rexroad (3 morphotypes)
- 2 indet. Pa fragments cavusgnathoids

Bar, blade and platform fragments: 2

Other pickedv: common ichthyoliths

CAI=4, 4.5 & 6, indicating host rock reached a temperature of at least 350° C

BIOFACIES: postmortem transport from *Cavusgnathus? tyththus* biofacies into probably shallower water restricted marine environment.

AGE: Lower *noduliferus-primus* Zone, earliest Pennsylvanian

AK90C-3: Base of bryozoan-pelmatozoan skeletal grainstone just above contact with red and gray chert-bearing interval, approximately 56 m above base of lower member of Wahoo Limestone. (6.1 kg of rock processed; 282 g of +20 mesh residue; 263g of 20-140 mesh residue). Sample yielded:

- 9 Pa elements *Cavusgnathus? tyththus* Brown & Rexroad (2 morphotypes)
- 17 Pa element fragments of chiefly cavusgnathoids
- 11 Pa elements *Declinognathodus noduliferus japonicus* (Igo & Koike)
- 1 Pa fragment *Hindeodus* sp. indet.
- 3 Pa elements *Rhachistognathus muricatus* Dunn

Unassigned elementsa: 1Pb

Bar, blade and platform fragments: 31

CAI=4 and 6, indicating host rock reached a temperature of at least 350° C

BIOFACIES: postmortem transport from declinognathodid and cavusgnathid? biofacies; warm, relatively high-energy, shallow-water depositional environment, near intermittently restricted environments.

AGE: *noduliferus-primus* Zone, earliest Pennsylvanian

AK92-4: Sample collected 2.1 meters below red-gray chert interval from a bryozoan, pelmatozoan and peloid grainstone, approximately 52.9 m above the base of the Wahoo Limestone. 8.5 kg of rock processed (169 g of +20 mesh residue: undissolved carbonate; 115 g of 20-140 mesh residue: heavies--dolomite and pyrite with minor phosphatized bioclasts). Sample yielded:

3 Pa elements *Cavusgnathus unicornis* Youngquist and Miller
1 Pa element *Cavusgnathus? tythus* Brown & Rexroad

Unassigned elements: 2 Pa
Bar, blade, and platform fragments: 12

CAI: 6, indicating host rock reached a temperature of at least 350° C
BIOFACIES: indeterminate (too few generically identifiable elements)
AGE: Upper *muricatus* Zone, latest Chesterian (based on nearby sampling, Krumhardt, 1992)

AK92-3: Sample collected 1.6 meters below red-gray chert interval from a bryozoan, pelmatozoan, and peloid grainstone, approximately 53.4 meters above the base of the Wahoo Limestone. 6.9 kg of rock processed (557 g of +20 mesh residue: chert nodules, silicified crinoid ossicles, and undissolved carbonate; 101 g of 20-140 mesh residue: heavies--abundant weathered pyrite and dolomite). Sample yielded:

1 Pa element *Adetognathus lautus* (Gunnell)
2 Pa elements (juveniles) *Cavusgnathus unicornis* Youngquist and Miller
3 Pa cavusgnathoid fragments

Bar, blade, and platform fragments: 3

CAI: 4.5, indicating host rock reached a temperature of at least 300° C
BIOFACIES: indeterminate (too few generically identifiable elements)
AGE: Upper *muricatus* Zone, latest Chesterian

AK92-2: Sample collected 1.1 meters below red-gray chert interval from a bryozoan, pelmatozoan, and peloid grainstone, approximately 53.9 meters above the base of the Wahoo Limestone. 6.8 kg of rock processed (50 g of +20 mesh residue; heavies--abundant weathered pyrite and dolomite). Sample yielded:

1 Pa fragment of *Cavusgnathus unicornis* Youngquist and Miller
2 Pa cavusgnathoid fragments

CAI: Indeterminate
BIOFACIES: indeterminate (too few generically identifiable elements)
AGE: Upper *muricatus* Zone, latest Chesterian

AK92-1: Sample collected 0.6 meters below red-gray chert interval from a bryozoan and pelmatozoan grainstone, approximately 54.4 meters above the base of the Wahoo Limestone. 6.3 kg of rock processed (56 g of +20 mesh residue: chert nodules and undissolved carbonate: 60 g of 20-140 mesh residue: heavies--abundant pyrite). Sample yielded:

8 Pa elements *Gnathodus giryti simplex* Dunn

11 Pa elements *Gnathodus giryti giryti* Hass

Hindeodus minutus (Ellison)

1 Pa, and 1 Sa elements

2 Pa elements *Hindeodus* sp. indeterminate

Idioproniodus conjunctus (Gunnell)

1 M and 1 Sc elements

Unassigned elements: 6 pa, 1 Pb

Bar, blade, and platform fragments: 85

Other picked: 3 ichthyoliths

CAI: 4, 6, indicating host rock reached a temperature of at least 350° C

BIOFACIES: *Gnathodid*, relatively deep, normal-marine depositional environment.

