TAXONOMY, BIOSTRATIGRAPHY AND PALEOECOLOGY OF LOWER SILURIAN CONODONTS FROM THE ANSE A PIERRE-LOISELLE FORMATION, GASPE PENINSULA, QUEBEC

by

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ABSTRACT

Conodonts of late Llandovery age have been collected from the Anse à Pierre-Loiselle Formation, the deposition of which represents a deepening episode in the generally shallow deposition of the Chaleur Group in southern Gaspé. The Anse à Pierre Formation (65-72m) is a transitional unit characterized by nodular carbonate and clastic rocks, which is situated between the underlying, clastic Anse Cascon Formation containing brachiopods and conodonts of Llandovery C_3-C_4 age, and the overlying, carbonate La Vieille Formation which contains conodonts of late Llandovery (*Pterospathodus amorphognathoides*) to Wenlock (*Ozarkodina sagitta rhenana*) age.

Six measured sections of the Anse à Pierre-Loiselle Formation have been sampled yielding a total of 20,600 conodont elements. The fauna is dominated numerically by elements assigned to *Panderodus*, *Oulodus*?, and *Ozarkodina* with elements of *Aulacognathus*, *Carniodus*, *Distomodus*, *Johnognathus*, *Kockelella*, *Pterospathodus*, and *Walliserodus* as well as rare or indeterminate taxa. One genus is new, represented by one species: *Digitodontus bellistriatus*. Other new species include; *Apsidognathus sulcatus*, *Pseudooneotodus pyramis* and *Pterospathodus*? *ceragnathoides*.

Based on these faunas the unit is considered to represent deposition of Llandovery C_6 - early Wenlock age. Due to the low abundance of zonal indicator species *Pterospathodus celloni* and *P. amorphognathoides*, a new taxon range zone is established to encompass the total range of the new species *P.*? *ceragnathoides* which is locally abundant. The position of the Llandovery-Wenlock boundary remains unclear because the key brachiopods

and conodonts span the boundary.

Based on existing paleoecological models, the assemblage typifies intermediate water depths. Representatives of Icriodella and other shallow water taxa are virtually absent, as are elements of deeper water taxa such as Dapsilodus. Paleoecological reasons for the impoverished fauna near the top are unclear.

Within this conodont zone, the assemblage exhibits an overall similarity to faunas of the same age found elsewhere, but has some significant differences at the specific level, particularly in the genera Apsidognathus and Pterospathodus, suggesting subtle provincialism during the early Silurian.

RESUME

Des conodontes du Llandovery supérieur ont été recueillis dans la Formation de l'Anse à Pierre-Loiselle. L'accumulation de ces conodontes représente un épisode de surcreusement dans la sédimentation généralement peu profonde du Groupe Chaleur, situ dans la région méridionale de Gaspé. La Formation de l'Anse à Pierre-Loiselle (65 -72m) est une formation intermédiaire caractérisée par des carbonates nodulaires et des roches détritiques. Cette formation est situe entre la formation sous-jacente de l'Anse Cascon qui est une formation détritique contenant des brachiopodes et des conodontes du Llandovery C3-C4 et la Formation La Vieille, cette dernière étant une formation carbonate sous-jacente contenant des conodontes du Llandovery supérieur (Pterospathodus amorphognathoides) jusqu'au Wenlock (Ozarkodina sagitta rhenana).

Des prises d'échantillons provenant de six sections mesurées de la Formation de l'Anse à Pierre-Loiselle ont produit un total de 20,600 éléments de conodontes. La faune est dominée numériquement par des éléments attribués aux espèces Panderodus, Oulodus?, et Ozarkodina avec des éléments des espèces Aulacognathus, Carniodus, Distomodus, Johnognathus, Kockelella, Pterospathodus et Walliserodus ainsi que des taxons rares et indéterminés. Un genre nouveau est représenté par une espèce: Digitodontus bellistriatus. D'autres nouvelles espèces comprennent: Apsidognathus sulcatus, Pseudooneotodus pyramis et Pterospathodus? ceragnathoides.

En se basant sur cette faune, l'unité peut e re considérée comme représentant des dépots du Llandovery C_4-Wenlock antérieur. A cause du

fait que les indicateurs de zone des espèces Pterospathodus celloni et P. amorphognathoides sont insuffisants, une nouvelle unité biostratigraphique peut etre définie selon la répartition d'une nouvelle espèce P.? ceragnathoides, laquelle abonde localement. L'emplacement de la frontière Llandovery-Wenlock demeure imprécis parce que les brachiopodes et les conodontes indicatifs chevauchent la frontière.

En se basant sur les modèles paléoécologicaux, l'ensemble des éléments est caractéristique des niveaux d'eau intermédiaires. Des représentants de l'espèce Icriodella ainsi que d'autres taxons spécifiques à des eaux peu profonde y sont virtuellement absents de me que d'autres éléments provenant de taxons d'eau profonde comme l'espèce Dapsilodus. Les raisons paléoécologicales expliquant l'appauvrissement de la faune près du niveau supérieur sont obscures.

A l'intérieur de cette zone de conodontes, l'ensemble des éléments démontre une ressemblance générale à la faune de la me époque que l'on a retrouvée ailleurs. Il y a cependant des différences importantes à des niveaux spécifiques, surtout dans les genres Apsidognathus et Pterospathodus, ce qui suggère des distinctions subtiles au niveau local durant le Silurien antérieur.

ACKNOWLEDGEMENTS

I would like to thank my supervisor Dr. Godfrey S. Nowlan for his tireless guidance and financial, mental and often physical support received during the period of this study. Many thanks are due to Dr. A.D. (Sandy) McCracken for his expertise in the field and at the Prescott. Dr. T.E. Bolton of the Geological Survey of Canada is thanked for identifying the macrofossil fauna recovered from insoluble residues. Roddy and Alice Hayes and family of Chaleurs Chalets in Port Daniel, Québec are gratefully acknowledged for their wonderful hospitality during my stay. Dr. G.S. Nowlan and the Geological Survey of Canada are thanked for providing the base collection of this study. I thank the entire Department of Geology of the University of Ottawa, especially my office-mate Tim DeFreitas, for their understanding and cooperation with the unpleasant job of acid preparation and allowing me to live. The bulk of the figures in this study was produced at facilities provided with the kind permission of Mr. Steve Carisse of Carisse Graphic Design in Ottawa. The Department of Geology and Geophysics at the University of Calgary are acknowledged for their cooperation and assistance in the production of S.E.M. plates and allowing me to take up space during the final phases of this thesis.

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Final thanks and a dedication of this thesis are for my wife and best friend, Carol; without her graphic ability and constant encouragement, I would have become a hairdresser or worse.

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1. INTRODUCTION

1.1 Location and General Geology

This thesis is based on the collection and study of Lower Silurian conodonts from six measured sections of the Anse à Pierre-Loiselle Formation along the southern portion of the Gaspé Peninsula (Fig. 1). The Gaspé Peninsula (la Gaspésie) is located in southeastern Québec bounded by the St. Lawrence River to the north and Chaleurs Bay to the south. The Anse à Pierre-Loiselle Formation of the Chaleurs Group is contained within a NE-SW trending synclinorium. The Chaleurs Bay Synclinorium is a gently plunging structure which extends from the town of Chandler in the north-east into northern New Brunswick in the south-west. The general lithological character of the Chaleurs Group in the Port Daniel - Black Cape area of the Gaspé Peninsula is mainly siliciclastic sedimentary rocks with thick, intercalated limestone units and a unit of volcanic rocks that caps the sequence in some areas. Formations of the Chaleurs Group in ascending stratigraphic order are: the Clemville, Weir, Anse Cascon, Anse à Pierre-Loiselle, La Vieille, Gascons, Bouleau, West Point and Indian Point (Fig. 2). Bourque et al. (in press) report that the Chaleurs Group comprises a thickness of 2588 metres in the eastern portion and 5199 metres in the western portion of the synclinorium.

In the Port Daniel area, the Chaleurs Group is underlain by the Mictaw Group (Middle Ordovician) at Clemville and by the Maquereau Group (pre-Middle Ordovician) at Gascons (railroad cut and Anse à Pierre-Loiselle).

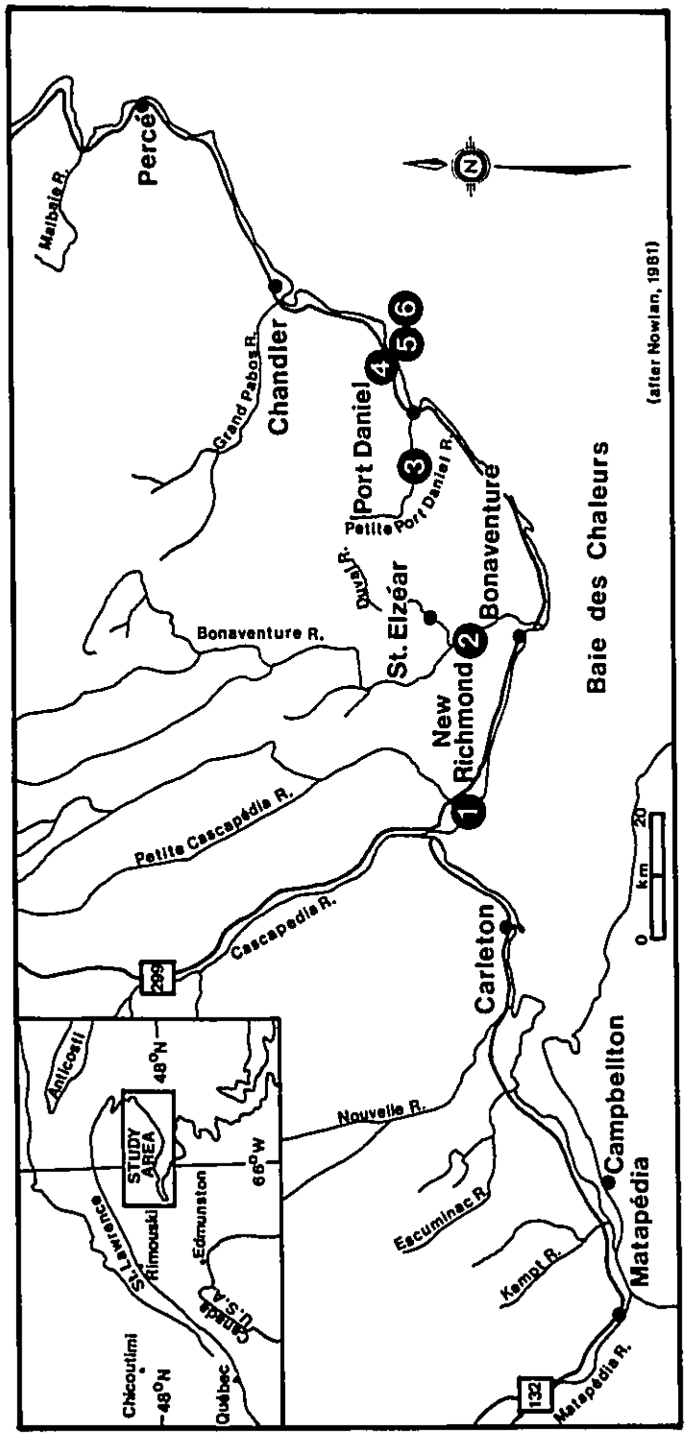

Figure 1. Location Map of study area (inset) and measured study sections.

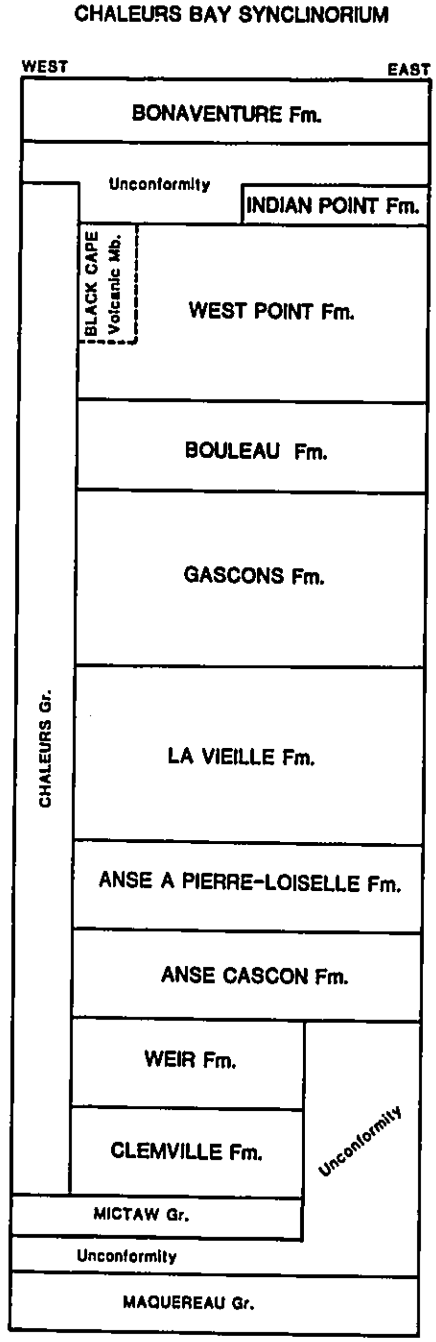

Figure 2. Table of Formations of the Chaleurs Bay Synclinorium (Bourque, 1975).

At New Richmond (Black Cape) and the Bonaventure River, the Chaleurs Group is conformably underlain by the Matapedia Group. In all study areas, the Chaleurs Group is unconformably overlain by the Carboniferous Bonaventure Formation.

The Anse à Pierre-Loiselle Formation is a transitional unit between the underlying non-calcareous sandstone and mudstone of the Anse Cascon Formation and the dense, locally reefal, limestone of the succeeding La Vieille Formation.

1.2 Previous Studies

Sir William Logan (1863) was the first to describe the rocks around the Port Daniel - Gascons area and in the Gaspé Peninsula as a whole. As a result of this pioneering work, ten lithologic divisions were recognized. Clarke (1912, 1913) re-examined the Black Cape section using Logan's stratigraphic scheme and published a short article in a guidebook for the Twelfth International Geological Congress. Following Logan's original divisions, Schuchert and Dart (1926) were the first workers to complete detailed studies. They erected six lithologic units of formation status in the Silurian of the Port Daniel area. The bulk of this early stratigraphic scheme forms the basis of the stratigraphic nomenclature in use today. Other workers amended and modified the early stratigraphic framework including Alcock (1935), Northrop (1939), Badgely (1956), Skidmore (1958), Burk (1964), and Ayrton (1967).

The current stratigraphic framework and nomenclature for the Silurian of the Port Daniel-Black Cape areas of Gaspé Peninsula is the result of extensive work by Bourque (1975), and Bourque and Lachambre (1980). In the past decade a great deal of interest and effort has been concentrated in the Gaspé region partly as a result the desire of the International Union of Geological Sciences Commission on Stratigraphy to identify an Ordovician-Silurian boundary stratotype. Several sections, including some on Anticosti Island, were candidates for this landmark. Bolton (1981) and Boucot and Bourque (1981) studied the Anthozoa and brachiopod biostratigraphy (respectively) of the rocks of the Llandovery Chaleurs Group. The first published stratigraphic and paleontological works using conodonts in the Chaleurs Group were by Nowlan (1981, 1983).

1.3 Purpose

The main objectives of this thesis are:

(1) to provide the taxonomy of conodonts from the Anse à Pierre-Loiselle Formation;

(2) to evaluate the conodont biostratigraphy of the Anse à Pierre-Loiselle Formation particularly with respect to the Llandovery-Wenlock boundary;

(3) to assess the correlation potential of a local conodont zonation with zonation schemes in place in other parts of North America and Europe;

(4) to examine the paleoecology of the conodontophorid animal by studying the distributional patterns of the conodonts.

1.4 Field Methods and Laboratory Processing

Field work for this project was initiated by Dr. Godfrey S. Nowlan (Geological Survey of Canada) in 1978 but detailed collections were not made until the 1981 field season. In 1978, Nowlan took representative samples from both the Black Cape Section (Section I) and the Gascons Railroad Cut (Section IV); a few additional samples were collected in 1979, when Nowlan concentrated on the lower formations of the Chaleurs Group. Four exposed stratigraphic sections were sampled in detail by Nowlan during the 1981 season: the Petite Port Daniel River (Section III), the Gascons Road Cut (Section IV), the Anse à Pierre-Loiselle Railroad Cut (Section V) and the Anse à Pierre-Loiselle Formation type section (Section VI).

Sections I and II (Black Cape, and Bonaventure River) respectively were sampled during the 1987 field season by the writer with the aid of Drs. G.S. Nowlan and A.D. McCracken. Additional samples were taken from the original four sections where the earlier conodont yields were either too low or extraordinarily high. Samples were taken at measured intervals ranging from less than a metre at the Petite Port Daniel River (Section III) (Fig. 36) to nine meters at the Bonaventure River (Section II) (Fig. 35). The variation in sample interval was dependent on the availability of beds with a lithology suitable for conodont recovery. A total of 211 samples with an average mass of 6 kg were processed using standard laboratory techniques of digestion in 14-20% acetic acid. Because of the highly clastic nature of the sampled formation, acid digestion ranged between 10 and 100 per cent of the original sample mass. Separation of the resultant residues was accomplished using tetrabromethane (=Bromoform $CH_4H_2Br_4$) as outlined by

Collinson (1963) and Stone (1987). Specimens recovered and selected for illustration, were photographed using Cambridge 150 (University of Calgary) and Cambridge 180 (GSC Ottawa) scanning electron microscopes.

2. STRATIGRAPHY

2.1 Regional Geologic Setting

The Silurian of the Gaspé region is divided into three distinct outcrop belts which correspond to the three major structural units of Québec and northern New Brunswick, the Matapedia Belt, the Gaspé Belt and the Chaleurs Belt (Bourque et al., in press). These broad and informal outcrop belts are roughly equivalent to the St. Anne River Nappe, Connecticut Valley- Gaspé Synclinorium and Aroostock- Matapédia Anticlinorium of Williams (1979).

The study area of this thesis is located within the Chaleurs Belt of Bourque et al. (in press), which is located between the Matapedia Belt to the northwest and the Miramichi Anticlinorium of New Brunswick to the southeast. The Chaleurs Belt lies across both the Dunnage and Gander zones as defined by Williams (1979) and Williams and Hatcher (1983). Three structural units are contained within the Chaleurs Belt: the Chaleurs Bay Synclinorium, the Restigouche Syncline and the Maria Fault Zone. Figure 3 illustrates the main outcrop zones of the Gaspé Peninsula. The studied sections of this thesis are contained within the Chaleurs Bay Synclinorium. Structurally, the Chaleurs Belt is dissected by two major east-west trending dextral strike slip faults, the Millstream and McKenzie Gulch faults which have an overall displacement of 25km to 35km as determined by the resulting sedimentary facies relationships that are solved by the recognition of major strike-slip systems between Anticosti Island and Gaspé Peninsula (Bourque et al., in press).

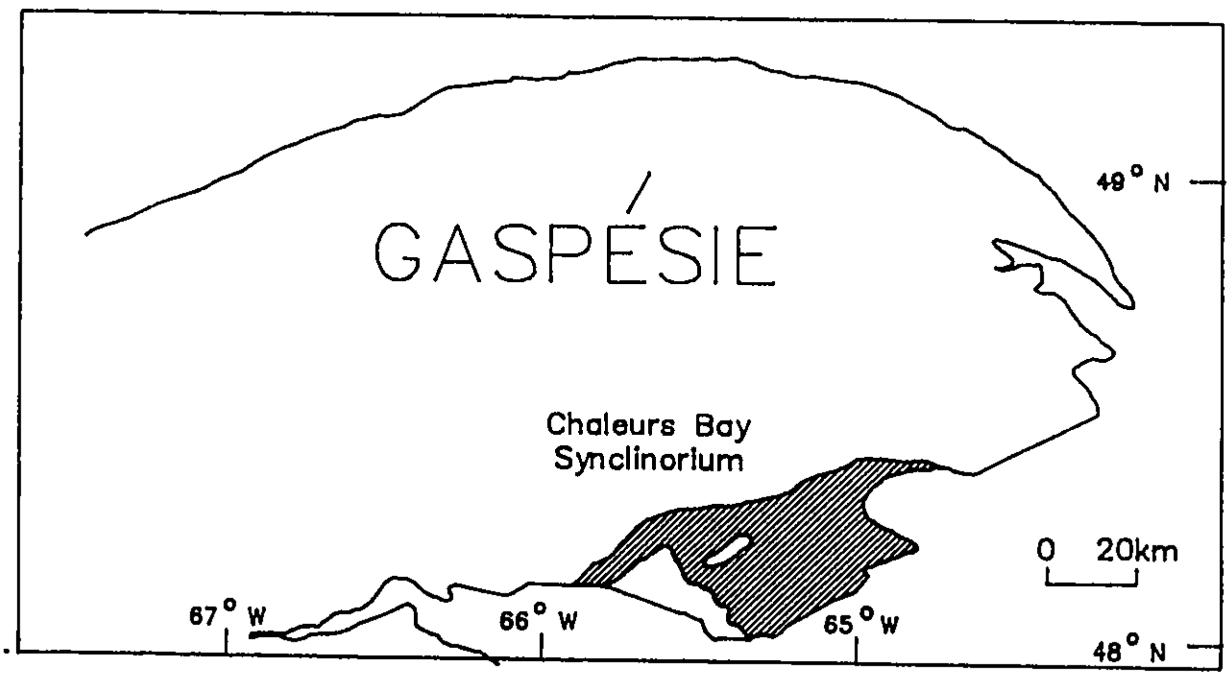

Figure 3. Location of main outcrop zones of Silurian and basal Devonian strata in Gaspé (modified after Bourque, 1975).

During the Acadian Orogeny, the Grand Pabos-Restigouche fault systems developed. The northeast - southwest trending folds and subsequent small - scale extensional faults recognized in the Chaleurs Belt are related to these extensive fault systems. In the Port Daniel area Bourque and Lachambre (1980) mapped box folding which they interpreted as the structural response to early Silurian sediments being draped over the highly deformed Macquereau Group.

Ayrton et al. (1969), reported on the lower Llandovery paleogeography of the northern Appalachians and adjacent regions. Their work resulted in the recognition of six depositional belts, the Central Clastic Belt being the depositional site for the Anse à Pierre-Loiselle Formation and the southern Chaleurs Group as a whole. The Weir Formation was deposited in this depositional belt. Lithologically the Weir Formation is composed of dark, fine grained clastic rocks with interbedded conglomerates containing subangular jasper and quartz clasts possibly derived from underlying Ordovician rocks. This conglomeratic unit is interbedded with local fossiliferous carbonates. Ayrton et al. (1969) concluded that the source area for the Weir Formation lay to the west. This source area consisted of Ordovician rocks uplifted as a result of the earlier Taconic orogenic event.

2.2 Lithostratigraphy

The development of a unified lithostratigraphic framework for the lower Chaleurs Group has undergone an extensive, and often confusing, evolution. This nomenclatural development and the relative thickness of units is presented in Figure 4.

As noted above, Sir William Logan (1863) was the first to report on the geology of the Gaspé Peninsula. He recognized ten lithologic divisions at Anse à La Vieille (Anse à Pierre-Loiselle) and higher in the sequence at Anse à La Barbe. Only the first four divisions of Logan (1863) are relevant to this summary (Fig. 4).

The following is a brief summary of Logan's (1863) first four divisions of the Chaleurs Series complete with measured thickness in ascending order after Northrop (1939, p.24):

"Macquereau schist unconformably below

1. Reddish-grey micaceo-arenaceous limestone, weathering to a dull ochre-yellow, interstratified with six bands of siliceous conglomerate; (of which the four-feet millstone bed at the base, is one;) and abounding fossils (140 feet)

2. Greenish calcareous shale, including a few beds of yellow weathering limestone, with many nodules of the same, and holding many fossils (200 feet)

There is a break in the succession, occasioned by a fault, which creates an interval of great confusion. The cliff shows many of the details of the disturbance but is not high enough to afford evidence of the amount of displacement. Judging however, by the different colour of the strata on the west side, it appears probable that there is a downthrow to the west, which would cause no repetition, to exaggerate the apparent volume of the

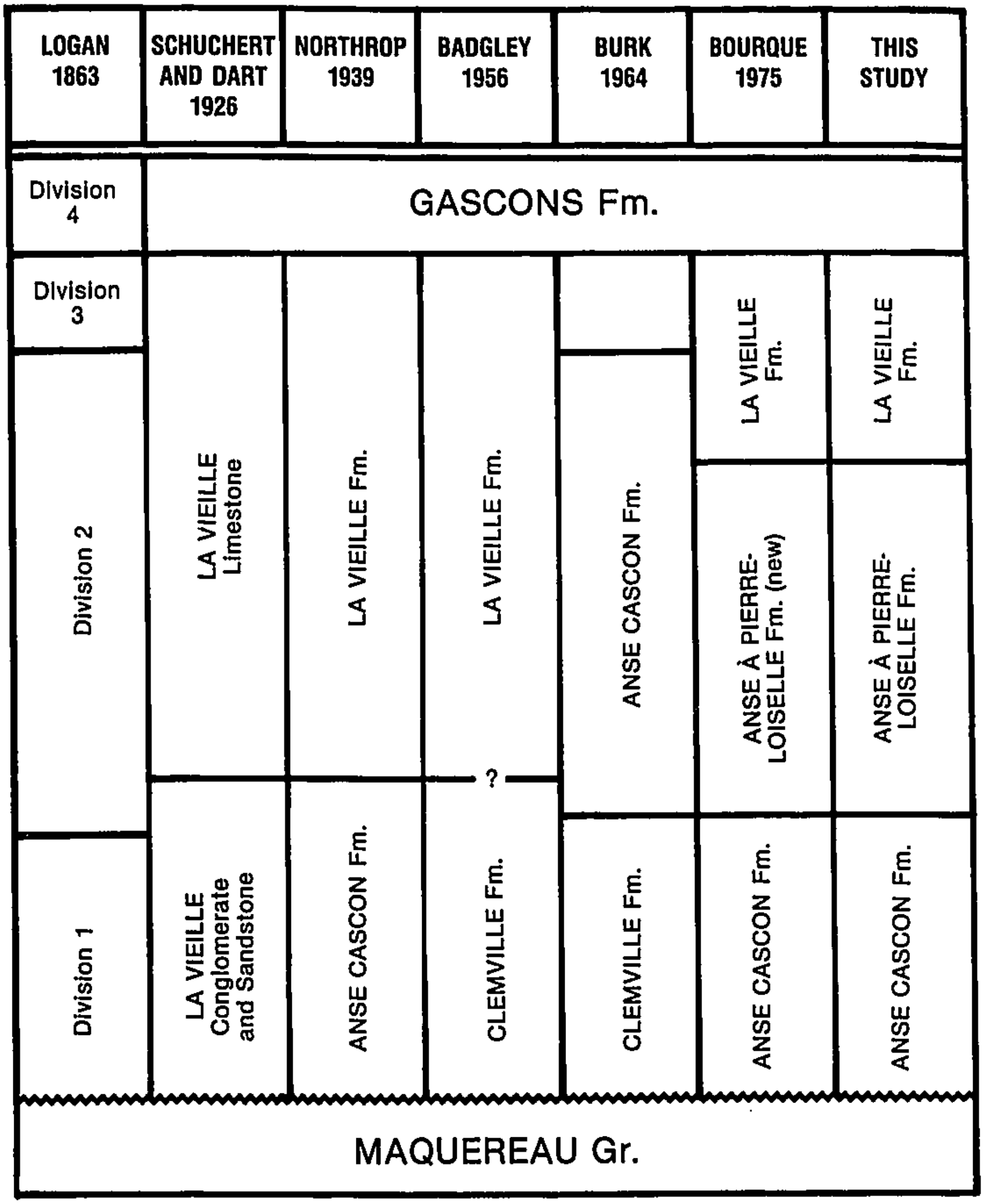

Figure 4. Nomenclatural evolution of the lower Chaleurs Group at Anse à Pierre-Loiselle (after Bourque, 1975).

formation. On the west side of the dislocation, the following is the succession:

3. Grey hard limestone, in beds from six inches to a foot (50 feet)
4. Red micaceo-arenaceous shale, with very few fossils (200 feet) "

The present position of the Anse à Pierre-Loiselle Formation with respect to Logan's (1863) framework lies within the lower 75 per cent of Logan's (1863) Division 2.

Schuchert and Dart (1926) were the first workers to complete detailed studies after the pioneering work of Logan (1863). As a result of their investigations, they divided the Chaleurs Series into seven lithologic divisions of formation status which form the basis of the present stratigraphic nomenclature. The following is a brief summary of Schuchert and Dart's (1926) relevant lithologic units in ascending order modified after Northrop (1939, p. 25):

" Conformably underlying Ordovician strata

Clemville (385 feet)
La Vieille sandstones and conglomerates (170 feet)
La Vieille limestone or stricklandia beds (285 feet)
Gascons or Taonurus muddy and shaly sandstone (1800 feet) "

The Anse à Pierre-Loiselle Formation lies within the uppermost 20 per cent of Schuchert and Dart's (1926) La Vieille Conglomerate and Sandstone formation and the lowermost 50 per cent of the succeeding La Vieille Limestone Formation.

Schuchert and Dart (1926) concluded that divisions 1-3 of Logan (1863) were equivalent to their La Vieille Formation and division 4 represented the basal Gascons Formation. They also stated that the underlying Ordovician strata at the Petite Port Daniel River graded conformably into their Silurian Clemville Formation. This conclusion was based on the observation of little or no change of bedding attitude and an apparent lithological gradation from the younger calcareous rocks into the green shales interbedded with conglomerates containing pebbles of the Macquereau Series and that the lowest Silurian beds were missing.

Alcock (1935) reported on the Silurian succession at Black Cape and Port Daniel and found that Schuchert and Dart's (1926) stratigraphic framework was still valid and recognizable at both localities.

Northrop (1939) revised Schuchert and Dart's (1926) stratigraphic work slightly and established the Anse Cascon formation at Anse à La Vieille (Anse à Pierre-Loiselle) to replace Schuchert and Dart's (1926) La Vieille sandstone and conglomerate formation. The following is the revised stratigraphy of the lower Chaleurs Series in the Port Daniel area in ascending order modified after Northrop (1939, p. 25):

" Unconformably underlying Macquereau or Mictaw Group

Clemville (824 feet)

Anse Cascon (332 feet)

La Vieille (405 feet)

Gascons (1890 feet)"

Northrop (1939) recognized that the Clemville Formation was not found at Anse à La Vieille (Anse à Pierre-Loiselle) but was found inland along the Petite Port Daniel River. Northrop believed that the conglomerates described as Ordovician by Schuchert and Dart (1926) were in fact the basal portion of his Silurian Clemville Formation. He similarly interpreted the clasts of the conglomerate to have been derived from the Ordovician? Macquereau Group and thus deposited from the Taconic highlands as the earliest phase of Silurian deposition in the area.

Schuchert and Dart (1926) did not travel any farther up-river from their Clemville Formation type section to the northwest flank of the Clemville anticline. Northrop, however, ventured farther up and commented on the succeeding strata (Northrop, 1939, p.27):

"Still farther upstream the structure becomes complicated, and the strata are much disturbed for a considerable distance. Beyond this is encountered a uniformly dipping section up to the gorge cut by the river through a ridge of the La Vieille limestone."

He concludes:

"Below the La Vieille limestone there is an unexposed interval representing 385 feet of strata, probably in large part the Anse Cascon Formation."

These unexposed strata include the Anse à Pierre-Loiselle Formation.

The uppermost 20 per cent of Northrop's Anse Cascon Formation is the lower Anse à Pierre-Loiselle Formation and the lower 50 per cent of his La Vieille Formation comprises the remainder of the studied formation.

Badgely (1956) did not recognize the validity of the Anse Cascon in the Chaleurs Bay Series as outlined by Northrop (1939) and assigned all pre-La Vieille Formation strata, including part of the Mictaw (Schuchert and Dart's (1926) Ordovician conglomerates) and Schuchert and Dart's (1926) La Vieille sandstones and conglomerates, to the Clemville Formation.

Burk (1964) re-examined sections of the Chaleurs Group on the Petite Port Daniel River and at Anse à La Vieille (Anse à Pierre-Loiselle) and arrived at the following conclusions:

1. That Schuchert and Dart's (1926) type-Clemville Formation does in fact represent the lowermost Silurian beds.

2. That Northrop's (1939) expanded Clemville Formation from the Petite Port Daniel River is lithologically similar and stratigraphically equivalent to his Anse Cascon Formation found at Anse à Pierre-Loiselle.

3. That Schuchert and Dart's (1926) original assumption was correct such that the lowermost conglomerates of the Clemville Formation are in fact pre-Silurian.

4. That Badgely (1956) was incorrect in stating that Schuchert and Dart's (1926) Clemville Formation and La Vieille sandstones and shales belong to the same unit.

Burk (1964) pointed out that the type - section of the Clemville Formation does not contain a large portion of quartzose sandstone and is clearly two distinct formations based on lithology.

In summary, Burk (1964) attempted to equate the boundaries of Northrop's (1939) Clemville, Anse Cascon and La Vieille formations with Logan's (1863) objective Divisions 1, 2 and 3 respectively (Fig. 4). The present-day Anse à Pierre-Loiselle Formation comprises the lowermost 65 per cent of Burk's (1964) Anse Cascon Formation.

Ayrton (1967) erected the Weir Formation to represent some of the strata which previous workers (Schuchert and Dart, 1926; Northrop, 1939; Badgely, 1956; and Burk, 1964) assigned to the basal Clemville Formation. Ayrton restricted the Weir Formation to those rocks composed of grey-green siltstone interbedded with quartz-pebble conglomerate and arkosic sandstone. Badgely (1956) reported on 100 feet of green shale and thin bedded sandstone on the Petite Port Daniel River which Ayrton (1967) suggested may represent part of the Weir Formation.

Ayrton (1967), unlike previous workers, restricted the term Clemville Formation to rocks composed of quartzite, sandstone and siltstone which underlie the La Vieille limestone and overlie the green siltstone and conglomerate of the Weir Formation. Bourque (1975) pointed out that the rocks Ayrton assigned to the Clemville Formation are lithologically identical and correlative with strata of the Anse Cascon Formation. At the type-Clemville of Schuchert and Dart (1926) the unit composed of feldspathic conglomerate, sandstone and arkose which they assigned to the Weir Formation actually overlies the Clemville.

Ayrton (1967) recognized two members of the La Vieille Formation. The

Lower Member is composed of muddy, greenish-grey nodular limestone with green shaly partings comprising 285 feet. He also recognized a gradational boundary with the underlying Clemville Formation placing the base of the Lower Member of the La Vieille Formation at the top of the first hard sandstone bed of the Clemville Formation. It seems likely that Ayrton was the first worker to recognize what today is referred to as the Anse à Pierre-Loiselle Formation (his Lower Member of the La Vieille Formation).

Extensive work by Bourque (1975) and Bourque and Lachambre (1980) has produced a unified stratigraphic framework for the Silurian strata of the Port Daniel and Black Cape regions of the Gaspé Peninsula. Their re-examination of the Chaleurs Group resulted in the establishment of the Anse à Pierre-Loiselle Formation (Fig. 4).

The Anse à Pierre-Loiselle Formation is a transitional unit between the underlying non-calcareous sandstone and mudstone of the Anse Cascon Formation and the dense, nodular limestone of the succeeding La Vieille Formation. The Anse à Pierre-Loiselle Formation constitutes a stratigraphic thickness of 65-170 metres.

The base of the Anse à Pierre-Loiselle Formation is placed at the first continuous carbonate bed in upward succession. For the purpose of this study, the formation is divided into three distinct and locally mappable lithological members (Figs. 5, 6). The lowermost member, member 1, consists of nodular calcisiltite, calcilutite and calcarenite with continuous interbeds of calcarenite and calcareous sandstone (Figs. 7, 8). Small rhynchotremid brachiopods are common together with a few solitary and colonial corals and domal stromatoporoids.

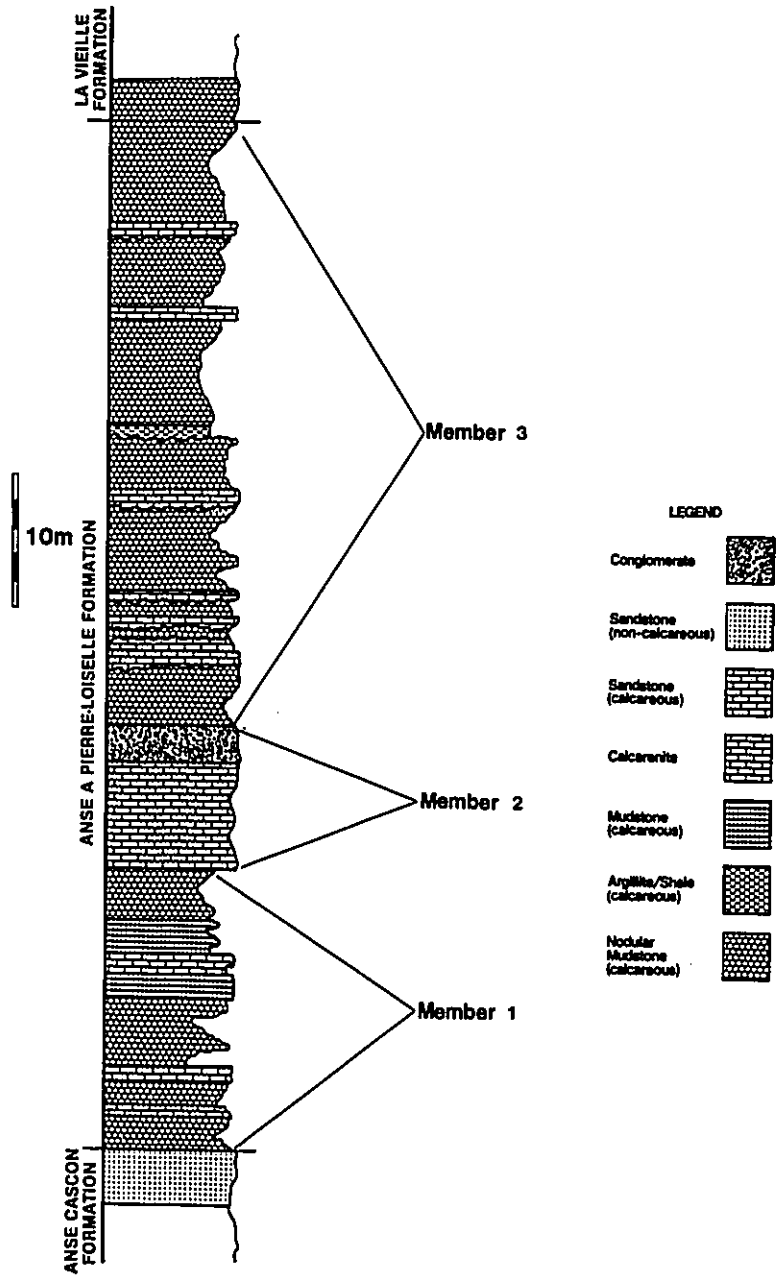

Figure 5. Composite section illustrating three locally mappable and lithologically distinct informal members.

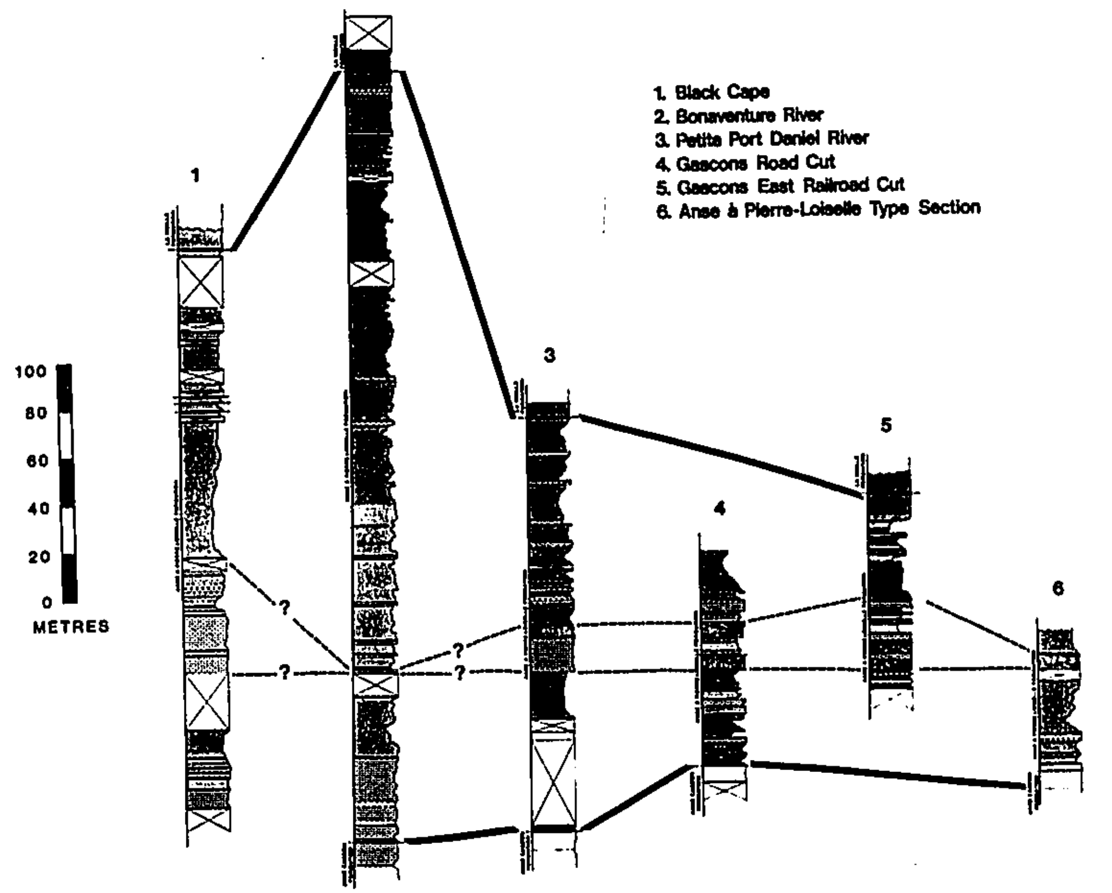

Figure 6. Correlation of the six studied sections based on three informal members. Lithologic legend found in Fig. 5.

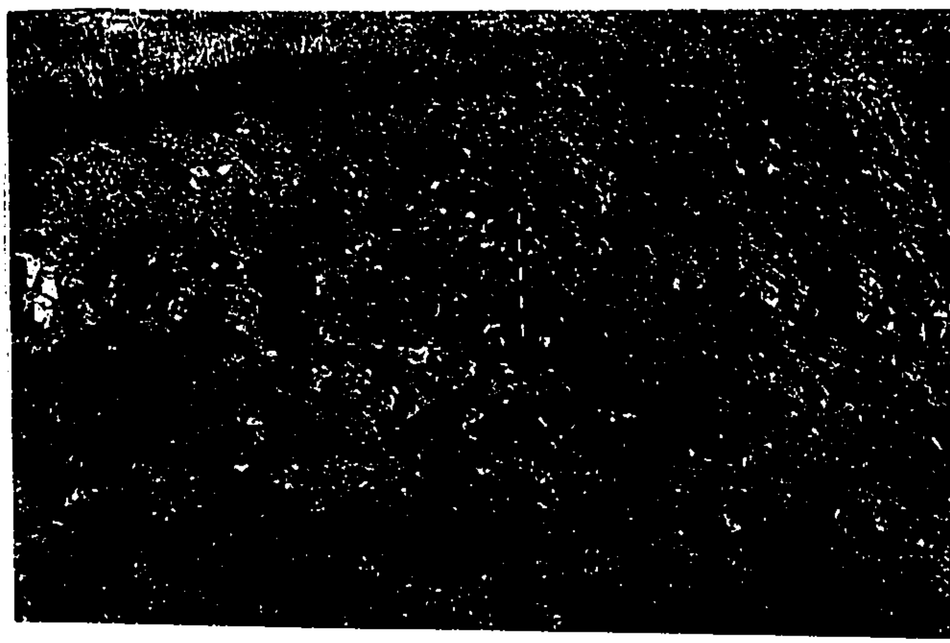

Figure 7. Lower contact of Member 1 of the Anse à Pierre with the preceding Anse Cascon Formation at the Gascons Road Cut. Pogo stick rests on contact and is 1m in length.