AGE: Upper *muricatus* Subzone, latest Chesterian

Eastern Sadlerochit Mountains

Mt. Michelson C-1 Qd.

NW1/4 SEC. 7, T.3N., R.31E.

Reference: Wahoo Section (86RC17) of Carlson (1987)

Collector: Andrea Krumhardt

Samples **AK90E** and **AK92 11-14** were collected from the Mississippian-Pennsylvanian boundary interval from a section measured by R.C. Carlson (1987) located approximately 1 km to the south of the section measured by Krumhardt (1992). These samples were collected to better define the Mississippian-Pennsylvanian boundary in the eastern Sadlerochit Mountains.

AK90E-54: From a skeletal grainstone that is immediately below red and gray chert-bearing interval and approximately 54 m above base of lower member of Wahoo Limestone. (5.7 kg of rock processed: 0 g +20 mesh residue; 177g of 20-140 mesh residue). Sample yielded:

- 4 Pa elements *Cavusgnathus? tythus* Brown & Rexroad
- 2 Pa elements *Declinognathodus noduliferus japonicus* (Igo & Koike)
- 1 Pa element *Rhachistognathus muricatus* (Dunn)

Unassigned elements: 1 Pb

Bar, blade and platform fragments: 16

CAI=4 and 6, indicating host rock reached a temperature of at least 350° C

BIOFACIES: postmortem transport into or within shallow, high-energy, normal marine depositional environment.

AGE: Lower *noduliferus-primus* Zone, earliest Pennsylvanian

AK90E-55: From peloidal, spiculitic mudstone. with common bryozoans and bioturbation containing red and gray chert, approximately 55 m above base of lower member of Wahoo Limestone. (5.9 kg of rock processed: 0 g +20 mesh residue; 63 g of 20-140 mesh residue). Sample yielded:

- 6 Pa *Adetognathus?* sp. indet. elements
- 1 Pa fragment *Rhachistognathus* aff. *R. muricatus* (Dunn)
- 2 Pa *Vogelgnathus postcampbelli* (Austin and Husri)

Unassigned elements: 6 Pa, 2 Pb

Bar, blade and platform fragments: 9

Other picked: ichthyoliths

CAI=4 and 6, indicating host rock reached a temperature of at least 350° C

BIOFACIES: indeterminate, postmortem transport into shallow-water, probably restricted marine environment.

AGE: lower *noduliferus-primus* Zone, earliest Pennsylvanian

AK90E-55.3: From interlaminated peloidal grainstone and lesser packstone/wackestone with minor spicules and echinoderm debris--chiefly peloids, very slightly burrowed, some mud laminae still partly intact. Interpreted as restricted-platform depositional environment. Immediately above peloidal, spiculitic mudstone containing red and gray chert, approximately 55.3 m above the base of the lower member of the Wahoo Limestone. (6.2 kg of rock processed: 27 g +20 mesh residue; 149g of 20-140 mesh residue). Sample yielded:

6 Pa elements *Cavusgnathus? tyttus* Brown & Rexroad
40 Pa elements *Declinognathodus noduliferus japonicus* (Igo & Koike) (90% juvenile)
5 juvenile Pa elements *Rhachistognathus muricatus* (Dunn)
1 Pa element *Vogelgnathus* aff. *V. campbelli* (Rexroad)
53 Pa elements *Vogelgnathus postcampbelli* (Austin & Husri)

Unassigned elements: 9 Pa, 13 Pb (2 morphotypes), 1 M 3 Sa & 3 Sc (2 morphotypes)
Bar, blade and platform fragments: +100

CAI=chiefly 4, indicating host rock reached a temperature of at least 250° C

BIOFACIES: vogelgnathid-declinognathodid biofacies--this species association appears to represent a mixed restricted and normal marine platform assemblage.

AGE: lower *noduliferus-primus* Zone, earliest Pennsylvanian.

AK92-14: Sample collected 2 m below the red-gray chert interval from a bryozoan and pelmatozoan grainstone. 7.4 kg of rock processed (153 g of +20 mesh residue: undissolved bioclastic carbonate; 75 g of 20-140 mesh residue: heavies--cubic pyrite and dolomite). Sample yielded:

2 Pa elements *Gnathodus bilineatus* subspp. indeterminate
2 Pa elements *Gnathodus girtyi simplex* Dunn
16 Pa elements *Gnathodus girtyi girtyi* Hass
Gnathodus girtyi sub spp. indeterminate
1 M and 1 Sb elements
1 Pb element *Idioproniodus* sp. indeterminate
Kladognathus sp. indeterminate
1 Sa and 1 Sb elements

Unassigned elements: 5 Pa, 2 M

Bar, blade, and platform fragments: 100

Other picked: 3 Ichthyoliths

CAI: 4, 6, indicating host rock reached a temperature of at least 350° C

BIOFACIES: Gnathodid, relatively deep water, normal-marine depositional environment.

AGE: Upper *muricatus* Subzone, latest Chesterian (based on nearby sampling, Krumhardt, 1992)

AK92-13: Sample collected 1.5 m below the red-gray chert interval from a bryozoan, pelmatozoan, and peloid grainstone. (Heavies--pyrite, dolomite, and phosphatic grains). Sample yielded:

5 Pa elements *Cavusgnathus? tyttus* Brown and Rexroad
10 Pa elements *Declinognathodus noduliferus japonicus* (Igo and Koike)
29 Pa elements *Gnathodus giryt simplex* Dunn
Hindeodus minutus (Ellison)
2 Pa and 1 Sa elements
1 ? elements *Idioproniodus* sp. indeterminate
1 M element *Kladognathus* sp. indeterminate
6 Pa elements *Rhachistognathus muricatus* (Dunn)
1 Pa element *Vogelgnathus postcampbelli* (Austin and Husri)

Unassigned elements: 15 Pa, 1 Pb, 1 M

Bar, blade, and platform fragments: 114

CAI: 4, 6, indicating host rock reached a temperature of at least 350° C

BIOFACIES: gnathodid-declinognathodid, relatively deep water, normal-marine depositional environment.

AGE: *noduliferus-primus* Zone, earliest Pennsylvanian

AK92-12: Sample collected 1 m below the red-gray chert interval from a bryozoan-pelmatozoan grainstone. (Heavies--dolomite, hematite? and pyrite with minor phosphatized bioclasts). Sample yielded:

1 Pa element *Cavusgnathus? tyttus* Brown and Rexroad
1 Pa element *Declinognathodus noduliferus japonicus* (Igo and Koike)
8 Pa elements *Gnathodus giryt simplex* Dunn transitional to *Declinognathodus*
1 Pa element *Hindeodus* sp. indeterminate
2 Sc elements *Kladognathus* sp. indeterminate
2 Pa elements *Rhachistognathus muricatus* (Dunn)

Unassigned elements: 5 Pa, 1 Pb

Bar, blade, and platform fragments: 40

CAI: 4, 5.5, 6, indicating host rock reached a temperature of at least 350° C

BIOFACIES: indeterminate (too few generically identifiable elements), but conodonts suggest, relatively deep, normal-marine depositional environments.

AGE: *noduliferus-primus* Zone, earliest Pennsylvanian

AK92-11: Sample collected 0.5 m below the red-gray chert interval from a bryozoan-pelmatozoan grainstone. (Heavies--dolomite, pyrite and hematite?). Sample yielded:

5 Pa elements *Cavusgnathus? tyttus* Brown and Rexroad
4 Pa elements *Declinognathodus noduliferus japonicus* (Igo and Koike)
3 Pa elements *Gnathodus giryt simplex* Dunn transitional to *Declinognathodus*
2 Pa elements *Rhachistognathus muricatus* (Dunn)
2 Pa elements (juveniles) *Rhachistognathus prolixus* Baesemann and Lane

Unassigned elements: 4 Pa, 1 M, 1 Sb

Bar, blade, and platform fragments: 36

CAI: 4, 5.5, 6, indicating host rock reached a temperature of at least 350° C

BIOFACIES: indeterminate (too few generically identifiable elements), but conodonts suggest, relatively deep, normal-marine depositional environments.