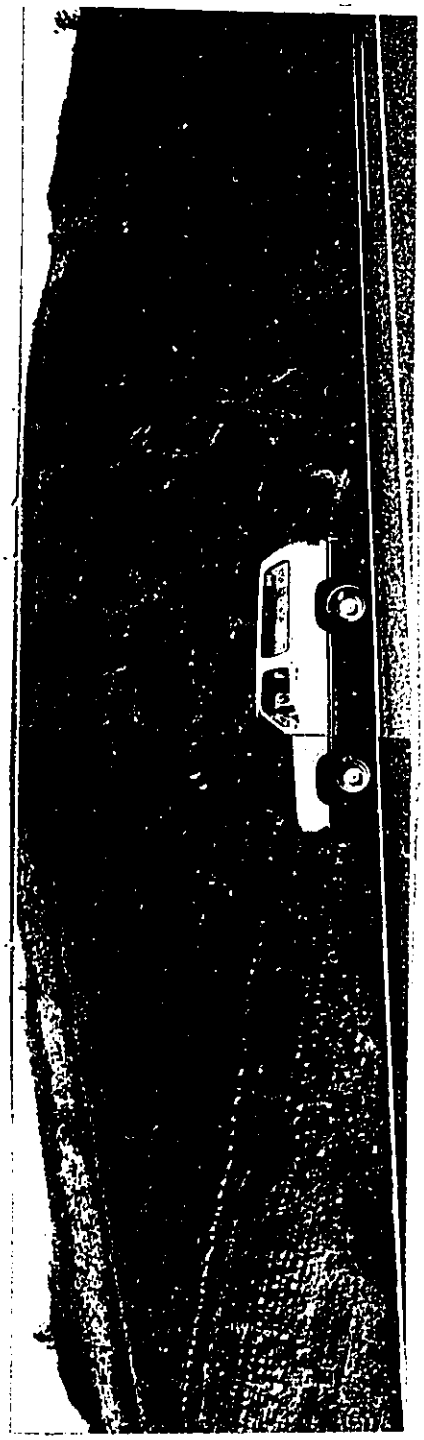

Figure 8. Wide angle view of the lower portion of the Gascons Road Cut illustrating Members 1 and 2.

The middle portion (member 2) of the Anse à Pierre-Loiselle Formation is characterized by coarse grained calcareous and non-calcareous sandstone and conglomerate (Figs. 8, 9). Biotic clast types of the conglomerate include: disarticulated crinoid ossicles, articulated and disarticulated brachiopods and anthozoans. Abiotic material consists of subangular jasper and milky quartz pebbles possibly derived from the underlying highly deformed Middle Ordovician Mictaw or pre-Middle Ordovician Macquereau Group rocks. Member 2 forms a distinctive marker horizon and serves as an effective lithostratigraphic correlation datum for five of the six study sections (Fig. 6). The unit is absent from Section II on the Bonaventure River.

The third lithologic unit, member 3, is composed of nodular calcisiltite, calcilutite and calcarenite with a few discontinuous lenses of calcarenite. The stromatoporoid Densastroma? sp. (Figs. 10-13) (T.E. Bolton, pers. comm., 1988) is found in life position with the stratigraphically significant brachiopod Costistricklandia lirata (= C. gaspensis) (Fig. 13). Favositid corals are rare in this upper unit with the solitary coral Palaeocyclus sp. being fairly abundant.

The base of the La Vieille Formation was defined by Bourque (1975) and Bourque and Lachambre (1980) at the point where the ratio of limestone nodules to matrix is greater than 50 per cent. This criterion is locally difficult to observe especially at the Bonaventure River Section (Section II). For the purpose of this study, the base of the La Vieille Formation is placed at a point where the nodules coalesce to form distinctive irregular beds.

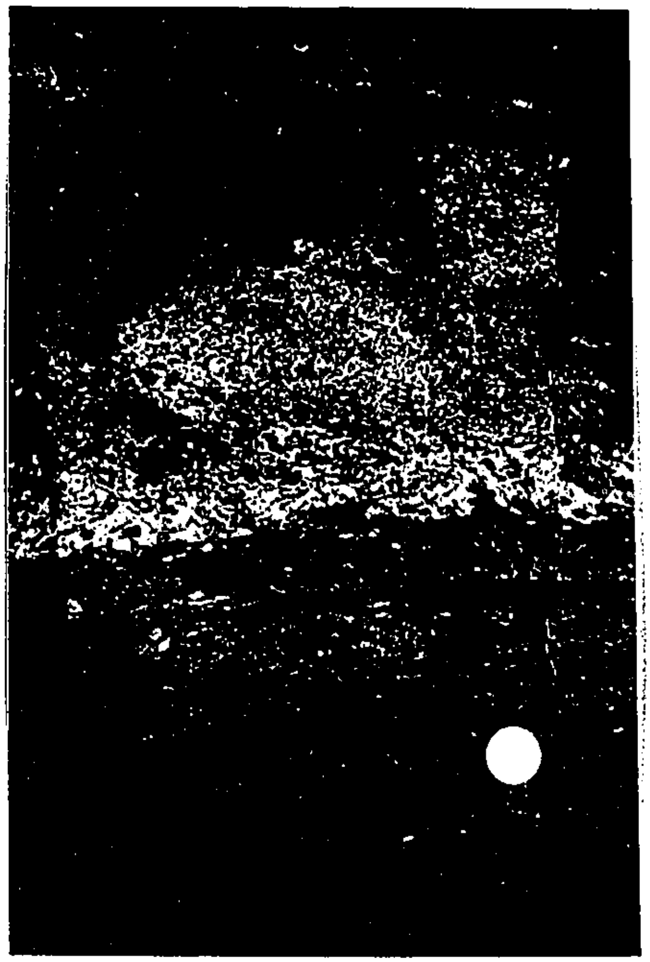

Figure 9. Member 2, conglomerate/crinoidal grainstone at Gascons Road Cut. Canadian five cent coin (2cm) for scale.

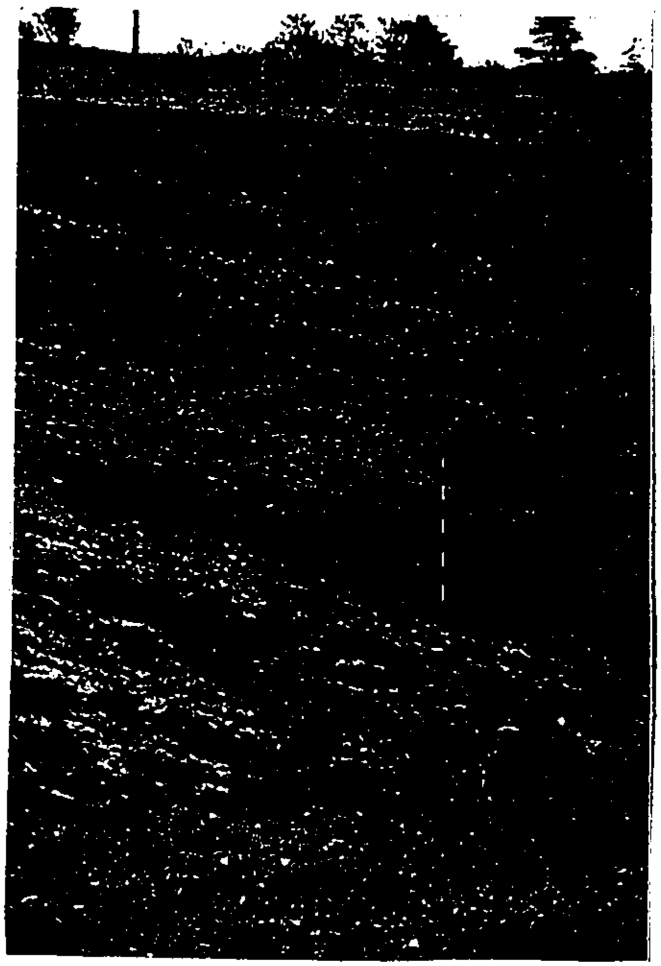

Figure 10. Upper Member 3, nodular mudstone from the Gascons Road Cut. Pogo stick (1m) rests on internal division of nodule size within Member 3.

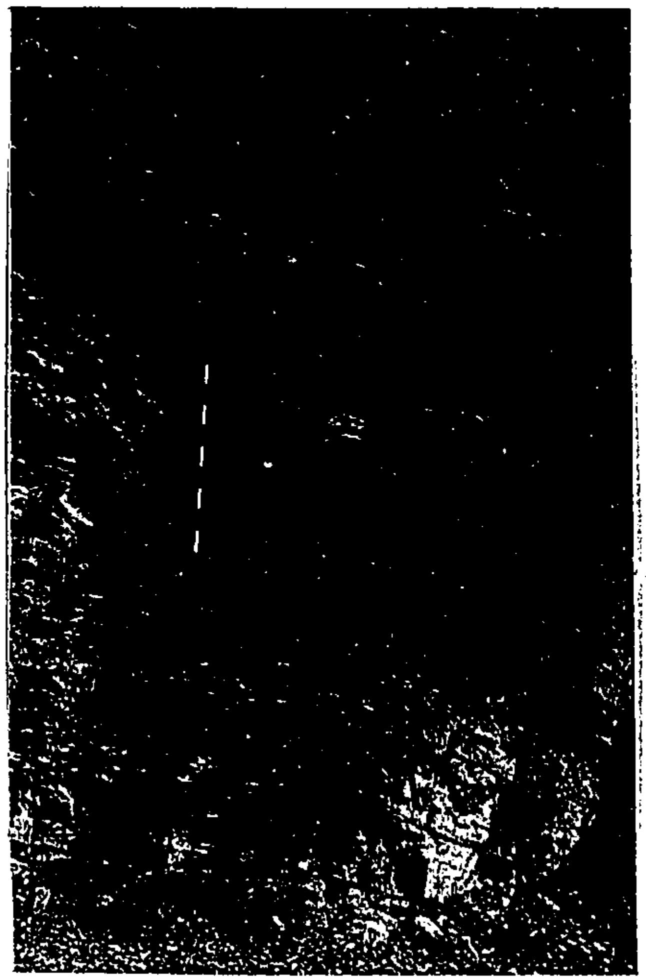

Figure 11. Lower Member 3 at Gascons Road Cut illustrating the stromatoporoid Densastroma? sp. in life position. Pogo stick (1m) rests on last competent bed of Member 2.

Figure 12. The stromatoporoid <u>Densastroma</u>? sp. in life position within Member 3 at Gascons Road Cut. Canadian twenty-five cent coin (2.3cm) for scale.

Figure 13. The stratigraphically significant brachiopod Costistricklandia lirata in Member 3 at Gascons Road Cut. Canadian ten cent (1.7cm) coin for scale.

2.3 Depositional Environment

Noble and Howells (1974) discussed the nodular nature of sediments found in the Lower Silurian La Vieille Formation of northern New Brunswick. The sediments described by these authors are similar to those described above as belonging to members 1 and 3 of the Anse à Pierre-Loiselle Formation.

Macroscopically, the nodules consist of irregular boudins to nearly perfectly spheroidal masses of fine grained calcilutite to calcisiltite found primarily in a shaly argillite matrix in outcrop. Minor amounts of calcarenite are present in some beds. Fine allochems, including trilobite, brachiopod and anthozoan fragments, comprise approximately 3 per cent of a nodule. In thin section, the nodules are composed of calcite microspar with fine clay and silt with interspersed fine non - carbonate sand. Minerals identified from the insoluble residues include detrital pyrite, marcasite and smithsonite.

Noble and Howells (1974) concluded that these nodules were the product of early marine lithification and differential compaction within 10 cm of the sediment - water interface. The mechanism of nodule formation they proposed consisted of anthozoans affixing themselves to discarded shell fragments in an environment of relatively low rates of sedimentation. Upon burial in the soft clay-rich sediment, the anchoring shell matter dissolved adding to the high Mg budget of the geochemical reservoir. The shell mould was quickly filled with the soft sediment leaving little or no trace of its position and the nodule was subsequently cemented to a hard nodule utilizing the dissolved $CaCO_3$ from the shell fragment. The final step in this process consists of the continued sediment deposition and differential compaction of the surrounding clay-rich matrix.

The environment of deposition of the nodules as envisioned by Noble and Howells (1974) was that which initiated early diagenesis, soon after the deposition of the original sediment. This deposition under low energy conditions in an offshore position of the shelf, below wave base and from a few tens of metres to one hundred metres in depth (Noble and Howells, 1974).

Member 2, the conglomerate (crinoidal wackestone) and non-calcareous sandstone unit, suggests a period of shallowing. The lithology which consists of reworked Ordovician material in conjunction with disarticulated crinoid material suggests a high energy shoal environment on an open platform which received detritus from nearby Ordovician highland exposures.

2.4 Previous Biostratigraphic Studies

Billings (1857, 1866), Schuchert and Dart (1926) and Northrop (1939) established the first systematic taxa lists from the southern Gaspé region.

The first definitive biostratigraphic analyses of the Anse à Pierre-Loiselle Formation were completed in 1981 by Boucot and Bourque (1981), Bolton (1981) and Nowlan (1981). Subsequently, Nowlan (1983) published a short synthesis of the Early Silurian conodonts of eastern Canada.

Boucot and Bourque (1981) established a brachiopod biostratigraphic zonation based on brachiopods for the Chaleurs Group, including the Anse à Pierre-Loiselle Formation, as part of a larger project of analysis of the benthic communities and paleogeography of the Gaspé Basin. They recognized three brachiopod zones in the Llandovery rocks of the Chaleurs Bay Synclinorium. These zones are: the Stricklandia lens typica Phylozone indicated a Llandovery A_3-A_4 age and occurs in the Clemville Formation; the Eocoelia curtisi Phylozone which indicates a Llandovery C_4-C_5 age and occurs within the lower to medial Anse Cascon Formation; and the Costistricklandia lirata Phylozone (also known as Costistricklandia gaspensis (Schuchert and Dart, 1926; Northrop, 1939; Bourque and Lachambre, 1980; among others) indicative of a Llandovery C_6 to Wenlock age. The strata of the Anse à Pierre-Loiselle Formation are all assigned to the Costistricklandia lirata Phylozone. Boucot and Bourque (1981) conclude that brachiopods alone are not useful for the definition of the Llandovery-Wenlock boundary, as the indicative species Costistricklandia lirata is found well into the Wenlock. They did, however, feel that the Llandovery-Wenlock boundary exists within the La Vieille Formation because of the occurrence of late Wenlock (Ludlovian) graptolite Pristiograptus ludensis within the lowermost Gascon Formation (Lenz, 1975). A modification of Boucot and Bourque's (1981) brachiopod range chart illustrating the three phylozones for the Llandovery portion of the Chaleurs Group is shown in Figure 14.

Nowlan (1981) was the first worker to attempt a conodont-based biostratigraphic analysis of the strata of the lower Chaleurs Group. Nowlan's preliminary biostratigraphic interpretations were based on very few conodont samples collected during the 1979 field season. Collections from the three formations which underlie the Anse à Pierre-Loiselle Formation yielded approximately 900 conodont elements that are numerically dominated by species of Panderodus. Other taxa recovered include:

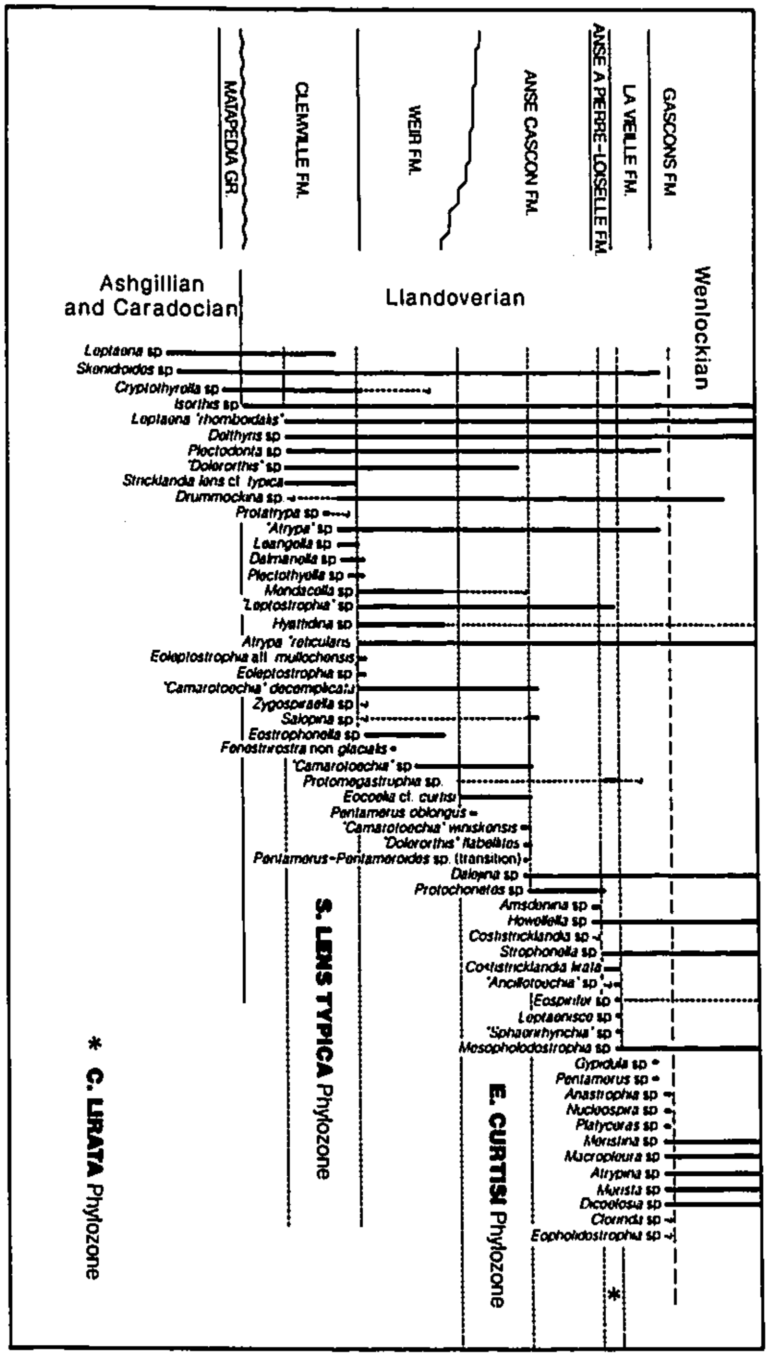

Figure 14. Vertical range of brachiopod taxa and brachiopod zonation for the lower Silurian portion of the Chaleurs Group (modified after Boucot and Bourque, 1981).

Icriodella discreta, I. deflecta, a probable new species of Distomodus, rare elements of Oulodus? nathani, Ozarkodina hassi, O. oldhamensis and simple cone fauna assigned to Walliserodus and Decoriconus. This faunal assemblage led Nowlan to determine an early Llandovery age for the underlying strata of the Chaleurs Group.

Nowlan (1981) reported on 5 samples obtained from various levels within the Anse à Pierre-Loiselle Formation. Taxa recovered from within this interval included Apsidognathus tuberculatus, Pterospathodus pennatus procerus, P. amorphognathoides and Carniodus carnulus indicating a latest Llandovery to early Wenlock age (Nowlan, 1981).

In 1983, Nowlan published a synthesis of the biostratigraphic correlation of the Early Silurian conodonts of eastern Canada. The portion of Nowlan's study dealing with the Gaspé Peninsula was based on many new samples from the Chaleurs Group, thus providing a broader data base. Nineteen regions were correlated to standard conodont zones in North America and Great Britian as well as standard brachiopod zones.

Asselin et al. (1989) published a zonation scheme using chitinozoans of the lower Silurian in the Chaleurs Bay region. They established six zone of which zone E and the lower part of zone F span the Anse à Pierre-Loiselle Formation.

3. Conodont Biostratigraphy

3.1 Previous Conodont Zonations

Walliser (1964) provided the first Silurian conodont zonation based on material collected at Cellon in the Carnic Alps of Austria. This pioneering study was based primarily on a single section. Eleven conodont zones (10 formal, 1 informal) were defined encompassing strata from the Silurian to basal Devonian. The base of each conodont zone was defined upon the first occurrence of a zonal index species and the top of the zone defined at the first occurrence of the succeeding zonal index species representing a successive range zone as described by Cooper (1980).

The lowest of Walliser's (1964) conodont zone divisions is Conodonten - Bereich I. Walliser (1964) described this zone informally due to the lack of diagnostic forms, and did not assign a definite base, but indicated that it contains forms that strongly resemble those found in the Ordovician. These taxa include Ambalodus triangularis and other elements of the genus Amorphognathus. The basis for defining this conodont zone as the lowermost division of the Silurian System was the occurrence of Icriodina irregularis, previously known from the Lower Silurian of eastern Kentucky. The base of Bereich I was tentatively placed at the Ordovician - Silurian boundary and the top at the succeeding formal conodont zone and first occurrence of the zonal index Pterospathodus celloni (Fig. 15).

The celloni Zone is defined by the first occurrence of P. celloni. Other taxa characteristic of this interval include Apsidognathus tuberculatus Walliser and Distomodus staurognathoides (Walliser). The top of

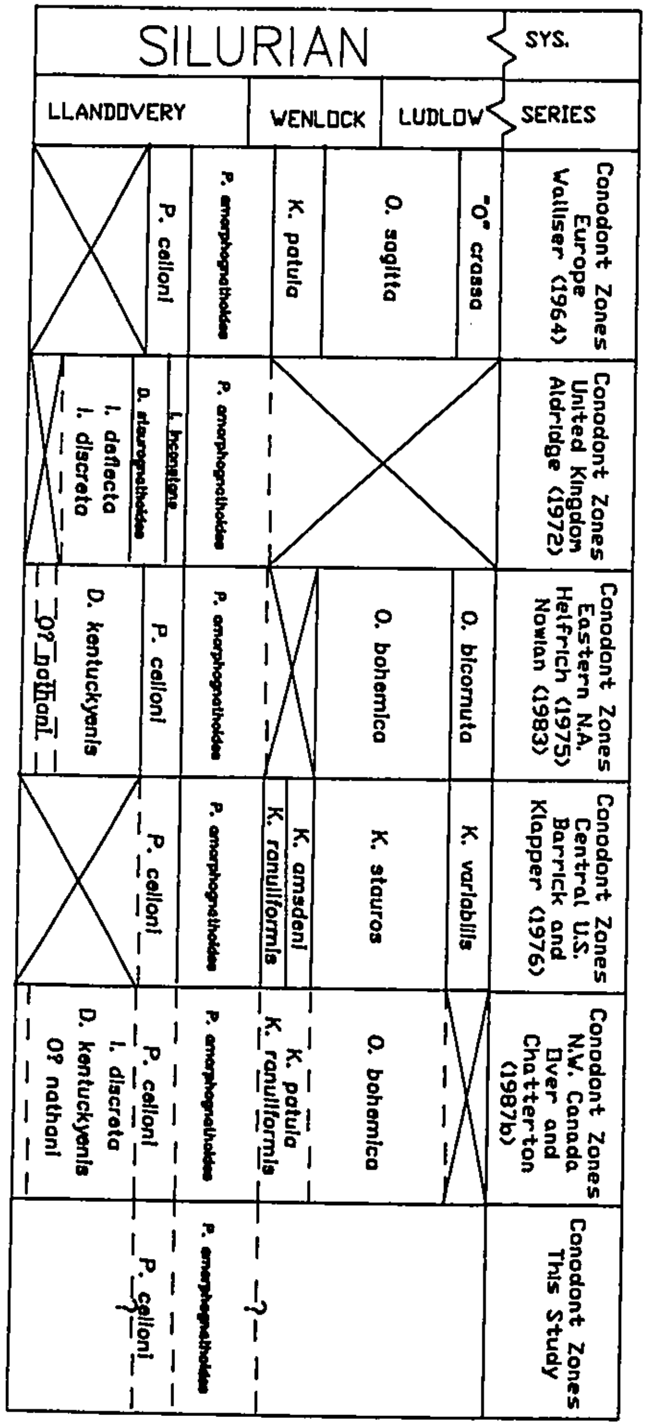

Figure 15. Summary chart of previously accepted Silurian conodont zones and the informal use of accepted zones for this study.

this zone is defined by the base of the succeeding amorphognathoides Zone whose base is marked by the first occurrence of P. amorphognathoides Walliser. Species characteristic of this zone include Pterospathodus amorphognathoides, P. pennatus procerus (Walliser), A. tuberculatus, D. staurognathoides and Carniodus carnulus Walliser. The top of the zone is marked by the base of the succeeding patula Zone defined by the first occurrence of Kockelella patula Walliser. The only taxon characteristic of this fauna is the zonal species itself and the form species Ozarkodina ziegleri aequalis Walliser and Synprioniodina silurica Walliser which occur commonly. The top of the zone is located at the base of the following saggita conodont zone. The subsequent zones of Walliser (1964) are not relevant to the present study and are not discussed further.

In North America, Nicoll and Rexroad (1969) recovered conodonts which they considered to resemble those assigned by Walliser to his lowest three zones. Nicoll and Rexroad (1969) and Rexroad and Rickard (1965) made some slight modifications to Walliser's (1964) zonation scheme outlined below, necessitated by differences in the recovered fauna.

Walliser (1964) had based his lowermost zone on the occurrence of Icriodina irregularis Branson and Branson (= Icriodella Rhodes). Rexroad and Rickard (1965) found their youngest occurrence of Icriodella within a fauna associated with the celloni Zone from the Hickory Corners Limestone Member of the Reynales Formation of Ontario. Nicoll and Rexroad (1969) found that specimens assigned to Walliser's Icriodina irregularis Zone were found associated with Pterospathodus celloni and other celloni Zone taxa. They also noted that specimens Walliser (1964) had assigned to Spathognathodus pennatus angulatus (= Pterospathodus pennatus angulatus) were in fact juvenile elements of P. amorphognathoides within the celloni Zone.

Nicoll and Rexroad (1969) proposed three assemblage zones to clarify the Cellon zonation scheme: Icriodina irregularis, Neospathodus celloni and Pterospathodus amorphognathoides- Spathognathoides ranuliformis Assemblage Zones.

The Icriodina irregularis Assemblage Zone (=Distomodus kentuckyensis Assemblage Zone) is based on the first occurrence of D. kentuckyensis. Conodonts characteristic of this zone include Ozarkodina oldhamensis. This zone does not represent the oldest Silurian conodonts in North America as Rexroad (1967) noted a pre-kentuckyensis fauna from the Belfast member of the Brassfield as well as the Edgewood Dolomite in Illinois (Liebe, 1962 in Nicoll and Rexroad, 1969). Therefore, there is an unzoned gap between the uppermost Ordovician and the base of the D. kentuckyensis zone. Nicoll and Rexroad felt that the I. irregularis - D. kentuckyensis zone correlated with the upper part of Walliser's Bereich I. The top of the zone is marked by the base of the N. celloni Assemblage Zone.

The lower limit of the Neospathodus celloni Assemblage Zone is marked by the first occurrence of species assigned to the genus Neospathodus or Ozarkodina adiutricis both considered to be constituent elements of the genus Pterospathodus. The characteristic conodonts of this fauna include D. staurognathoides, D. kentuckyensis, P. amorphognathoides, P. celloni and P. pennatus. Nicoll and Rexroad (1969) intended this zone to encompass the entire range of the form-genus Neospathodus. With the recognition of Neospathodus as part of the multielement genus Pterospathodus, their zone theoretically would include the entire range of P. amorphognathoides. The validity of this zone and the overlying Pterospathodus amorphognathoides -

Kockelella ranuliformis Assemblage Zone is maintained when the range of P. celloni is only considered.

The base of the succeeding Pterospathodus amorphognathoides - Spathognathodus ranuliformis (Pterospathodus amorphognathoides - Kockelella ranuliformis) Assemblage Zone is at the last occurrence of Neospathodus interpreted as P. celloni and the first occurrence of P. amorphognathoides. The upper limit of this Assemblage zone is at the lower limit of the K. patula Zone of Walliser. Characteristic conodonts of this assemblage zone include P. amorphognathoides, Kockelella ranuliformis, D. staurognathoides and Dapsilodus obliquicostatus (Branson and Mehl).

Pollock et al. (1970) refined the Early Silurian conodont zonation based on material from northern Michigan and Ontario. They established the Panderodus simplex Assemblage Zone to represent strata between the Ordovician-Silurian boundary and the succeeding Icriodina irregularis (D. kentuckyensis) Assemblage Zone of Nicoll and Rexroad (1969). The P. simplex Assemblage Zone (= Panderodus unicostatus Assemblage Zone) was based above the last occurrence of conodonts considered to be Late Ordovician in age and the top defined at the base of the D. kentuckyensis Assemblage Zone or the first occurrence of Icriodella discreta Pollock, Rexroad and Nicoll. The only characteristic conodont of this zone is Panderodus unicostatus which ranges from earliest Silurian time to the Early Devonian.

Aldridge (1972) proposed four Early Silurian conodont assemblage zones from the Welsh Borderland area of Great Britain. These zones cover a stratigraphic interval similar to that of Nicoll and Rexroad (1969) and are more closely correlated with Walliser's original zonal scheme (Fig. 15).

The base of Aldridge's lowermost zone, the Icriodella discreta-

Icriodella irregularis Assemblage Zone, is drawn at the first occurrence of Icriodella discreta or Icriodella irregularis. Although the lowermost limit of the zone is unknown due to the nature of the sampling localities, it may be defined at the earliest occurrence of the zonal species (Aldridge, 1972). This zone spans the upper part of the Idwian and the upper part of C_1-C_2 of the Fronian (Aldridge, 1972). The upper limit of this zone is the base of the following Hadrognathus staurognathoides (= D. staurognathoides) Assemblage Zone. The characteristic taxa of the Icriodella discreta-Icriodella irregularis Assemblage Zone, assemblage zone include Icriodella discreta occupying the lower part of the zone and I. deflecta occupying the upper part. Rare elements of D. kentuckyensis and Ozarkodina hassi (Pollock, Rexroad and Nicoll) and O. oldhamensis occur in the upper part of this zone in the Welsh Borderland.

The base of the Hadrognathus staurognathoides (=D. staurognathoides) Assemblage Zone is placed at the earliest occurrence of D. staurognathoides and the top of the zone at the base of the succeeding Icriodella inconstans zone. The H. staurognathoides Assemblage Zone occupies a time-stratigraphic position from the upper Fronian (C_2-C_3) to approximately the top of the C_4 division of the Telychian (Aldridge, 1972). The characteristic conodonts include D. staurognathoides which ranges well into the following zone, Ozarkodina aldridgei Uyeno, Ozarkodina sp. A Aldridge, Lonchodina detorta s. f. and Lonchodina fluegeli s. f. (= Oulodus? fluegeli).

The Icriodella inconstans Assemblage Zone is defined at the first occurrence of Icriodella inconstans Aldridge or I. malvernensis Aldridge. The top of the zone is defined at the first occurrence of Pterospathodus amorphognathoides and other associated zonal fauna. This zone approximates a time-stratigraphic position equivalent to part of the C_5 subdivision of the Telychian (Aldridge, 1972). Characteristic species of this interval include _Icriodella inconstans_, _I. malvernensis_, _Kockelella ranuliformis_, _Ozarkodina gulletensis_ Aldridge, _Pterospathodus celloni_, and _P. pennatus_.

The uppermost Llandovery conodont zone defined in the Welsh Borderland is the _Pterospathodus amorphognathoides_ Assemblage Zone. This zone encompasses an interval which includes the upper part of the C_6 subdivision of the Telychian and the early Wenlock (Aldridge, 1972). The base of the assemblage zone is defined at the first occurrence of _Pterospathodus amorphognathoides_ and other assemblage species. The top of the zone was not defined by Aldridge from Wales or the Welsh Borderland area. Characteristic species of this interval include _Pterospathodus amorphognathoides_, _Carniodus carnulus_, and _Kockelella ranuliformis_. Due to the occurrence of _P. amorphognathoides_ in older strata in North America and Europe, Aldridge (1972) redefined the base of the _P. amorphognathoides_ Assemblage Zone from Walliser's (1964) equivalent zone to include the association of _K. ranuliformis_ and _C. carnulus_.

Barrick and Klapper (1976) identified conodonts assignable to an _amorphognathoides_-zone fauna from the Prices Falls Member of the Clarita Formation of south-central Oklahoma and erected a zonation scheme for the upper Llandovery to lower Ludlow interval. This zonation is based on the evolutionary lineages of four species of the genus _Kockelella_.

Barrick and Klapper (1976) assigned strata to the _Pterospathodus amorphognathoides_ Zone that contained the first occurrence of _P. amorphognathoides_. Other significant conodonts characteristic of this interval include _Distomodus staurognathoides_, _Kockelella ranuliformis_, _Ozarkodina_ hadra (Nicoll and Rexroad), O. polinclinata (Nicoll and Rexroad), Carniodus carnulus, Delotaxis petila (Nicoll and Rexroad), Pterospathodus celloni, and P. pennatus procerus as well as abundant simple cone taxa including four species of Panderodus. The top of the Pterospathodus amorphognathoides Zone occurs at the first occurrence of Pseudooneotodus bicornus which forms the base of the succeeding Kockelella ranuliformis Zone (Barrick and Klapper, 1976) (Fig. 15).

Cooper (1980) summarized accepted zonal schemes and erected eight datum planes for strata from middle Llandovery to upper Ludlow. He utilized both appearance and extinction datum planes. An appearance datum plane is an horizon defined by the lowest stratigraphic occurrence of a taxon and an extinction datum is an horizon defined by the last appearance of a taxon (Cooper, 1980). Only taxa with known ancestry can be used to define datum planes. The stratigraphic value of extinction datum planes is less than that of appearance datum planes and can only be defined where a significant number of taxa become extinct at the same time. Each datum is defined from a reference section in a continuous stratigraphic sequence. The following descriptions refer to those datum planes which are relevant to this study. For a complete listing of associated taxa above and below each datum horizon, see Cooper (1980, pp. 218-224).

The Distomodus staurognathoides Datum is defined by the first occurrence of the multielement taxon D. staurognathoides. Cooper (1980) suggested that D. staurognathoides is closely related to D. kentuckyensis and indicated a possible phylogenetic relationship. The datum correlates with the base of Aldridge's (1972) Hadrognathus staurognathoides Assemblage Zone. It also probably occurs near the top of the Icriodina irregularis (=

D. kentuckyensis) Assemblage Zone of Nicoll and Rexroad (1969) and below the base of Walliser's (1964) celloni Zone.

The Pterospathodus amorphognathoides Datum is based on the first appearance of the multielement taxon P. amorphognathoides. According to Cooper (1980), P. amorphognathoides evolved from Llandoverygnathus celloni (= Pterospathodus celloni) through L. pennatus (= Pterospathodus pennatus). Cooper (ibid.) correlates this datum to the base of the amorphognathoides Zone in Europe (Walliser, 1964). This horizon also occurs in the top half of the Neospathodus celloni Assemblage Zone of Nicoll and Rexroad (1969) and at, or slightly below, the base of the Pterospathodus amorphognathoides Assemblage Zone in the Welsh Borderland (Aldridge, 1972).

Using the graphic correlation method (see Shaw, 1964), Kleffner (1989) developed a composite stratigraphic section (CSS) for strata of late Llandovery to Pridoli age. This section is based on the total stratigraphic ranges of 70 established Silurian taxa from 30 localities in Europe and North America. Kleffner subdivided the CSS into 48 standard time units which offers a resolution on the order of two to four times higher than any previous zonal scheme for the Silurian. For a complete listing of taxa with total stratigraphic ranges in the CSS see Kleffner (1989, p. 909).

Subsequent to Walliser's (1964) classic zonation of Silurian conodonts from the Carnic Alps in Austria, conodonts of Early Silurian age have been reported in North America (Rexroad, 1967; Nicoll and Rexroad, 1969; Craig, 1969; Pollock, Rexroad and Nicoll, 1970; Rexroad and Nicoll, 1972; Miller, 1972, 1975; Klapper and Murphy, 1974; Cooper, 1975, 1976; Barrick and Klapper, 1976; Thompson and Satterfield, 1975; Liebe and Rexroad, 1977; Helfrich, 1975, 1980; Nowlan, 1981, 1983; Over and Chatterton, 1987a, 1987b); in Great Britian, Ireland and Wales (Brooks and Druce, 1965; Aldridge, 1972, 1975, 1980; Aldridge, Dorning and Siveter, 1981; Aldridge and Mabillard, 1981; Mabillard and Aldridge, 1983, 1985); in the Austrian Carnic Alps (Schonlaub, 1969, 1971; Manara and Vai, 1970); in Norway (Aldridge, 1974; Aldridge and Mohamed, 1982); in Greenland (Aldridge, 1979); in the Soviet Union (Mashkova, 1977; Mannik, 1983); in Australia (Bischoff, 1986) and in Asia (Igo and Koike, 1968; Kuwano 1976, Lee, 1982; Ding and Li, 1985; Yu, 1985; Wang and Li, 1986).

3.2 Previous Conodont Biostratigraphy In Gaspé

3.2.1 Clemville Formation

Nowlan (1981) collected a total of 32 samples from three sections of the Clemville Formation (110m) (Bourque, 1975; Bourque and Lachambre, 1980), yielding 500 conodont elements. In 1983, Nowlan reported an additional 1200 elements recovered from this interval. Elements of the genus *Panderodus* numerically dominate the collected fauna comprising almost 55 per cent of the fauna with elements of the genera *Icriodella* and *Ozarkodina* representing 26 and 10 per cent of the fauna, respectively. The remaining 9 per cent include the genera: *Decoriconus*, *Distomodus*, *Oulodus*? and *Walliserodus* (Nowlan, 1981, 1983).

Nowlan (1981, 1983) suggested that the Clemville conodont fauna corresponded with the *Oulodus*? *nathani* and *Distomodus kentuckyensis* zones of

Anticosti Island (McCracken and Barnes, 1981) indicating a Llandovery (A?-C_2) age which is correlative to the Icriodella discreta-I. deflecta Assemblage Zone of Great Britain as established by Aldridge (1972). Nowlan (1981) suggested that the interval represented by the Clemville Formation was similar to that which Schonlaub (1971) first recognized as being absent from Walliser's (1964) reference sections in the Carnic Alps.

3.2.2 Weir Formation

Two samples were obtained from a section of the Weir Formation (45m) on the Petite Port Daniel River by Nowlan (1981) yielding a total of 300 specimens. Included in this fauna are the following species: Distomodus kentuckyensis, Icriodella deflecta, I. aff. I. malvernensis, Ozarkodina hassi, Panderodus gracilis and P. recurvatus. The pattern of relative abundance of the species is similar to that of the Clemville Formation with elements of the genera Panderodus and Icriodella representing 50 and 30 per cent (respectively) of the fauna (Nowlan, 1981). Conodonts from this formation indicate a Llandovery C_1-C_2 (Fronian) age, which is somewhat younger than brachiopods recovered from the Weir Formation which indicate a Llandovery A_3-A_4 age (Boucot and Bourque, 1981). Nowlan (1981) suggested that the Weir Formation may be diachronous.

3.2.3 Anse Cascon Formation

One 3kg sample was obtained by Nowlan (1981) from the Anse Cascon

Formation which produced over 100 conodont specimens. The fauna was numerically dominated by the genus Panderodus representing 80 per cent of the recovered fauna with the remainder of the specimens belonging to two genera, Distomodus and Ozarkodina.

The recovered assemblage of specimens is suggestive of a late Llandovery (Telychian) age (Nowlan, 1981). Nowlan (1981) admitted that further sampling is necessary in order to provide a definitive age assignment and this has subsequently been carried out.

3.2.4 Anse à Pierre-Loiselle Formation

Nowlan (1981) reported on six samples collected from the Anse à Pierre-Loiselle Formation (65m-170m) yielding a total of 1,075 conodont elements. Numerous specimens were added to his collections by the time of publication of his synthesis in 1983. The fauna of the Anse à Pierre-Loiselle Formation, like that of the lower units, was numerically dominated by specimens assigned to species of Panderodus comprising almost 80 per cent of the total fauna. The remaining 20 per cent consisted of a diverse fauna including: Apsidognathus tuberculatus, Carniodus carnulus, Distomodus staurognathoides, Pterospathodus pennatus, Ozarkodina excavata excavata, Ozarkodina cf. O. gulletensis and two new species of Pterospathodus (Nowlan, 1981, 1983). The biostratigraphically significant brachiopod Costistricklandia lirata is found within the upper portion of this unit suggesting a Llandovery C_6 to early Wenlock age (Boucot and Bourque, 1981; Nowlan, 1983; among others). The conodont fauna recovered also suggests a late Llandovery age based on the occurrence of Apsidognathus tuberculatus and a late Llandovery -early Wenlock age based on the occurrence of Carniodus carnulus, Pterospathodus pennatus and the biostratigraphically significant Pterospathodus amorphognathoides (Nowlan, 1981, 1983). This fauna is described in detail herein and several of Nowlan's taxonomic assignments are revised.

3.2.5 La Vieille Formation

In 1981, a total of 22 samples were reported by Nowlan from the La Vieille Formation. The fauna recovered from the lower member of the unit was numerically dominated by species of Panderodus (70 per cent). The remaining taxa include: Distomodus staurognathoides, Carniodus carnulus, Ozarkodina cf. O. gulletensis, O. excavata excavata, Pseudooneotodus beckmanni, and the biostratigraphically significant species Pterospathodus amorphognathoides (Nowlan, 1981, 1983). Member 2 of the unit yielded a sparse fauna dominated by specimens assignable to the genus Ozarkodina. Member 3 only yielded conodonts from the top of the formation including Ozarkodina confluens which ranges in age from late Sheinwoodian to Pridolian. Taxa recovered from the lower and middle members of the formation are similar to those recovered from the uppermost of the Anse à Pierre-Loiselle Formation suggesting a late Llandovery to early Wenlock age for these two members (Nowlan 1981). Because of the occurrence of Ludlovian graptolites recovered from the overlying Gascons Formation, Nowlan (1981) suggested that the Llandovery-Wenlock Boundary lies within the lower portion of the La Vieille Formation. Nowlan (1983, p. 106) reported conodonts diagnostic of Wenlock age about 100m above the base of the La Vieille Formation in Northern New Brunswick which tend to confirm this suggestion.

3.3 Conodont Zonation of the Anse à Pierre-Loiselle Formation

Strata contained within the Anse à Pierre-Loiselle Formation can be informally correlated globally with the uppermost Pterospathodus celloni and lowermost P. amorphognathoides Zones of Walliser (1964). Due to the absence of true P. celloni and the scarce elements of P. amorphognathoides in eastern Canada, the erection of a local taxon range zone is attempted for this interval.

The base of the new taxon range zone, the P.? ceragnathoides Zone herein, is defined at the first occurrence of the nominal species which occurs at 4.8m above the base of Section IV. Occurrence of P.? ceragnathoides is unknown from the underlying Anse Cascon Formation. The upper limit of this zone is within the lowermost La Vieille Formation, 126.5 m above the base of Section I. The position of the new total taxon range zone with respect to existing biostratigraphic zonations is illustrated in Figure 16.

Additional taxa associated with this interval include: Apsidognathus sulcatus n.sp., Digitodontus bellistriatus n.gen n.sp., Kockelella ranuliformis, Pterospathodus pennatus pennatus, and P. p. procerus (Figs. 17-22).