AGE: *noduliferus-primus* Zone, earliest Pennsylvanian

Demarcation Pt., Mt. Michelson, various

Reference: LePain, 1993

Collector: Dave LePain

90ADL1-0.1: Sample collected 0.1 m above base of Alapah Limestone from SW1/4, Sec. 5, T.3N., R.31E., Mt. Michelson Qd., 69°38'05"N., 144°35'00"W. (332g of 20-140 mesh residue; heavies: pyrite and abundant dolomite).

NO CONODONTS WERE RECOVERED.

90ADL1-25.3: Sample collected 25.3 m above the base of the Alapah Limestone. Same locality as above. (Heavies: non-mag--abundant phosphatized bioclasts, minor dolomite; mag--small amount of weathered pyrite.) All allochems show extreme hydraulic wear.

6 Pa elements *Cavusgnathus unicornis* Youngquist and Miller

1 Pa element *Cavusgnathus* sp. Indeterminate

16 Pa elements *cavusgnathoides*

2 Pa elements *Gnathodus* sp. Indeterminate

5 Pa elements *Gnathodus girtyi girtyi* Hass

1 Sa element *Hindeodus* sp. indet.?

Idioproniodus sp.

1 Pb, 1 M, and 1?elements

8 Sc elements *Kladognathus* spp.

1 Pa element *Rhachistognathus muricatus* (Dunn)

Unassigned elements: 1 Pb, 3 M (2 morphotypes)

Bar, blade, and platform fragments: 195

Other picked: 5 bioclasts, 1 ichthyolith, 2 phosphatized ooids?, steinkerns: 3 foraminifera, 1 bryozoan, 2 gastropod.

CAI: 4 (minor), 5.5-6.5 (chiefly), indicating host rock reached a temperature of at least 440° C

BIOFACIES: postmortem transport within or from *cavusgnathid*-*gnathodid*-*kladognathid* biofacies.

Normal marine, relatively shallow, near shoal. The high degree of rounding indicates significant hydraulic action which undoubtedly influenced biofacies mixture.

AGE: late Chesterian (*muricatus* Zone)

90ADL2-2.5: Sample collected 2.5 m above base of Alapah Limestone from SW1/4, S1/2, Sec. 6, T.3N., R.31E., 69°38'05"N., 144°36'00"W. Sample processed and picked at USGS, Reston, Va. (Heavies: small amount of dolomite).

1 bar fragment

CAI: 4, indicating host rock reached a temperature of at least 190° C

BIOFACIES: indeterminate

AGE: indeterminate

90ADL2-6.6: Sample collected 6.6 meters above base of Alapah Limestone from same locality as above. (Heavies: small amount of cubic pyrite, hematite?, and minor rounded bioclasts.)

Bar, blade, and platform fragments: 26

Other picked: 1 sponge spicule?, 1 bioclast

CAI: 4-4.5-5, indicating host rock reached a temperature of at least 300° C

BIOFACIES: indeterminate, but probably represents a high energy environment.

AGE: indeterminate

90ADL2-13: Sample collected 13 m above base of Alapah Limestone from same locality as above. (Heavies: pyrite, dolomite. No bioclasts noted.)

1 Pa element *Hindeodus?* sp. indeterminate
Vogelgnathus postcampbelli (Austin and Husri)
8 Pa and 1 Sc? elements

Unassigned elements: 4 M (2 morphotypes), 1 Sb
Bar, blade and platform fragments: 43

CAI: 3.5-4, indicating host rock reached a temperature of at least 190° C
BIOFACIES: indeterminate, postmortem winnow probably from inner platform to partly restricted.
AGE: upper Merimecian to Chesterian (Late Mississippian)

90ADL3-160: Sample collected 160 m above base of Alapah Limestone from SW1/4, SE1/4, Sec. 6, T.3N., R.31 E., Mt. Michelson Qd., 69°38'04"N., 144°37'00"W. (Heavies: non-mag--large amount of phosphate grains with minor dolomite, quartz, and pyrite; Mag--dolomite and weathered pyrite). All conodont elements show extreme hydraulic wear.

1 Pa element *Cavusgnathus unicornis* Youngquist and Miller
18 Pa elements cavusgnathoids
1 Pa element *Gnathodus girtyi girtyi* Hass
2 Pa elements *Hindeodus?* sp. indeterminate
6 Sc elements *Kladognathus* sp. indeterminate
1 Pa element rhachistognathid

Unassigned elements: 1 M
Bar, blade and platform fragments: 200
Other picked: 1 foraminifera steinkern, 1 gastropod steinkern

CAI: 4, 4.5 (chiefly), 6, indicating host rock reached a temperature of at least 350° C
BIOFACIES: indeterminate, (too few generically identifiable conodonts), however, conodonts suggest open-marine to near-restricted depositional environment.
AGE: upper Meramecian to Chesterian.