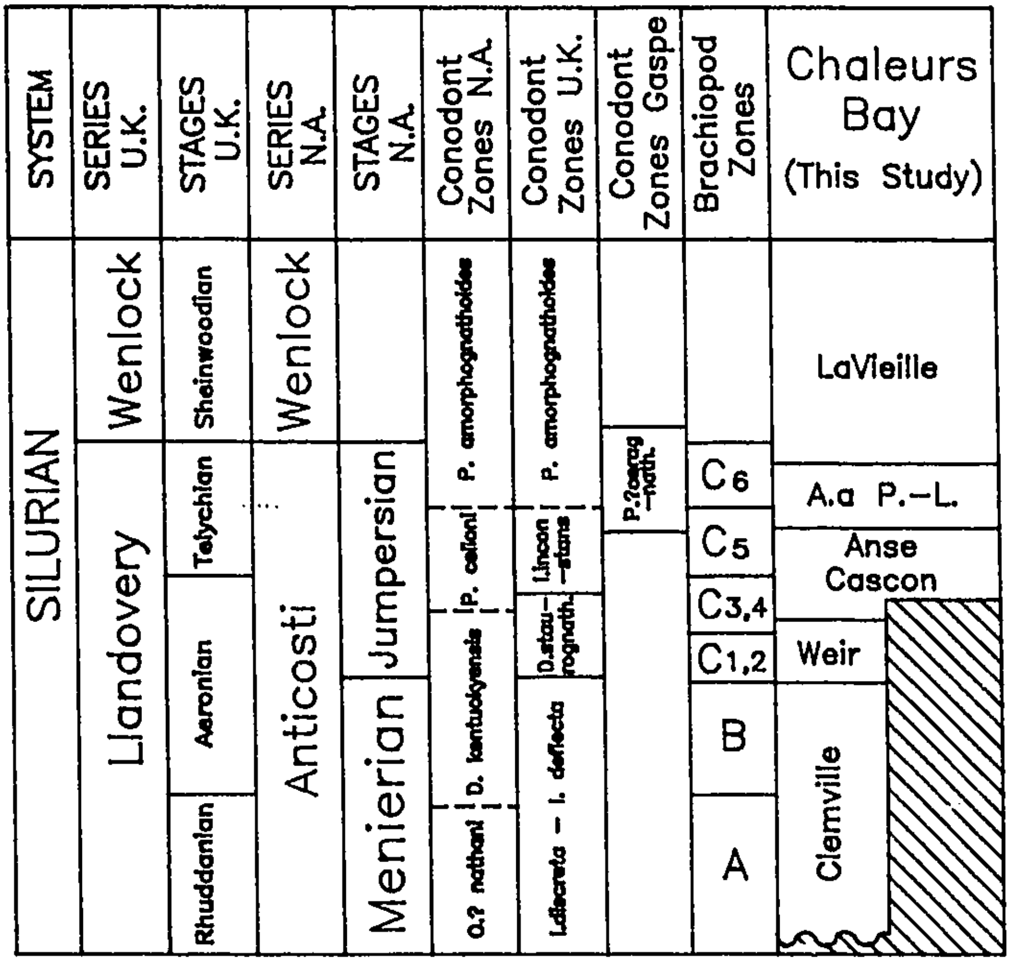

Figure 16. Conodont zonation of the Anse à Pierre-Loiselle Formation (A. à P.-L.) with respect to existing stratigraphic nomenclature and biostratigraphy.

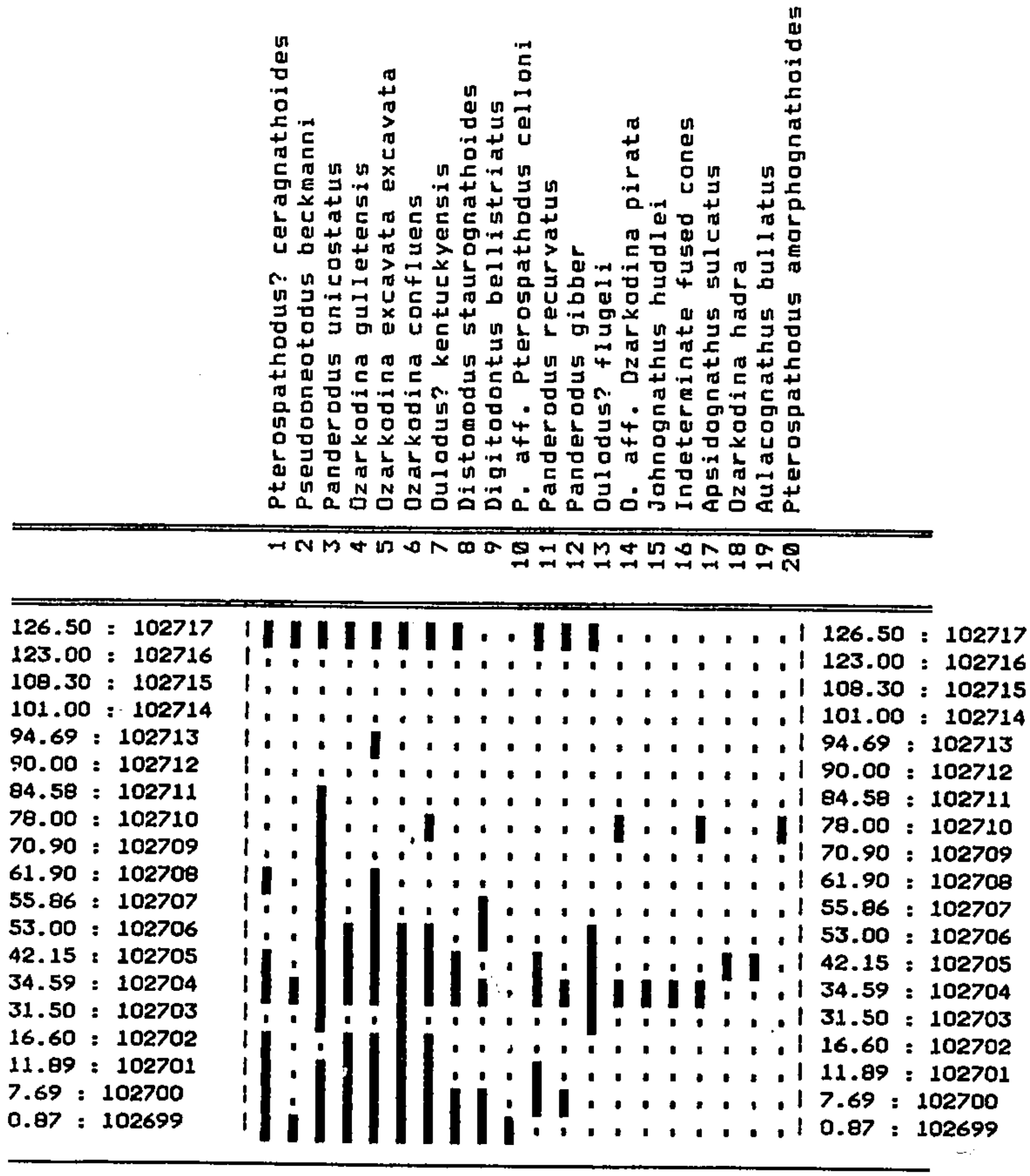

Figure 17. Conodont range chart for the Anse à Pierre-Loiselle Formation at Black Cape (Section I).

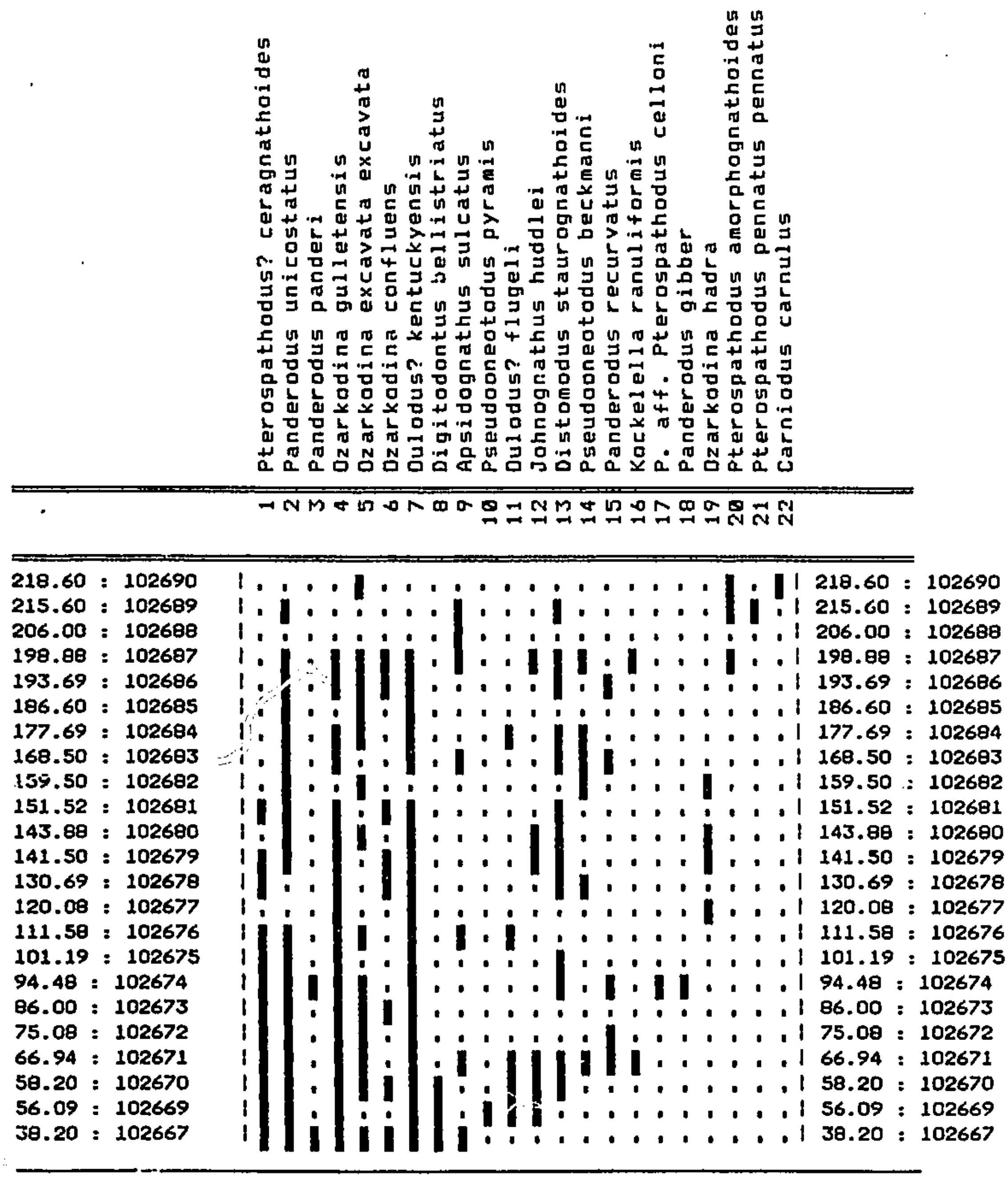

Figure 18. Conodont range chart for the Anse à Pierre-Loiselle Formation at the Bonaventure River (Section II).

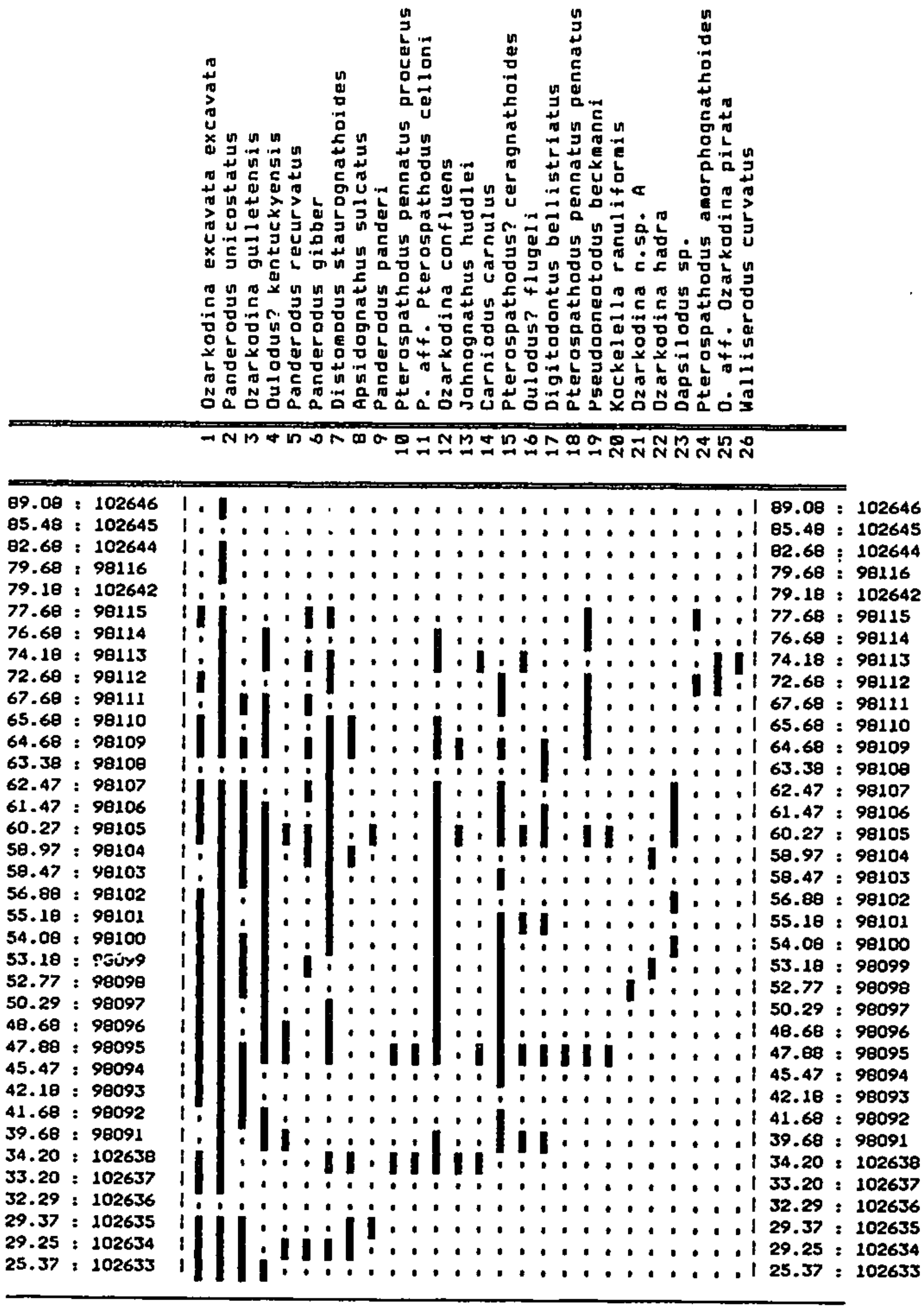

Figure 19. Conodont range chart for the Anse à Pierre-Loiselle Formation at the Petite Port Daniel River (Section III).

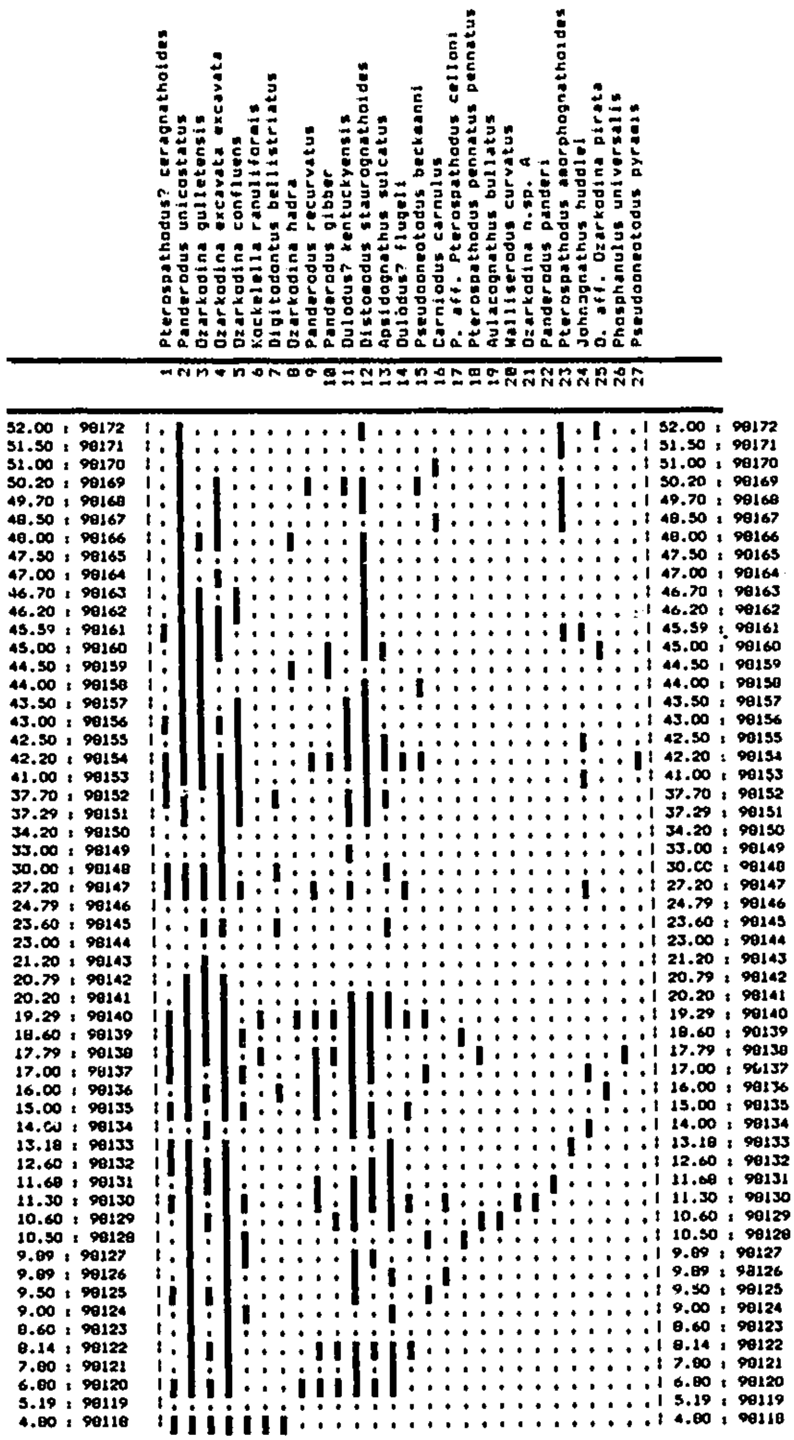

Figure 20. Conodont range chart for the Anse à Pierre-Loiselle Formation at the Gascons Road Cut (Section IV).

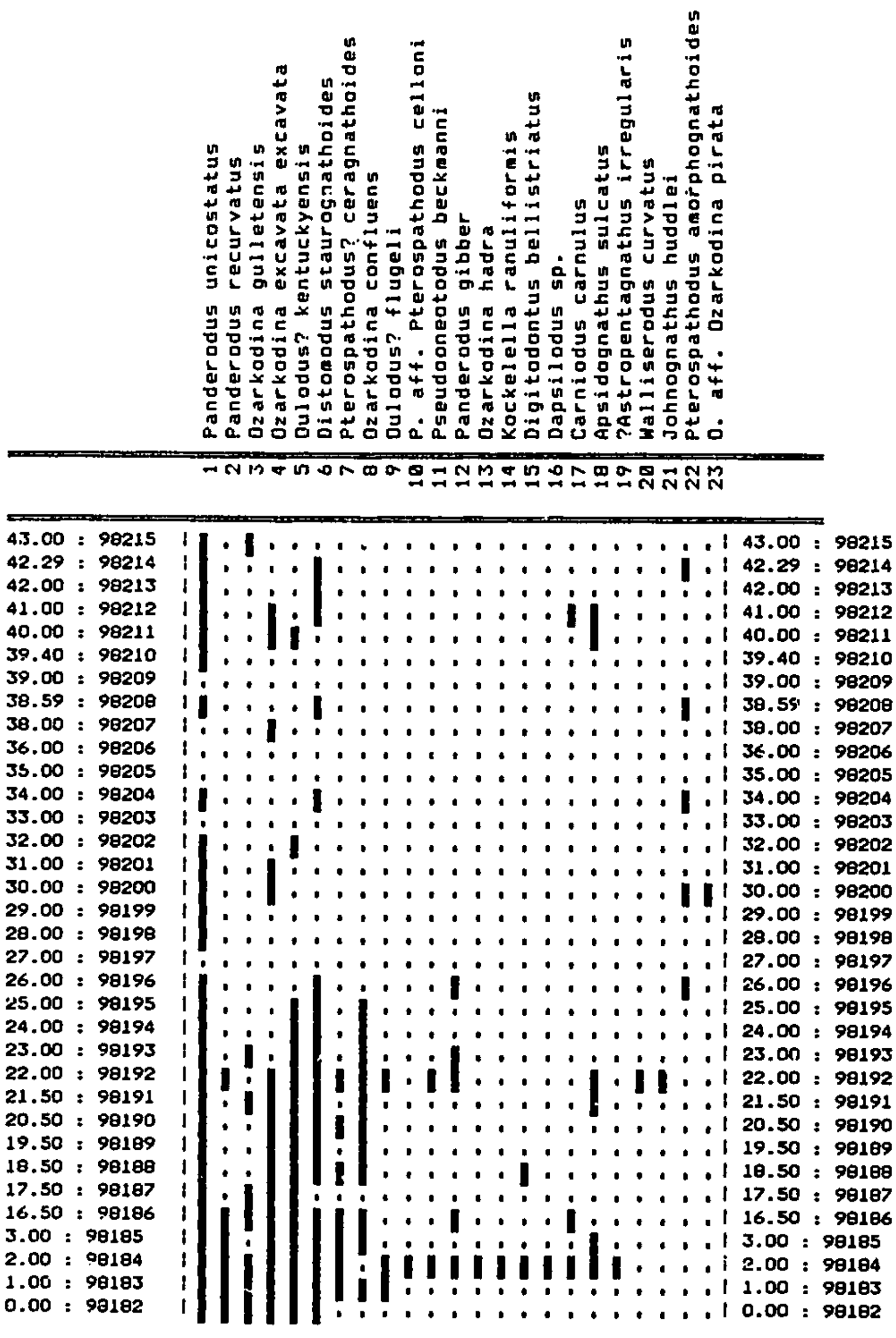

Figure 21. Conodont range chart for the Anse à Pierre-Loiselle Formation at the Railway Cut (Section V).

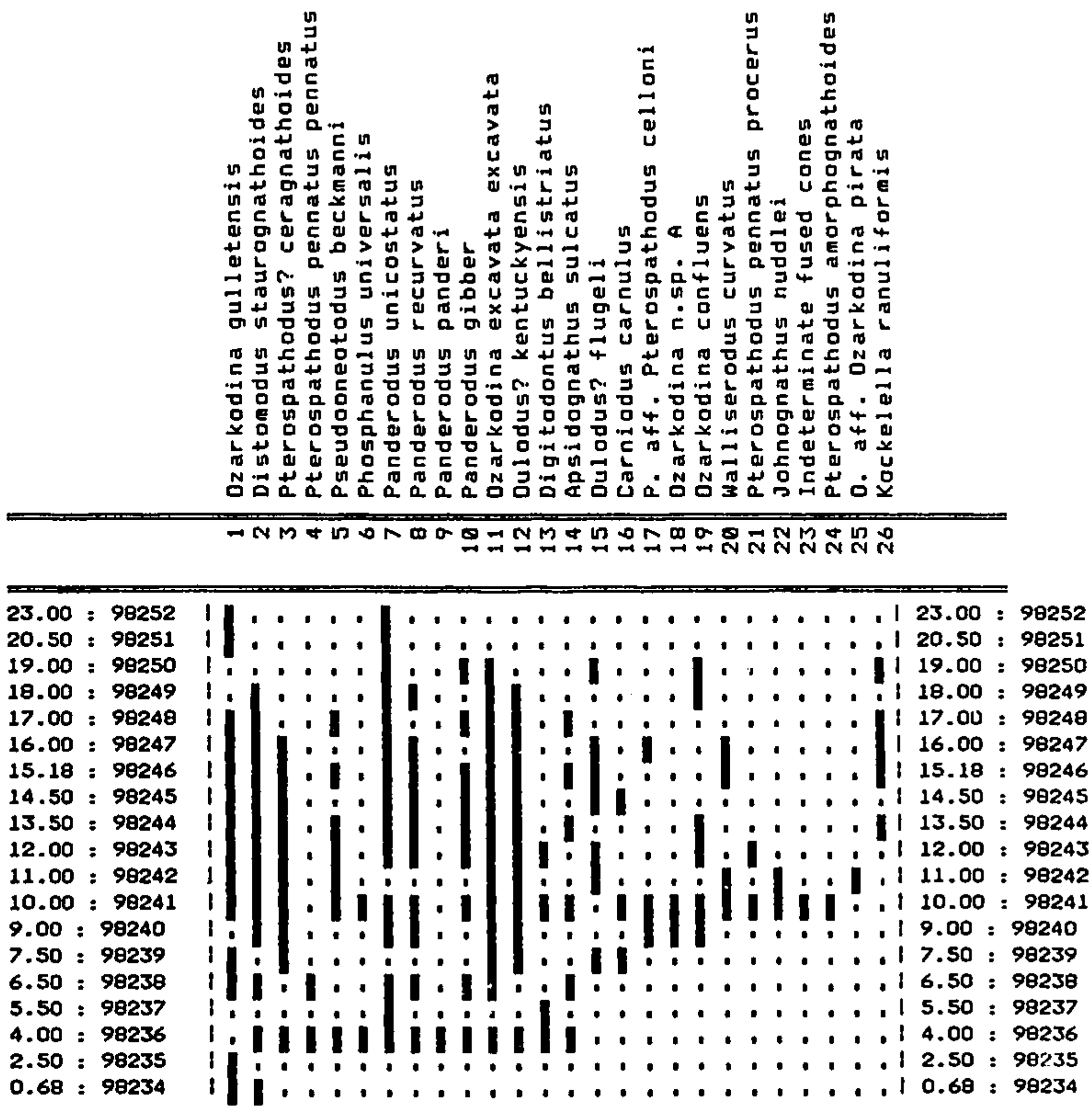

Figure 22. Conodont range chart for the Anse à Pierre-Loiselle Formation at Anse à Pierre-Loiselle (Type Section, Section VI).

4. Conodont Paleoecology and Biofacies

4.1 Introduction

Conodonts are found in most marine lithologies: platform carbonates, black euxinic shales and deep-sea radiolarian cherts. The ubiquity of conodont elements arouses interest in the possible life habit of the ancient conodont animal. Until the relatively recent discovery of preserved impressions of the soft parts of the conodont animal (Briggs et al., 1983, Janvier, 1983, Mikulic et al., 1985a, b, Aldridge et al., 1986, Smith et al. 1987), previously suggested affinities included; plants, conulariids, aschelminthes, gnathostomulids, molluscs, annelids, arthropods, tentaculates, chaetognaths and chordates. These affinities were based on morphological comparisons with elements of other fossils. Nowlan and Carlisle (1987) concluded that the conodont animal was a protochordate chaetognath similar to the modern day Amphioxus based upon similarities in muscle block arrangement.

The life mode of the organism has been the problem in establishing its biologic affinity. Life modes have been hypothesised based upon conodont element distribution relative to each other and the host rock lithologies. Clark (1972), Seddon and Sweet (1971), Druce (1973) and others suggested a pelagic model and concluded that conodontophorids occurred in depth stratified communities. They concluded that some taxa were found exclusively in deeper water environments whereas surface-dwelling taxa would settle down through the water column upon death into all environments.

Barnes and Fahraeus (1975) and Fahraeus and Barnes (1975) proposed an alternative model based on the observation that many Ordovician taxa are strongly laterally segregated, concluding that most conodontophorids had a benthic to nektobenthic life habit whereas others were pelagic.

Klapper and Barrick (1978) reviewed the distribution patterns of modern ecologic analogues which include; chaetognaths, marine isopods and foraminifera. They concluded that the patterns of conodont distribution used to substantiate different life modes could be reproduced by organisms with either planktonic, nektonic or nektobenthic life modes.

In a discussion of the paleoecology of Devonian conodonts in a reef-margin facies, Nicoll (1984) reviewed the influence of conditions such as temperature, turbidity and clastic input and energy level on the distribution of conodonts. He also pointed out that certain chemical parameters such as salinity levels and nutrient content of the water column may influence the conodontophorid animal's distribution. He also suggested that the distribution of plant and animal communities will influence the distribution of conodonts.

Conodont biofacies are defined as distinct assemblages of conodont elements formed under one set of environmental conditions, as compared with another assemblages formed at the same time under different conditions. Recognition of biofacies can be accomplished by two methods, numerical analysis and graphic depiction. Numerical analysis involves the grouping of variables such as species or samples according to their degree of similarity (R and Q-mode respectively). A matrix of coefficients is calculated measuring the degree of similarity between groups and presented in dendrogram form (McCracken and Barnes, 1981a).

Graphic depiction involves the construction of relative abundance logs based upon the relative abundance of conodont taxa. The resulting diagram illustrates changes in relative abundance of one or more groups of taxa with respect to another (see McCracken and Barnes, 1981a, Nowlan and Barnes, 1981, Nowlan et al., 1988). When a lithologic log is added to the relative abundance log, associations between relative abundance of conodonts and host lithologies may be recognized (Hitch and Nowlan, 1988).

4.2 Previous Silurian Studies

Paleoecological studies of the Llandoverian - early Wenlock are limited to a small number from North America and Britain including: Aldridge (1976), Le Févre et al. (1976), Aldridge and Mabillard (1981), McCracken and Barnes (1981a), and Barrick (1983).

Aldridge and Jeppsson (1984) summarized the ecological restrictions and established two communitites (biofacies) for each epoch of the Silurian.

During the early Llandovery - early Wenlock, high energy, nearshore environments were characterized by species of Icriodella, Oulodus, Distomodus, Ozarkodina and Panderodus (Le Févre et al., 1976,; Aldridge, 1976). In the early Llandovery, species of Distomodus become more widespread with Icriodella becoming more confined to the near-shore environment. In the lower energy, near-shore communities, Icriodella is less common with O. excavata excavata and variants of O. excavata stock become more widespread.

The offshore environments of the late Llandovery were characterized by the high abundance of coniform elements especially Dapsilodus obliquicostatus and Decoriconus fragillis (Aldridge and Jeppsson, 1984).

Barrick (1983) recognized a similar pattern in North America. He recognized a D. obliquicostatus biofacies which occupied the most off-shore quiet-water environmental conditions. He suggested that the distributional patterns are similar to those of modern-day foraminifera.

During the early Wenlock conodonts experienced a world wide drop in diversity with the disappearance of many characteristic Llandovery species with highly developed platform elements. Species of Icriodella and Distomodus are rare after the earliest Wenlock. Representatives of the genera Apsidognathus, Aulacognathus, Johnognathus and Pterospathodus are unknown from post- lower Wenlock strata.

Aldridge and Mabillard (1981) reported that for strata in the Welsh Basin, the nearshore group comprises Ozarkodina excavata, Kockelella ranuliformis, and Panderodus unicostatus, which became less abundant towards the basin.

The most offshore group comprises of P. celloni, P. amorphognathoides and Carniodus carnulus which show preference for deeper water conditions. They reported that elements of Distomodus staurognathoides showed little variation across the shelf. They also reported occurrences below and above the amorphognathoides interval and concluded that the distribution patterns within these other time intervals were similar. During the period previous to the amorphognathoides zone, O. kentuckyensis was further offshore and O. excavata extended across the shelf with little variation. Species of Icriodella were restricted to the nearshore regions. Panderodus unicostatus existed as the sole coniform apparatus inhabiting the nearshore environment. Other simple cone genera including Walliserodus and Decoriconus became more important in the offshore regions.

Nowlan (1983) speculated on the paleoecology of the Lower Silurian of eastern Canada in light of paleoecological studies of the British Silurian by Aldridge (1976) and Aldridge and Mabillard (1981). Nowlan's (1983) paleoecological assessment was strikingly similar to interpretations from Great Britain. He concluded that species of Icriodella and several species of Ozarkodina inhabited shallow water environments as Aldridge (1976) found for the British Silurian. Nowlan (1983) found that some small generalized species of Ozarkodina which include O. hassi and two new species, inhabited both offshore and nearshore environments early in the Silurian but moved to more offshore environments in the mid-Llandovery. In the Chaleurs Bay region, Nowlan (1983) observed that a fauna composed of representatives of Apsidognathus, Pterospathodus and Ozarkodina inhabited a nearshore to intermediate environment during the C_5-C_6 interval of the late Llandovery in the Chaleurs Bay region. In agreement with Barnes and Fahraeus (1975), Nowlan (1983) concluded that Panderodus probably represents a pelagic form because of its widespread distribution.

4.3 Conodont Paleoecology of the Anse à Pierre-Loiselle Formation

Paleoecological interpretations of the present collections are based on relative abundance diagrams presented for each section (Figs. 23-29). Samples with fewer than ten elements were excluded from the paleoecological study to avoid numerical percentage exaggeration (see Patterson and Fishbein, 1989). Taxa used in determining the relative abundance patterns were combined at the generic level for Ozarkodina, Oulodus?, Panderodus, Pterospathodus and Apsidognathus. The remaining taxa were combined

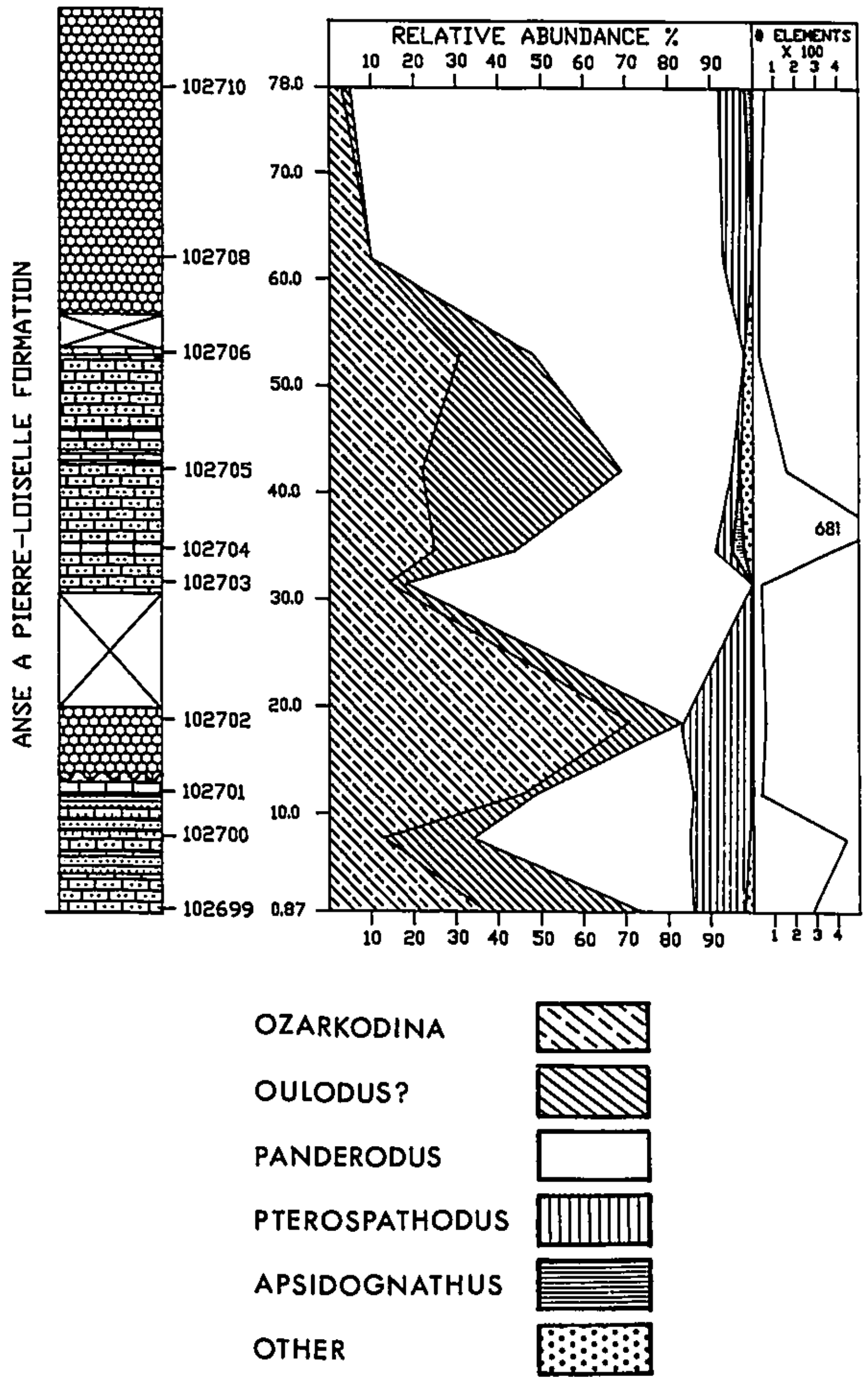

Figure 23. Relative abundance chart for the Black Cape Section of the Anse à Pierre-Loiselle Formation. Lithologic legend found in Fig. 5.

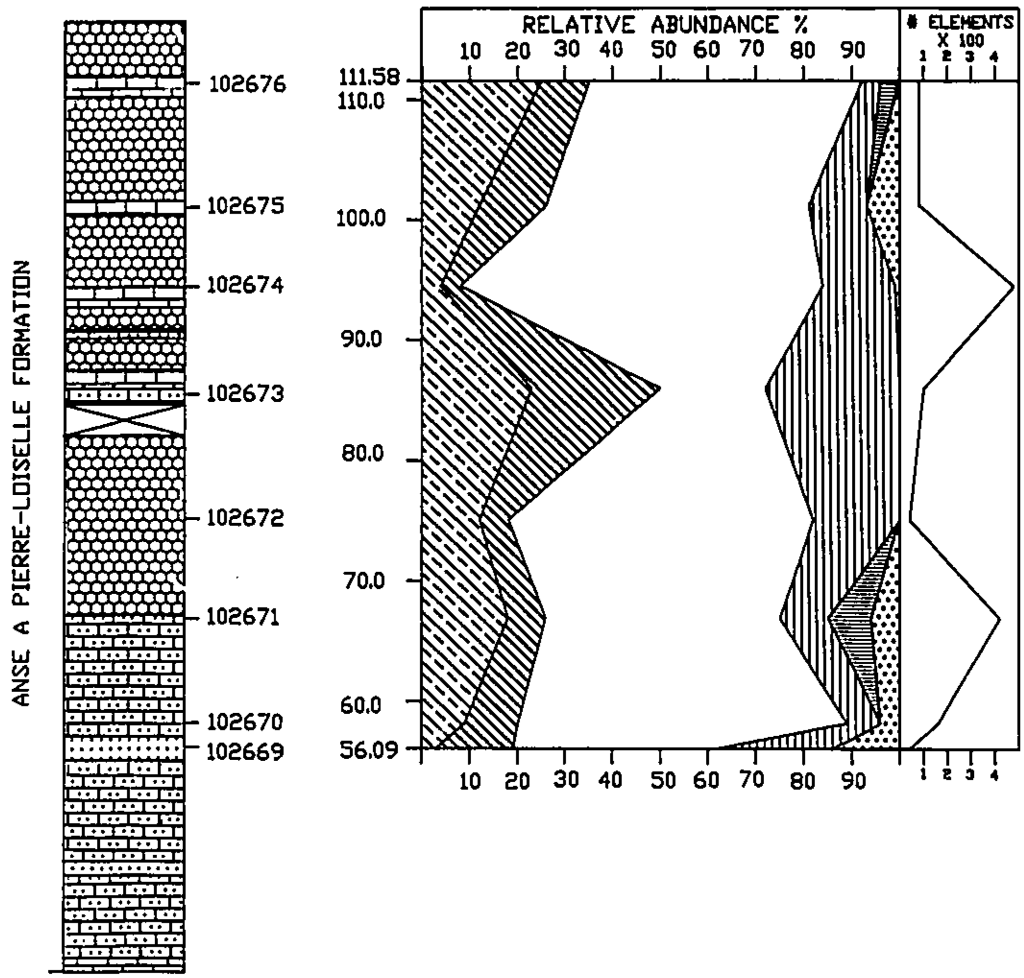

Figure 24. Relative abundance chart for the lower Bonaventure River Section of the Anse à Pierre-Loiselle Formation. Generic legend found in Fig. 23. Lithologic legend found in Fig. 5.

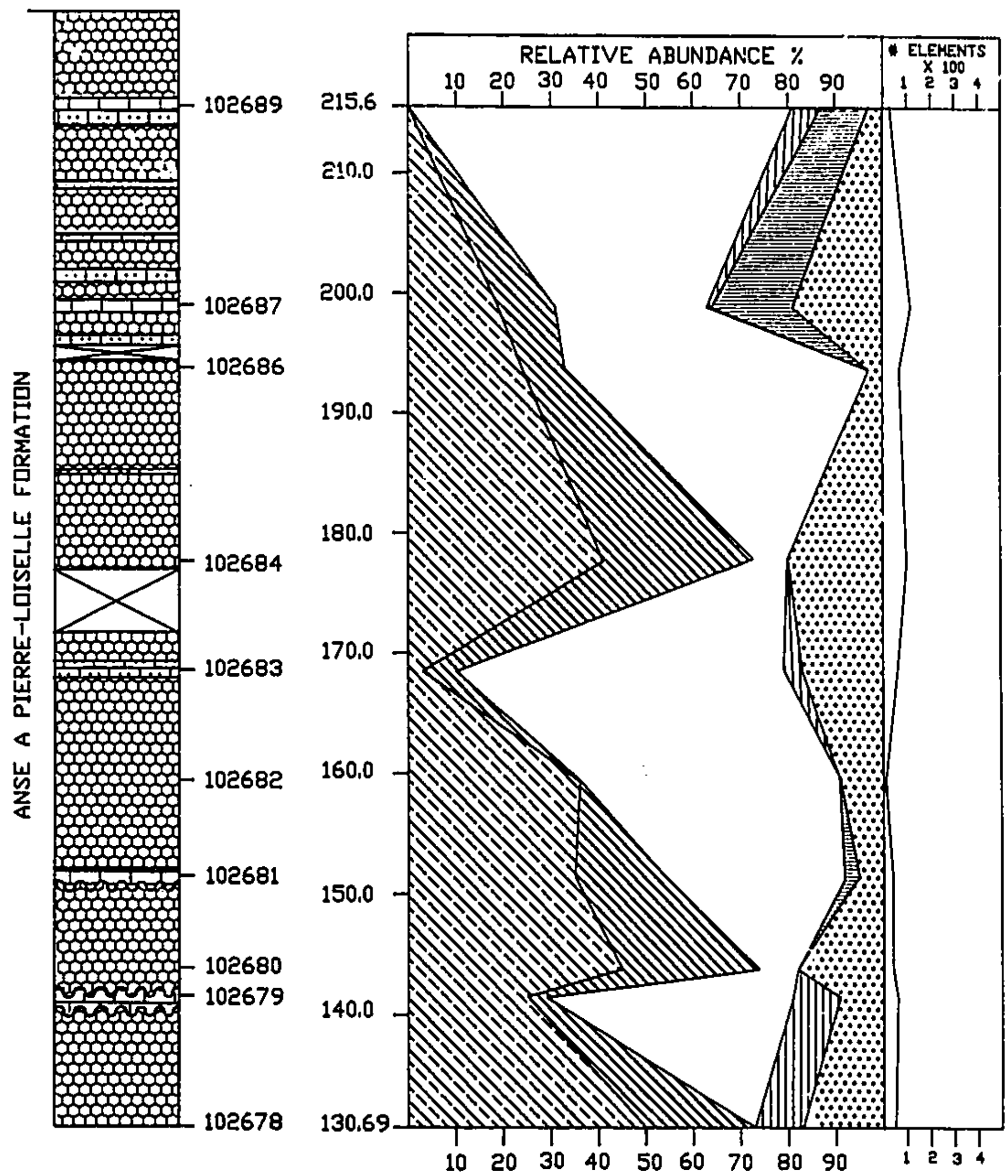

Figure 25. Relative abundance chart for the upper Bonaventure River Section of the Anse à Pierre-Loiselle Formation. Generic legend found in Fig. 23. Lithologic legend found in Fig. 5.