90ADL6-174: Sample collected 174 m above base of Kayak Fm., (mapped as undivided Endicott) from SE1/4, NW 1/4, Sec. 31, T.2N., R.37E., Demarcation Pt B-4 Qd., 69°29'00"N., 143°07'15"W. (Heavies: non-mag--abundant ichthyoliths and shell fragments; Mag-- abundant weathered pyrite and minor phosphatic bioclasts).

1 M element *Kladognathus* sp. indet.
1 blade fragment

Other picked: 8 ichthyoliths, 1 ooid, 1 foraminifera steinkern, 2 phosphatic bioclasts, 2 unknown mineral grains with double terminations.

CAI: 4.5-5, indicating host rock reached a temperature of at least 300° C
BIOFACIES: indeterminate (too few generically identifiable elements)
AGE: Mississippian

90ADL6-231.4: Sample collected 231.4 m above base of Kayak Fm., (mapped as undivided Endicott) from same locality as above. (Heavies: non-mag--abundant bioclasts, minor dolomite; mag--pyrite, hematite, dolomite, and bioclasts.) All conodont elements recovered are relatively large--may represent a lag deposit.

1 Pa? element *Bispathodus* sp.?
1 Pa element *Cavusgnathus unicornis* Youngquist and Miller
1 Pa element *Hindeodus* sp. indet.
Kladognathus
1 P, 2 M, 3 Sc, and 1 Sa? elements

Bar, blade, and platform fragments: 18

Other picked: 3 bioclasts, 2 ichthyoliths, steinkerns: 4 bryozoan, 1 gastropod

CAI: 5, 5.5 (chiefly), 6, indicating host rock reached a temperature of at least 350° C

BIOFACIES: Indeterminate (too few generically identifiable conodonts)

AGE: upper Meramecian if bispathodid identified correctly, if not, then upper Merimecian to Chesterian.

90ADL6-296: Sample collected from Alapah Limestone, 296 m above the base of the Kayak Fm at the the Kayak/Alapah contact from same locality as above. (Heavies: abundant phosphatized bioclasts with minor dolomite and quartz). Most allochems show extreme hydraulic wear.

1 Pa element *Cavusgnathus unicornis* Youngquist and Miller
3 Pa fragments of cavusgnathoids
Kladognathus sp.
1 P, 1 Sa, and 1 Sc elements
Synclydognathus? sp. indeterminate
1 P and 3 S elements

Bar, blade, and platform fragments: 19

CAI: 5.5-6.5, indicating host rock reached a temperature of at least 440° C

BIOFACIES: Indeterminate

AGE: upper Meramecian to lower Chesterian

90ADL7-168: Sample collected 168 m above base of Kayak Fm., (mapped as undivided Endicott Group) from NE1/4, E1/2, Sec. 16, T.2N., R. 38E., Demarcation Pt. B-3 Qd., 69°31'50"N., 142°47'00"W. (Heavies: Non-mag-- large amount of phosphatized bioclastic hash; mag-- large amount of weathered pyrite and hematite). Conodont elements are in poor condition (broken) and difficult to recognize.

1 M *Kladognathus* sp. indet.
2 S elements *Synclydognathus* spp. indeterminate

Unassigned elements: 2 Pa, 1 partial set fused S elements

Bar, blade, and platform fragments: 21

CAI: 5.5-6, indicating host rock reached a temperature of at least 350° C

BIOFACIES: indeterminate

AGE: Osagean to lower Chesterian

90ADL8-141: Sample collected 141 m above base of Kayak Fm., (mapped as undivided Endicott Grp.) from SE1/4, N1/2, Sec. 15, T.2N., R.38E., 69°31'40"N., 142°45'00"W. (Heavies: 1 tray, weathered pyrite, hematite, dolomite, and unidentified fibrous white crystals.

NO CONODONTS WERE RECOVERED

90ADL8-155: Sample collected 155 m above base of Kayak Fm. (mapped as undivided Endicott Group) from same locality as above. (Heavies: small amount of residue with abundant pyrite, minor dolomite and rare bioclasts, mainly ichthyoliths.)

NO CONODONTS WERE RECOVERED.

90ADL9-63: Sample collected 63 m above base of Kayak Fm. (mapped as undivided Endicott Group) from SW1/4, NE1/4, Sec. 23, T.2N., R. 38E., Demarcation Pt. B-3 Qd., 69°30'55"N., 142°44'69"W. (Heavies: small amount of residue with abundant dolomite, minor pyrite, and phosphatic bioclasts?)

NO CONODONTS WERE RECOVERED.

90ADL9-97: Sample collected 97 m above base of Kayak Fm. (mapped as undivided Endicott Group) from same locality as above. (Heavies: non-mag--phosphatized bioclasts; mag--abundant weathered pyrite.)

2 Pa elements *Cavusgnathus unicornis* Youngquist and Miller
1 Pa fragment of a *cavusgnathoid*
1 S element *Synclydogathus geminus* (Hinde)

Unassigned elements: 2 Sa (2 morphotypes)

Bar, blade, and platform fragments: 7

Other picked: 2 coral fragments, 2 ichthyoliths, 1 bioclast, steinkerns: 2 foraminifera, 5 bryozoan, 1 gastropod

CAI: 5.5, indicating host rock reached a temperature of at least 300°C

BIOFACIES: indeterminate (too few generically identifiable conodonts)

AGE: upper Meramecian to lower Chesterian

90ADL10-159.8: Sample collected 159.8 m above base of Kayak Fm. (mapped as undivided Endicott Grp.) from NE1/4, NE1/4, Sec. 12, T.1 N., R.45E., Demarcation Pt. B-3, 69°32'57"N., 142°25'30"W. (Heavies: 2 trays hematite, pyrite and minor dolomite).

Cavusgnathus unicornis Youngquist and Miller
4 Pa (1 juvenile), 1 M

Other: 1 ichthyolith

Bar, blade, and platform fragments: 10

CAI: 4, 5.5, 6, indicating host rock reached a temperature of at least 350° C

BIOFACIES: indeterminate

AGE: upper Meramecian to lower Chesterian (constrained by overlying samples)

90ADL10-191.5: Sample collected 191.5 m above base of Kayak Fm. (mapped as undivided Endicott Group) from same locality as above. (Heavies: abundant glauconite?, minor pyrite and dolomite.)

7 Pa elements *Bispathodus utahensis* Sandberg and Gutschick
1 Pa element *Hindeodus* sp. indet.
Kladognathus sp. indet.
1 M and 1 Sc elements

Unassigned elements: 4 Pa, 1 Pb, 2 M, 2 Sa

Other picked: 2 ichthyoliths, 2 bioclasts, steinkerns: 1 bryozoan, 1 foraminiferan

CAI: 4 (chiefly), 6 (minor), indicating host rock reached a temperature of at least 350° C

BIOFACIES: indeterminate

AGE: upper Meramecian to lower Chesterian

90ADL10-248: Sample collected 248 m above base of Kayak Fm. (mapped as undivided Endicott Grp.) from same locality as above. (Heavies: non-mag-- large amount of dolomite; mag--weathered pyrite, hematite, and dolomite).

4 Pa elements *Cavusgnathus unicornis* Youngquist and Miller

1 Pa element *Bispathodus?* sp. indet. (redeposit)

4 Pa elements *Hindeodus minutus* (Ellison)

Kladognathus spp.

2 P, 12 M, 2 Sa, and 9 Sc elements

2 Pa elements *Lochrlea commutata* (Branson and Mehl)

Unassigned elements: 13 Pa, 1 Sa

Bar, blade, and platform fragments: 107

CAI: 5 (rare) - 6 (common), indicating host rock reached a temperature of at least 350° C

BIOFACIES: kladognathid-syncladognathid (shallow, normal marine; low to moderate energy).

AGE: late Chesterian (no older than *monceras* Zone)

90ADL10-310: Sample collected from the Alapah Limestone, 310 m above the base of the Kayak Fm., at the contact with the Alapah Limestone from same locality as above. (Heavies: 2 trays dolomite and pyrite).

NO CONODONTS WERE RECOVERED

90ADL12-173.4: Sample collected 173.4 m above base of Kayak Fm from SE1/4, NE1/4, Sec. 28, T.1N., R.45E., Demarcation Pt. B-1 Qd., 69°24'50"N., 141°04'30"W. (Heavies: non mag--small residue [2 trays] with abundant dark black phosphatized bioclasts; mag--abundant weathered pyrite.)