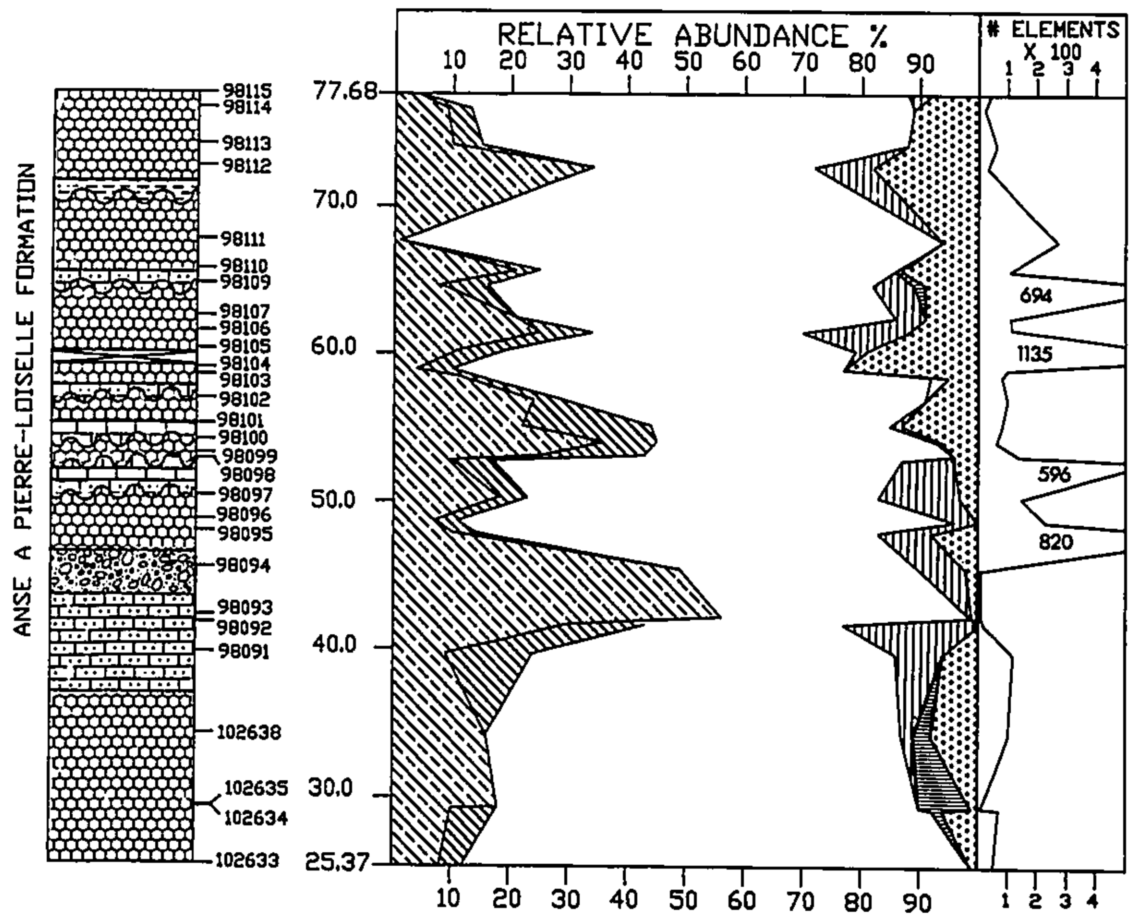

Figure 26. Relative abundance chart for the Petite Port Daniel River Section of the Anse à Pierre-Loiselle Formation. Generic legend found in Fig. 23. Lithologic legend found in Fig. 5.

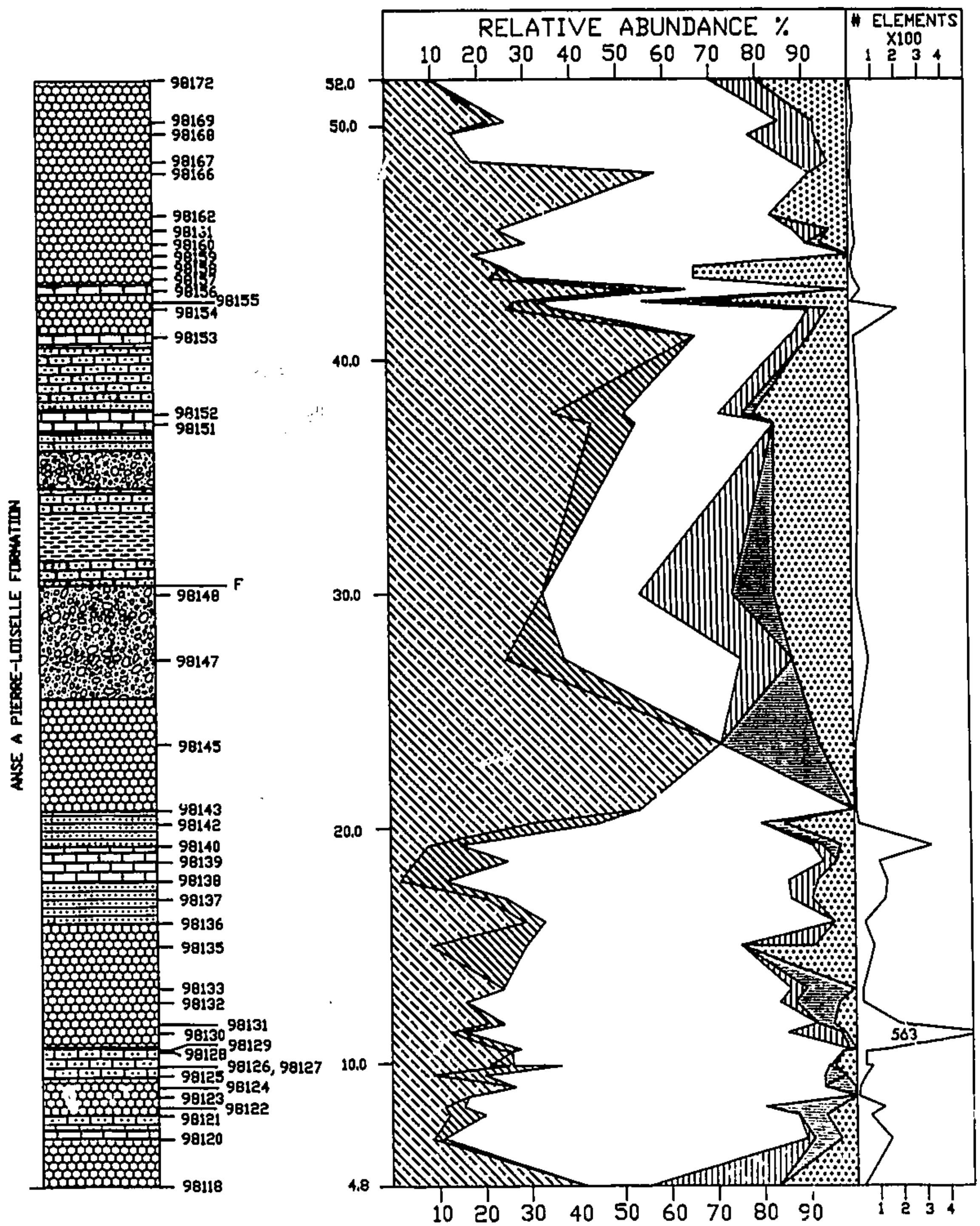

Figure 27. Relative abundance chart for the Gascons Road Cut Section of the Anse à Pierre-Loiselle Formation. Generic legend found in Fig. 23. Lithologic legend found in Fig. 5. "F" refers to fault zone.

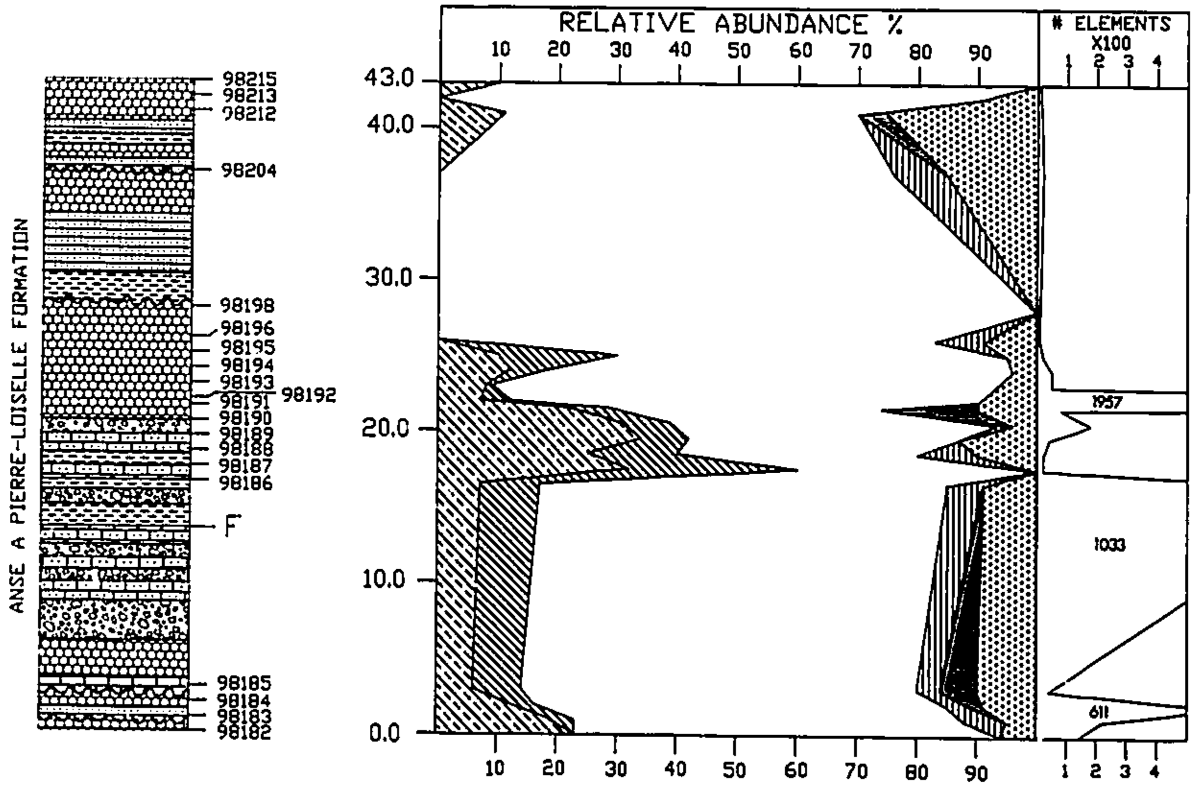

Figure 28. Relative abundance chart for the Railway Cut Section of the Anse à Pierre-Loiselle Formation. Generic legend found in Fig. 23. Lithologic legend found in Fig. 5. "F" refers to fault zone.

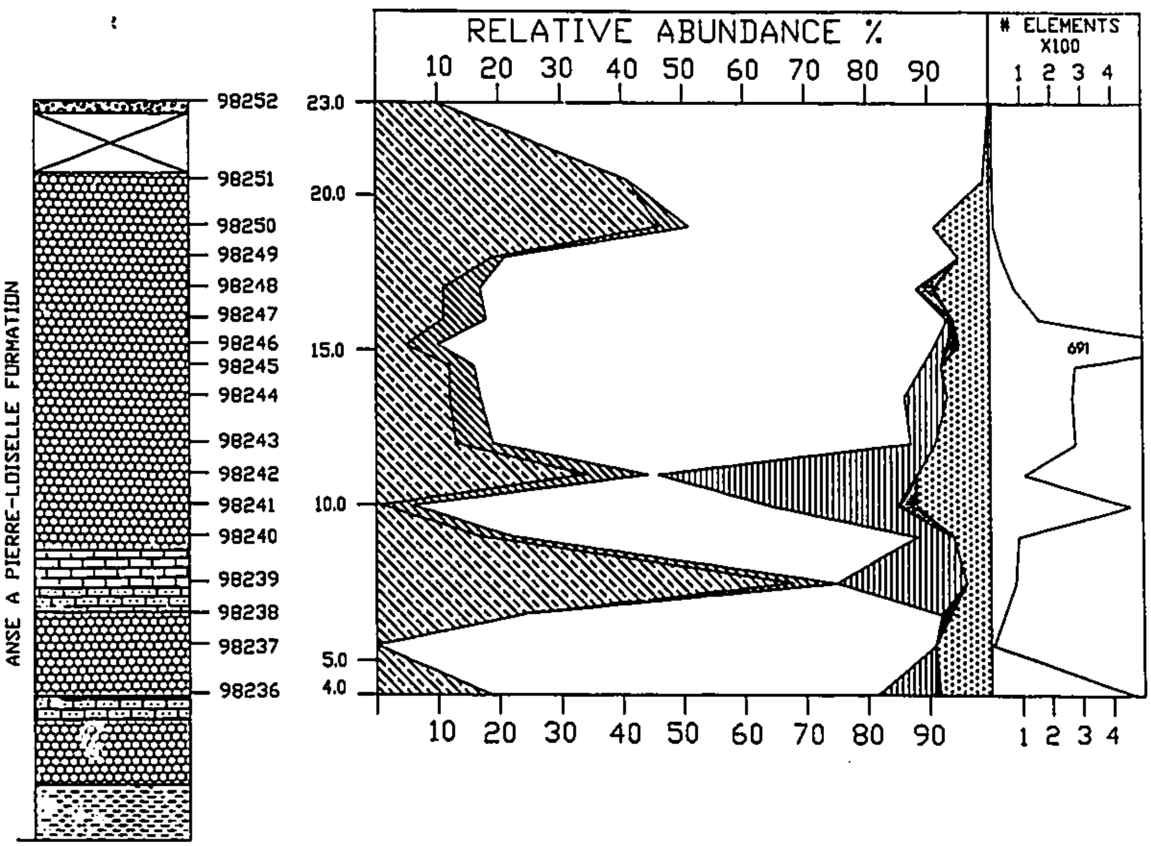

Figure 29. Relative abundance chart for the Anse à Pierre-Loiselle Type Section. Generic legend found in Fig. 23. Lithologic legend found in Fig. 5.

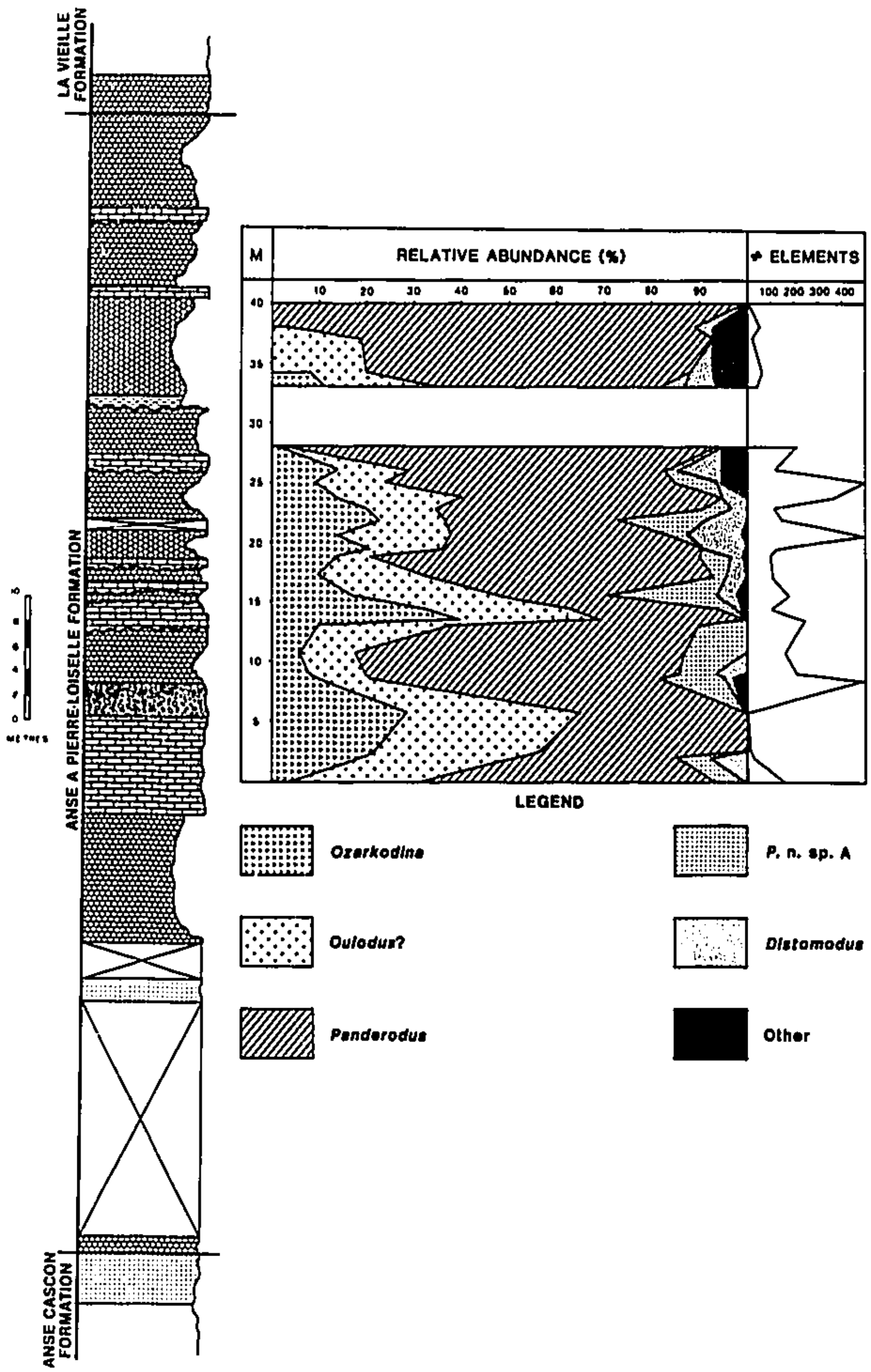

Figure 30. Relative abundance diagram of the Petite Port Daniel River Section based on preliminary samples collected in 1981 (from Nowlan and Hitch, 1989 and Hitch and Nowlan, 1988). Lithologic legend found in Fig. 5.

under the "Other" category.

Member 1 of the studied sections is characterized by a moderate abundance of all species. Samples from this interval are dominated by elements of Panderodus unicostatus and elements of Ozarkodina and Oulodus?. Species of Apsidognathus and Pterospathodus make up a small percentage of the fauna of Member 1. Ozarkodina and Oulodus? follow strikingly parallel patterns of distribution regardless of absolute abundance. At the top of Member 1 a relative abundance peak of Ozarkodina and Oulodus? occurs just below the conglomeratic Member 2 in two of the study sections (Figs. 26, 27).

Member 2 is characterized by a generally low abundance of all taxa which is interpreted to be due to the highly clastic nature of this interval. Species of Ozarkodina and to a lesser extent Oulodus? are the dominant species of this interval. Elements of Panderodus are less abundant to absent through this interval. Species of Pterospathodus and Apsidognathus remain a minor part of the fauna through this interval except in the Gascons Road Cut section (Fig. 27).

The absolute abundance of taxa in Member 3 decreases towards the top of the formation. This interval is characterized by the dominance of Panderodus, Pterospathodus and elements assigned to the "Other" category at the expense of species of Ozarkodina and Oulodus?.

4.3.1 Interpretation

Based upon previous conodont environment interpretations of Aldridge (1976), Le Févre et al. (1976), Aldridge and Mabillard (1981), McCracken and

Barnes (1981a), Barrick (1983), Nowlan (1983) and Aldridge and Jeppsson (1984) the paleoecology of the conodont fauna of the Anse à Pierre-Loiselle Formation is indicative of an intermediate water depth. The collection from the present study is numerically dominated by species of Panderodus with species of Apsidognathus, Ozarkodina, Oulodus? which are characteristically nearshore but not shallow. The extreme scarcity of P. amorphognathoides and C. carnulus, which are deeper water taxa and the absence of Icriodella (shallow), Decoriconus (deep) and true Dapsilodus (deep) confirms this interpretation.

Apparent changes in water depth can be interpreted from the distribution and relative abundance of conodont elements with respect to sample lithology.

Elements of Panderodus are abundant throughout the studied formation with a drop in abundance within Member 2. Previous workers (Barnes and Fahraeus, 1975 among others) have suggested that Panderodus occupied a variety of environments and was distributed over the entire shelf and represents a pelagic form. The drop in abundance of Panderodus through the Member 2 interval was probably due to the inability of the organism to cope with the highly clastic conditions in which the conglomerate and sandstone were deposited. The current study substantiates the idea of a pelagic life habit.

Species of Ozarkodina and Oulodus? are quite abundant in this formation. Previous authors (Aldridge and Mabillard, 1981 among others) have suggested that Ozarkodina species inhabited a nearshore environment and had a wide distribution over the shelf. Different species may well have occupied a wide variety of ecological settings. Oulodus? has also been previously interpreted as having a wide distribution over the shelf. Although less abundant, distribution patterns of species of Oulodus? parallel the relative abundance of Ozarkodina throughout the formation. The abundance peak at or just below Member 2 in four of the six study sections (Sections 3-6) suggests that, during the shallowing event which initiated the deposition of Member 2, species of Ozarkodina and Oulodus found favourable environmental conditions and dominated the fauna. Because of the parallel distribution patterns and varied environments inhabited, it is suggested that these genera were probably nektonic to nektobenthic with a possible preference for shallow water conditions and that the organisms represented by these taxa were not mutually competitive.

Species included under the name Pterospathodus include: P. aff. P. celloni, P. amorphognathoides, P. pennatus procerus, P. p. pennatus and P.? ceragnathoides n.sp. All the pterospathodan species mentioned above, with the exception of the new species, have been interpreted to represent offshore, deep water conditions. Members of the genus occur throughout the formation with relative abundance peaks in Member 1 and Member 3, intervals which lithologically suggest relatively deeper water deposition. The paleoenvironmental significance of P.? ceragnathoides n.sp. is masked by the other species of Pterospathodus. Previously, Hitch and Nowlan (1988) pointed out that, when differentiated out of the generic grouping, P.? ceragnathoides n.sp. (P. n.sp. A) showed high relative abundance peaks coincident with low relative abundances of species of Ozarkodina and Oulodus? (Fig. 30). P.? ceragnathoides n.sp. possibly inhabited a shallower position on the shelf than other species of Pterospathodus, which are rare in the collections. A relative abundance peak occurs in Member 2 of the Gascons

Road-Cut section (Fig. 27) illustrating two points: P.? ceragnathoides n.sp. is the dominant pterospathodan and this species locally inhabited shallow water environments.

Apsidognathus sulcatus n.sp. is the only representative of the genus recovered from the study collection and comprises less than 10 per cent of the total recovered taxa. Nowlan (1983) suggested that Apsidognathus tuberculatus (= A. sulcatus n.sp.) inhabited a nearshore but not shallowest environment. Occurrences of A. sulcatus n.sp. are roughly parallel to occurrences Pterospathodus. Similarily, A. sulcatus n.sp. appears to have preferred shallower conditions but is also found in deeper environments. Because of the varied occurrences, it is suggested that A. sulcatus n.sp. represents a nektonic or nektobenthic form.

Genera assigned to the "Other" category include: Aulacognathus (shallow), Carniodus (deep), Digitodontus (pelagic), Distomodus (intermediate), Kockelella (shallow), and Walliserodus (intermediate).

4.4 Conodont Provincialism in the Silurian

Throughout the geological history of conodonts, it has been recognized that similar environments can have very different faunas in geographically separate areas during certain time periods. These areas are defined as provinces, each with a characteristic fauna. Lindstrom (1976, p. 6) defined a province as "a major area that is demarked by such strong barriers that few, if any, organisms are able to migrate across it". Provinces, therefore, are geographic entities whose boundaries can shift through geologic time.

The boundaries to these provinces are environmental or geographic barriers which consist of physico-chemical parameters restricting the immigration and/or emigration of certain species. Within a province, some communities exist in which a distinct lateral distribution occurs from a near-shore environment to a more offshore environment, as illustrated by the Midcontinent and North Atlantic Provinces of the Middle to Late Ordovician (Barnes and Fahraeus, 1975).

Provincialism during the Early Silurian (Llandovery-early Wenlock) is relatively poorly known due to the bias in sampling from mostly paleo-equatorial regions. Carpentier (1984) reported that a mostly cosmopolitan fauna existed during the Early to Late Silurian based on a statistical analysis of reported conodont occurrences.

Over and Chatterton (1987b) reported a similarity between their fauna from the Mackenzie Mountains of western Canada and one Savage (1985) reported from southeastern Alaska both of which are believed to have been endemic to the western or northwestern portion of Laurentia. They also noted a similarity with collections from the Canadian Arctic (Mirza 1976), Greenland, (Aldridge, 1979) and California (Miller, 1978). These widespread occurrences were believed to represent the migration of conodonts along northern and western Laurentia.

4.4.1 Provincialism in the Anse à Pierre-Loiselle Formation

Collections from the Anse à Pierre-Loiselle differ from similar collections from elsewhere in North America and Europe in both faunal composition and character of individual elements. The collections from the Anse à Pierre-Loiselle are characterized by the scarcity of elements of Pterospathodus amorphognathoides and P. celloni with an abundance of platform-bearing taxa and an overall heavy, overgrown fauna.

Uyeno in Uyeno and Barnes (1983) illustrated a fauna that is similar to those collections of the Welsh Borderland (Aldridge, 1976 among others) and Scandinavia (Aldridge, 1979). The faunas recovered from these localities contain several representative species of Pterospathodus, with Carniodus which from the present study are relatively rare. The overall character of their recovered fauna is that of fine, denticulate elements which are unlike taxa from the present study. Collections from the U.S. (Barrick and Klapper, 1976, Cooper, 1976, and others) also differ in containing abundant icriodellids and ramiform bearing taxa.

Mannik (1983) reported collections from Severnaya Zemlya in the Soviet Union. His collections are the most similar to those of the present study. Lithologically, the Srednii Formation is similar to the Anse à Pierre-Loiselle Formation. The unit is a highly clastic mudstone with abundant nodules and stromatoporoids. Mannik's (1983) collections are similar in that they contain a new species of Apsidognathus (Apsidognathus sp. B s.f.,ibid., p. 116, fig. 5Y) and elements identical to Pterospathodus? ceragnathoides n.sp of the present study. He also reported the conspicuous lack of elements of Pterospathodus amorphognathoides and P. celloni which are widespread in Europe, Asia, and North America.

The close similarity with faunas recovered from the Soviet Union and the differences between the present study material and those collections from the cratonic U.S., Welsh Borderland and Scandinavia suggest that a migratory pathway existed between the southern Gaspé (eastern Laurentia) and the northwest of the Soviet Union (northwestern Baltica) and that some indications of provincialism in the late Llandovery can be found in the Anse à Pierre-Loiselle Formation.

5. SYSTEMATIC PALEONTOLOGY

Multielement taxonomic analysis was performed on the recovered elements following principles outlined by Bergstrom and Sweet (1966), Jeppsson (1969, 1971, 1972), Sweet (1970), Klapper and Philip (1971), Sweet and Bergstrom (1972) and Fahraeus and Hunter (1985). Conodont element position within the multielement apparatus is noted by terminology outlined in Barnes et al. (1979). Figure 31, is a comparison between published schemes of elemental notation.

Overall, the study collection is poorly preserved due to the highly clastic nature of the Anse à Pierre-Loiselle Formation. Elements recovered from study sections 1 and 2 exhibit better preservation than those from sections 3 - 6 which are commonly fragments.

Conodonts from this study have been subjected to burial metamorphic alteration as outlined by Epstein et al. (1977). Elements recovered from sections 1 and 2 have a higher Colour Alteration Index (CAI) of 3 than elements from sections 3 - 6 (1.5) which have been subject to lesser metamorphic alteration.

Repository of type and figured specimens is at the Institute of Sedimentary and Petroleum Geology, Calgary, Alberta, Canada.

Klapper & Phillip (1971)	Jeppsson (1971)	Sweet et al. (1975)	Sweet & Schonlaub (1975)	Barnes et al. (1979)
P	sp	P	Pb	g
O_1	oz	O_1	Pa	f
N	ne	N	M	e
A_1	hi	A_1	Sc	a
A_2	pl	A_2	Sb	b
A_3	tr	A_3	Sa	c

Figure 31. Comparison of accepted notation schemes for six member conodont apparatuses (after Barnes et al. 1979).

Phylum CONODONTA Pander, 1856

Class CONODONTATA Pander, 1856

Order CONODONTOPHORIDA Eichenberg, 1930

5.1 Genus Apsidognathus Walliser, 1964

Type species: A. tuberculatus Walliser, 1964.

REMARKS

The first reconstruction of an Apsidognathus- like apparatus was made by Aldridge (1974) for A. walmsleyi in which he included a platform and a pygodiform (=lyriform element of Mabillard and Aldridge, 1983) element exhibiting bilateral symmetry. Aldridge (1974) suggested that it also may contain an ambalodiform element similar to Ambalodus galerus Walliser s.f. Further additions to the apparatus were made by plan Mabillard and Aldridge (1983) and Uyeno and Barnes (1981, 1983) who added a modified ambalodiform element to their species of Apsidognathus. This element (Pygodus lenticularis Walliser s.f. in A. tuberculatus) , occupied the Pa2 (= g-2) position within the reconstruction of Uyeno and Barnes (1981, 1983). These authors did not include an ambalodiform element, such as A. galerus s.f, in their reconstruction but a cruciform Pb element Astrognathus tetractis s.f. Savage (1985) included all five elements in his reconstruction of A. tuberculatus.

In the following reconstruction of a new species of the genus Apsidognathus, it is believed that the apparatus consists of at least five elements. Specific positions within the apparatus are difficult to interpret as it appears that the apparatus plan is composed entirely of platform elements. Tentative positions for each element are as follows; a 'ramiform' element which is modified tetractiform, an e element which is pygodiform, an f element which is ambalodiform, a g-2 element which is modified ambalodiform and a g-1 element which is a highly modified amorphognathiform.

Apsidognathus sulcatus n.sp.

Plate 1, figures 1-21, Plate 2, figures 1-3

Multielement

?Apsidognathus tuberculatus Walliser. HELFRICH, 1980, Pl. 1, figs. 25, 29.

Apsidognathus tuberculatus Walliser. NOWLAN, 1981, Pl. 7, figs. 7, 12-14,17; NOWLAN, 1983, Fig. 4(A,B).

Apsidognathus sp. B MANNIK, 1983, p. 114, fig. 54.

DIAGNOSIS

A new species of Apsidognathus consisting of at least five elements. Each element has a deeply excavated basal cavity. The following tentative elemental position assignments are made; 'ramiform' element is modified tetractiform, e element is pygodiform, f element is ambalodiform, g-2 is modified ambalodiform and the g-1 element is highly modified amorphognathiform.

DESCRIPTION

The 'ramiform' element is cruciform and assymmetrical in gross appearance with two well developed processes, one highly reduced process, and a blade. Each of the two processes are equal in length, width and height, and diverge from a central point on the blade. The basal cavity is located under the blade and extends slightly under the lateral processes. The entire element appears to be completely excavated (Pl. 2, fig. 1.). Denticulation exists as sharp nodes. No cusp is present on this element.

The e element is pygodiform and bilaterally subsymmetrical. A short, narrow anterior process bears up to five nodose transverse ridges similar to the anterior blade of the 'ramiform' elements. The anterior process bisects two lateral ridges that are similarly nodose at their margins. The oral surface is extremely smooth with a short, narrow posterior carina that originates near the centre of the oral surface and extends beyond the margin of the element to form a pointed projection. The basal cavity is of moderate depth with the deepest point lying below the midlength of the element and extending under the posterior process. It is wide posteriorly, narrowing beneath the anterior process (Pl. 1, fig. 2).

The f element is ambalodiform consisting of a slightly inwardly flexed blade with a high main cusp and subequal denticulate anterior and posterior processes. Ornamentation on the main blade consists of low, subrounded denticles that are fused for most of their length. The basal outline is elliptical and the basal margin is flared. Some specimens exhibit a thickened and locally tuberculate basal edge (Pl. 1, figs. 10, 11).

The g-2 element is an orally compressed, modified ambalodiform element with an overall triangular outline. The oral surface is ornamented with ridges of tubercles arranged in a faint radiating pattern diverging from a point at the anterior end of the element. The areas between the ridges have a few less defined tubercles. The aboral surface is deeply excavated and triangular. The apex of the triangle forms the anterior point of the element; the posterior margin is straight to slightly concave posteriorly. The posterior face of the element is smooth and concave with a crest of nodose denticles along the postero- oral margin.

The g-1 element is highly modified amorphognathiform consisting of a broad, rounded platform and a free anterior blade. The outline of the element varies from well rounded to leaf-like. The oral surface bears randomly oriented tubercles with faint rows originating from a central point on the element and extending to the platform margin. The anterior process is denticulate and arched and continues onto the platform as a row of tubercles that coalesce to form a central nodose ridge. Smooth sulci extend from the anterior end, on either side of the blade, to the posterior edge along the sides of the main ridge. Some elements have subequal sulci (Pl. 1, fig. 2) whereas others show unequal dextral or sinistral development (e.g. Pl. 1, fig. 4) of a single sulcus. The aboral surface is deeply excavated for the entire undersurface of the element, and faint concentric growth rings are visible on some specimens (Pl. 1, fig. 5).

REMARKS

The 'ramiform' element (tetractiform) (Pl. 2, figs. 1-3) is unlike *Astrognathus tetractis* Walliser s.f. (Walliser, 1964, Pl. 14, figs. 1, 2) as only two fully developed and one highly reduced lateral processes exist in material from the Anse à Pierre-Loiselle Formation. In addition, the basal cavities are somewhat smaller than those on the specimens illustrated by Walliser. Uyeno and Barnes (1983, Pl. 6, fig. 9) illustrated a similar tetractiform (= cruciform) element as representing "an aberrant form with an abbreviated anterior part of the blade". I suggest that this form is natural and represents the new species *A. sulcatus*.

The pygodiform e element (Pl. 1, figs. 18-21) is unlike Walliser's (1964 Pl. 12, figs. 8-14) as the basal cavity is not as extensive and deeply excavated. The lateral processes lack the fine ornamentation described by Walliser (1964) but rather reduced as described by Aldridge (1974) for the pygodiform element of A. walmsleyi. Uyeno and Barnes (1981, Pl. 1, fig. 15; 1983, Pl. 6, fig. 11) illustrated a pygodiform element in which the oral surface is highly overgrown with a high degree of ornamentation. The e element is identical to those illustrated by Nowlan (1981, Pl. VII, figs. 14, 17) bearing broad, flat lying, and smooth lateral processes that exhibit reduced ornamentation. The element illustrated by Nowlan (1983, Fig. 4B) from the Limestone Point Formation of New Brunswick, has lateral processes that terminate posteriorly in a blunt, squarish manner. This may represent variation in the e element.

The ambalodiform f element is similar to A. galerus Walliser s.f. but with a more highly developed collection of fine tubercles on the basal margin. The denticulation pattern is identical to those illustrated by Nowlan (1983, Fig 3, H) with low subdued, and subrounded denticles (see Pl. 1, fig. 9). This denticulation differs from that of Walliser (1964, Pl. 12, figs. 1-7) as he illustrates a distinct, sharp main cusp which is absent from f elements of this collection.

The highly modified g-2 element is similar to those illustrated by Uyeno and Barnes (1981, Pl. 1, fig. 15; 1983, Pl. 6, fig. 11) but has fine, randomly oriented, ornamentation on the oral surface. The g-2 elements of this collection have significantly less ornamentation that forms ridge-like features. Walliser (1964, Pl. 12, fig. 15) illustrated ?Pygodus lenticularis which differs from the g-2 element in overall outline and style of surficial tubercle pattern.

The g-1 element is most characteristic of this species. The element is highly modified amorphognathiform. Mannik (1983, Fig. 5Y) illustrated what he believed to be a new species of Apsidognathus based on the well rounded outline of the oral view and the occurrence of one prominent ridge of denticles (tubercles) which has a smooth sulcus to one side of the ridge. Figure 32, illustrates the variation of g-1 elements in oral view. I concur with Mannik in his recognition of the variant of A. tuberculatus as a new species. Helfrich (1980) also recognized the occurrence of the ridge and groove relationship and suspected a new species.

MATERIAL STUDIED

15 'ramiform, 18 e, 80 f, 77 g-2 153 g-1

DERIVATION OF NAME

From the Latin sulcatum (=furrow) describing the furrow or groove located on the inner side of the central carina of the palmate platform element.

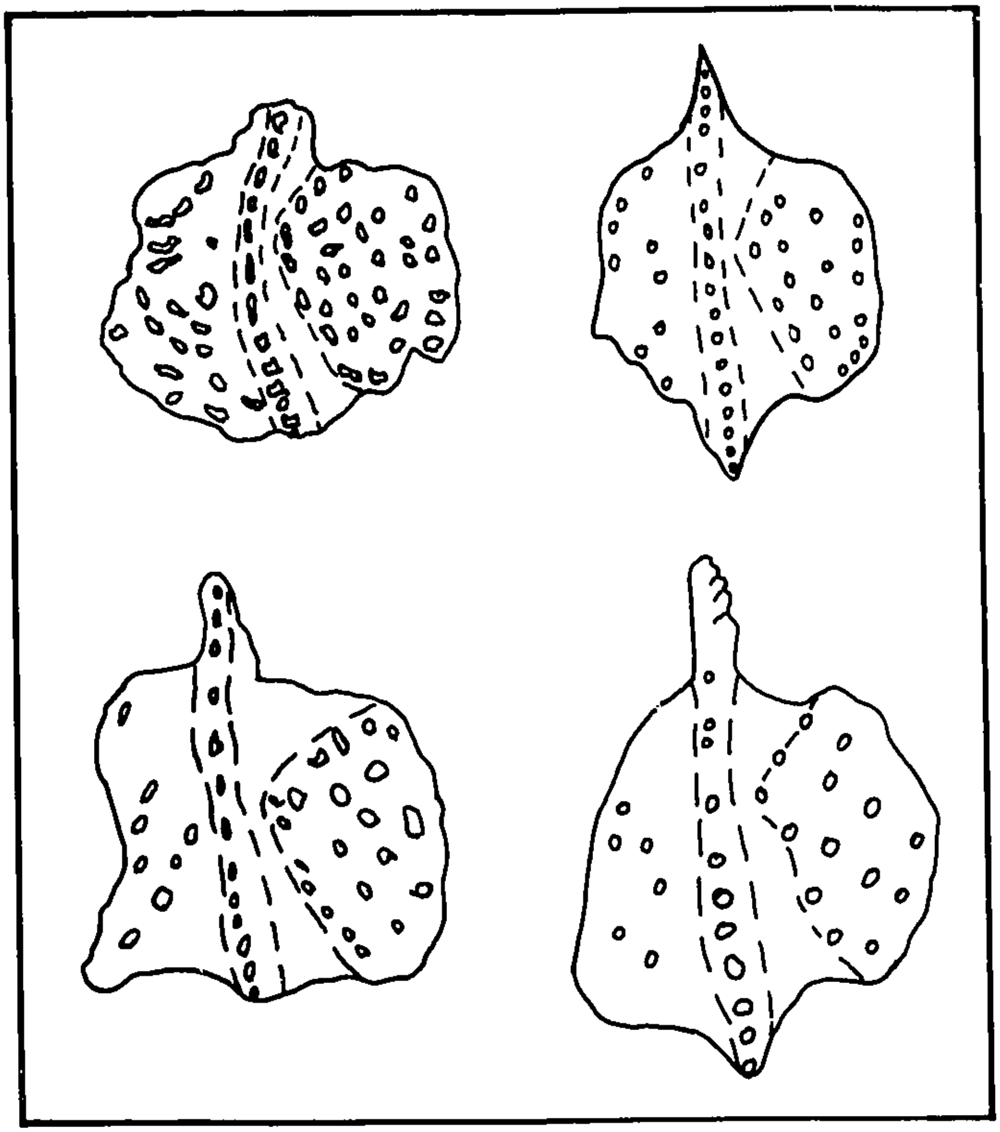

Figure 32. Range of morphologic variation exhibited by recovered specimens of Apsidognathus sulcatus n.sp. Not to scale.

5.2 Genus Astropentagnathus Mostler, 1967

Type species: A. irregularis Mostler, 1967.

?Astropentagnathus irregularis Mostler

Plate 2, Figures 4, 5

?Astropentagnathus irregularis MOSTLER, 1967, p. 298-300, Pl. 1, figs 1-11.

REMARKS

Only a single fragment of a g element was found. This fragment consists of a part of two of the characteristic lateral processes. The processes bear short, subrounded nodes of approximately equal size. The remaining basal cavity is deeply excavated and extends the full length of the lateral processes.

MATERIAL STUDIED

1 g

5.3 Genus Aulacognathus Mostler, 1967

Type species: A. kuehni Mostler, 1967.

Aulacognathus bullatus (Nicoll and Rexroad)

Plate 2, figures 6, 7

q element

Neospathognathodus bullatus NICOLL and REXROAD, 1969, pp. 44, 45, Pl. 1, figs. 5-7.

Multielement

Aulacognathus bullatus (Nicoll and Rexroad). UYENO in UYENO and BARNES, 1983, p. 15, Pl. 4, figs. 18, 20-22, (includes synonymy to 1981); NOWLAN, 1983, p. 104, fig. 4 (E, O, P); JEPPSSON, 1983, p. 122; CRAIG et al., 1986, Pl 2. figs. 20, 21; OVER and CHATTERTON, 1987b, p. 39, Pl. 3, figs. 1, 6.

Neospathodus latus Nicoll and Rexroad. PICKETT, 1978, p. 35, Pl. 1, fig. 31 (q element only).

REMARKS

The q element of this apparatus is rare and is the only element assignable to this taxon in the collection from the Anse à Pierre-Loiselle Formation. This element has been sufficiently described in the literature with emphasis on the wide degree of variability in form. Hence, no additional comments can be made.

MATERIAL STUDIED

2 g

5.4 Genus Carniodus Walliser, 1964

Type species: C. carnulus Walliser, 1964.

REMARKS

The multielement interpretation of Carniodus was established in detail by Barrick and Klapper (1976) to include six elements reconstructed in a plan similar to that of the Ordovician Prioniodus. These elements occupy the a, b, c, e, f and g positions of the apparatus. The a element is subcarniform, b is carniform, c is latialatiform, e is carniform, f is carnuliform and g is carinthiaciform.

Carniodus carnulus Walliser

Plate 2, figures 8-21

a element

Neoprioniodus subcarnus WALLISER, 1964, p. 51-52, Pl. 5, fig. 7, Pl. 28, figs. 12-18.

b element

Carniodus carnus WALLISER, 1964, p. 34, Pl. 5, fig. 3, Pl. 10, fig. 13, Pl. 28, figs 2-7, text-fig. 4(y-z).

c element

Roundya latialata WALLISER, 1964, p. 71, Pl. 6 fig. 15, Pl. 31, figs. 11-14.

e element

Carniodus carnicus WALLISER, 1964, p. 32, Pl. 6, fig. 11, Pl. 28, figs. 8-11.

f element

?Carniodus carthiniacus WALLISER, 1964, p. 31-32, Pl. 6, fig. 8, Pl. 27, figs. 20-26, text-fig. 4(n).

g element

Carniodus carnulus WALLISER, 1964, p. 32-33, Pl. 6, fig. 10, Pl. 10, fig. 20, 21, Pl. 27, figs 27-38, Pl. 28, fig. 1, text-fig. 4(a-f).

Multielement

Conodonten-Apparat D WALLISER, 1964, p. 17.

Carniodus carnulus Walliser. WALLISER, 1972, p. 76-77; ALDRIDGE, 1975, Pl. 1, figs. 3, 4, 8, 9; BARRICK and KLAPPER, 1976, p. 68-69, Pl. 1, figs. 1, 2, 6-8; ALDRIDGE and MOHAMED, 1982, Pl. 2, figs. 17-24; MABILLARD and ALDRIDGE, 1983, Pl. 2, figs. 13, 14; UYENO in UYENO and BARNES, 1983, p. 16, Pl. 5, figs 1-10 (includes synonymy to 1981); ALDRIDGE, 1985, p. 83, Pl. 3.2 figs. 10-18; MABILLARD and ALDRIDGE, 1985, text-fig. 7c; NEHRING-LEFELD, 1985, Pl. 2, figs. 1-10; SAVAGE, 1985, p. 714, figs. 2 A-N; STOUGE and BAGNOLI-STOUGE, 1985, p. 105, figs. 11-19; BISCHOFF, 1986, p. 278-281, Pl. 5, figs. 18-34; Pl. 6, figs. 1-37; CRAIG et al., 1986, Pl. 2, fig. 3; NAKREM, 1986, p. 127, Pl. 6, fig. 1; KLEFFNER, 1987, p. 86, figs. 1-7.

?Carniodus sp. ALDRIDGE, 1979, Pl. 1, fig. 8.

REMARKS

Reconstruction of the apparatus of C. carnulus is identical to that of Barrick and Klapper (1976). A distinct variation occurs within elements assigned to the f position of the apparatus. The development of the characteristic carniodan thickening just above the base of the unit is consistent with all elements of C. carnulus of this study as well as with those described in the literature. However, elements assigned to the f position display an exaggerated carniodan thickening unlike any other element in the comparable position of the apparatus. In addition, the g element is considerably shorter in length, and has fewer, but larger and possibly more extensively laterally compressed, denticles than the element illustrated by Barrick and Klapper (1976, Pl. 1, fig. 6). This thickening is common to many elements from this study.

MATERIAL STUDIED

10 a, 9 b, 4 c, 9 e, 6 f, 15 g

5.5 Genus Dapsilodus Cooper, 1976

Type species: Distacodus obliquicostatus Branson and Mehl, 1933.

Dapsilodus? sp.

Plate 2, figures 22, 23, 26, 27

DESCRIPTION

Elements that are questionably assigned to the genus Dapsilodus consist of gently recurved, laterally compressed simple cones. Striations extend from the basal margin to the apex. There is a distinct keel along the anterior margin of the elements and the posterior edge of the cusp extends as an outer postero- lateral costa onto the base. The basal cavity is triangular and extends one third of the element height. Only one elemental position is speculated, that being the a element illustrated.

REMARKS

Elements of this form have not been previously described from the Silurian. They have been questionably assigned to the genus Dapsilodus due to the extensive longitudinal striations and to the nature of the base. The keel arrangement is similar to that of D. obliquicostatus but the costa does not follow the posterior margin of the element. Elements of Dapsilodus? sp. are less laterally compressed than specimens of D. obliquicostatus, which is highly compressed laterally. Elements assigned to this taxon may represent a new genus. However, due to the lack of material a formal generic and specific assignment cannot be responsibly made. They are most similar in general morphology to Ordovician elements assigned to *Paroistodus*? sp. A by Nowlan et al. (1988).

MATERIAL STUDIED

8 *a*

5.6 Genus Digitodontus n.gen

Type Species: Digitodontus bellistriatus n.sp.

DIAGNOSIS

The new genus includes elements that exhibit a trimembrate apparatus of antero- posteriorly compressed and posteriorly reclined striate simple cone elements.

REMARKS

Elements assigned to this genus have been described and their affinity to existing published taxa discussed by Uyeno in Uyeno and Barnes (1983). This generic assignment combines elements identical to those described as simple cone elements "Group c" and new elements from the present study.

Digitodontus bellistriatus n.sp.

Plate 2, figures 24, 25; Plate 3, figures 1-7

Multielement

Simple cone elements, Group "c" UYENO in UYENO and BARNES, 1983, p. 47, Pl. 8, fig. 9-11 (only).

DIAGNOSIS

Elements assigned to this species consist of antero-posteriorly compressed, posteriorly reclined, simple cones with distinct striations. The elements range from bilaterally symmetrical to asymmetrical, interpreted as occupying three elemental positions within the apparatus.

DESCRIPTION

The a element of the apparatus consists of an inwardly flexed laterally compressed simple cone (scandodiform). The element is distinctly striated the entire length of the element on both the lateral surfaces. The basal cavity is ovoid in outline, broad and shallow as a result of the lateral compression, and does not extend far into the interior of the element. The cusp is triangular with sharp anterior and posterior edges. The inner cusp face is flat to slightly convex; outer face is broadly convex. The outline of the posterior edge is gently concave; outline of the anterior edge is mostly straight with a weakly developed convexity near the antero-basal corner.

The element occupying the b position is similar to the element in the a position, however the cone is more bilaterally symmetrical and the cusp is shorter and more anter-posteriorly compressed. The cusp edges may be extended as long low processes (Pl. 3, figs. 1, 2).

The element occupying the c position is the most distinctive element of the species. This element is perfectly symmetrical with extensive striations covering the entire upper portion of the element. The basal portion of the element is devoid of ornamentation. The element is antero-posteriorly compressed and gently reclined posteriorly. The margins of the base are square in outline and strongly compressed. The basal cavity is ovoid in outline and shallow.

REMARKS

Uyeno in Uyeno and Barnes (1983) was the first and only author to document the occurrence of this group of simple cones from the Silurian. He considered that this group of elements had a distinct morphological affinity to the genus Acodina. He also recognized the apparent symmetry transition series. Elements herein assigned to the b position of this study (Pl. 3, figs. 1, 2, 6, 7) are identical to those Uyeno in Uyeno and Barnes (1983) illustrated as Sa elements in their Plate 8, figures 9, 10. The elements they illustrated are obviously not symmetrical but are slightly deflected over the central basal cavity. They did not recognize a true c element (=Sa) as illustrated in Plate 2, figs. 24, 25. The element they assigned to the Sc (a) position (Plate 8, fig. 12) was not identified from the present collection; a more asymmetrical element (Plate 3, figs. 3-5) completes the symmetry transition series.

DERIVATION Of NAME

From the Latin digitus (=finger) and dontus (=tooth) describing the long narrow appearance of the c element.

MATERIAL STUDIED

21 a, 29 b, 18 c

5.7 Genus Distomodus Branson and Branson, 1947

Emended Cooper, 1975

Type Species: D. kentuckyensis Branson and Branson, 1947.

REMARKS

Cooper (1975) was the first person to reconstruct a multielement apparatus for Distomodus. Barrick and Klapper (1976) expanded Cooper's reconstruction to include a platform element with four to six processes. The multielement genus Distomodus is composed of six element types. The a element is ligonodiniform, b is zygognathiform, c is trichonodelliform, e is distomodiform, f is modified ambalodontiform and the g is icriodiniform.

Distomodus staurognathoides (Walliser)

Plate 3, figures 8-27, Plate 4, figures 1, 2, 7, 9, 26, Plate 11, figure 13.

a element

Ligonodina egregia WALLISER, 1964, p. 40-41. Pl. 6, fig. 3, 4.

b element

Roundya caudata WALLISER, 1964, p. 70, Pl. 5, fig. 9, Pl. 31, figs. 18, 19.

c element

Exochognathus brassfieldensis Branson and Branson. REXROAD and NICOLL, 1972, Pl. 2, fig. 23.

_e_ element

Distomodus _kentuckyensis_ Branson and Branson. REXROAD and NICOLL, 1972, Pl. 2, fig. 46.

_f_ element

Trichonodella? _expansa_ NICOLL and REXROAD, 1969, p. 2, fig. 46.

_g_ element

Hadrognathus _staurognathoides_ WALLISER, 1964, p. 35, Pl. 5, fig. 2, Pl. 13, figs. 6-15.

Multielement

Distomodus _staurognathoides_ (Walliser). ALDRIDGE and MOHAMED, 1982, Pl. 2, figs. 1-6; MABILLARD and ALDRIDGE, 1983, Pl. 1, figs. 15-20; UYENO _in_ UYENO and BARNES, 1983, p. 17, Pl. 3, figs. 1-15 (includes synonymy to 1983); NOWLAN, 1983, fig. 4(F-H); ALDRIDGE, 1985, p. 79, Pl. 3.1, figs. 12-17; MABILLARD and ALDRIDGE, 1985, text-fig. 7d; SAVAGE, 1985, p. 718, fig. 9 A-L; CRAIG et al., 1986, Pl. 2, fig. 8; KLEFFNER, 1987, p. 86, fig. 5 23-29; OVER and CHATTERTON, 1987b, p. 580, fig. 1-6.

Distomodus? sp. NORFORD and ORCHARD, 1985, Pl. 1, fig. 4

Distomodus sp. STOUGE and BAGNOLI-STOUGE, 1985, Pl. 2, figs. 18-19.

DESCRIPTION

The complete apparatus _D._ _staurognathoides_ has been described in the literature by Barrick and Klapper (1976).

REMARKS

The apparatus of Distomodus staurognathoides is composed of six element types: a, b, c, e, f, and g. The g element is the most diagnostic of the apparatus, is characterized by five radiating lateral processes; four more or less subequal in length and width, and the fifth somewhat larger (longer). The f element (= Trichonodella? expansa Nicoll and Rexroad, 1969, p. 2, fig. 46.) consists of a prominent twisted and triangular cusp on a three or four pronged platform. The symmetry transition series (a-c) elements are indistinguishable from those of Distomodus kentuckyensis.

Barrick and Klapper (1976, Pl. 1, fig. 24) illustrate a Pb element (= f) with a denticulated platform. The denticles are oriented in rows radiating away from the cusp. Elements assigned to the f position from this collection, lack these distinct rows of denticles. This minor variation is interpreted to lie within the range of variation for this species and does not necessitate the erection of a new species. Over and Chatterton (1987a) describe the johnognathiform element as representing the posterior process of a ramiform element forming a platform-like process similar to those found on either of the platform elements of the apparatus. Only a single element of this type was recovered from the Anse à Pierre-Loiselle Formation. This may possibly be due to breakage upon processing. I agree with Over and Chatterton's (1987a) argument based upon their figured specimens (p. 580, figs. 4-6). However, I feel that some elements included in their synonymy as fragments of ramiform elements of D. staurognathoides represent the original concept of Johnognathus huddlei as described by Mashkova. For a complete discussion of Johnognathus huddlei Mashkova see below.

MATERIAL STUDIED

64 a, 151 b, 130 c, 134 e, 65 f, 115 g

5.8 Genus Johnognathus Mashkova, 1977

Type species: J. huddlei Mashkova, 1977

REMARKS

Mashkova (1977) erected the genus Johnognathus to represent a bilaterally symmetrical, elongated and slightly arched platform element with nodes on the antero- oral surface and suture-like "scar" extending from the midline of the element to the posterior. The aboral surface of the element is characterized by a basal cavity which is slightly shorter than the platform with the maximum breadth and depth at the posterior, narrowing and shallowing towards the anterior of the element. Mashkova (1977) suggested that this element occupies a medial position in conjunction with other multielement genera including Pterospathodus, Apsidognathus, Hadrognathus (Distomodus), Carniodus and Ozarkodina which all are present in the present collection. Over and Chatterton (1987a) concluded that the type species J. huddlei was a fragment of Distomodus and not an individual taxon.

Johnognathus huddlei Mashkova

Plate 4, figures 3-6, 8, 10, 11

Multielement

Johnognathus huddlei Mashkova. ALDRIDGE and MOHAMED, 1982, Pl. II, fig. 25; MABILLARD and ALDRIDGE, 1983, Pl. 2, figs. 11, 12; ALDRIDGE, 1985, Pl. 3.3, fig. 12; SAVAGE, 1985, Fig. 6, a-e, h-k.

?"Johnognathus huddlei" Mashkova. UYENO and BARNES, 1981, p. 183, Pl.

1, fig. 25; UYENO *in* UYENO and BARNES, 1983, p. 17-18, Pl. 8, fig. 25.

DESCRIPTION

Fragmentary elements assigned to this taxon exhibit varied form. The following description accounts for the species-specific characteristics common to all morpotypes found in the present collection.

This taxon consists of a single platform element. The element is bilaterally symmetrical, long and narrow. A straight axial keel or carina is composed of four to six nodes increasing in size towards the proximal portion of the element. A principal node occurs near the proximal end of the element, and is significantly larger than the others. The proximal and distal ends of the element may be rectangular or pointed. The upper surface is commonly ornamented with a series of costae at oblique angles to the central carina and perpendicular to the margin. The basal cavity is deep and wide.

REMARKS

Over and Chatterton (1987a) disagreed with Mashkova's (1977) concept of an independent taxon and its relationship as an "accessory" element with other taxa because of distinct ranges and distribution from other localities with *Distomodus staurognathoides*. They (1987a) proposed that elements previously described as *Johnognathus huddlei* are developed from the posterior bar of ramiform elements of *D. staurognathoides* and as such, are merely fragments. They reconcile Mashkova's complete *J. huddlei* elements as having been broken and repaired as single elements in the soft tissue of the conodont animal, or as an element position split with the development of a second element.

Over and Chatterton's (1987a) argument is quite convincing as to the remarkable similarity of fragmental elements of J. huddlei to fragments of D. staurognathoides. In the collections from the Anse à Pierre-Loiselle Formation, several fragments have been recovered which strongly support Over and Chatterton's interpretation. However, only one element that could possibly support their position was recovered (Pl. 3, figs. 24, 25). This element occupies the a? position in the reconstructed apparatus of D. staurognathoides. Although still fragmentary, it illustrates the posterior process which Over and Chatterton (1987a) would consider to be equivalent to J. huddlei. Close examination reveals fine fracture lines at the point of connection of the extended posterior process with the cusp and anterior component of the element. Consequently, upon complete breakage, the separate process may resemble a fragment of J. huddlei. Other fragments recovered from the present collection are interpreted as fragments of D. staurognathoides (Plate 4, figures, 1, 2, 7, 9). Some elements recovered bear little resemblance to those illustrated by Over and Chatterton (1987a) and are not suggestive of fragments of D. staurognathoides but rather of J. huddlei as Mashkova intended. Plate 4, figs. 5, 6, 8, 10, 11 more closely resemble the anterior portion of J. huddlei that Mashkova illustrated (1977, p. 515, text-fig. 1a). The anterior parts of the fragments are as sharp as the one illustrated by Mashkova (1977) with approximately five small secondary nodes and one major node at the broken edge of the fragments. The basal cavity of the fragment is shorter than the oral surface, consistent with Mashkova's (1977) description. The element figured in Plate 4, figs. 3, 4 closely resembles the posterior portion of the figured holotype (Figure 2e). Savage (1985) attempted a reconstruction of J. huddlei from his collection from the Heceta Limestone of Alaska. His reconstruction consists of a doubly pointed element. He has two sets of nodes instead of just one at the anterior of the element as Mashkova (1977) illustrated (p. 515, Fig. 1a). Savage (1985) did not report any complete specimen but reconstructed his element from fragments only.

MATERIAL STUDIED

33 specimens

5.9 Genus *Kockelella* Walliser, 1957

Type species: *K. variabilis* Walliser, 1957.

REMARKS

Barrick and Klapper (1976) reconstructed the multielement apparatus for the genus *Kockelella* which is composed of six elements. The *a* element is ligonodiniform; *b* is lonchodiniform, *c* is trichonodelliform, *e* is neoprioniodiform, *f* is ozarkodiniform and *g* is a spathognathodiform element.

Kockelella ranuliformis (Walliser)

Plate 4, figures 12, 13

g element

Spathognathodus ranuliformis WALLISER, 1964, p. 82, Pl. 6, fig. 9., Pl. 22, figs. 5-7.

Multielement

Kockelella ranuliformis (Walliser). BARRICK and KLAPPER, 1976, p. 76, Pl. 2., figs. 1-11 (includes synonymy to 1976); UYENO and BARNES, 1981, Pl. 1, fig. 11; BARRICK, 1983, fig. 18I; UYENO *in* UYENO and BARNES, 1983, p. 43, Pl. 6, fig. 1; NOWLAN, 1983, p. 100, fig. 3V, W; ALDRIDGE, 1985, p. 83, Pl. 3.2, fig. 8; SAVAGE, 1985, p. 720, fig. 12A-N; BISCHOFF, 1986, p. 296, Pl. 14, figs. 1-15 (Pa elements only); CRAIG et al., 1986, Pl. 2, fig. 11; KLEFFNER, 1987, p. 88, fig. 6 30; OVER and

CHATTERTON, 1987b, Pl. 7, fig. 1.

Kockelella cf. K. ranuliformis (Walliser). UYENO in UYENO and BARNES, 1983, p. 43, Pl. 6, fig. 5.

Ozarkodina ranuliformis (Walliser). COOPER, 1976, p. 216, Pl. 2, fig. 9, JEPPSSON, 1979, pp. 241, 242, 244, fig. 72 (1-3 only).

DESCRIPTION

Only the g element can be identified from the present collection. This g element consists of a free blade with partially fused, laterally compressed denticles of unequal size. The denticles are short and stout with blunt terminations. Approximately mid-way along the blade on the lateral faces, the blade thickens. The basal cavity is characterized by an asymmetrical circular flare exhibiting faint growth rings. The basal cavity and flare are situated at the posterior of the element approximately two denticle widths from the extreme anterior of the element. A basal groove extends from the basal cavity to the extreme posterior of the element, decreasing in width posteriorly.

REMARKS

The g elements recognized are identical to those illustrated by Uyeno and Barnes (1981), Uyeno in Uyeno and Barnes (1983), Nowlan (1983), and Over and Chatterton (1987b). The remaining elements of this taxon were not identified from the present collecion as they are not distinct but similar to those associated with the genus Ozarkodina and may have been included in that genus.

MATERIAL STUDIED

23 g

5.10 Genus Oulodus Branson and Mehl, 1933

Type species: Cordylodus serratus Stauffer, 1930 (= senior subjective synonym of O. mediocris Branson and Mehl, 1933).

REMARKS

The multielement genus Oulodus comprises a full apparatus of six skeletal elements (Sweet and Schnlaub, 1975). The a element is cordylodiform or ligonodiniform, b is zygognathiform, c is trichonodelliform, e element is cyrtoniodiform, prioniodiform or neoprioniodiform, the f element is oulodiform or prioniodiniform and the g element is oulodiform.

The distinction between Ordovician and Silurian forms of Oulodus remains unclear and several species are assigned only questionably to Oulodus. Ordovician forms of Oulodus have a cordylodiform or eoligonodiniform (or both) a element(s) whereas Silurian forms have ligonodiniform a elements.

Oulodus? fluegeli (Walliser)

Plate 4, figures 14-23

c element

?Roundya trichonodelloides WALLISER, 1964, p. 72, Pl. 6, fig. 2, Pl. 31, figs. 22-25.

e element

Neoprioniodus planus WALLISER, 1964, p. 51, Pl. 4, fig. 10, Pl. 6, fig. 3, Pl. 29, figs. 12, 13, 15.

f element

Lonchodina detorta WALLISER, 1964, p. 43, Pl. 9, fig. 20, Pl. 30, figs. 34-37.

g element

Lonchodina fluegeli WALLISER, 1964, p. 44, Pl. 6, fig. 4, Pl. 32, figs. 22-24.

Multielement

Ozarkodina plana (Walliser). SWEET and SCHONLAUB, 1975, p. 52-53, Pl. 1, figs. 1, 3-6 (only).

Oulodus? fluegeli (Walliser). ALDRIDGE, 1979, p. 14-15, Pl. 2, figs. 6-11; ALDRIDGE and MOHAMED, 1982, Pl. 11, figs. 26, 27.

REMARKS

Elements of this taxon are rare in the study collection with only c, f, and g elements being recovered. Elements assigned to the a, b, and e positions of this subspecies were not readily identified from this study suggesting that element sharing is common and consistent within species and sub-species of Oulodus? during this time interval as reflected in the unusual elemental ratios.

MATERIAL STUDIED

26 c, 2 f, 42 g

Oulodus? kentuckyensis (Branson and Branson)

Plate 4, figures 24-30; Plate 5, figures 1-6

a element

Ligonodina kentuckyensis BRANSON and BRANSON, 1947, p. 555, Pl. 82, figs. 28, 35.

b element

Prioniodina irregularis BRANSON and BRANSON, 1947, p. 555, Pl. 82, figs. 30, 31.

c element

Trichonodella n. sp. A REXROAD, 1967, p. 52-53, Pl. 3, figs. 16, 17.

e element

Euprioniodina cf. Prioniodus excavatus (Branson and Mehl), REXROAD, 1967, p. 31-32, Pl. 3, figs. 7, 8.

f element

Lonchodina n. sp. b WALLISER, 1957, p. 40, Pl. 3, figs. 27, 28.

g element

Lonchodina sp. REXROAD, 1967, p. 38, Pl. 3, fig. 5.

Multielement

Oulodus? kentuckyensis (Branson and Branson). McCRACKEN and BARNES, 1981a, p. 80-81, Pl. 6, figs. 1-20; FAHRAEUS and BARNES, 1981, Pl. 1, figs. 5, 6; NOWLAN, 1981, Pl. 4, figs. 15, 19; McCRACKEN and BARNES, 1982, p. 1481-1482, Pl. 2, fig. 14; ALDRIDGE and MOHAMED, 1982, p. 116, Pl. 1, figs. 29-32; NOWLAN, 1983, p. 100, fig. 3, A, D; MABILLARD and ALDRIDGE, 1983, p. 34, Pl. 2, figs. 19-23; MOSKALENKO, 1986, Pl. 24, figs. 15-24; OVER and CHATTERTON, 1987b, Pl. 1, figs. 25-27.

Oulodus? cf. kentuckyensis (Branson and Branson). MANNIK, 1983, p. 114, fig 4 F-H, J, K.

Oulodus? cf. O.? kentuckyensis (Branson and Branson). NORFORD and ORCHARD, 1985, p. 29, figs., 1, 3, 6, 7, 8, 11.

DESCRIPTION

The apparatus Oulodus? kentuckyensis is described in great detail in McCracken and Barnes (1981a).

REMARKS

The apparatus of Oulodus? kentuckyensis consists of six skeletal elements which are characteristically robust, with round to sub-ovoid denticles, and U-shaped spaces between individual denticles. The g element has denticles which are more laterally compressed and closely spaced. Elements of this taxon are exactly conspecific with those described and illustrated by McCracken and Barnes (1981a).

Elements of this taxon are abundant in this collection, constituting approximately 20 per cent of the recovered fauna.

Within close species of Oulodus?, there appears to be a great deal of element "sharing" especially with those elements occupying positions in the ramiform series.

MATERIAL STUDIED

539 a, 253 b, 345 c, 232 e, 212 f, 54 g

5.11 Genus Ozarkodina Branson and Mehl, 1933

Emended Lindstrom, 1970

Type species: O. typica Branson and Mehl, 1933 (= junior synonym of O. confluens Branson and Mehl, 1933).

REMARKS

The multielement apparatus of Ozarkodina was first reconstructed by Klapper and Philip (1971) and includes a total of six skeletal elements. These elements are: a (hindeodeliform), b (plectospathodiform), c (trichonodeliform), e (neoprioniodiform), f (ozarkodiniform) and g (spathognathodiform).

Ozarkodina confluens (Branson and Mehl)

Plate 5, figures 7-21, 24, 25

a element

Hindeodella confluens BRANSON and MEHL, 1933, p. 45, Pl. 3, figs. 21-33.

b element

Plectospathodus flexuosus BRANSON and MEHL, 1933, p. 47, Pl. 3, figs. 31, 32.

c element

Trichognathus symmetrica BRANSON and MEHL, 1933, p. 50, Pl. 3, figs. 33, 34.

e element

Prioniodus bicurvatus BRANSON and MEHL, 1933, p. 44, Pl. 3, figs. 9-12.

f element

Ozarkodina typica BRANSON and MEHL, 1933, p. 51-52, Pl. 3, figs. 43-45.

q element

Spathodus primus BRANSON and MEHL, 1933, p. 46, Pl. 3, figs. 25-30.

Multielement

Hindeodella confluens Branson and Mehl. JEPPSSON, 1969, p. 15-18, Text fig. 1 A-F; Text fig. 2.

Ozarkodina confluens (Branson and Mehl). KLAPPER and MURPHY, 1974, p. 30-33, Pl. 3, figs. 1-23; Pl. 4, figs. 1-27; Pl. 8, figs. 11-15; ALDRIDGE, 1975, Pl. 2, figs. 1-6; COOPER, 1977a, p. 187-188, Pl. 16, figs. 1-7; HELFRICH, 1978, Pl. 1, fig. 3; PICKETT, 1978, Pl. 1, fig. 1-9; REXROAD et al., 1978, p. 7, Pl. 1, figs. 11-16; MAYR et al., 1980, Pl. 32.1, figs. 15, 16, 22-25, 36, 41, 42; NOWLAN, 1981, Pl. 7, figs. 18, 19, 22-24; BARRICK, 1983, fig. 18H; HARRIS et al., 1983, p. 729, Pl. 1, fig. A; ALDRIDGE, 1985, p. 89, Pl. 3.4, fig. 1; CRAIG et al., 1986, Pl. 2, figs. 12, 15; KLEFFNER, 1987, p. 88, Fig. 6 27-29, 31; OVER and CHATTERTON, 1987b, Pl. 8, figs, 8-11.

Ozarkodina aff. O. hadra (Nicoll and Rexroad). NOWLAN, 1983, p. 101, fig. 3 I, J, L-O.

DESCRIPTION

Elements of this apparatus have been extensively described by Klapper and Murphy (1974).

REMARKS

Klapper and Murphy (1974), established five informal morphotypes of elements assigned to the q position of the apparatus. These elements are similar in general morphology but are subdivided based upon the nature of lobes around the basal cavity and denticle shape and orientation.

Two of the five morphotypes of Klapper and Murphy (1974) were identified from the present study: alpha and gamma. In addition, a large number of fragmentary elements that can be confidently assigned to O. confluens, could not be assigned to any of the five morphotypical forms and are identified as g indeterminate. Elements of O. confluens are generally robust and often fragmentary making positive identification difficult. Elements assigned to the e and ramiform (a-c) positions of the apparatus are identical to those illustrated by Nowlan (1981, Pl. VII figs. 18, 19, 22-24) from the overlying La Vieille Formation.

There is a distinct similarity between the g elements of O. hadra and O. gulletensis and the O. confluens g morphotypes from the present study (Pl. 6 figs. 23, 24; Pl. 6, figs. 5, 16, 21, 22; Pl. 5, figs. 15-18, respectively). Based on the morphology of elements assigned to the g position, Barrick and Klapper (1976) and Helfrich (1980) suggested that an evolutionary lineage occurs between these three species of Ozarkodina. The stratigraphic ranges of these three species are almost identical in the studied sections, hence, no clear evolutionary trend was recognized. Elements assigned to Ozarkodina n. sp. A (Pl. 7, figs. 3-8) may represent ramiform elements of another species related to the hadra-gulletensis-confluens lineage. The occurrence of O. confluens is the first pre- Wenlock occurrence reported in the literature.

MATERIAL STUDIED

61 a, 82 b, 95 c, 30 e, 54 f, 56 g alpha morph., 120 g gamma morph., 276 g indet.

Ozarkodina excavata excavata (Branson and Mehl)

Plate 5, figures 21, 22, 25, 26; Plate 6, figures 1-8

a element

Hindeodella equidentata RHODES, 1953, p. 303, Pl. 23, figs. 248, 252-254.

b element

Plectospathodus extensus RHODES, 1953, p. 323, Pl. 23, figs. 236, 238-240.

c element

Trichognathus excavata BRANSON and MEHL, 1933, p. 51, Pl. 3, figs. 35, 36.

e element

Prioniodus excavatus BRANSON and MEHL, 1933, p. 45, Pl. 3, figs. 7, 8.

f element

Ozarkodina simplex BRANSON and MEHL, 1933, p. 52, Pl. 3, figs. 46, 47.

g element

Ozarkodina sp. RHODES, 1953, p. 333, Pl. 23, fig. 244.

Multielement

Hindeodella excavata (Branson and Mehl). JEPPSSON, 1969, p. 18-20 (includes synonymy to 1969); JEPPSSON, 1979, p. 240.

Ozarkodina excavata (Branson and Mehl). COOPER, 1976, p. 215, 216, Pl. 2, figs. 1-4, 6, 7 (includes synonymy to 1976); COOPER, 1977a, p. 188, Pl. 16, figs. 8-15; HELFRICH, 1980, Pl. 2, figs. 31-38; ALDRIDGE and MOHAMED, 1982, Pl. 1, figs. 16, 17; MABILLARD and ALDRIDGE, 1983, Pl. 3, figs. 1-6; DUMOULIN and HARRIS, 1987, p. 37, fig. 4 J-M; KLEFFNER, 1987, p. 88, fig. 6 21-26.

Ozarkodina excavata excavata (Branson and Mehl). KLAPPER and MURPHY, 1974, p. 34, Pl. 6, figs. 1-20; BARRICK and KLAPPER, 1976, pp. 78, 79, Pl. 4, figs. 13-23, 26 (includes synonymy to 1976); KUWANO, 1976, Pl. 2, figs. 7-10, 12-19; REXROAD et al., 1978, pp. 9, 10, Pl. 1, figs. 17-22 (includes synonymy to 1978); MAYR et al., 1980, Pl. 32.1, figs. 28, 29, 32, 38; NOWLAN, 1981, p. 288, Pl. 6, figs. 10-16, 18; HARRIS et al., 1983, Pl. 1, figs. D-H; NOWLAN, 1983, p. 100, fig. 3 (N,Q,U); NORFORD and ORCHARD, 1985, p. 29, fig. 19; SAVAGE, 1985, p. 722, fig. 14 A-L, CRAIG et al. 1986, Pl. 2, figs. 10, 13, 16, 17; BISCHOFF, 1986, p. 318, figs. 35-40, p. 320, Pl. 26, figs. 1-40; KLEFFNER, 1987, p. 88, fig. 6 27-29, 31; OVER and CHATTERTON, 1987b, Pl. 7, figs. 18, 19.

DESCRIPTION

Complete descriptions of elements which constitute O. e. excavata are found in Walliser (1964) and Bischoff (1986).

REMARKS

The apparatus of Ozarkodina excavata excavata consists of six skeletal elements characterized by moderately arched and bowed elements with long blades and with short, laterally compressed denticles. Specimens recovered from the Anse à Pierre-Loiselle Formation are most similar to those illustrated by Barrick and Klapper (1976) from the Clarita Formation of Oklahoma. This is by far the most abundant species of Ozarkodina recovered from the studied sections, comprising almost 10 per cent of the total recovered fauna.

MATERIAL STUDIED

398 a, 102 b, 342 c, 108 e, 246 f, 458 g

Ozarkodina gulletensis (Aldridge)

Plate 6, figures 9-22

a Element

Hindeodella equidentata RHODES, 1953, p. 303, Pl. 23, figs., 248, 253-254, Figs. 248, 252-254.

b Element

Synprioniodina silurica WALLISER, 1964, p. 88, Pl. 6, fig. 18; Pl. 29, figs. 38-41; Pl. 30, figs. 1-4.

c Element

Trichognathus symmetrica BRANSON and MEHL, 1933, p. 50, Pl. 3, figs. 33-34.

e Element

Prioniodus bicurvatus BRANSON and MEHL, 1933, p. 44, Pl. 3, figs. 9-12.

f Element

Ozarkodina alisonae ALDRIDGE, 1972, p. 198, Pl. 5, figs. 4, 6.

g Element

Spathognathodus gulletensis ALDRIDGE, 1972, p. 212-213, Pl. 4, figs. 9-12.

Multielement

Ozarkodina gulletensis (Aldridge). ALDRIDGE, 1975, Pl. 2, figs. 7, 8; HELFRICH, 1980, p. 568, Pl. 2, figs, 21-24, 26-29; UYENO and BARNES, 1981, Pl. 1, fig. 10; UYENO in UYENO and BARNES, 1983, p. 21, Pl. 4, figs. 11-14, 16, 17, 19; ALDRIDGE , 1985, Pl. 3.2, fig. 9; OVER and

CHATTERTON, 1987b, Pl. 4, fig. 25.

Ozarkodina aff. O. gulletensis (Aldridge). FAHRAEUS and BARNES, 1981, Pl. 1, figs. 14, 15.

Ozarkodina cf. O. gulletensis (Aldridge). NOWLAN, 1981, Pl. VII, figs. 15, 16, 20.

DESCRIPTION

All elements of this taxon have been previously described as discrete elements (see Jeppsson, 1969).

REMARKS

Only the f and g elements of this apparatus are diagnostic of this taxon. Elements assignable to the e and ramiform (a-c) positions are indistinguishable from those of O. hadra and most similar to those elements of O. confluens and are counted under this taxon. Specimens illustrated by Helfrich (1980) and Uyeno in Uyeno and Barnes (1983) do not exhibit the characteristic flared lips Aldridge (1972) originally described as being an essential characteristic of the component form elements.

As mentioned above, there are similarities between the g elements of O. gulletensis and O. confluens, suggestive of possible phylogenetic relationships between the two species, however, the taxonomic ranges of both species are similar from the collections of the Anse à Pierre-Loiselle Formation and do not permit identification of evolutionary trends.

MATERIAL STUDIED

66 a, 94 b, 153 c, 46 e, 60 f, 304 g

Ozarkodina hadra (Nicoll and Rexroad)

Plate 6, figures 23, 24

q Element

Spathognathodus hadros NICOLL and REXROAD, 1969, p. 59, Pl. 5, figs. 17, 18.

Multielement

Ozarkodina hadra (Nicoll and Rexroad) KLAPPER and MURPHY, 1974, Pl. 8, figs. 5, 6; BARRICK and KLAPPER, 1976, p. 79, Pl.1, fig. 18; KUWANO, 1976, Pl. 2, fig. 6; ALDRIDGE, 1985, Pl. 3.3, fig. 11; STOUGE and BAGNOLI-STOUGE, 1985, p. 106, Pl. 2, figs. 6-13; CRAIG et al., 1986, Pl. 2, fig. 22; OVER and CHATTERTON, 1987b, Pl. 5, figs. 1-8.

Ozarkodina aff. O. hadra (Nicoll and Rexroad). NOWLAN, 1981, Pl. VII, fig. 21.

?Ozarkodina hadra (Nicoll and Rexroad). SAVAGE, 1985, p. 722, fig. 15, D-F.

DESCRIPTION

The q element consists of a narrow blade which is slightly bowed and arched. The denticles are fused and laterally compressed, decreasing in height posteriorly. The basal cavity is relatively small and is located at the mid-point of the element.

REMARKS

The multielement apparatus of O. hadra consists of six skeletal elements. The f and q elements are diagnostic of this species, of which only q elements were recovered; the remaining e and ramiform elements being indistinguishable from those of O. gulletensis. Elements in the a, b, c and e positions are counted under O. gulletensis.

Elements of O. hadra have a similar range to elements of O. gulletensis and O. confluens, therefore, little can be concluded with regard to a phylogenetic lineage as suggested by Barrick and Klapper (1976).

MATERIAL STUDIED

24 g

Ozarkodina aff. O. pirata Uyeno

Plate 7, figures 1, 2; Plate 11, figures 9, 11

Multielement

aff. Ozarkodina pirata UYENO in UYENO and BARNES, 1983, Pl. 1, figs. 16, 24, 25; Pl. 2, figs. 12, 13.

Ozarkodina n. sp. C UYENO in UYENO and BARNES, 1981, Pl. 1, fig. 2 (Pa).

DESCRIPTION

The b element is similar to the c element but is more asymmetrical. The denticles are situated in the medial portion of one lateral process and are much larger than any adjacent denticles.

The c element is symmetrical with relatively broad lateral processes directed downward forming a narrow angle. The basal cavity is small and slightly flared posteriorly. Denticles on the process are narrow, and sharp- edged. The cusp is narrow with sharp lateral edges and a weak posterior carina.

The g element is small and laterally compressed with 7 to 11 small, laterally compressed denticles. The posterior process is short, bearing 2 or 3 posteriorly reclined denticles which decrease markedly in size posteriorly. The anterior process bears up to seven erect denticles of subequal size except for the most proximal which is much smaller. The cusp is reclined posteriorly and is broader than all the denticles. A small notch is developed on the anterior process. The basal cavity is shallow and situated posteriorly beneath the main cusp.

REMARKS

The apparatus of O. pirata as reconstructed by Uyeno in Uyeno and Barnes (1983), consists of six skeletal elements and one possible transition element occupying the acb position. Elements assignable to the b, c and g positions of a related species were identified from the present collection.

Elements assigned to the g position of O. aff. O. pirata are similar to those illustrated as Pa (=g) elements of O. pirata by Uyeno in Uyeno and Barnes (1981, 1983), however, elements assigned to the ramiform positions differ somewhat from those of previous authors. The c elements exhibit narrower and more downwardly directed lateral processes with a much tighter angle between the processes.

Elements that occupy the b position of O. aff. O. pirata also have narrow downwardly directed lateral processes and a narrower angle between processes than equivalent elements of O. pirata.

Elements identified as O. aff. O. pirata may represent a close relative to those described by Uyeno in Uyeno and Barnes (1981, 1983), but the low abundance and lack of elements with which to complete a reconstruction precludes the erection of a new species at this time.

MATERIAL STUDIED

5 b, 4 c, 17 g

Ozarkodina n. sp. A

Plate 7, figures 3-8

DIAGNOSIS

A partial reconstruction of a new species of Ozarkodina consisting of rare fragmental elements occupying four elemental positions including; a, b c and f. The a element is hindeodelliform, b is plectospathodiform, c is trichonodelliform and f is ozarkodiniform.

DESCRIPTION

Elements occupying all three positions are very robust but are only recovered as fragments. Elements in the a position consist of a large cusp with a short antero-lateral process with three or more denticles that are oval in cross section. The posterior process has denticles of a similar shape. The basal cavity is shallow and located under the cusp.

The elements in the b position consist of a cusp with two lateral processes, one high and one lower in height. The high process has three denticles that are oval in cross-section, and the narrow process has up to four similarly shaped denticles. The basal cavity is expanded under the cusp with a small flare posteriorly.

The c element consists or a large cusp with two equal lateral processes. The denticles are oval in cross section and are slightly antero-posteriorly compressed. The basal cavity is relatively small and flares posteriorly.

The f element is an arched, slightly bowed blade with a large, discrete central cusp. Denticles are laterally compressed and oval in cross-section. The basal cavity is expanded and flared beneath the cusp and tapers both posteriorly and anteriorly.

REMARKS

Few specimens of this taxon were recovered. What was recovered, however, is strikingly similar in form to elements assigned to Ozarkodina confluens and O. gulletensis, possibly suggesting a closely genetically related fauna. No elements were identified that could confidently be assigned to the g position of the apparatus. It is suspected that some fragmentary elements that are identified as O. confluens g indet. could possibly be g elements of this new species.

MATERIAL STUDIED

8 a, 3 b, 2 c, 1 f

5.12 Genus *Panderodus* Ethington, 1959

Type species: *Paltodus unicostatus* Branson and Mehl, 1933.

Panderodus gibber Nowlan and Barnes

Plate 7, figures 12, 13

Multielement

Panderodus gibber NOWLAN and BARNES, 1981, p. 16, Pl. 6, figs. 15-19, text-figs. 7H-J; McCRACKEN and BARNES, 1981a, p. 85, Pl. 2, figs. 7-10; NOWLAN, 1981, p. 288, Pl. 6, fig. 20.

Panderodus? *gibber* Nowlan and Barnes. NOWLAN and McCRACKEN *in* NOWLAN, McCRACKEN and CHATTERTON, 1988, Pl. 6, figs. 12-20.

DESCRIPTION

Elements of *P. gibber* have been adequately described by Nowlan and Barnes (1981) and Nowlan et al. (1988).

REMARKS

Three element types are assigned to this taxon. These include, asymmetrical (*a*), slightly asymmetrical (*b*) and symmetrical (*c*).

Specimens identified from the collection are identical to those described by Nowlan and Barnes (1981) and Nowlan et al. (1988). Elements assigned to this species are less common than *P. unicostatus* and *P. recurvatus* and comprise less than 10 per cent of the simple cone fauna.

MATERIAL STUDIED

176 a, 1 b, 17 c

Panderodus recurvatus (Rhodes)

Plate 7, figures 10, 11, 16, 22, 23

Paltodus recurvatus RHODES, 1953, p. 297, Pl. 23, figs. 219, 220.

Multielement

Panderodus recurvatus (Rhodes), BARRICK, 1977, P. 54-55, Pl. 3, figs. 3, 4, 7-12 (includes synonymy to 1977); MILLER, 1978, Pl. 1, fig. 6; NOWLAN, 1981, p. 284, Pl. 4, fig. 11; LEE, 1982, p. 96, Pl. 4, fig. 12; JEPPSSON, 1983, p. 125; UYENO in UYENO and BARNES, 1983, Pl. 9, figs. 23-26.

Panderodus sp., ALDRIDGE, 1979, Pl. 2, figs. 29, 30.

DESCRIPTION

Complete descriptions and discussion of symmetry transition series elements are found in Barrick (1977).

REMARKS

The only elements of the apparatus of P. recurvatus reconstructed by Barrick (1977) found in the present collection include, Sc (=a), Sb (=b), and Sa (=c) elements. The elements described by Barrick (1977) as M elements have not been identified in this material.

MATERIAL STUDIED

53 a, 105 b, 82 c

Panderodus unicostatus (Branson and Mehl, 1933)

Plate 7, Figures 20, 21, 24-27

Multielement

Panderodus unicostatus (Branson and Mehl). COOPER, 1976, Pl. 1, figs. 1-7, 22; BARRICK, 1977, Pl. 3, figs. 1, 2, 5, 6; HELFRICH, 1978, Pl. 1, figs. 1, 2; REXROAD et al., 1978, Pl. 1, figs. 6-8; ALDRIDGE, 1979, Pl. 2, figs. 17-22; ALDRIDGE, DORNING and SIVETER, 1981, Pl. 2.2, figs., 1-3; LEE, 1982, pp. 63-69, Pl. 4, figs. 1-11, 13-15 (includes synonymy to 1982); UYENO in UYENO and BARNES, 1983, pp. 22, 23, Pl. 9, figs. 17-22 (includes synonymy to 1983).

DESCRIPTION

Elements of P. unicostatus have been extensively described by Cooper (1976).

REMARKS

Three elements of this appatarus have been confidently identified including: graciliform, arcuatiform and compressiform.

Simple cone panderodans numerically dominate collections from the Anse à Pierre-Loiselle Formation, constituting approximately sixty per cent of the recovered forms.

MATERIAL STUDIED

9205 graciliform, 1640 arcuatiform, 1861 compressiform

Panderodus panderi (Stauffer)

Plate 7, figures 17-19

Paltodus panderi STAUFFER, 1940, p. 427, Pl. 60, figs. 8,9; GLENISTER, 1957, p. 728-729, Pl. 85, figs. 8,9.

Multielement

Panderodus panderi (Stauffer). SWEET, THOMPSON, and SATTERFIELD, 1975, p. 33,34, Pl. 1, fig. 12 (includes synonymy to 1975); BARNES, 1977, p. 107, Pl. 3, fig. 21 only; NOWLAN in BOLTON and NOWLAN, 1979, p. 20, Pl. 7, figs. 3,4,7; SWEET, 1979, p. 64, fig. 7; ORCHARD, 1980, p. 23, Pl. 3, fig. 24; NOWLAN, and BARNES, 1981, p. 17, Pl. 6, figs. 3,4,14; McCRACKEN and BARNES, 1981a, p. 86, Pl. 2, figs. 11-13; NOWLAN, McCRACKEN and CHATTERTON, 1988, p. 69, Pl. 7, figs. 14, 20, 21, 23-25.

DESCRIPTION

Elements assigned to P. panderi have been described by Nowlan and Barnes (1981) and Nowlan et al. (1988).

REMARKS

Nowlan et al. (1988) commented on the reconstruction of type material of P. panderi and the mixed nature of the original samples. The type material was recovered from a mixed sample of Ordovician and Devonian conodonts resulting in difficulty in confident apparatus reconstruction (Nowlan et al., 1988).

Nowlan and Barnes (1981) reported an occurrence of P. panderi from the Vaureal Formation on Anticosti Island. The Vaureal Formation is considered Richmondian in age. Nowlan et al. (1988) identified elements of P.? panderi from Upper Ordovician strata (approx. 30m below the apparent Ord.-Sil. boundary) of the Whittaker Formation, Mackenzie Mountains, N.W.T. This occurrence of P. panderi is considerably younger.

MATERIAL STUDIED

4 a/b, 2 b/c

5.13 Genus Pseudooneotodus Drygant, 1974

Emended Barrick, 1977

Type species: Oneotodus? beckmanni Bischoff and Sannemann, 1958.

REMARKS

Elements of the genus Pseudooneotodus have not always been regarded as true conodonts. Detailed examinations by Jentzsch (1962), Schulze (1968), Drygant (1974), and Cooper (1976) established morphological characteristics that are similar to conodonts including: overlapping growth lamellae in the basal cavity, basal fillings like those of conodonts and the colour and distribution of hyaline and white matter. Elements of Pseudooneotodus are characteristically short, squat cones that have a deep basal cavity and walls that thicken apically. Species level taxonomic divisions of this genus are based upon the number of apical denticles.

Pseudooneotodus beckmanni (Bischoff and Sannemann)

Plate 8, figures 1-4

Oneotodus? beckmanni BISCHOFF and SANNEMANN, 1958, p. 98, Pl. 15, figs. 22-25.

Pseudooneotodus beckmanni (Bischoff and Sanneman). DRYGANT, 1974, p. 67, Pl. 2, figs. 34-39; COOPER, 1977b, p. 1068-1069, Pl. 2, figs. 14, 17 (includes synonymy to 1977); McCRACKEN and BARNES, 1981a, p. 89, Pl. 2, figs. 30, 31; NOWLAN, 1981, p. 286, Pl. 5, fig. 31; JEPPSSON, 1983, p. 126.

Oneotodus mitratus (Moskalenko). DZIK, 1976, p. 435, figs. 12e, f.

Indeterminate element - form C. WEYANT, 1968, p. 64, Pl. 6, figs. 13, 15 only.

REMARKS

The multielement reconstruction of the apparatus of Pseudooneotodus beckmanni is unclear. Cooper (1977b) attempted a reconstruction considering the variation in basal outline. Specimens of this study are commonly asymmetrical with a flattened face, while others are symmetrical. All elements assigned to this taxon have a single denticle (cusp) at the apex of the cone. This denticle may be recurved posteriorly or be upright. Surficial ornamentation varies within specimens of the collection. Some elements are smooth with no evidence of growth lines or ornamentation while others display a distinct pattern of striations running longitudinally.