Kladognathus spp.

2 M, 1 Sa, 1 Sb, and 6 Sc elements

1 Pa element *Syncladognathus geminus?* (Hinde)

Bar, blade, and platform fragments: 38

Other: 3 phosphatized ooids, 1 conodont pearl (contamination?), 1 bryozoan steinkern, 1 bioclast, 10 ichthyoliths.

CAI: 4.5 (rare), 5 (chiefly), indicating host rock reached a temperature of at least 300° C

BIOFACIES: indeterminate (too few generically identifiable conodonts)

AGE: Osagean to lower Chesterian based on questionable specimen of *S. geminus*.

90ADL12-204: Sample collected from the Alapah Limestone, 204 m above base of Kayak Fm. at contact with the Alapah Limestone from same locality as above. (Heavies: dolomite, pyrite, and minor fluorite and bioclasts).

1 conodont fragment

CAI: 5.5, indicating host rock reached a temperature of at least 300° C

BIOFACIES: indeterminate

AGE: no older than Osagian to Merimecian, based on adjacent sample

90ADL13-310: Sample collected 209 m above base of Alapah Limestone from NW1/4, NW1/4, sec. 29, T.1N., R.45E., Demarcation Pt. B-1 Qd., 69°25'00"N., 141°08'20"W. (Heavies: non-mag--3 trays of abundant dolomite; mag--pyrite.)

2 S elements *Syncladognathus geminus* (Hinde)

CAI: 6, indicating host rock reached a temperature of at least 350° C

AGE: Osagean to lower Chesterian

BIOFACIES: indeterminate

90ADL15-125.6: Sample collected 125.6 m above base of Alapah Limestone from SE1/4, E1/2, Sec. 19, T.1S., R.42E., Demarcation Pt. B-2, 69°20'05"N., 142°03'50"W. (Heavies: non-mag--2 trays dark black bioclasts with common ichthyoliths; mag-- abundant pyrite and pyritized bioclasts).

Kladognathus? sp. indeterminate

1 P, 1 M, and 1 Sb elements

Other picked: 5 ichthyoliths, 2 ooids, 2 bioclasts

Bar, blade, and platform fragments: 32

CAI: 4.5 (rare), 5 (chiefly), indicating host rock reached a temperature of at least 300° C

BIOFACIES: indeterminate

AGE: Osagean to lower Chesterian (constrained by overlying sample)

90ADL15-393: Sample collected 393 m above base of the Alapah Limestone from same locality as above. (Heavies: abundant phosphate grains and rare bioclasts).

2 S elements *Syncladognathus* sp. indeterminate

Other picked: 1 bioclast

CAI: 5-5.5, indicating host rock reached a temperature of at least 300° C

BIOFACIES: indeterminate (too few generically identifiable elements)

AGE: Osagean to lower Chesterian

91ADL3-209: Sample collected 209 m above base of Kayak Fm from NE1/4, Sec. 2, T.2S., R.27E., Mt. Michelson B-3 Qd., 69°18'00"N., 145°31'00"W. (Heavies: non-mag--abundant phosphatized bioclasts and common ichthyoliths; mag--large amount of weathered pyrite, quartz, dolomite, and glauconite?).

1 Pb? element *Idioproniodus* sp. indeterminate

Other picked: 6 ichthyoliths, 1 bryozoan fragment

CAI: indeterminate

BIOFACIES: indeterminate (too few generically identifiable elements)

AGE: Late Mississippian to Middle Pennsylvanian

91ADL5-148.2: Sample collected 148.2 m above base of Alapah Limestone from NE1/4, SE1/4, Sec. 8, T.1S., R.31E., Demarcation Pt B-4 Qd., 69°22'00"N., 147°13'50"W. (40 g +20 mesh residue; 57 g 20-140 mesh residue; heavies: dolomite and pyrite). Sample yielded:

6 Pa elements *Adetognathus lautus* (Gunnell)
1 Pa element *Hindeodus minutus?* (Ellison)

Indeterminate elements: 17 Pa, 1 Pb
Bar, blade, and platform fragments: 61

CAI: 6-6.5, indicating host rock reached a temperature of at least 440° C
BIOFACIES: indeterminate (too few generically identifiable conodonts)
AGE: upper *muricatus* Subzone (latest Chesterian) to Lower Permian

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