Cooper (1977b) considered the apparatus of P. beckmanni to be monoelemental with elements displaying variable basal outlines.

MATERIAL STUDIED

132 elements

Pseudooneotodus pyramis n.sp.

Plate 8, figures 5, 6

DIAGNOSIS

A monoelemental, simple cone apparatus characterized by pyramidal elements. The element consists of three equal area faces with a triangular shaped basal cavity, commonly filled with basal material.

DESCRIPTION

The single, simple cone that makes up the apparatus consists of three triangular faces and triangular basal opening forming the overall shape of a pyramid. The height of the element is twice the width of the base. Each face is generally smooth, with low amplitude swells at the mid-height of the element. The anterior face is perpendicular to the axis of symmetry and is slightly convex.

In all recovered specimens of P. pyramis n.sp, the basal cavity is filled. However, there is a suggestion that the unit is thin walled and is entirely excavated similar to other species of Pseudooneotodus.

REMARKS

Elements of this apparatus have not been described by previous workers on simple cones. Elements of P. pyramis are rare in the collection from the Anse à Pierre-Loiselle Formation.

MATERIAL STUDIED

2 pyramidal cones

DERIVATION OF NAME

From the overall pyramid-like shape of the element.

5.14 Genus *Pterospathodus* Walliser, 1964

Type species: *P. amorphognathoides* Walliser, 1964.

REMARKS

Walliser (1964) first tentatively erected a multielement apparatus for *Pterospathodus* as Apparatus C to include the form species *P. amorphognathoides* and *Ozarkodina gaertneri*. Schnlaub (1971) also considered *Pterospathodus* to be a bimembrate apparatus. Klapper and Murphy (1974) assigned the multielement species *Llandoverygnathus celloni* Walliser to *Pterospathodus* on the basis of apparent phylogeny and apparatus components. Thus the genus *Llandoverygnathus* became a junior synonym of *Pterospathodus*. Klapper and Murphy (1975) also included Walliser's *Spathognathodus pennatus* in *Pterospathodus* although elements other than the *g* element are not known from this species but are suspected to have shared accessory elements with other species of *Pterospathodus*. Barrick and Klapper (1976) added M and S (terminology of Sweet and Schonlaub, 1975) elements to the apparatuses of *P. celloni* and *P. amorphognathoides*. Cooper (1977b) chose to restrict classification of the genus *Pterospathodus* to those taxa that contained *g* elements with distinct lateral processes. For clarity of description, Barrick and Klapper's (1976) interpretation of the genus will be used.

Pterospathodus amorphognathoides Walliser

Plate 8, figures 7-19, 21, 22

e element

Neoprioniodus triangularis triangularis WALLISER, 1964, p. 52, Pl. 6, fig. 13, Pl. 28, figs. 25-30, Text-fig. 6 d-f.

f element

Ozarkodina gaertneri WALLISER, 1964, p. 57, Pl. 6. fig. 6, Pl. 27, figs. 12-19, text-fig. 1g; ALDRIDGE, 1972, p. 200, Pl. 5, figs. 5, 7 (includes synonymy to 1969)

g element

Pterospathodus amorphognathoides WALLISER, 1964, p. 67., Pl. 6, fig. 7, Pl. 15, figs. 9-15, text-fig. 1f.

Multielement

Pterospathodus amorphognathoides Walliser. SCHONLAUB, 1971, Pl. 2, figs. 6-12; ALDRIDGE, 1972, p. 208, Pl. 3, fig. 17-19; WALLISER, 1972, p. 76; ALDRIDGE, 1974, p. 301, text-fig. 1e, f; ALDRIDGE, 1975, Pl. 1, figs, 22, 23; BARRICK and KLAPPER, 1976, p. 82, Pl. 1, figs. 4, 9, 11, 16; COOPER, 1977b, p. 1065-1066, Pl. 2, figs. 3, 6; LIEBE and REXROAD, 1977, p. 850, Pl. 1, fig. 9; HELFRICH, 1980, Pl. 2, figs. 17-19; NOWLAN, 1981, p. 290, Pl. 7, fig. 6; UYENO and BARNES, 1981, Pl. 1, fig. 24; ALDRIDGE and MOHAMED, 1982, p. 118, Pl. 2, figs. 13-16; BARRICK, 1983, fig. 18 M; MABILLARD and ALDRIDGE, 1983, Pl. 2, figs. 25-27; NOWLAN, 1983, p. 104, fig. 4K; UYENO in UYENO and BARNES, p. 47, Pl. 8, fig. 24; ALDRIDGE, 1985, Pl. 3.3, figs. 7-10; MABILLARD and ALDRIDGE, 1985, p. 95, fig. 7b; NEHRING-LEHFELD, 1985, Pl. 5, figs. 3-8, Pl. 5, figs. 1-7; BISCHOFF, 1986, p. 329, Pl. 30, figs. 19, 20 , p. 331, Pl. 31, figs. 15-27, 31; CRAIG et al., 1986, Pl. 2, figs. 1, 2; NAKREM, 1986, fig. 6 b-d; KLEFFNER, 1987, p. 86, fig. 5 8, 9, 11; OVER and CHATTERTON, 1987b, Pl.

4, figs. 1-3.

Apparat "C" of Walliser, Pl. 4, figs. 8-11.

DESCRIPTION

Elements assigned to the b?, c?, e, f and g positions within the apparatus of P. amorphognathoides have been identified from collections of the Anse à Pierre-Loiselle Formation.

The b? element is asymmetrical with a tall striated cusp over the basal cavity. The posterior process bears at least five laterally compressed and striated denticles. The lateral process is highly reduced and directed downward with at least one striated denticle. The basal cavity is widest under the cusp and is reduced to a groove under each of the processes.

The c? element is almost symmetrical, consisting of a tall cusp with a sharp posterior margin and a flat anterio-lateral process extending downward forming an anticusp. The posterior process is projected downward and has 7 or more laterally compressed denticles. A weakly thickened platform or ridge is present on the lateral portions of the posterior bar. The basal cavity is shallow and deepest under the cusp. The basal cavity becomes a groove posteriorly.

The e element is asymmetrically triangular with a large striated cusp and an anteriorly and downwardly directed anticusp. The posterior margin is convex with a small denticle on the posterior process. Each process exhibits thickening above the aboral margin of the element. The basal cavity is deepest beneath the cusp and reduced to a groove under each process. The inner cusp face is carinate.

The f element is ambalodiform and characterized by fused, laterally compressed denticles on the anterior process that increase in size towards the posterior. The main cusp is situated posteriorly of the mid-length of the element. Denticles on the posterior process are approximately half the height of the denticles anteriorly. The denticles are set on a "platform-like" widening of the element. A blunt adenticulate, outer lateral process projects slightly below the aboral margin of the element.

The g element is characterized by narrow platform ledges, short and round peg-like denticles with a bifurcated lateral process at the mid-length of the element. The basal cavity consists of a narrow basal groove which extends the full length of the element and under the lateral processes.

REMARKS

Complete specimens of this apparatus are rare from collections of the Anse à Pierre-Loiselle Formation and other locally correlated units.

Elements have been tentatively assigned to positions in the ramiform series based on the presence of a thickening above the aboral margin of each element. All elements in this group have deeply striated denticles and basal cavities which become reduced along the processes. Elements belonging to this series are very similar to those in the equivalent positions in C. carnulus. Both taxa exhibit the same thickening above the base of the element, suggesting a possible suprageneric relationship between the two genera.

Barrick and Klapper (1976, Pl. 1, fig. 10) illustrated an element they believed to represent a ramiform element of the apparatus. Aldridge (1985) also illustrated a similar element (Pl. 3.3, fig. 8). No elements of this form were identified from the present collection and therefore cannot be included in the apparatus.

MATERIAL STUDIED

2 b, 3 c, 1 e, 9 f, 20 g

Pterospathodus aff. *P. celloni* (Walliser)

Plate 8, figures 20, 23-27; Plate 9, figures 1-4; Plate 10, figure 4

aff. *Spathognathodus celloni* WALLISER, 1964, Pl. 4, fig. 13, Pl. 14, figs. 3-16, text-fig. 1b, text-fig. 7 b-f.

Multielement

Pterospathodus cf. *P. celloni* (Walliser). NOWLAN, 1983, figs. 4 V, X, Y.

Pterospathodus celloni (Walliser). UYENO *in* UYENO and BARNES, 1983, p. 24, Pl. 5, fig. 24 (e element only); ALDRIDGE, 1985, Pl. 3.1, figs. 26 (f element only).

DESCRIPTION

The 'ramiform' element is an arched blade with a large posteriorly inclined cusp and a denticulate posterior process. Both the posterior and anterior margins of the cusp are sharp, with the cusp being laterally compressed. The anterior margin extends downward to form an anticusp. The inner face of the element has a small flare and the outer face has a small downwardly directed lateral process. The denticles on the main bar are also laterally compressed, proclined and are faintly striated. The basal cavity is deepest under the main cusp reducing to a groove under the posterior process.

The element assigned to the e position of the apparatus is distomodiform, asymmetrical and triangular with a large, striated cusp and an anteriorly and downwardly directed anticusp. The cusp is reclined over the posterior process, which is arched and bears a small proclined denticle. Each process exhibits slight thickening above the aboral margin of the element. The basal cavity is deepest beneath the cusp and reduced to a groove under the anticusp and posterior process. The inner face of the cusp is carinate; carina is grooved near the cusp-base junction.

Elements assigned to the f position (Pl. 9, figs. 3, 4) consist of an ozarkodiniform element with a tall cusp that is vertical to slightly inclined posteriorly. The anterior process bears up to four denticles and is significantly higher than the posterior process that has up to four denticles. Each denticle is laterally compressed and fused for nearly two thirds of its length. The basal cavity is deepest under the cusp and extends laterally under a weak outer lateral flare.

Elements assigned to the g position are rare but variable. Generally, they consist of a spathognathodiform blade with at least eleven subrounded, laterally compressed, low denticles. The lateral process consists of a small protrusion with an associated, oral costa that extends part way up the main cusp (Pl. 8, figs. 25, 27). A small lobe occurs on the opposite side of the lateral process. The basal cavity is largest under the midlength of the element and becomes reduced along the anterior and posterior extensions of the blade. Some g elements (eg. Pl. 8, fig. 26) have highly reduced denticles and a weaker and blunter lateral process. The lateral process of one figured specimen (Pl. 9, figs. 1, 2) bears a single denticle.

REMARKS

The first multielement reconstruction of P. celloni was proposed by Barrick and Klapper (1976) and consisted of four skeletal elements. Elements of P. aff. P. celloni recovered from the present collection are not identical to any of those elements and may represent a new taxon. Although the denticulation varies on the taxonomically significant q element, the inner lateral process distinguishes P. celloni from other species of Pterospathodus. Nowlan (1983) first recognized this variation of P. celloni from his collections in eastern Canada. He did not, however, recognize any elements that could be assigned to the e or ramiform positions of the apparatus. Uyeno in Uyeno and Barnes (1983) (Pl. 5, fig. 24) recognized an M (=e) element identical to those recovered from this study. The remaining elements of their reconstruction of P. celloni do not resemble any other elements of P. aff. P. celloni identified herein. Aldridge (1985, Pl. 3.1, fig. 26) illustrated an element assigned to the Pb (=f) position which is most similar to those assigned to the f position of this reconstruction. His element appears somewhat thinner with less discrete denticulation than the element illustrated from this study (Pl. 9, figs. 3, 4).

MATERIAL STUDIED

1 'ramiform', 2 e, 9 f, 12 q

Pterospathodus? ceragnathoides n.sp.

Plate 9, figures 5-23; Plate 10, figures 1-3, 5, 6, 8-11, 13-17, 19-21

Multielement

Pterospathodus aff. P. amorphognathoides Walliser. NOWLAN, 1981, pp. 291, figs. 2, 3, 5; MANNIK, 1983, p. 117, fig. 5P.

Pterospathodus n. sp. A NOWLAN, 1983, pp. 105, Fig. 4(T, W, Z).

Pterospathodus n. sp. B NOWLAN, 1983, pp. 105, Fig. 4(J, L Q, R, U).

DIAGNOSIS

A new species consisting of four skeletal elements, including; a, c, e, and g.

DESCRIPTION

The a element is small, slightly asymmetrical with a cusp and a posterior process. The cusp is slightly laterally compressed and oval in cross-section. A weak anticusp extends slightly below the lowest downward deflection of the posterior process. The posterior process contains at least three posteriorly reclined denticles which are also oval in cross-section. The aboral margin is highly arched. The basal cavity extends the full length of the element.

The c element is symmetrical, consisting of a cusp, posterior process and two lateral processes. The entire element is deeply striated. The cusp is roughly triangular in cross-section and recurved posteriorly. The posterior process is long and bears at least one large denticle. The denticle is laterally compressed with sharp anterior and posterior margins and is reclined posteriorly with deep striations. Lateral processes are short, antero-posteriorly compressed and downwardly directed. Lateral costae extend from the lateral processes to the full length of the cusp. The basal cavity is deepest under the cusp and reduced under the posterior process.

The e element consists of a large, laterally compressed cusp with a short posterior process bearing 1 or 2 small, triangular striated denticles. The cusp is deeply striated with sharp posterior and anterior margins; inner face is flat, outer lateral face bears a weak costa that is median proximally and anterior distally. The costa continues downward, merging with a basal flare that is produced as a short outer lateral process that in some elements bears a short denticle. The basal cavity is deepest under the cusp and lateral processes are reduced under the posterior process.

Elements assigned to the g position consist of a narrow, laterally compressed blade which is straight to slightly sigmoidal in oral view. The anterior end of the blade is sharply bent towards the inner side in some specimens (Pl. 9, figs. 12, 14). The denticles on the main blade are laterally compressed, triangular and discrete for the full length of the element. Denticles decrease in size both anteriorly and posteriorly and a distinct main cusp is lacking. Each element has a broad inner lateral process situated centrally or slightly anteriorly of the mid-length of the element. This process bears one or more denticles which are arranged in a "V" pattern diverging from the main blade. There is a progression of denticles on the inner lateral process from one denticle to expansion into a nodose platform. On some elements assigned to this position, only a single denticle is present, due to breakage during post mortem transport or processing. All g elements have a distinct furrow separating the inner lateral process from the main blade. On some elements (Pl. 9, figs. 5, 6, 9-11, 13) a large, rounded denticle forms an outer-lateral process, whereas on most elements, only a lateral flare exists. The basal cavity is deeply excavated, reaching its maximum depth beneath the mid-point of the element and lateral processes and reducing both posteriorly and anteriorly.

REMARKS

Nowlan (1981, 1983) was the first to recognize elements of this species and he questionably assigned them to Pterospathodus. He concluded that these elements had an affinity with P. amorphognathoides and that they may in fact represent juvenile forms. Elements occupying the g position of the apparatus lack the expanded blade with associated platform ledges, and the peg-like denticles of P. amorphognathoides, but are more similar to platform elements of P. pennatus.

The basal cavity of this element is striking in contrast to those of P. amorphognathoides in that ?P. ceragnathoides n.sp. has a wide unrestricted basal cavity extending the entire length of the element whereas in elements of P. amorphognathoides the basal cavity is highly reduced and no more than a basal groove.

The platform elements of this new species are variable in both the degree of lateral process development and blade shape. It is suspected that the variation in platform morphology is due to biologic conditions, including the ontogenetic stage of development of the organism or sexual dimorphism between organisms. Figure 33 illustrates the wide variety of g elements ç

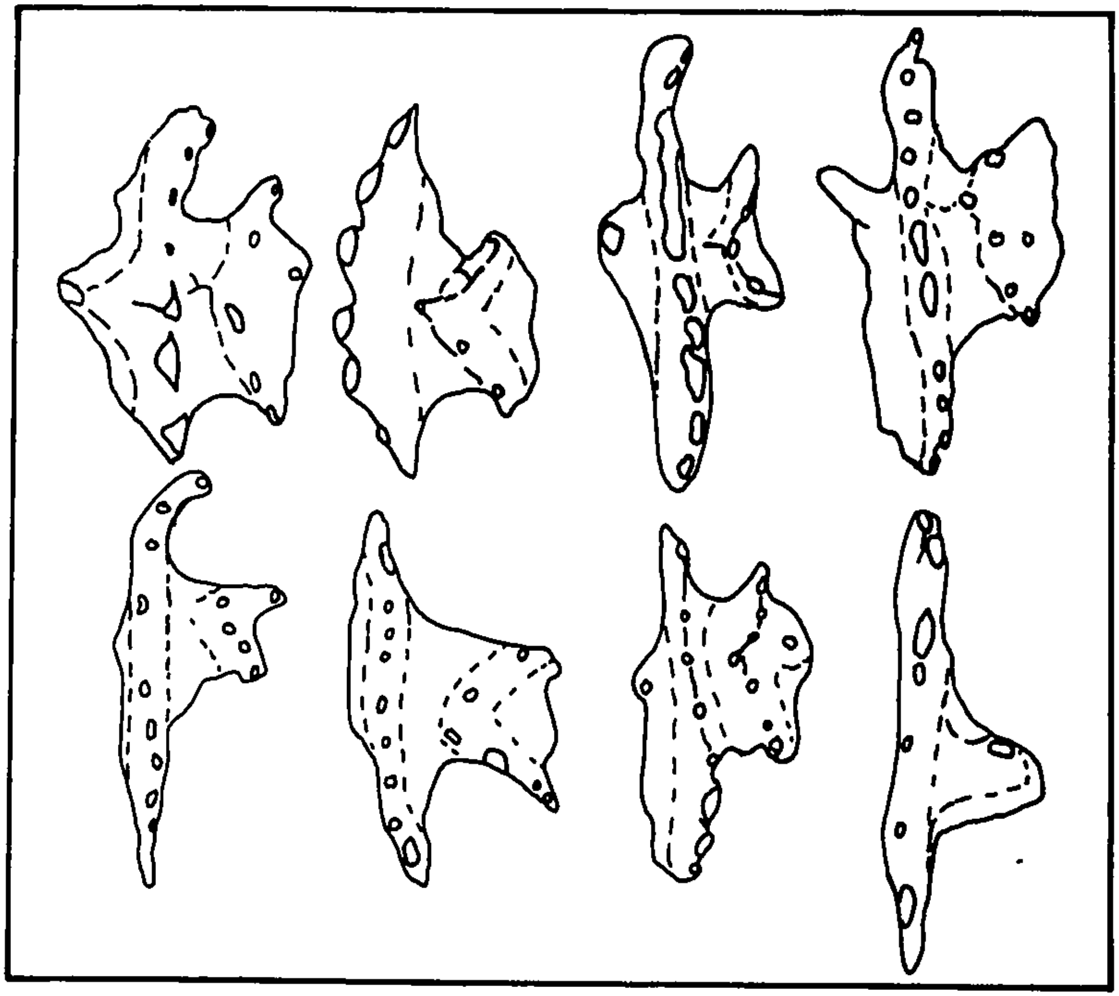

Figure 33. Range of morphologic variation exhibited by recovered specimens of Pterospathodus? ceragnathoides n.sp. Not to scale.

(Pl. 9, figs. 9, 17, 19, 23, 24; Pl. 10, fig. 1) have small lateral processes that bear either a single denticle or are simply thin phosphatic flanges or flares extending from the basal cavity. The denticles on the blade portion of these elements are much thinner than those of later ontogenetic stages. As development of the organism progressed, the elements accumulated more phosphatic material (Pl. 9, figs. 7, 12, 15; Pl. 10 , fig. 17). The final stage or adult stage of growth of the organism would culminate with the maximum amount of phosphatic buildup and the development of an outer lateral process (Pl. 9, figs. 5, 6, 9-11, 13, 14). Elements mentioned above as juvenile forms could be re-interpreted as representing elements occupying the f position in the apparatus. Elements occupying the other positions of the apparatus have little similarity with any other species of Pterospathodus. They are extremely rare. Their rarity may be a result of loss during sample processing due to their small size.

Uyeno in Uyeno and Barnes (1983) identified a new species of Pterospathodus (P. posteritenuis, Pl. 2, figs. 1-11, 14-18) from their collections of the Jupiter Formation on Anticosti Island. This species has a platform element similar to that of P.? ceragnathoides n.sp., however, the denticles on the Pb element of P. posteritenuis are considerably shorter and stouter in appearance. In addition, the denticle arrangement on the main blade is more arched than that of P.? ceragnathoides n.sp.. The other elements he assigned to his new species were not identified from the collections of the Anse à Pierre-Loiselle Formation.

MATERIAL STUDIED

41 a, 36 c, 37 e, 1051 g

DERIVATION OF NAME

From the Greek keras (=horn) and Latin gnathus (=jaw) describing the horn-like nature of the lateral processes of elements occupying the g position of the apparatus.

Pterospathodus pennatus pennatus (Walliser)

Plate 10, figures 22, 23

g element

Spathognathodus pennatus pennatus WALLISER, 1964, Pl. 15, fig. 1, p. 80, text-fig. 1d.

Multielement

Pterospathodus pennatus pennatus (Walliser). ALDRIDGE and MOHAMED, 1982, p. 118, Pl. 2, fig. 12; JEPPSSON, 1983, p. 126, ALDRIDGE, 1985, p. 79, Pl 3.1, figs. 27a, 27b; NAKREM, 1986, p. 127, fig. 6 h.

Pterospathodus pennatus procerus Walliser. OVER and CHATTERTON, 1987b, Pl. 4, fig. 4.

DESCRIPTION

Elements of P. pennatus pennatus have been adequately described by Walliser (1964).

REMARKS

Only elements assigned to the g position of the apparatus were identified from the present collection. The remaining elements of the apparatus are indistinguishable from those belonging to P. celloni and therefore, were not identified separately.

MATERIAL STUDIED

3 g

Pterospathodus pennatus procerus (Walliser)

Plate 10, figure 24

g element

Spathognathodus pennatus procerus WALLISER, 1964, p. 80, Pl. 15, figs. 2-8, text-fig. 1e; IGO and KOIKE, 1968, pp. 18, 19, Pl. 2, figs. 8-11.

Multielement

Llandoverygnathus pennatus (Walliser). ALDRIDGE, 1979, Pl. 1 fig. 11.

Pterospathodus pennatus (Walliser). NOWLAN, 1983, fig. 4S (g element only).

Pterospathodus pennatus procerus (Walliser). BARRICK and KLAPPER, 1976, p. 83, Pl. 1, fig. 19; JEPPSSON, 1979, pp. 235-238, fig. 71(1-8); UYENO and BARNES, 1981, Pl. 1, fig. 23; SAVAGE, POTTER, and GILBERT, 1983, fig. 2(A-F); UYENO in UYENO and BARNES, 1983, P. 24, Pl. 8, figs. 1-3 (includes synonymy to 1983); SAVAGE, 1985, p. 714, fig. 4 A-K; NEHRING-LEFELD, 1985, Pl. 1, figs. 1, 2, Pl. 5, figs. 8, 9.

DESCRIPTION

Elements assigned to the g position of the apparatus of P. p. procerus have been sufficiently described by Walliser (1964).

MATERIAL STUDIED

7 g

5.15 Genus Walliserodus Serpagli, 1967

Type species: Acodus curvatus Branson and Branson, 1947.

REMARKS

Serpagli (1967) was the first to erect the multielement genus Walliserodus for a series of costate simple cone form species. Barrick (1977) discussed the genus extensively and included new elements. He assigned five elements to the multielement apparatus consisting of an e element and four transition series elements (Sd-Sa of Barrick, 1977). The a element is asymmetrical biconvex, b element is asymmetrical triangular, c element is symmetrical triangular, d element is symmetrical biconvex and the e element is acodontiform. Nowlan et al. (1988) recognized two symmetry transition series within the genus Walliserodus (sensu Barnes et al., 1979).

Walliserodus curvatus (Branson and Branson)

Plate 11, figures 1-8

Multielement

Walliserodus curvatus (Branson and Branson). COOPER, 1975, p. 995, Pl. 1, figs. 10, 11, 16-21; MILLER, 1978, Pl. 1, figs. 10-17, REXROAD et al., 1978, p. 12, Pl. 1, figs. 1-5; HELFRICH, 1980, Pl. 2, figs 20, 25; McCRACKEN and BARNES, 1981a, p. 90, Pl. 1, figs. 26-30; NOWLAN et al., 1988, p. 41, Pl. 19, fig. 16.

Walliserodus cf. W. curvatus (Branson and Branson). NOWLAN and BARNES, 1981, p. 49, Pl. 8, figs. 17-24.

DESCRIPTION

Elements assigned to the a position are deeply excavated, simple cones. The basal cavity is flared, "v" shaped and extends to the point of recurvature. The element is asymmetrical and laterally compressed with sharp anterior and posterior margins. The entire surface of the element is deeply striated with the deepest striations concentrated at the base and at the point of recurvature of the element.

Elements in the c position have a deeply excavated basal cavity and a flared basal opening. The surfical striations are concentrated at the base of the element and almost non-existant elsewhere.

Elements assigned to the d position are asymmetrical with a series of secondary lateral costae extending their full length. The walls are very thin and are commonly broken. The anterior and posterior margins are sharp forming a continuous keel. The basal cavity is deep and "v" shaped, extending to the point of recurvature.

REMARKS

Cooper (1975) erected Walliserodus curvatus to represent those elements which include those that occupy the a (Sc) position of the apparatus and which lack costae on the inner lateral face. Cooper's (1975) illustrations do not clearly show the characteristics for which the species is named. Costate elements have more secondary costae than those illustrated by Cooper (1975). As a result, only those specimens that can be positively identified to this species have been included.

Nowlan and Barnes (1981) described elements of W. cf. W. curvatus which are similar to those elements of W. curvatus identified herein.

MATERIAL STUDIED

4 a, 3 e, 3 d

5.16 Genus Indeterminate

Indeterminate fused cones

Plate 11, figures 10, 1

REMARKS

A few specimens of simple cone elements that are fused at the base have been recovered. Individual cones are compressed, triangular and coarsely striated longitudinally. Edges of the cones are sharp and continue as costae from cone to cone on the oral surface. Broad faces of the cone are convex and fluted with the margins being more compressed. Elements are deeply excavated and the aboral margin is irregularly curved.

MATERIAL STUDIED

5 specimens

5.17 MISCELLANEOUS MICROFOSSILS

Order HYOLITHELMINTHES Fisher, 1962

Family Phosphannulidae Muller, Nogami and Lenz

Genus *Phosphannulus* Muller, Nogami and Lenz

Type species: *Phosphannulus universalis* Muller, Nogami and Lenz

Phosphannulus universalis Muller, Nogami and Lenz

Plate 11, figures 14, 15

Phosphannulus universalis MULLER, NOGAMI, and LENZ, 1974, p. 89, Pl. 18, figs. 1-12, Pl. 19, figs. 1-13, Pl. 20, figs. 1-7, Pl. 21, figs. 1-9; NOWLAN *in* BOLTON and NOWLAN, 1979, Pl. 8, fig. 33; NOWLAN, McCRACKEN, and CHATTERTON, 1988, p. 99, Pl. 22, fig. 16.

REMARKS

Elements assigned to this species are interpreted by Muller et al. (1974) to represent adhering discs of organisms belonging to the Order Hyolithelminthes which were attached to the substrate. These specimens are approximately the same size as recovered conodont elements. The specimens assigned to *P. universalis* lack the characteristic tube-like projection as illustrated by Muller et al. (1974, p. 101, fig. 1a-2a) but rather consist of a near symmetrical phosphatic ring consistent with other incomplete specimens described and illustrated by Muller et al. (1974).

MATERIAL STUDIED

3 specimens

Phylum VERTEBRATA

Class PISCES

Order THELODONTA

As a result of fraction separation using heavy liquids, approximately 100 separate thelodont specimens were recovered. Specimens recovered fall into two general shape categories; the oval, corrugated shape (gen. *Katoporus*) and the tear-drop shape (gen. *Thelodus*). Taxonomic classification is beyond the scope of this study and the majority of specimens are being examined by Dr. S. Turner (Queensland Museum, Brisbane, Australia). Several new taxa have been recognized from previous collections of the Anse à Pierre-Loiselle Formation and the Chaleurs Group as a whole. An attempt is made to classify these specimens to the generic level from residual and recent collections. Complete descriptions of thelodonts are given by Gross (1967) and Turner (1973, 1975).

Genus *Katoporus* Gross, 1967

Plate 11, Figures 18, 20

Genus *Thelodus* Pander, 1856

Plate 11, Figures 16, 17

6. PLATES

PLATE 1

Figures 1-21. Apsidognathus sulcatus n.sp.

1, 5. Oral and aboral views, g-1 element, X55, Holotype, MWH001, GSC loc. 98140.

2, 6. Oral and aboral views, g-1 element, X39, Paratype, MWH002, GSC loc. 98104.

3, 7. Oral and aboral views, g-1 element, X49, Paratype, MWH003, GSC loc. 102671.

4, 8. Oral and aboral views, g-1 element, X32, Paratype, MWH004, GSC loc. 102687.

9. Lateral view of denticulation, f element, X91, MWH005, GSC loc. 98104.

10, 11. Inner and outer lateral views, f element, X37, Paratype, MWH005, GSC loc. 98104.

12, 13. Inner and outer lateral views, f element, X80, Paratype, MWH006, GSC loc. 98140.

14, 16. Oral and aboral views, g-2 element, X69, Paratype, MWH007, GSC loc. 98140.

15, 17. Oral and aboral views, g-2 element, X69, Paratype, MWH008, GSC loc. 98104.

18, 19. Lateral and oral views, e element, X78, X69, Paratype, MWH009, GSC loc. 98104.

20, 21. Oral and aboral views, e element, X77, Paratype, MWH010, GSC loc. 98192.

More elements of A. sulcatus n. sp. are illustrated in Plate 2.

PLATE 2

Figures 1-3. Apsidognathus sulcatus n.sp.

1. Postero- oral view, 'ramiform' element, X82, Paratype, MWH011, GSC loc. 98104.
2. Anterior view, 'ramiform' element, X69, Paratype, MWH011, GSC loc. 98104.
3. Oral- oblique view, 'ramiform' element, X82, Paratype, MWH011, GSC loc. 98104.

Figures 4, 5. ?Astropentagnathus irregularis Mostler

4, 5. Oral and aboral views, g element, X48, MWH012, GSC loc. 98184.

Figures 6, 7. Aulacognathus bullatus (Nicoll and Rexroad)

6, 7. Oral and aboral views, g element, X66, Hypotype, MWH013, GSC loc. 98129.

Figures 8-21. Carniodus carnulus Walliser

8, 9. Inner and outer lateral views, g element, X160, Hypotype, MWH014, GSC loc. 102698.

10. Lateral view, c element, X117, Hypotype, MWH015, GSC loc. 98241.

11, 12. Inner and outer lateral views, f element, X93, MWH016, GSC loc. 98184.

13. Posterior view, c element, X69, MWH015, GSC loc. 98241.

14, 15. Inner and outer views, e element, X141, Hypotype, MWH017, GSC loc. 98113.

16, 17. Outer and inner lateral views, b? element, X118, MWH018, GSC loc. 98241.

18, 19. Inner and outer views, b element, X94, Hypotype, MWH019, GSC loc. 98241.

20, 21. Outer and inner lateral views, a element, X103, Hypotype, MWH020, GSC loc. 98241.

Figures 22, 23, 26, 27. Dapsilodus? sp.

22, 23. Outer and inner lateral views, a element, X105, MWH021, GSC loc. 98107.

26, 27. Outer and inner lateral views, a element, X105, MWH022, GSC loc. 98100.

Figures 24, 25. Digitodontus bellistriatus n.gen, n.sp.

24, 25. Posterior and anterior views, c element, X160, Holotype, MWH023, GSC loc. 98108.

More elements of D. bellistriatus n.gen, n.sp. are illustrated in Plate 3.

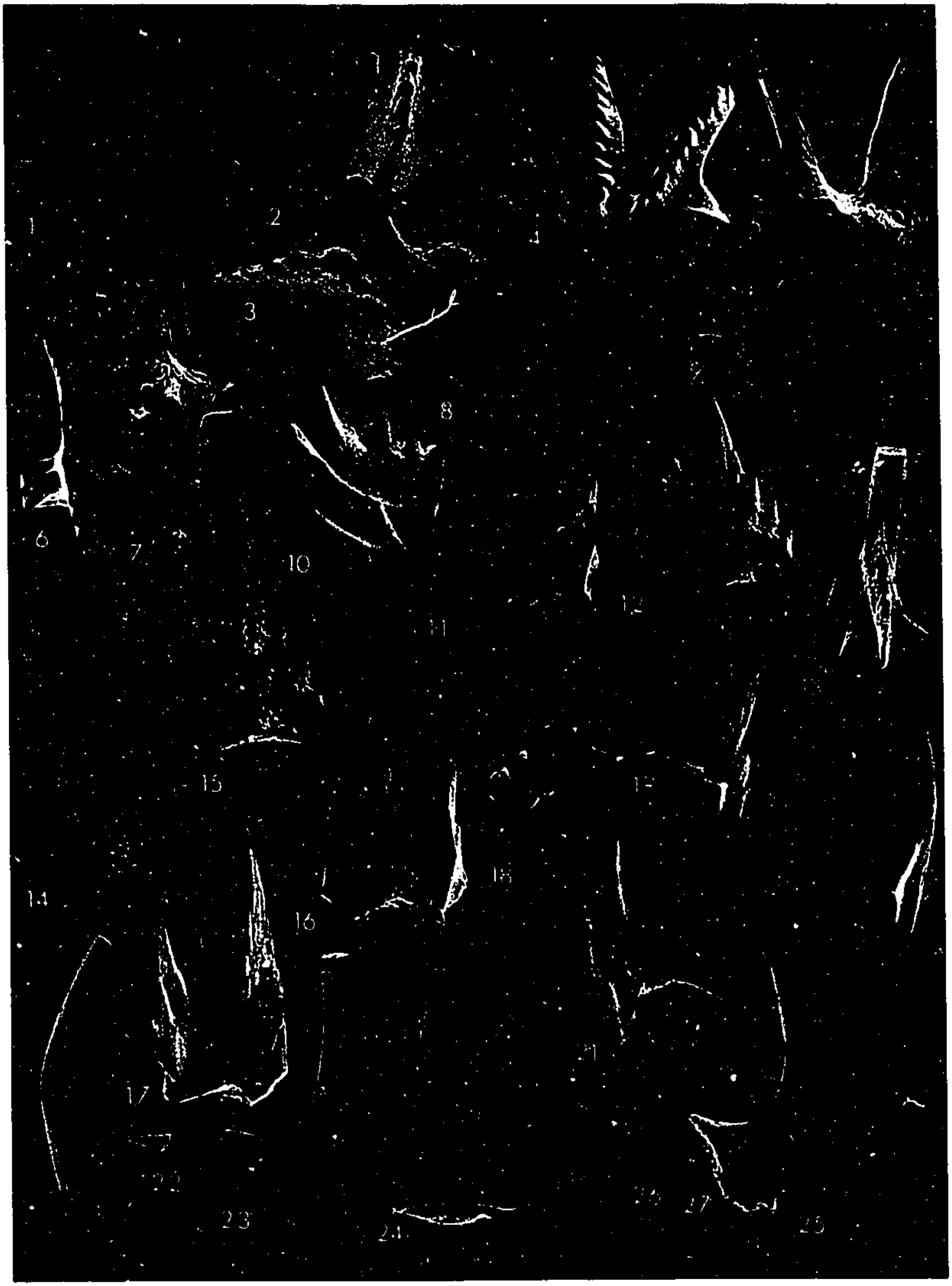

PLATE 3

Figures 1-7. Digitodontus bellistriatus n.gen., n.sp.

1, 2. Inner and outer lateral views, b? element, X123, Paratype, MWH024, GSC loc. 98241.

3. Inner view, a? element, X91, Paratype, MWH025, GSC loc. 98236.

4, 5. Inner and outer lateral views, a element, X96, Paratype, MWH026, GSC loc. 98236.

6, 7. Outer and inner views, b element, X105, Paratype, MWH027, GSC loc. 98108.

Figures 8-27, Distomodus staurognathoides (Walliser)

8, 9. Oral and aboral views, g element, X35, Hypotype, MHW028, GSC loc. 98105.

10, 11. Oral and aboral views, g element, X59, X55, Hypotype, MWH029, GSC loc. 98241.

12, 13. Oblique antero- lateral and oblique postero-lateral views f element, X76, Hypotype, MWH030, GSC loc. 98105.

14, 15. Oblique aboro- lateral and oblique oral views, f element, X91, Hypotype, MWH031, GSC loc. 98108.

16, 17. Oblique anterior and postero- lateral views, f element, X78, MWH032, GSC loc. 98105.

18, 19. Antero-lateral and posterior views, b element, X49, X41, Hypotype, MWH033, GSC loc. 98105.

20, 21. Inner and outer lateral views, a element, X47, MWH034, GSC loc. 98105.

22, 23. Outer and inner lateral views, e element, X35, Hypotype, MWH035, GSC loc. 98105.

24, 25. Outer and inner lateral views, a? element, X50, X52, MWH036, GSC loc. 102678.

26, 27. Lateral and oblique posterior views, c element, X49, Hypotype, MWH037, GSC loc. 98105.

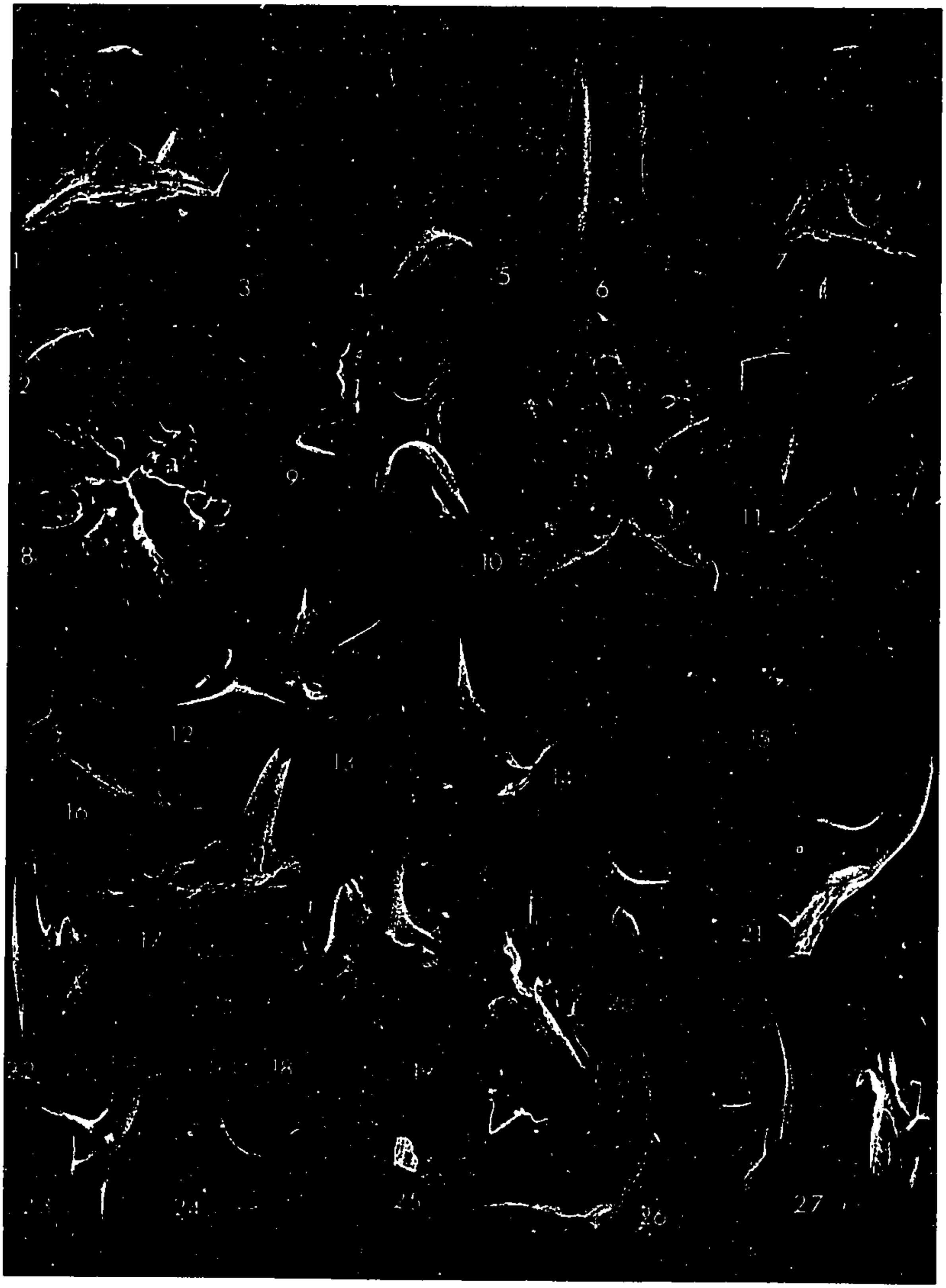

PLATE 4

Figures 1, 2, 7, 9 Distomodus staurognathoides (Walliser)

1, 2. Oral and aboral views, "huddlei" element, X35, MWH038, GSC loc. 98105.

7. Oral view, "huddlei" element, X82, MWH041, GSC loc. 98246.

9. Oral view, "huddlei" element, X43, MWH043, GSC loc. 102669.

Figures 3-6, 8, 10, 11 Johnognathus huddlei Mashkova

3, 4. Oral and aboral views, g? element, X32, MWH039, GSC loc. 98105.

5, 6. Oral and aboral views, g? element, X59, MWH040, GSC loc. 102638.

8. Oral view, g? element, X33, MWH042, GSC loc. 98161.

10, 11. Oral and lateral views, "huddlei" element, X52, X62, MWH044, GSC loc. 98241.

Figures 12, 13. Kockelella ranuliformis (Walliser)

12, 13. Latero- oblique and oro- oblique views, g element, X51, Hypotype, MWH045, GSC loc. 98140.

Figures 14-23. Oulodus? fluegeli (Walliser)

14, 15. Anterior and posterior views, g element, X87, MWH046, GSC loc. 98105.

16, 17. Inner and outer lateral views, f element, X82, MWH047, GSC loc. 98105.

18, 19. Outer and inner lateral views, f element, X78, MWH048, GSC loc. 98105.

20, 21. Inner and outer views, g element, X55, MWH049, GSC loc. 98105.

22, 23. Posterior and anterior views, c element, X91, MWH049, GSC loc. 98105.

Figures 24-30. Oulodus? kentuckyensis (Branson and Branson)

24, 25. Posterior and anterior views, g element, X51, Hypotype, MWH050, GSC loc. 102673.

27, 28. Posterior and anterior views, f element, X50, Hypotype, MWH052, GSC loc. 102673.

29, 30. Anterior and postero- oral views, b element, X62, Hypotype, MWH053, GSC loc. 102673.

Figure 26. Distomodus staurognathoides (Walliser)

26. Oral view, g element, X38, Hypotype, GSC type no. 66551, GSC loc. 96040.

More elements of O.? kentuckyensis are illustrated in Plate 5.

PLATE 5

Figures 1-6. Oulodus? kentuckyensis (Branson and Branson)

1, 2. Outer and inner lateral views, a element, X73, Hypotype, MWH054, GSC loc. 102673.

3, 4. Posterior and anterior views, c element, X52, Hypotype, MWH055, GSC loc. 102673.

5, 6. Anterior and posterior lateral views, e element, X58, Hypotype, MWH056, GSC loc. 102673.

Figures 7-21, 24, 25. Ozarkodina confluens (Branson and Mehl)

7, 8. Posterior and anterior views, c element, X64, X55, Hypotype, MWH058, GSC loc. 98105.

9, 10. Posterior and anterior views, b element, X82, Hypotype, MWH059, GSC loc. 98105.

11, 12. Anterior and posterior views, e element, X69, X91, Hypotype, MWH060, GSC loc. 98099.

13, 14. Inner and outer lateral views, f element, X80, X73, Hypotype, MWH061, GSC loc. 98105.

15, 16. Inner and outer lateral views, g alpha morphotype element, X39, Hypotype, MWH062, GSC loc. 98099.

17, 18. Inner and outer views, g gamma morphotype element, X45, Hypotype, MWH063, GSC loc. 98099.

19, 20. Outer and inner lateral views, a element, X82, X98, Hypotype, MWH064, GSC loc. 98105.

23, 24. Outer and inner lateral views, a element, X73, Hypotype, MWH065, GSC loc. 98105.

Figures 21, 22, 25, 26. Ozarkodina excavata excavata (Branson and Mehl)

21, 22. Inner and outer lateral views, a element, X80, Hypotype, MWH066, GSC loc. 98130 (specimen broke during re-mounting for SEM).

25, 26. Anterior and posterior views, b element, X80, Hypotype, MWH067, GSC loc. 98130.

More elements of O. excavata excavata are illustrated in Plate 6.

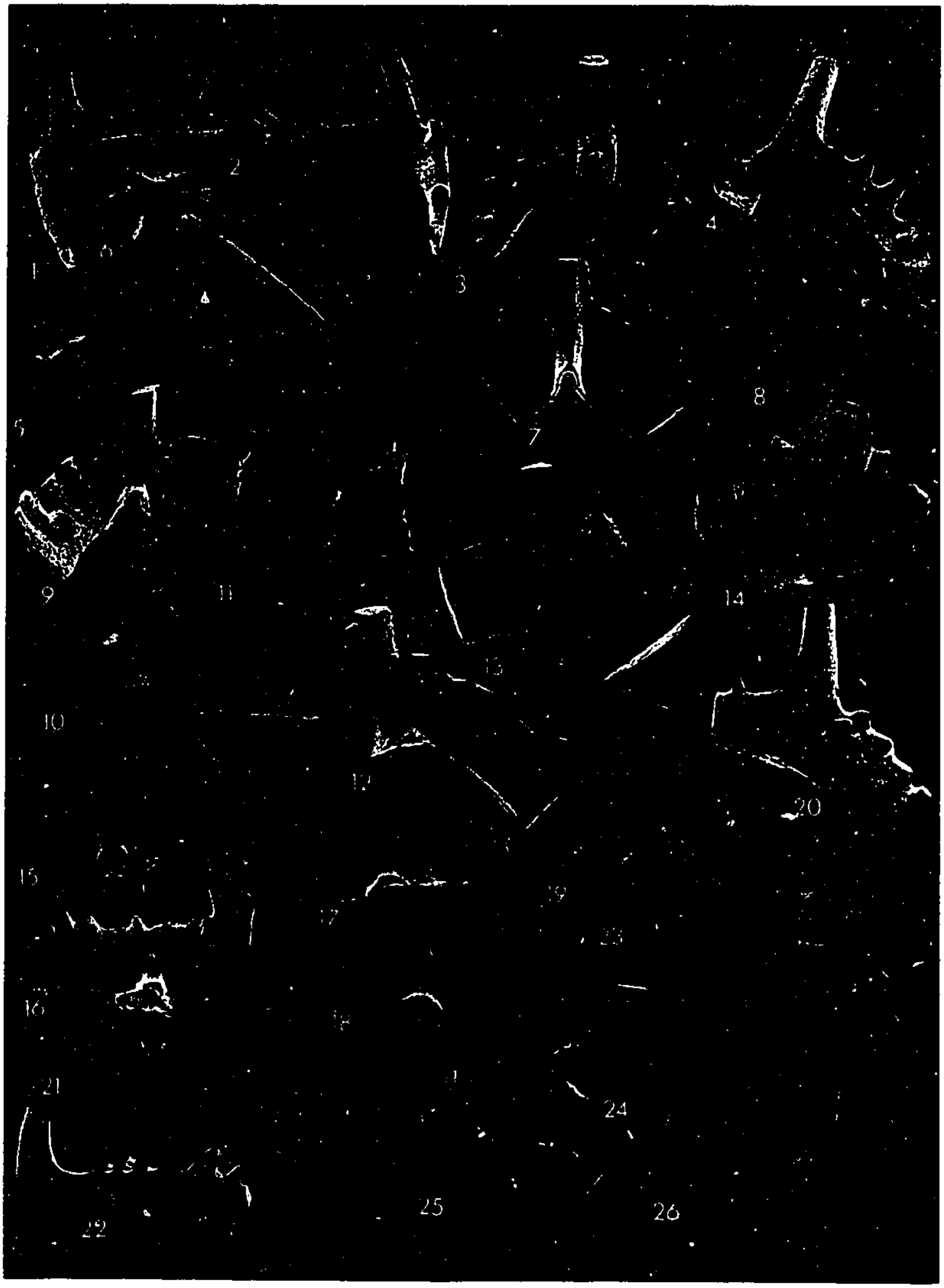

PLATE 6

Figures 1-8. Ozarkodina excavata excavata (Branson and Mehl)

1, 2. Posterior and anterior views, c element, X55, Hypotype, MWH068, GSC loc. 98130.

3, 4. Anterior and posterior views, e element, X96, Hypotype, MWH069, GSC loc. 98130.

5, 6. Outer and inner lateral views, f element, X44, Hypotype, MWH070, GSC loc. 98130.

7, 8. Outer and inner views, g element, X58, Hypotype, MWH071, GSC loc. 98130.

Figures 9-22. Ozarkodina gulletensis (Aldridge)

9, 10. Outer and inner lateral views, f element, X34, X40, Hypotype, MWH072, GSC loc. 98120.

11, 12. Outer and inner lateral views, f element, X31, Hypotype, MWH073, GSC loc. 102677.

13, 14. Anterior and posterior views, e element, X44, Hypotype, MWH074, GSC loc. 102670.

15, 16. Outer and inner lateral views, g element, X49, Hypotype, MWH075, GSC loc. 102677.

17, 18. Posterior and anterior views, c elemen X42, Hypotype, MWH076, GSC loc. 102670.

19, 20. Posterior and anterior views, b? element, X32, MWH077, GSC loc. 98098.

21, 22. Inner and outer lateral views, g element, X21, Hypotype, MWH077, GSC loc. 98120.

Figures 23, 24. *Ozarkodina hadra* (Nicoll and Rexroad)

23, 24. Outer and inner lateral views, g element, X50, Hypotype, MWH078, GSC loc. 98120.

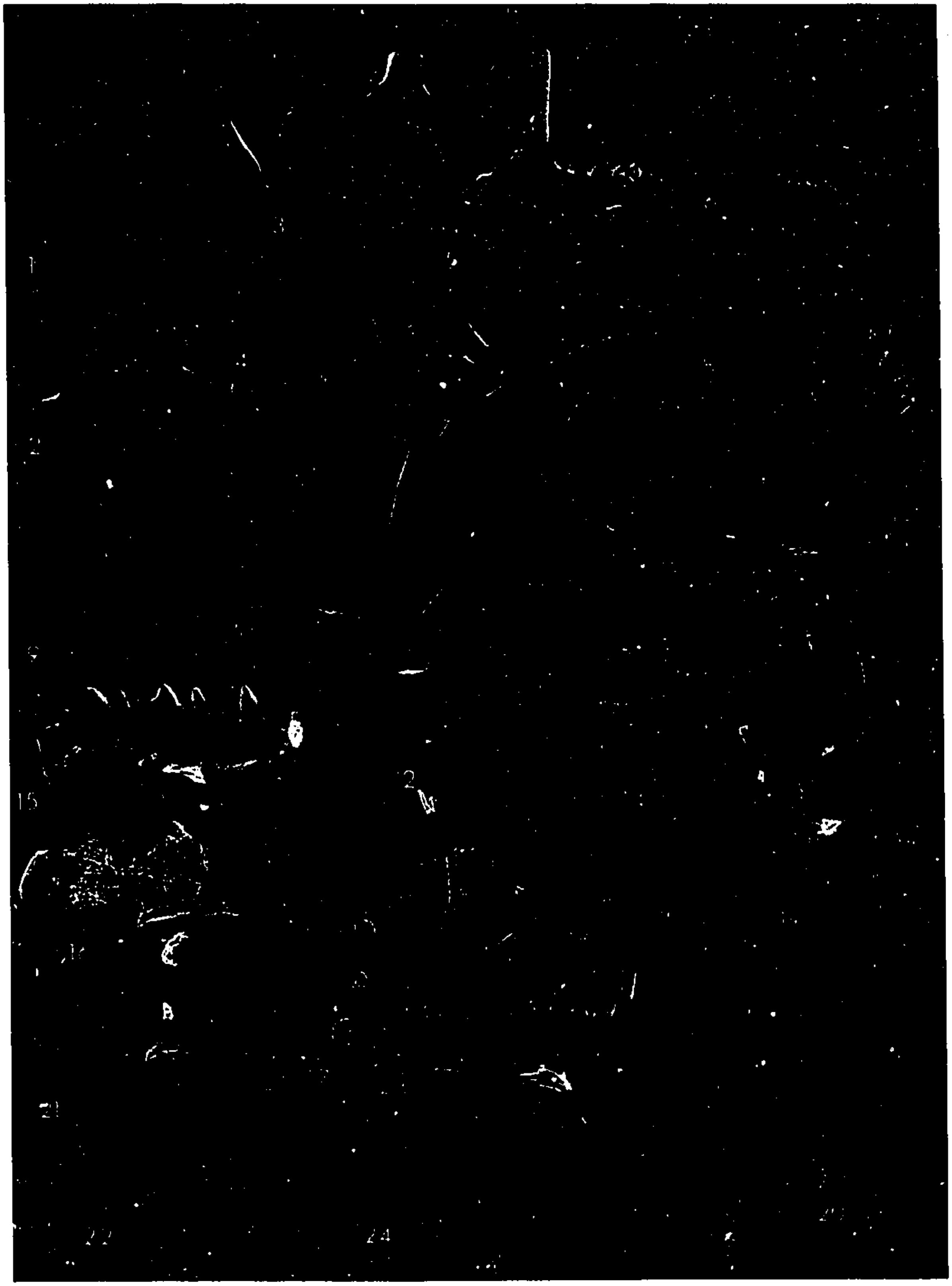

PLATE 7

Figures 1, 2. Ozarkodina aff. O. pirata Uyeno

1, 2. Outer and inner lateral views, g element, X78, Hypotype, MWH079, GSC loc. 98200.

Figures 3-8. Ozarkodina n.sp. A

3, 4. Postero- lateral and antero- lateral views, b element, X69, Figured specimen, MWH080, GSC loc. 98098.

5, 6. Postero- lateral and antero- lateral views, a element, X57, Figured specimen, MWH081, GSC loc. 98098.

7, 8. Postero- lateral and antero- lateral views, f element, X46, Figured specimen, MWH082, GSC loc. 98098.

Figures 10, 11, 16, 22, 23. Panderodus recurvatus (Rhodes)

10. Lateral view, b element, X73, Hypotype, MWH085, GSC loc. 98236.

11. Lateral view, c element, X78, Hypotype, MWH086, GSC loc. 98236.

16. Inner lateral view, c element, X64, Hypotype, MWH087, GSC loc.98241.

22, 23. Inner and outer lateral views, c element, X55, X75, Hypotype, MWH088, GSC loc. 98236.

Figures 12, 13 Panderodus gibber Nowlan and Barnes

12, 13. Outer and inner lateral views, symmetrical element, X82, Hypotype, MWH089, GSC loc. 98241.

Figures 14, 15. Panderodus sp.

14, 15. Outer lateral and posterior views, diagenetically altered panderodan element, X64, X73, MWH091, GSC loc. 102708.

Figures 17, 18, 19 Panderodus panderi (Stauffer)

17. Inner lateral view, b/c element, X59, Hypotype, MWH084, GSC loc. 102674.

18, 19. Inner and outer lateral views, a/b element, X96, Hypotype, MWH090, GSC loc. 102674.

Figure 20, 21, 24-27. Panderodus unicostatus (Branson and Mehl)

20, 21. Inner and outer lateral views, graciliform element, X55, Hypotype, MWH092, GSC loc. 98241.

24, 25. Inner and outer lateral views, arcuatiform element, X50, Hypotype, MWH093, GSC loc. 98241.

26, 27. Inner and outer lateral views, compressiform element, X48, Hypotype, MWH094, GSC loc. 98241.

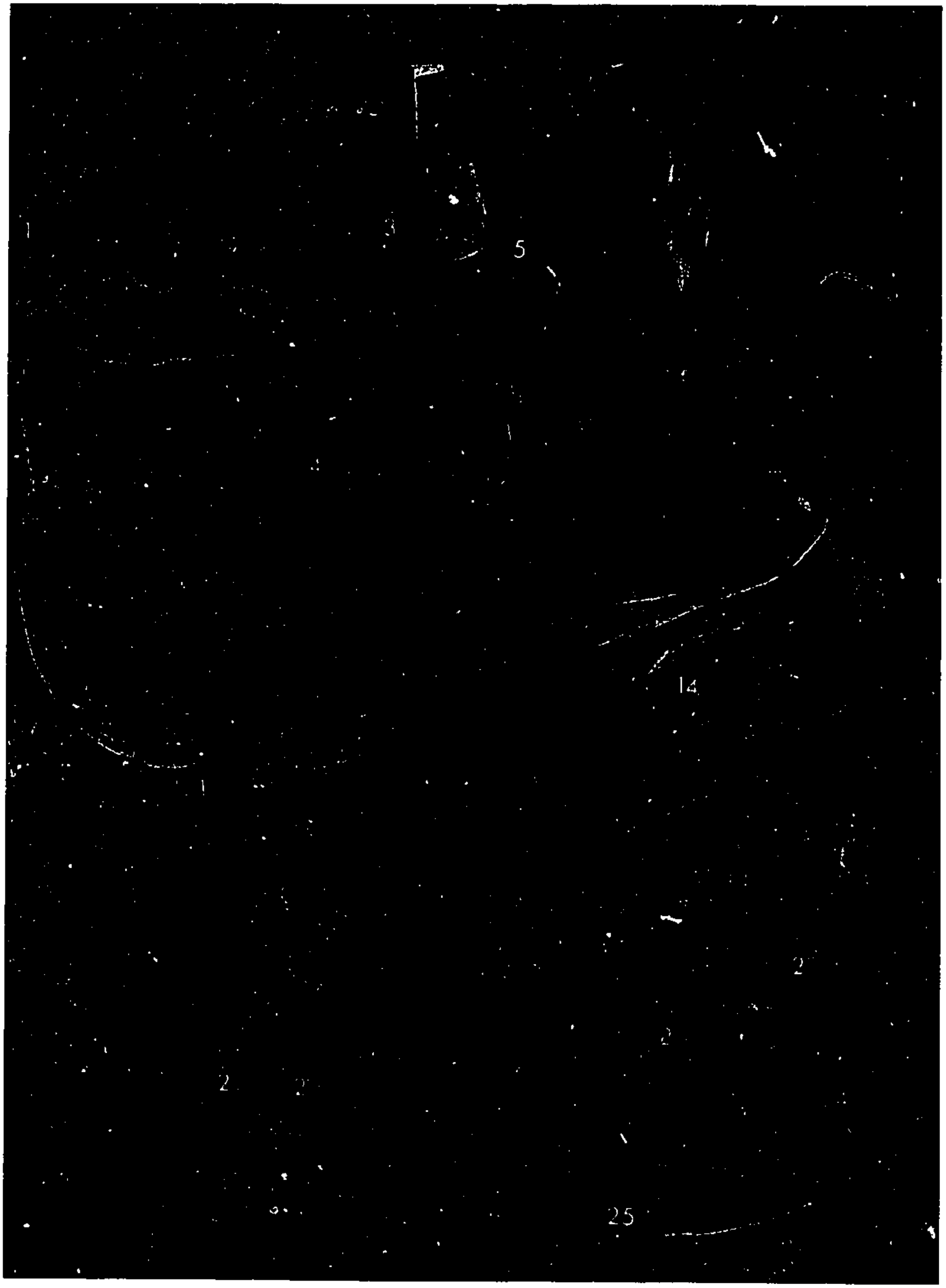
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PLATE 8

Figures 1-4. Pseudooneotodus beckmanni (Bischoff and Sannemann)

1, 2. Lateral and oblique oral views, X104, Hypotype, MWH095, GSC loc. 98236.

3, 4. Oral and oblique aboral views, X123, Hypotype, MWH096, GSC loc. 98192.

Figures 5, 6. Pseudooneotodus pyramis n.sp.

5, 6. Lateral and oblique oral views, X133, Holotype, MWH096, GSC loc. 98154.

Figures 7-19, 21, 22. Pterospathodus amorphognathoides Walliser

7, 8. Oral and aboral views, g element, X52, Hypotype, MWH097, GSC loc. 102690.

9, 10. Oral and aboral views, g element, X57, Hypotype, MWH098, GSC loc. 98241.

11, 12. Outer lateral and oral views, g element fragment, X50, MWH099, GSC loc. 98133.

13. Oral view, g element fragment, X82, MWH100, GSC loc. 98169.

14, 15. Inner and outer lateral views, c element, X82, Hypotype, MWH101, GSC loc. 102690.

16, 17. Inner and outer latral views, f element, X64, Hypotype, MWH102, GSC loc. 102690.

18, 19. Inner and outer lateral views, c element, X55, Hypotype, MWH103, GSC loc. 98200.

21. Lateral views, e element, X119, Hypotype, MWH104, GSC loc. 98241.

22. Inner lateral view, b element, X50, Hypotype, MWH105, GSC loc. 102690.

Figures 20, 23-27. Pterospathodus aff. P. celloni (Walliser)

20. Antero- lateral view, e element, X73, Hypotype, MWH155, GSC loc. 102699.

23, 24. Outer and inner lateral views, 'ramiform' element, X59, MWH106, GSC loc. 102674.

25. Oblique inner lateral view, g element, X76, MWH107, GSC loc. 98241.

26. Oral view, g element, X42, Hypotype, MWH108, GSC loc. 102638.

27. Inner lateral view, g element, X76, MWH109, GSC loc. 98241.

More elements of Pterospathodus aff. P. celloni are illustrated in Plate 9.

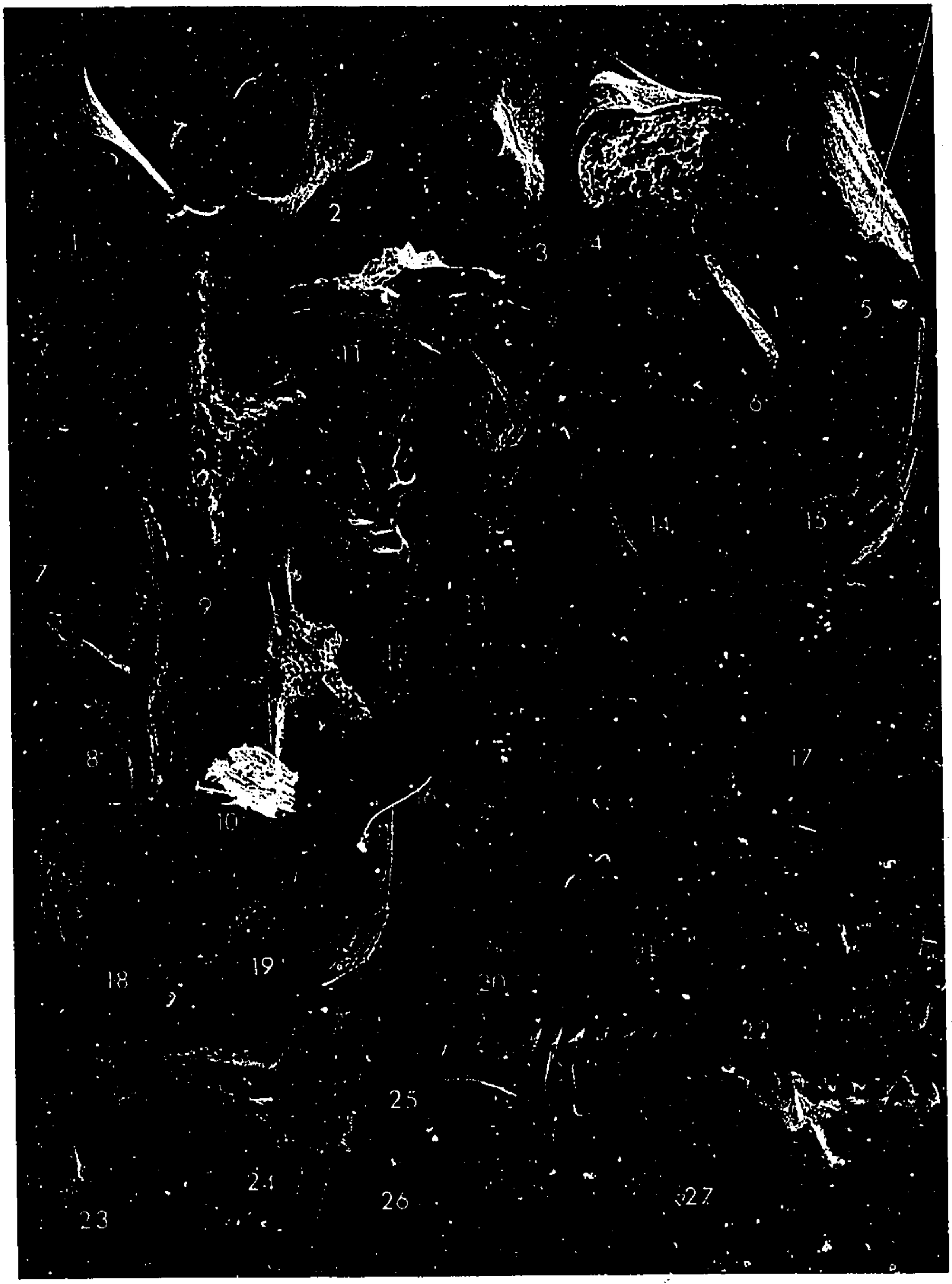
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PLATE 9

Figures 1-4. Pterospathodus aff. P. celloni (Walliser)

1, 2. Inner lateral view and detailed view of inner lateral process, g element, X42, X64, MWH110, GSC loc. 102638.

3, 4. Inner and outer lateral views, f element, X59, Hypotype, MWH111, GSC loc. 102674.

Figures 5-23. Pterospathodus? ceragnathoides n.sp.

5, 6. Oral and aboral views, g element, X73, Paratype, MWH112, GSC loc. 102671.

7, 8. Oral and inner lateral views, g element, X120, Holotype, MWH113, GSC loc. 98095.

9, 10. Oral and outer lateral views, g element, X84, Paratype, MWH114, GSC loc. 98097.

11. Oral view, g element, X69, Paratype, MWH115, GSC loc. 98095.

12. Oral view, g element, X96, Paratype, MWH116, GSC loc. 98130.

13, 14. Oral and aboral views, g element, X78, Paratype, MWH117, GSC loc. 98236.

15. Oral view, g element, X59, Paratype, MWH118, GSC loc. 98130.

16. Oral view, g element, X104, Paratype, MWH119, GSC loc. 98109.

17. Inner lateral view, g element, X104, Paratype, MWH120, GSC loc. 98109.

18. Inner lateral view, g element, X105, Paratype, MWH121, GSC loc.

98130.

19. Inner lateral view, q element, X111, MWH122, GSC loc. 98095.

20. Inner lateral view, q element, X80, Paratype, MWH123, GSC loc. 98095

21. Inner lateral view, q element, X69, Paratype, MWH124, GSC loc. 102671.

22, 23. Inner and outer lateral views, q element, X110, MWH125, GSC loc. 102669.

More elements of Pterospathodus? ceragnathoides n.sp. are illustrated in Plate 10.

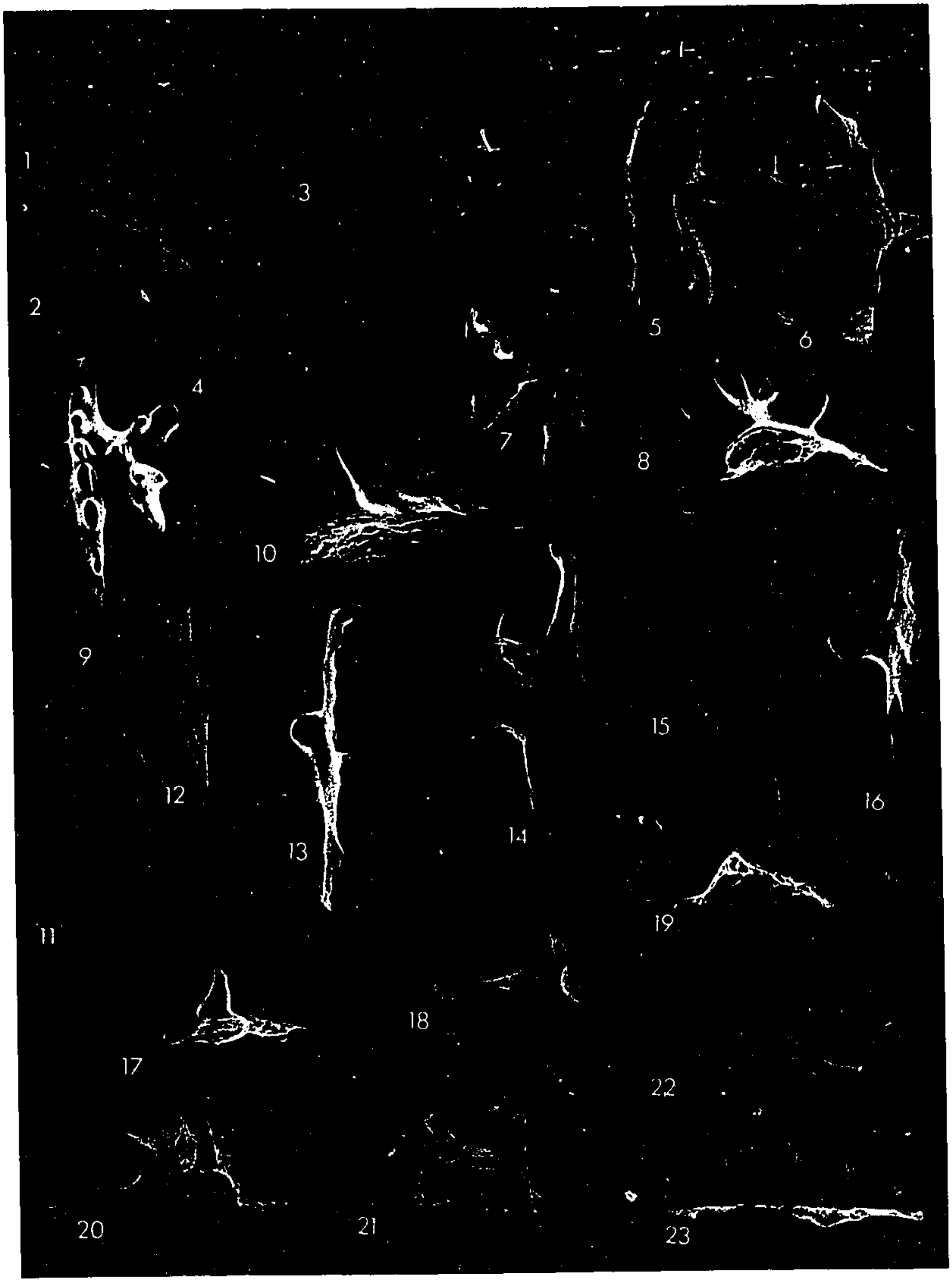
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PLATE 10

Figures 1-3 Pterospathodus? ceragnathoides n.sp.

1. Inner lateral view, g element, X69, Paratype, MWH126, GSC loc. 98241.

2, 3. Outer and inner lateral views, e element, X137, Paratype, MWH127, GSC loc. 98130.

Figure 4. Pterospathodus aff. P. celloni (Walliser)

4. Outer lateral view, e element, X69, MWH128, GSC loc. 98241.

Figures 5, 6, 8-11, 13-17, 19-21. Pterospathodus? ceragnathoides n.sp.

5, 6. Outer and inner lateral views, a element, X142, Paratype, MWH129, GSC loc. 98241.

8, 9. Inner and outer lateral views, e element, X94, Paratype, MWH131, GSC loc. 98139.

10, 11. Outer and inner lateral views, a element, X151, Paratype, MWH132, GSC loc. 102669.

13, 14. Inner and outer lateral views, e element, X87, Paratype, MWH132, GSC loc. 98242.

15, 16. Lateral views, c element, X148, Paratype, MWH133, GSC loc. 102669.

19, 21. Inner and outer lateral views, e element, X148, Paratype, MWH136, GSC loc. 98095.

20. Posterior view, c element, X148, Paratype, MWH148, GSC loc. 98130.

17. Oral view, g element, X81, GSC type no. 66569, GSC loc. 98039.

Figures 22, 23. Pterospathodus pennatus pennatus (Walliser)

22, 23. Inner lateral and oral views, g element, X58, Hypotype, MWH137, GSC loc. 98095.

Figure 24. Pterospathodus pennatus procerus (Walliser)

24. Oral view, g element, X69, Hypotype, MWH138, GSC loc. 98241.

Figures 7, 12, 18. Indeterminate ramiform elements

7, 12. Outer and inner lateral views, c element, X78, MWH130, GSC loc. 98245.

18. Inner lateral view, e? element, X64, MWH135, GSC loc. 98184.

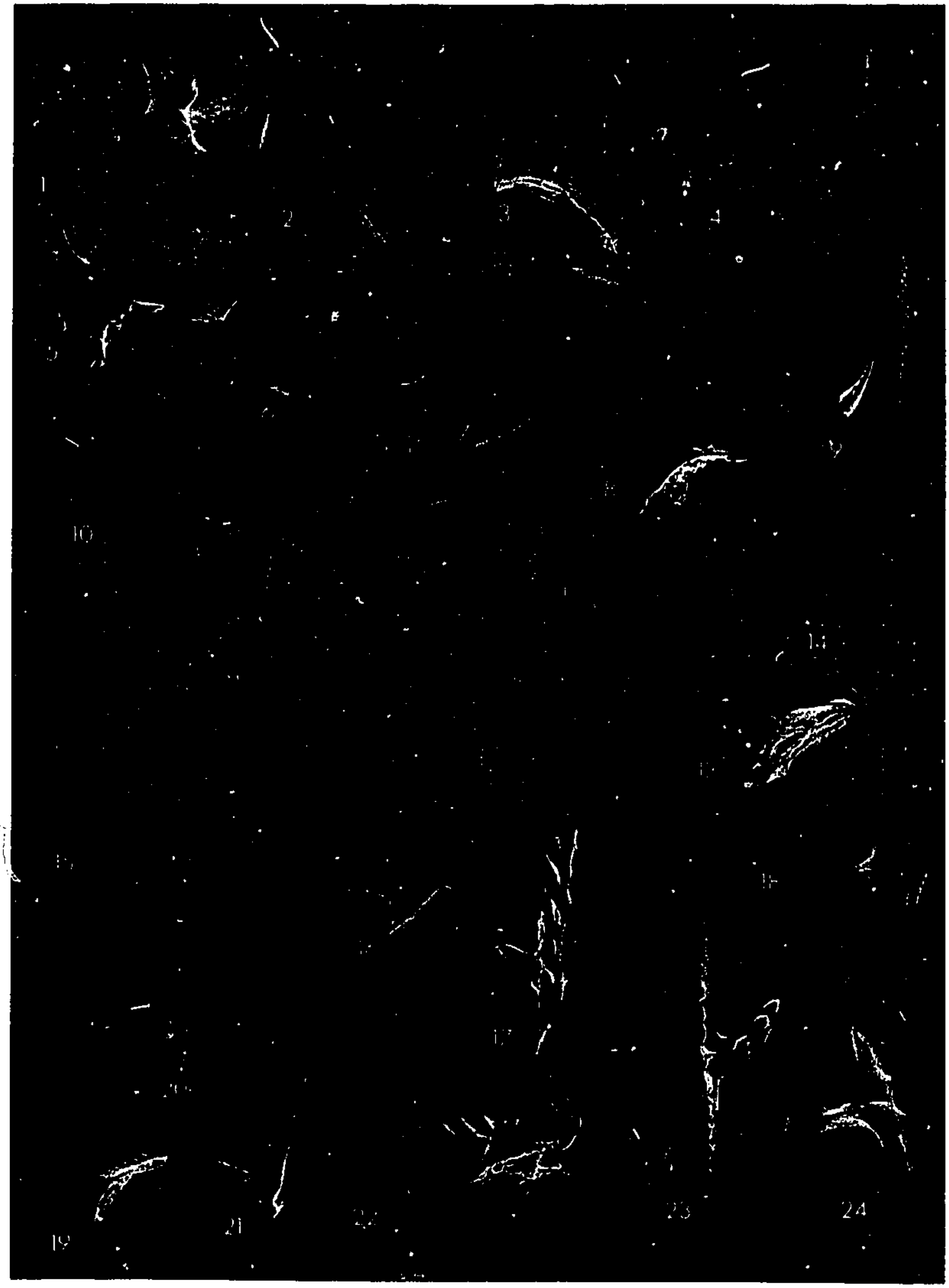


PLATE 11

Figures 1-8. Walliserodus curvatus (Branson and Branson)

1, 2. Outer and inner lateral views, d element, X91, MWH139, GSC loc. 98241.

3, 4. Outer and inner lateral views, a element, X73, MWH140, GSC loc. 98241.

5, 6. Inner and outer lateral views, d element, X73, MWH141, GSC loc. 98241.

7, 8. Inner and outer lateral views, e element, X78, MWH142, GSC loc. 98039.

Figures 9, 11 Ozarkodina aff. O. pirata Uyeno

9. Posterior view, b element, X152, Figured specimen MHW152, GSC loc. 98242.

11. Posterior view, c element, X154, Figured specimen MWH151, GSC loc. 98242.

Figures 10, 12. Indeterminate fused cones

10, 12. Oblique oral and lateral views, X168, MWH143, GSC loc. 98241.

Figure 13. Distomodus staurognathoides? (Walliser)

13. Oral view of a fragment, *q*? element, X81, MWH154, GSC loc. 98169.

MISCELLANEOUS MICROFOSSIL MATERIAL

Figures 14, 15. *Phosphanulus universalis* Muller et al.

14, 15. Upper and lower views, X81, MWH146, GSC loc. 98236.

Figures 16, 17. *Thelodus* sp.

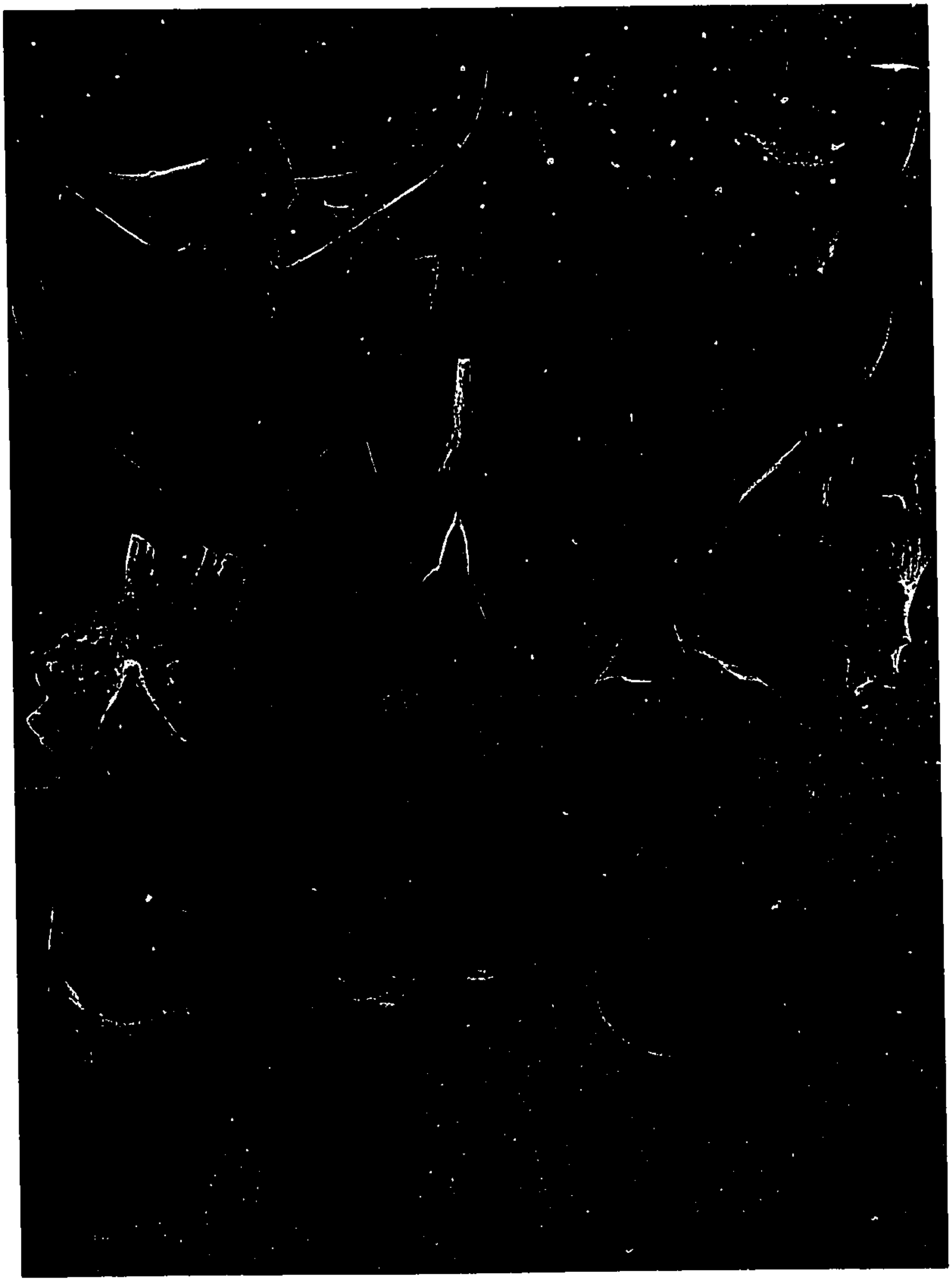
16, 17. Upper and lower views, X82, MWH145, GSC loc. 102679.

Figures 18, 20. *Kataporus* sp.

18, 20. Lateral and upper views, X75, MWH144, GSC loc. 98241.

Figure 19. Indeterminate juvenile brachiopod.

19. X32, MWH147, GSC loc. 98169.



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8. APPENDIX A

Appendix A contains the field logs of the six sections examined. Each section was measured from the base. Lithological descriptions generally refer to the sampled lithology for conodonts.

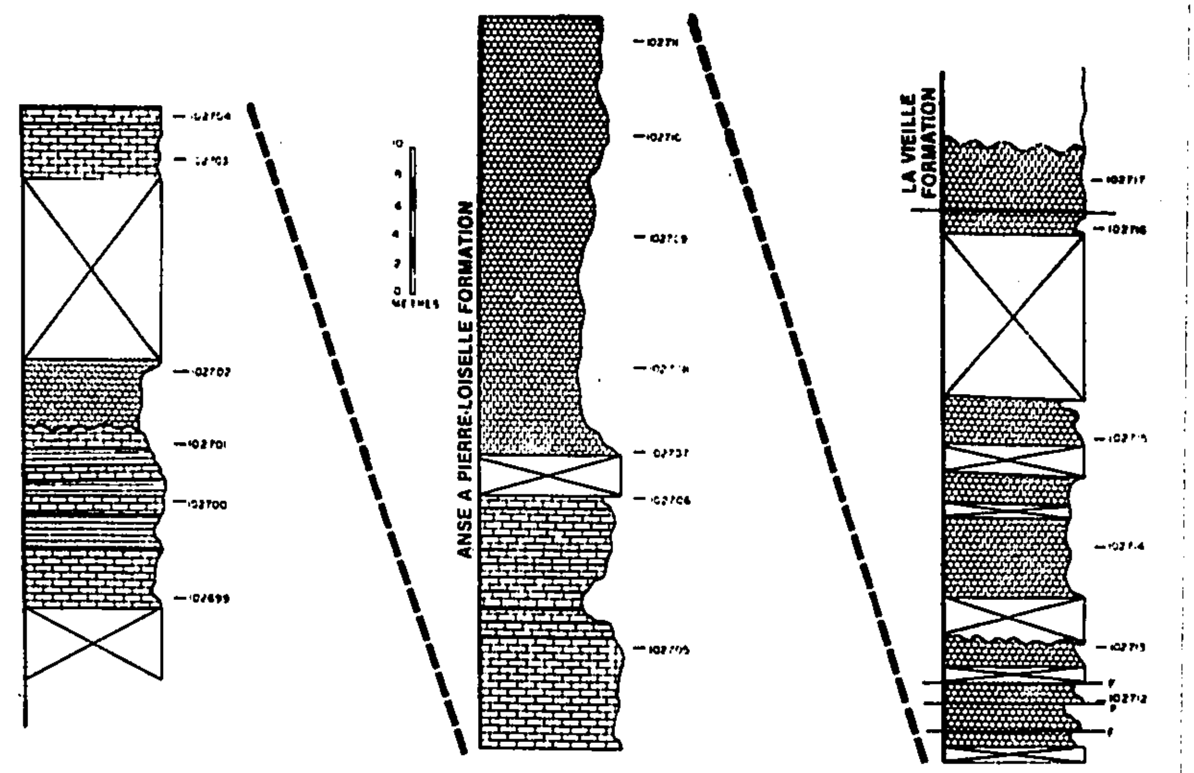

Figure 34. Stratigraphic section of the Black Cape Section with sample locations.

Black Cape (Section I)

GSC loc. no. 102699 to 102717 collected in 1987.

The Black Cape Section, Section I, is located on the north shore of Chaleurs Bay at the town of New Richmond (NTS. 022A/03). The strata are exposed 400m west of the Consolidated Bathurst wharf in the village of Black Cape (Lat. 48° 08' 50"N, Long. 065° 50' 24"W).

The base of the Black Cape Section is only exposed at low tide. The lowermost portion of this section is composed of a highly clastic unit (member 1) consisting of calcareous sandstone with minor calcisiltite, calcarenite lenses and nodular calcilutite interbeds.

Conodont sample (GSC loc. no.)	Sample level above base of section(m)	Description
102699	0.9	Calcareous sandstone: finely laminated.
102700	7.7	Siliceous to calcareous sandstone: thin bedded (3cm); shale interbeds; few small brachiopods.
102701	11.9	Calcarenite: thick (10cm) bed; large crinoid ossicles and brachiopod debris.
102702	16.6	Calcareous sandstone: near uppermost portion of exposed outcrop; coarse grained; high bioclastic content; smooth-shelled ostracodes and brachiopod debris.
	17.2 to 30.2	Covered interval.

Immediately following the covered interval, member 2, a coarse grained sandstone to conglomeratic marker unit, outcrops.

102703	31.5	Calacareous sandstone: finely laminated; abundant brachiopod debris.
102704	34.6	Calcareous sandstone to calcarenite: abundant brachiopods and possible crinoid ossicles.
102705	42.15	Calcarenite: medium (5cm) bedded; coarse grained; red stain; some crinoidal debris.
102706	53.0	Calcarenite: thick (10cm) lens; abundant crinoid and brachiopod debris; last bed before covered interval.
	53.1 to 55.7	Covered interval.

Member 3, consists of the upper nodular unit of the Anse à Pierre-Loiselle Formation. This unit is composed of nodular calcarenite to calcilutite in an argillaceous matrix with minor calcarenite lenses. At the Black Cape Section, Member 3 becomes visible underwater at 55.7m.

102707	55.87	Calcarenite: thin lenses in coalesced nodular calcilutite bed; syringoporid, haly sitid and solitary rugose corals; Palaeocyclus sp.
102708	61.9	Calcarenite: low outcrop shoreward of the main cliff near burned auto; thin lens; abundant brachiopods.

102709	70.9	Calcisiltite: more distinctive bedding "irregular" bedding similar to the La Vieille Fm. but still has a matrix; abundant stromatoporoids; large costistricklandid brachiopods with geopetal calcite filling in life position.
102710	78.0	Calcarenite: medium (8cm) bed; interbedded with nodular calcisiltite "irregular" beds; minor brachiopod debris.
102711	84.6	Same as 102710.

A structurally complex zone from 86.0 to 93.8m consists of a series of four faulted anticlinal structures producing a repeated stack of similar beds.

102712	90.0	Calcareous sandstone to calcarenite: medium (6cm) bedded; interbedded within "irregularly" bedded nodular calcisiltite; some brachiopod debris.
102713	94.7 to 94.8	Argillaceous calcisiltite: some brachiopod fragments.
	95.5 to 97.5	Rubble covered interval.
102714	101.0 to 101.1	Argillaceous calcilutite: same as 102713.
	103.0 to 104.0	Covered interval.
	106.1 to 108.0	Covered interval.
102715	108.3	Calcarenite: lens in nodular calcisiltite; <u>Palaeocyclus</u> sp.

102716	123.0 to 123.1	Calcarenite to calcisiltite: deeply weathered; purple; little matrix or a weathering product; larger nodules; possibly top Anse à Pierre-Loiselle Formation or lowermost La Vieille Formation.
102717	126.5	Calcarenite: medium (5cm) bed in a predominantly recessive zone; no matrix; interpreted to be the lowest of La Vieille Formation.

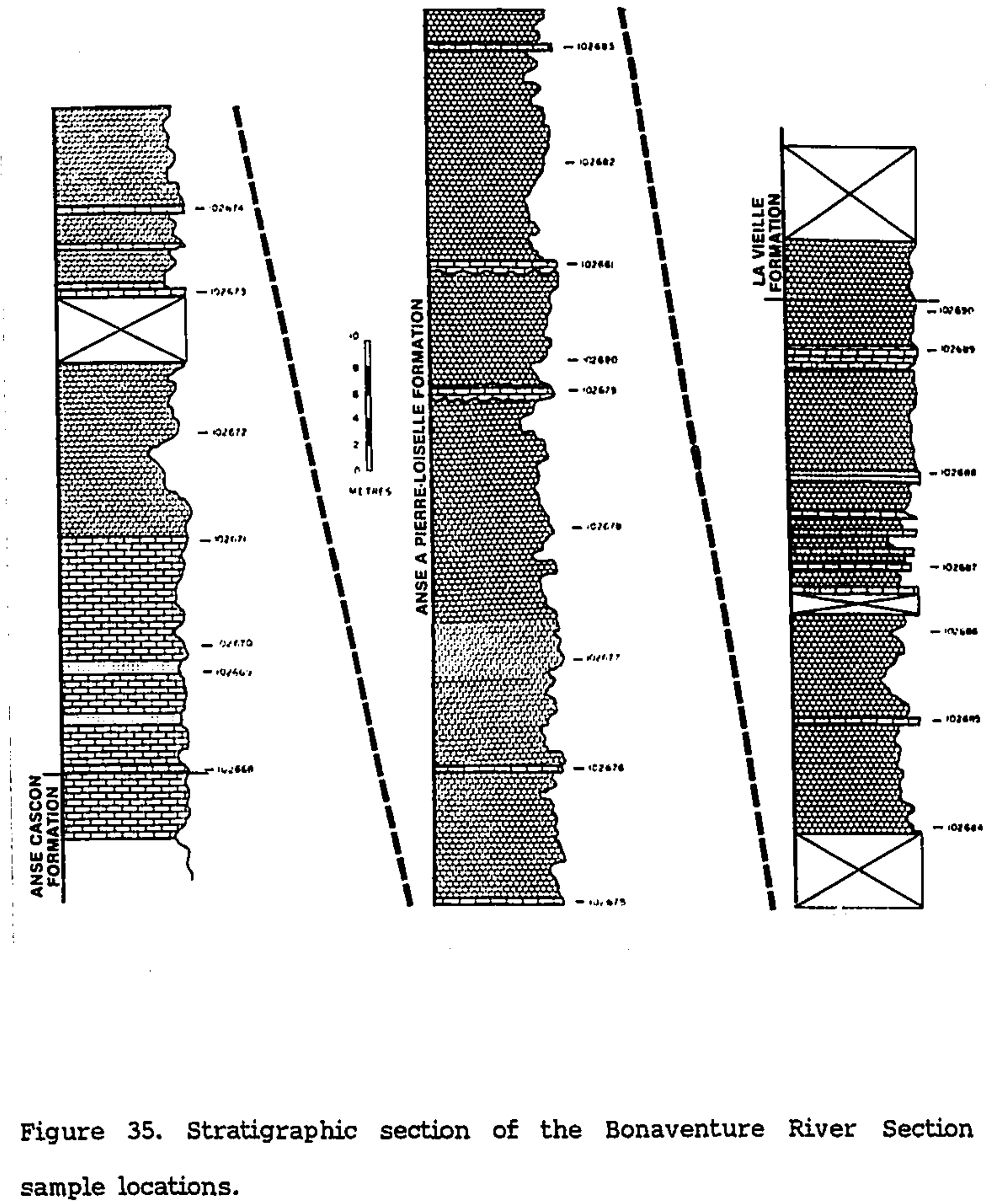

Figure 35. Stratigraphic section of the Bonaventure River Section and sample locations.

8.2 Bonaventure River (Section II)

GSC loc. no. 102668 to 102690 collected in 1987

The Bonaventure River Section, Section II, is located approximately 10km up river from the town of Bonaventure (N.T.S. 022A/03). The base of the measured section is at the camphouse on the west side of the river where the road is closest to the river at Sector B#19 (Lat. 48° 07' 34"N, Long. 065° 28' 43"W).

The base of the Anse à Pierre-Loiselle Formation is drawn at the point where the first continuous carbonate bed is encountered at 48m of measured section. The underlying Anse Cascon Formation consists of rippled and/or laminated calcareous and non-calcareous sandstone.

The first unit encountered of the Anse à Pierre-Loiselle Formation is member 1, which consists of calcareous sandstones and calcarenite with few non-calcareous sandstone beds.

Conodont sample (GSC loc. no.)	Sample level above base of section(m)	Description
102668	48.6	Calcareous sandstone: complete lens in a predominantly non-carbonate unit.
102669	56.1	Calcarenite: medium(6cm) bed; contains solution features; some brachiopods; favositid corals and stromatoporoids.
102670	58.2	Calcarenite: coarse grained; laminated with

		calcareous sandstone with calcarenite bases.
102671	66.94	Calcarenite: in a recessive unit; within a laminated bed; some trilobite debris; vertical burrows.

At this point in the section, a nodular interval begins that is predominant for the remainder of the section. This unit does not correspond with any other unit measured in the study area. Lithologically, this unit is composed of nodular calcilutite, calcisiltite and calcarenite with a few competent beds of calcareous sandstone.

102672	75.1	Calcarenite: nodular; in a calcisiltite matrix; contains brachiopods, crinoids and trilobites and possibly _Palaeocyclus_.
	80.6-85.1	Covered interval
102673	86.0	Calcarenite: medium(5cm) bed; within nodular interval; at the top of a 30cm laminated bed with fine grained shale partings; contains brachiopod fragments.
102674	94.48	Calcarenite: medium(7cm) bed; coarse grained; crinoid debris and a poorly preserved brachiopod.
102675	101.2	Calcisiltite and calcarenite: nodular with calcarenite lenses(5cm); brachiopod debris; unit becoming progressively more silty.

102676	111.6	Calcisiltite and calcarenite: thin(3.5cm) bed in which lithologies grade into each other.
102677	120.1	Calcarenite: thin(4cm) silty; in a predominantly silty limestone interval.
102678	130.7	Calcarenite: thin(3-5cm) bed; possible brachiopod fragments; encrinurid tail.
102679	141.5	Calcarenite: lenticular.
102680	143.9	Calcarenite: coarse grained.
102681	151.54	Same as 102680
102682	159.5	Calcisiltite: nodular; in an argillaceous matrix; few solitary horn corals; Palaeocyclus.
102683	168.5	Calcareous sandstone and calcisiltite: fine grained; interbedded; sandstone bed (2cm).
	171.7-177.2	Covered interval.
102684	177.7	Calcisiltite: nodular; calcareous sandstone lenses.
102685	186.6	Calcareous sandstone: medium(6cm) bed; calcisiltite partings.
102686	193.7	Calcarenite
	195.1-196.6	Covered interval
102687	198.9	Calcarenite: abundant Palaeocyclus
102688	206.0	Calcareous sandstone: fine grained
102689	215.6	Calcarenite:

		thick(10cm)bed; coarse grained; brachiopod debris and possible ostracodes.
102690	218.6	Calcareous sandstone: high bioclastic content; Costistricklandia; increasingly sandy

The top of the Anse à Pierre-Loiselle Formation is drawn at the 219.2m level. This boundary is based on a change in lithologic character from a predominantly nodular sequence to a more siliceous and sandy sequence. Above this level, the fauna changes radically to that of shallower water including abundant colonial and solitary corals (a large favositid coral head 26cm in diameter was observed), tabular and domal stromatoporoids and abundant Costistricklandia and pentamerid brachiopods.

The coarse grained sandstone/conglomerate marker unit, member 2, is conspicuously absent from this section. Without this marker unit, member 3, the upper nodular unit cannot be recognized. It is possible that faulting has occurred and these members are obscured by the covered intervals. Shearing and small scale faulting is not recognized on the outcrop as the nodular appearance and irregular bedding associated with the nodular lithologies obscure the small scale deformation features.

Another possible explanation for the absence of the marker unit would be that the entire lithologic sequence represents a still deeper water environment which is not recognized at the other study sections. The monotonous sequence of fine grained nodular limestones with few coarse grained beds or lenses suggests a quiet environment with little storm activity (i.e. below effective storm wave base). Biologically, the fauna suggests a deeper environment with the occurrence of the trilobite Encrinurus which was not recognized at the other sections.

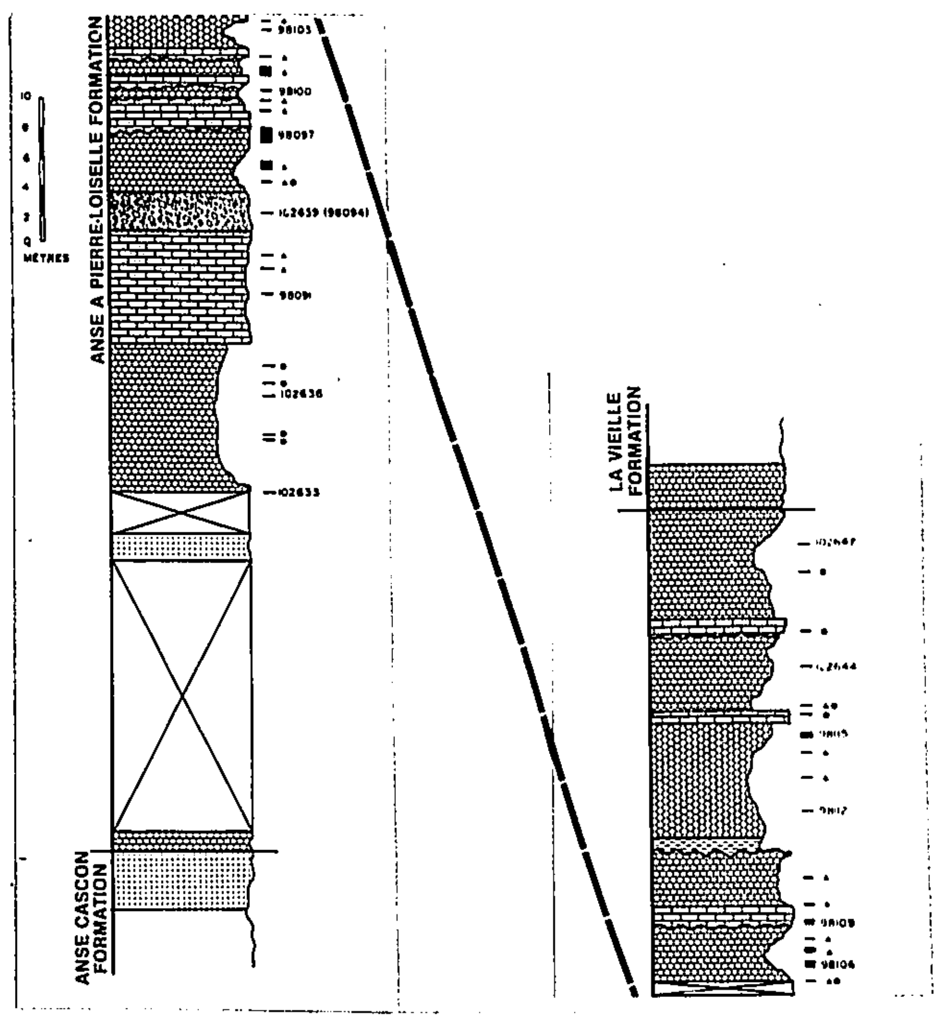

Figure 36. Stratigraphic section of the Petite Port Daniel River Section and sample locations.

8.3 Petite Port Daniel River (Section III)

GSC loc. no. 98091 to 98116 collected in 1981.

GSC loc. no. 102633 to 102674 collected in 1987.

The Petite Port Daniel Section, Section III, is located approximately 1.0 kilometre northwest of the the village of Clemville (NTS 022A/03). The measured section begins approximately 200 metres south of the old dam (Lat. 48° 10' 48"N, Long. 065° 01' 38"W).

The base of the section is marked by a collection of iron debris on the riverbank on the west side of the river. Exposure is generally poor and limited to low lying banks and the river bed. Water levels were fortuitously low during the 1987 field season allowing for easier acess to the underwater exposures.

The lowermost portion of the section is composed of the highly clastic member 1. This unit consists of non-calcareous sandstone, calcareous sandstone, few calcarenite lenses and nodular calcilutite to calcisiltite interbeds.

Conodont sample (GSC loc. no.)	Sample level above base of section(m)	Description
102633	25.37	Calcilutite to calcarenite: thinly bedded; slightly nodular; abundant fossil debris, including brachiopods, rugose corals and <u>Palaeocyclus</u> sp.
102634	29.25	Calcilutite: medium(7cm) bed; highly bioclastic.

102635	29.37	Calcarenite: thick(13cm); abundant fossil debris.
102636	32.30	Calcarenite: medium(8cm) bed; finely laminated; fine grained; extends well into river; algal covered, rusty brown; possible fossil debris and solution cavities.
102637	33.20	Calcarenite: thin(4cm) bed; finely laminated; fine grained; abundant crinoid debris.
102638	34.20	Calcilutite to calcarenite: thick(50cm) bed; nodular in appearance; no visible fossil material.

Member 2, a coarse grained sandstone to conglomerate marker unit begins at 36m just downsection from Nowlan's '81 0m large bent tree hanging over the river on the west bank.

98091	39.68	Calcarenite to calcareous sandstone: thick(17cm) bed; contains brachiopods.
98092	41.68	Calcareous siltstone to calcareous sandstone: thin(3cm) beds; highly fractured and massive.
98093	42.18	Calcareous sandstone; thin(3cm) beds; highly fractured and massive; minor fossil debris.
102639 (98094)	45.48	Same as 98093
	45.68 to 47.08	A ridge of thick medium grained sandstone forms a ledge running across the

river.

Member 3, the upper nodular unit of the Anse à Pierre-Loiselle Formation becomes apparent at this point in the section. At this section Unit C consists of nodular calcarenite to calcilutite in an argillaceous shale matrix with few continuous calcarenite lenses.

102640 (98095)	47.88	Calcarenite to calcilutite: poorly exposed; forming nodular beds; shale matrix.
98096	48.68 to 49.08	Calcisiltite: nodular in an argillaceous matrix.
98097	50.3 to 51.38	Same as 98096
98098	52.78	Calcarenite: thick(10cm)bed; coarse grained; some fossil debris; pinkish weathering; immediately on top of a sandstone bed.
98099	53.18	Calcilutite, calcisiltite and calcarenite: nodular; in a shale matrix.
	53.68	A thick(10cm) bed of resistant sandstone.
98100	54.08	Calcarenite: nodular beds in shale matrix; strophomenid-rich; beds below are highly bioturbated; nodules contain halysitid coral fragments.
98101	55.18 to 55.68	Calcilutite and calcisiltite: nodular in a shale matrix.
	56.68	A thin(4cm) bed of calcarenite to calcareous sandstone.

98102	56.88	Calcisiltite: nodular; rare ribbons of calcarenite with shale predominant.
98103	58.48	Calcisiltite: nodular beds; small strophomenid (<u>Sowerbeyella</u>?) brachiopods.
98104	58.98	Calcisiltite: nodular; thin beds, rare calcarenite pods.
	59.38 to 59.98	Covered interval
102641 (98105)	60.28	Calcarenite: thinly bedded; with few calcisiltite nodules, crinoid debris.
98106	61.48 to 61.88	Calcisiltite: nodular in a calcareous shale matrix; minor brachiopod debris.
98107	62.48 to 62.68	Calcarenite: thin beds; calcilutite nodules in a shale matrix; highly fractured.
98108	63.38	Calcarenite: sparse lenses in an argillaceous matrix weathering to a green shale.
98109	64.68 to 64.98	Calcareous sandstone: lenses; finely laminated; recessive; weathering grey; bedded together with argillaceous calcisiltite in nodular beds.
98110	65.68	Calcisiltite and calcilutite: nodular beds in a greenish brown weathering shale.
	65.68 to 67.68	Poorly exposed, covered with river bed load; appears to be a recessive nodular calcisiltite with

		calcareous sandstone interbeds with solution mould cavities.
98111	67.68	Calcareous sandstone: medium(8cm) bed; abundant strophomenid brachiopods and some halysitid corals.
	67.68 to 72.68	Exposed only underwater
98112	72.68	Calcisiltite: nodular; dark grey; argillaceous matrix; weathering brown.
98113	74.18 to 74.88	Calcisiltite: nodular in an argillaceous matrix; lenticular brachiopod-bearing calcarenite; typical Anse à Pierre-Loiselle Formation.
98114	76.68	Calcilutite: nodular; barren of all fossil material.
98115	77.68 to 78.08	Calcarenite: lenticular bed with nodular calcilutite in an argillaceous matrix.
102643 (98116)	79.68	Calcarenite: medium bed; beneath a large erratic boulder opposite pointed end of the large gravel channel bar.
102644	82.68	Calcilutite: nodular; interbedded with calcarenite in an argillaceous matrix; fossil fragments include costistricklandid brachiopods and halysitid corals; poorly exposed.
102645	85.48	Calcareous sandstone to calcarenite: medium bedded; extremely

		abundant costistricklandid brachiopod debris; rugose and halysitid corals; some large nodules (7-10cm); remarkably similar to the lower La Vieille Formation; but nodules to matrix ratio less than 50%.
102646	89.18	Calcilutite to calcarenite: large nodules in shale matrix.
102647	91.18	Calcarenite: bedded nodules; large >10cm; <50% matrix possibly uppermost Anse à Pierre-Loiselle Formation or lowermost La Vieille Formation; abundant costistricklandid brachiopod debris.

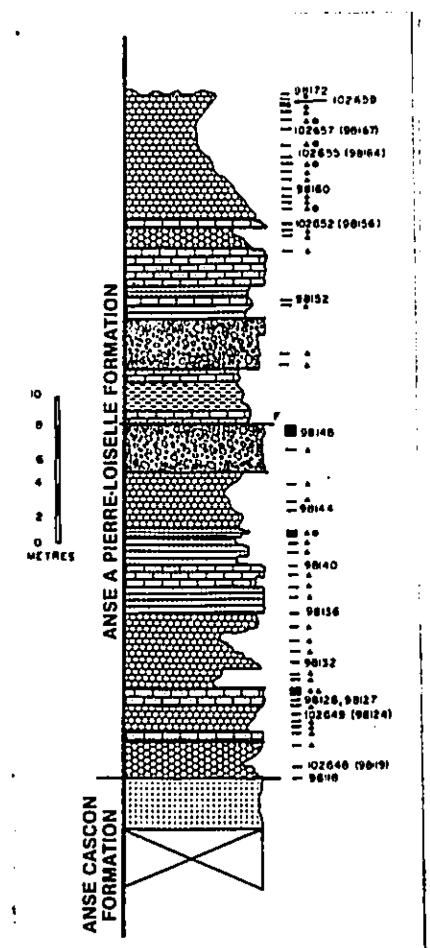

Figure 37. Stratigraphic section of the Gascons Road Cut Section and sample locations.

8.4 Gascons Road Cut (Section IV)

GSC loc. no. 98119 to 98172 collected in 1981.

GSC loc. no. 102648 to 102660 collected in 1987.

The Gascons Road Cut Section, Section IV, is located approximately 5km east of the village of Gascons on Highway 132 (NTS 022A/03, Lat. 48° 12' 22"N, Long. 064° 49' 29"W).

The section begins on the south side of the highway at the far eastern portion of the outcrop. The base of the section is in the Anse Cascon Formation which is composed mainly of medium to coarse grained calcareous and non-calcareous sandstone. The portion of the outcrop which displays the Anse Cascon Formation is moderately exposed with only a few representative beds visible. The Anse à Pierre-Loiselle Formation begins at the base of the first nodular calcisiltite to calcilutite bed.

The first unit encountered, member 1, consists of nodular calcilutite to calcisiltite, medium to thick bedded calcareous and non-calcareous sandstone with minor calcarenite interbeds.

Conodont sample (GSC loc. no.)	Sample level above base of section(m)	Description
102648 (98119)	5.2	Calcilutite: nodular in a shale matrix; with thin, resistant , fine grained sandstone interbeds; barren of fossil material
98120	6.8	Calcareous sandstone: very thin layer, in a shale matrix; no

		limestone present at this level; contains brachiopods.
98121	7.8	Calcareous sandstone: in recessive interval; nodular bedding; brachiopods are coarsely costate.
98122	8.15	Calcarenite: nodular beds; coarse grained; contains brachiopod Leptaena.
98123	8.6	Calcarenite: thin beds(0-2.5cm); coarse grained, fossil debris finely comminuted.
102649 (98124)	9.0	Calcisiltite with calcilutite and calcarenite: nodular; in an argillacous matrix.
98125	9.5	Same as 102649 with stromatoporoids at this level.
98126	9.9	Calcareous sandstone: just beneath a ledge of thick bedded sandstone.

There are prominent ledges of sandstone in the next 2m of section above which it reverts back to the more typical nodular limestone and shale.

98127	9.9	Argillite/mudstone: at same level as 98127 but farther along strike; pale grey weathering; contains gastropods.
98128	10.5-10.8	Carbonate nodules: sampled between medium to thick bedded sandstones; argillaceous matrix;

		sandstone beds have bases and tops comprising calcarenite.
98129	10.6	Calcarenite: base of a sandstone bed; coarse grained and crystalline.
98130	11.3	Calcarenite: thin(4cm) bed; coarse grained; crystalline.
	11.5	First <u>Palaeocyclus</u> observed.
98131	11.7	Calcisiltite and calcarenite: nodular; in a shale matrix; constitutes the interval from 11.6 to 12m.

Small tabulate coral colonies and tabular stromatoporoids are moderately abundant through the 10-12m interval.

98132	12.6	Calcisiltite and calcarenite: nodular; in an argillaceous matrix; halysitid corals large up to 35cm in diameter; <u>Palaeocyclus</u>; rhynchonellid brachiopods.
98133	13.2	Calcisiltite and calcarenite: calcarenite is fine grained; nodular; in a shale matrix; small(<1cm) <u>Palaeocyclus</u> present but not common.
98134	14.0	Calcisiltite and calcarenite: argillaceous; in a recessive interval.
102650 (98135)	15.0	Calcarenite: thin(5cm) bedded; nodular; in a shale matrix; large stromatoporoids and

		brachiopods within the shale.
98136	16.0	Calcarenite: ledge-forming bed; nodular but more persistent than most; argillaceous; brachiopod bearing.
98137	17.0	Calcisiltite: high in cliff; argillaceous.
98138	17.8	Calcisiltite and calcarenite: More indurated, less shale, but still nodular beds.
98139	18.6	Calcarenite: Massive bed; pale grey weathering; argillaceous; some nodules but the distinction between nodules and matrix is less distinct on fresh surfaces.
98140	19.3	Calcarenite: thin(2.5cm) beds; just below a recessive interval of shale.
98141	20.2	Calcarenite: thin(2.5cm) beds.

Above it is becoming more homogeneous, massive and it is still quite argillaceous.

98142	20.8	Calcarenite: lenticular; contains brachiopods and crinoid debris.
102651 (98143)	21.2-21.5	Limestone: argillaceous; greenish-grey weathering.

A band of stromatoporoids occurs at 22.5m; these weather white and form a conspicuous band on the surface of the outcrop.

98144	23.0	Limestone: argillaceous; greenish-grey weathering surface.
98145	23.6	Calcisiltite and calcareous sandstone: argillaceous.
98146	24.8	Sandstone and shale.

At 25.8m, the base of member 2 is encountered. Member 2, at the Gascons Roadcut section consists of a coarse grained conglomeratic interval. In the conglomerate, several clast lithologies can be identified including: metamorphic, igneous and foreign sedimentary rocks e.g. jasper). This unit generally correlates with member 2 at the railroad cut (Section V). The beds are generally graded and have irregular upper and lower surfaces.

Abundant fossil debris can be found in the coarsest beds including: crinoid ossicles and brachiopod debris. It appears that these conglomerate beds represent the failure and slide of a small shallow platformal shoal.

98147	27.2	Conglomerate: brachiopod and stromatoporoid debris bed.

At 29m, in the sandstone unit, a small fault disrupts bedding. Approximately 4m of section has been displaced and repeated.

98148	30.0-31.0	Calcilutite and calcisiltite: thin bedded; nodular; arenaceous. May be a repeti-

		tion of the unit underlying the main sandstone body because there is more sandstone above.
98149	33.0	Sandstone: coarse grained, conglomeratic; contains corals, stromatoporoids and crinoids. Similar to 98147.
98150	34.2	Calcareous sandstone and conglomerate: with intervening intervals of pure sandstone.
	34.0-36.0	Sandstone with local intervals of fossil debris.
	36.0	Several corals in a 40cm bed of coarse grained sandstone; favositid and syringoporid.
98151	37.3	Calcareous sandstone: thin, discontinuous bed; contains crinoid debris.
98152	37.7	Calcisiltite: thin layers; extremely argillaceous in shales; brachiopods.
	38.75-40.4	Sandstone: conspicuously horizontally laminated; immediately below is a bed of sandstone with detrital stromatoporoids.
	39.0-40.4	Sandstone: "pit-rock"; good porosity produced by corals and stromatoporoids; coarsens upwards.
	40.2-41.0	Sandstone: very coarse grained.

At 41.2m, member 3, or the upper nodular unit is encountered. This

unit at the Gascons road cut (Section IV) is composed of fine grained calcarenite, calcilutite and calcisiltite nodules in an argillaceous shale matrix. Occasionally, a fine grained calcarenite lens is encountered but these are rare. Abundant domal to tabular stromatoporoids are found in growth position.

98153	41.0-41.2	Calcisiltite: extremely argillaceous; highly weathered; some pieces are more calcareous; contains brachiopods.
98154	42.2	Calcarenite: thin bedded; complete brachiopods.
98155	42.5	Calcisiltite: nodular; some brachiopods.
102652 (98156)	43.0	Same as 98155
102653 (98157)	43.5	Calcisiltite: nodular; argillaceous matrix; brachiopods; few discontinuous calcarenite lenses; Palaeocyclus is rare; stromatoporoids are more common.
98158	44.0	Calcisiltite: nodular; brachiopod and crinoid fragments.
98159	44.5	Calcisiltite and calcarenite: nodular; some corals and minute Palaeocyclus.

From 44.9-52.3m, member 3 becomes more homogeneous consisting of smaller nodules and a more fine grained argillaceous shale matrix. Fauna include a few corals, domal stromatoporoids and the first occurrence of Costistricklandia in this section.

98160	45.0	Calcarenite: fine grained in nodular beds; brachiopods Leptaena?.
98161	45.6	Calcisiltite: nodular in a more argillaceous matrix; nodules are appearing smaller 2-3cm) in size.
98162	46.2	Calcisiltite: nodular in shale matrix.
102654 (98163)	46.7	Same as 98162
102655 (98164)	47.0-47.2	Same as 98162
102656 (98165)	47.5	Same as 98162 with rare stromatoporoids in this interval.
102657 (98167)	48.5-49.0	Calcisiltite: nodular in shale matrix.
102658 (98168)	49.7	Same as 102658
98169	50.2	Calcarenite: stromatoporoids and Costistricklandia.
98170	51.0	Calcisiltite: nodular; near top of sequence.
102659	51.3	Same as 98170
98171	51.5	Same as 98170
102660	51.8	Same as 98170
98172	52.0	Calcarenite: thin, lenticular bed exposed as a small ledge at very end of exposure.

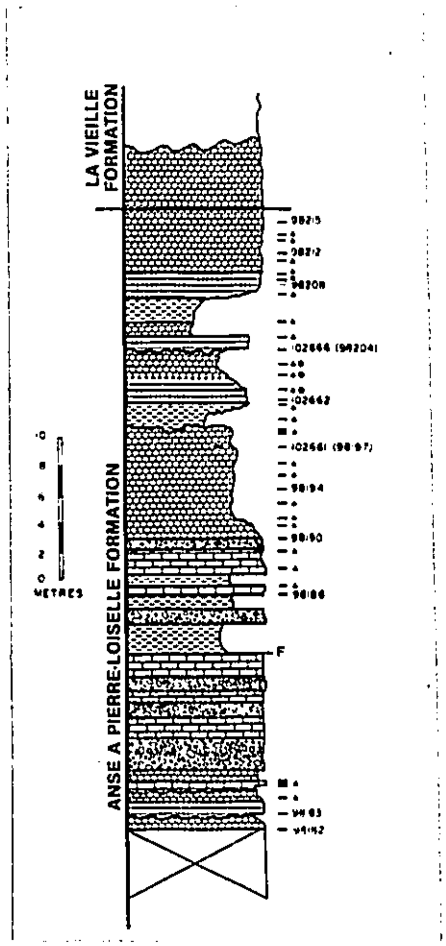

Figure 38. Stratigraphic section of the Gascons-East Railroad Cut Section and sample locations.

8.5 Gascons - East Railroad Cut (Section V)

GSC loc. no. 98182 to 98215 collected in 1981.

GSC loc. no. 102661 to 102666 collected in 1987.

The Gascons-East Railroad Cut Section, Section V is located approximately 5 km east of the village of Gascons (NTS 022A/02) The section is accessed by a small private road (formerly Highway 132) leading to Anse à Pierre-Loiselle and by following the railroad tracks east for approximately 500m to the base of the Anse à Pierre-Loiselle Formation (Lat. 48° 12' 13"N, Long. 064° 49' 05"W).

Nowlan's 1981 visit to this section resulted in a stratigraphic section from the Maquereau-Anse Cascon unconformity to well into the La Vieille Formation. The upper Anse Cascon Formation and lower Anse à Pierre-Loiselle Formation were reported to be discontinuous and obscured by erosion and talus from the overhanging cliffs. The degree of obscurity has increased and no outcrop occurs between the last portion of continuous outcrop of Anse Cascon Formation and the lowermost portion of continuous Anse à Pierre-Loiselle Formation. For this reason, the 1987 measured section commenced at the base of the main exposure of Anse à Pierre-Loiselle Formation some 41.5m up section as reported in Nowlan's 1981 field notes.

The first unit encountered at this section is member 1. At the Gascons-East Railroad Cut Section, this unit is composed of calcilutite and calcisiltite, in both competent beds and nodules with minor calcarenite and calcareous sandstone beds.

Conodont sample (GSC loc. no.)	Sample level above base of section(m)	Description
98182	0.0	Calcarenite: fine grained; nodular; trilobite and brachiopod fragments.
98183	1.0	Calcareous sandstone and calcisiltite: few brachiopods; partly covered with scree and vegetation.
98184	2.0	Calcarenite: coarse grained; highly bioturbated; in nodular limestone unit; a large coral head (1.3m in diameter) with beds slightly draped over probably due to compaction.

At 3.0m member 2 is first encountered. This unit at the Gascons-East Railroad Cut Section is composed of the calcareous and non-calcareous sandstone and coarse grained calcareous sandstone conglomerate marker beds which are characteristic of the Anse à Pierre-Loiselle Formation.

98185	3.0-3.5	Calcareous sandstone with calcarenite nodules: interval just in main massive sandstone unit.
	3.5-12.5	Calcareous sandstone and conglomerate: thick bedded.

At 12.5m a small fault zone is encountered. This fault is a normal fault with approximately 9.0m of visible displacement.

	12.5-14.5	Argillaceous to sandy shale: occurs as a highly weathered and recessive interval.
	14.5-16.25	Calcareous sandstone and conglomerate: thick(75cm) bedded; coarse grained.
	16.25-18.3	Calcareous sandstone: with shaly argillite interbeds.
98186	16.5	Calcareous sandstone: sampled immediately above last thick(75cm) sandstone bed; coarse grained; brachiopods <u>Eocoelia</u>?; rugose solitary corals and possible sponges.
98187	17.5	Calcareous sandstone: coarse grained; no fossils; comprises a thin ledge.
98188	18.5	Calcareous siltstone and calcareous sandstone.

40cm above this sample is a massive stromatoporoid-rich unit 1.5m thick which is in turn capped by a 30cm bed of calcareous sandstone.

98189	19.5	Calcareous siltstone and calcareous sandstone: immediately above the 30cm calcareous sandstone bed near top of cliff.

Above this point, member 3, the typical Anse à Pierre Loiselle Formation upper nodular unit, occurs which consists of nodular calcisiltite, calcarenite and calcilutite in a shaly argillite matrix along with more competent lenses of calcarenite.

98190	20.5	Calcisiltite: taken in lowest part of bluff; pale grey weathering; extremely argillaceous.
98191	21.5	Calcisiltite and calcarenite: nodular in an argillaceous mudstone matrix.
98192	22.0	Calcareous sandstone: thin bedded; continuous.

About 50cm of small nodules follow this horizon and above it the nodules become much larger and begin to form continous beds. The unit of larger nodules is about 2.0m thick.

98193	23.0	Arenaceous calcarenite: taken in large nodular unit; fine fossil debris; moderate abundance of stromatoporoids at the railroad level.
98194	24.0	Calcarenite and argillaceous calcarenite: at top of large nodular unit; just above Bourque's red mark at railroad level; local small brachiopods.
98195	25.0	Calcisiltite: nodules in argillaceous matrix; small (1-5cm across); tabulate favositid corals are interspersed as large nodules.
98196	26.0	Same as 98195
102661 (98197)	27.0	Arenaceous to argilla ceous calcarenite: medium(7cm) bed; contains Bourque's 68m mark; contains local stricklandid brachiopods

		and forms a continuous low-lying ledge.
98198	28.0-28.3	Argillaceous calcarenite: thin bed; slightly nodular; pale grey weathering; contains Palaeocyclus, and atrypid brachiopods in adjacent shale interbeds.
98199	29.0	Argillite/mudstone: similar to matrix in nodular units.
98200	30.0	Calcisiltite: massive; dark grey; argillaceous; small crinoid ossicles.
102662	30.3	Same as 98200
102663 (98201)	31.0	Calcisiltite and calcarenite: nodular; Palaeocyclus and stroph-omenid brachiopods pre-sent in intervening shale.
102664 (98202)	32.0	Calcarenite: irregular bed but remaining nodular in a shale matrix; brachiopods, stromatoporoids, solitary rugose and crinoid debris.
102665 (98203)	33.0	Calcilutite and argillaceous calcilutite: nodular and irregular beds.

Above this level the Anse à Pierre-Loiselle Formation becomes slightly more shaly and farther up (above the 34m mark) becomes even more shaly.

102666 (98204)	340	Calcarenite: from a thick(15cm) bed; argillaceous; Bourque has a painted line on bed

		(1981).
98205	35.0	Calcilutite: isolated nodules in a green shale; recessive; unfossiliferous.
98206	36.0	Siliceous mudstone: located in an isolated bank of green shale; weathers brown; one specimen of Palaeocyclus recovered; largely a recessive interval.
	36.0-37.0	Poorly exposed but probably green shale.
	37.0-38.0	Same siliceous material and shale as described above.
98207	38.0	Calcisiltite and calcarenite: fine grained; base of Costistricklandia-bearing beds.
98208	38.6	Calcisiltite: grey; nodular; arenaceous.
	38.75	Costistricklandia is very abundant.
98209	39.0	Calcisiltite: nodular; arenaceous; surrounded by green shale; local stropheminids and Costistricklandia.

Sampled immediately below a halysitid biostrome which is up to 50cm thick, infilled with sandy green shale: crinoid ossicles, bryozoa and rare brachiopods (some atrypids) are present in patches of sandy shale.

98210	39.4	Sample obtained from within the biostrome in areas of less dense

		biotic accumulation.
98211	40.0	Calcarenite: thick(10cm) bed; nodular similar to La Vieille lithology, but still contains more matrix than nodules; abundant fossil debris and abundant *Costistricklandia*.
98212	41.0	Green shale and limestone: intervening layers between the La Vieille-like calcarenites.
98213	42.0	Calcarenite: resistant; matrix still is proportionally greater than limestone; calcarenite has few *Costistricklandia* and some atrypids.
98214	42.3	Calcarenite: more argillaceous but similar to 98213; similar fauna also.
98215	43.0	Calcarenite: thin(3cm) bed; coarse grained; matrix is 50% or less.

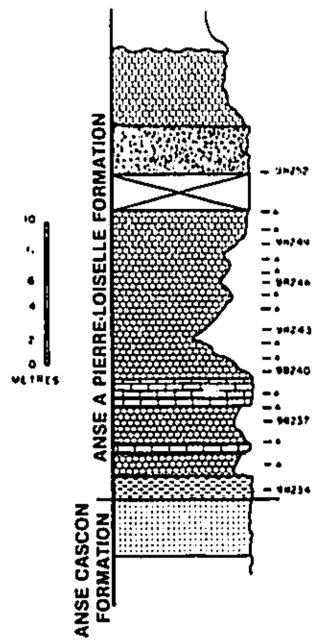

Figure 39. Stratigraphic section of the Anse à Pierre-Loiselle Type Section and sample locations.

8.6 Anse à Pierre-Loiselle Type Section (Section VI)

GSC loc. no. 98234 to 98252 collected in 1981.

The Anse à Pierre-Loiselle Formation Type Section, Section VI is located at Anse à Pierre-Loiselle (N.T.S. 022A/02, Lat. 48° 12' 11"N, Long. 064° 48' 54"W). The section is accessed either by boat or via a cleared trail down the cliff from the C.N.R. railway tracks approximately 300m east from the Anse à Pierre-Loiselle access road. The underlying Anse Cascon Formation lies unconformably on the Macquereau Group metasediments. The Anse à Pierre-Loiselle Formation commences at the base of Bourque and Lachambre's (1980) unit 25.

The base of the section is composed of member 1. This unit at the Anse à Pierre-Loiselle Formation type section consists of calcareous sandstone with nodular calcarenite and calcilutite to calcisiltite in an argillaceous shale or mudstone matrix.

Conodont sample (GSC loc. no.)	Sample level above base of section(m)	Description
98234	0.7m	Calcisiltite: thin bedded; highly argillaceous.
98235	2.5	Mudstone: medium(5-8cm) bedded; few calcareous nodules; in a recessive notch below main cliff, west of fault.
98236	4.0	Calcareous sandstone: surrounded by shale in a narrow recessive ledge above main ledge that

		projects into the sea; white; laminated.
98237	5.5	Limestone: arenaceous, nodular; some coarse quartz grains; bed forms a wave scoured ledge; overlies a sandy unit with abundant halysitid corals and stromatoporoids.
98238	6.5	Same as 98237 with disaggregated clasts.
98239	7.5	Mudstone and shale: arenaceous; colonial corals and brachiopods.
98240	9.0	Calcilutite: nodular in an argillaceous matrix; abundant stromatoporoids; and proporan corals.
98241	10.0	Calcarenite: nodular in a mudstone matrix.
98242	11.0	Calcarenite: thin bed; greenish-grey weathering; beneath a thick ledge; contains brachiopods, bryozoa and crinoids.
98243	12.0	Calcarenite: nodular; argillaceous; contains brachiopods and corals; taken at base of ledge that forms a promontory after the recess.
98244	13.5	Calcarenite: coarse grained; white weathering stromatoporoids; forms a prominent ledge; looks like a shoal in an otherwise nodular unit.
98245	14.5	Calcisiltite and calcarenite: nodular; at base of ledge; mixed lithologies.

98246	15.2	Calcarenite: quartz and feldspar are common components; beds are more terrigenous.
98247	16.0	Calcarenite: arenaceous; sucrosic; sample taken beside a small horst and graben fault.
98248	17.0	Calcisiltite and mudstone: nodular; 10-20cm below a thin but resistant ledge of white weathering calcarenite.
98249	18.0	Calcisiltite: thin bedded; arenaceous; rare fossils; indurated.

Large blocks of coral-stromatoporoid-crinoid-sandstone on beach below last sample.

98250	19.0	Limestone: arenaceous; dark greenish-grey weathering; regularly bedded.
98251	20.5	Calcisiltite: arenaceous; first conglomerate outcrops at beach level; highest outcrop available before a landslide cuts off the outcrop into a covered interval.
	20.5-23.0	Covered interval

At the top of the covered interval, member 2, the coarse grained sandstone-conglomerate unit is encountered. At the Type Section, this unit appears significantly thinner than at the other sections measured (except at the Bonaventure River Section where it is absent). Exposure is on the face of a high cliff which makes sampling and measuring both difficult and dangerous.

98252	23.0	Calcareous sandstone: coarse grained; base of sandstone sequence.
	23.0-26.5	Coarse grained sandstone-conglomerate sequence.

At 26.5, member 3 is encountered. At this section, like others measured, it is composed of nodular calcilutite and calcisiltite in an argillaceous matrix.

	26.5-31.5	Calcilutite: nodular; in an argillaceous shale matrix; brachiopods and crinoid debris.

Remainder of section is inaccessible.

BLACK CAPE SECTION
SECTION I
ABSOLUTE ABUNDANCE CHARTS

	1 A Barren Sample	2 Apsidognathus sulcatus (e)	3 Apsidognathus sulcatus (f)	4 Apsidognathus sulcatus (g1)	5 Apsidognathus sulcatus (g2)	6 Aulacognathus bullatus (g)
999.00 : TOTAL	4	1	4	7	5	1
126.50 : 102717	-	-	-	-	-	-
123.00 : 102716	1	-	-	-	-	-
108.30 : 102715	1	-	-	-	-	-
101.00 : 102714	1	-	-	-	-	-
94.69 : 102713	-	-	-	-	-	-
90.00 : 102712	1	-	-	-	-	-
84.58 : 102711	-	-	-	-	-	-
78.00 : 102710	-	-	-	1	-	-
70.90 : 102709	-	-	-	-	-	-
61.90 : 102708	-	-	-	-	-	-
55.86 : 102707	-	-	-	-	-	-
53.00 : 102706	-	-	-	-	-	-
42.15 : 102705	-	-	-	-	-	1
34.59 : 102704	-	1	4	6	5	-
31.50 : 102703	-	-	-	-	-	-
16.60 : 102702	-	-	-	-	-	-
11.89 : 102701	-	-	-	-	-	-
7.69 : 102700	-	-	-	-	-	-
0.87 : 102699	-	-	-	-	-	-

3 Apsidognathus sulcatus (f)	4 Apsidognathus sulcatus (g1)	5 Apsidognathus sulcatus (g2)	6 Aulacognathus bullatus (g)	7 Digitodontus bellistriatus (a)	8 Digitodontus bellistriatus (b)	9 Digitodontus bellistriatus (c)	10 Distomodus staurognathoides (a)	11 Distomodus staurognathoides (b)	12 Distomodus staurognathoides (c)	13 Distomodus staurognathoides (e)	14 Distomodus staurognathoides (f)	15 Distomodus staurognathoides (g)	16 Indeterminate fused cones
4	7	5	1	6	4	1	2	10	2	4	3	-	1
-	-	-	-	-	-	-	-	2	1	2	-	1	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	1	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	1	-	-	-	-	-	-	-	-
-	-	-	-	1	-	-	-	-	-	-	-	-	-
-	-	-	1	-	-	-	-	2	-	1	-	-	-
4	6	5	-	3	1	-	2	3	1	1	2	-	1
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	1	-	-	-	1	-	-	1	-	-
-	-	-	-	1	2	1	-	2	-	-	-	-	-

11 [illegible]	12 Distomodus staurognathoides (c)	13 Distomodus staurognathoides (e)	14 Distomodus staurognathoides (f)	15 Distomodus staurognathoides (g)	16 Indeterminate fused cones	17 Johnognathus huddlei	18 O. aff. Ozarkodina pirata (b)	19 O. aff. Ozarkodina pirata (c)
10	2	4	3	-	1	1	1	2
2	1	2	-	1	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	1
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
2	-	1	-	-	-	-	-	-
3	1	1	2	-	1	1	1	1
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
1	-	-	1	-	-	-	-	-
2	-	-	-	-	-	-	-	-

	20 O. aff. Ozarkodina pirata (g)	21 Oulodus? flugeli (c)	22 Oulodus? flugeli (g)	23 Oulodus? kentuckyensis (a)	24 Oulodus? kentuckyensis (b)	25 Oulodus? kentuckyensis (c)	26 Oulodus? kentuckyensis (e)	27 Oulodus? kentuckyensis (f)
999.00	5	6	3	100	63	89	71	78
126.50	-	2	2	5	6	4	5	-
123.00	-	-	-	-	-	-	-	-
108.30	-	-	-	-	-	-	-	-
101.00	-	-	-	-	-	-	-	-
94.69	-	-	-	-	-	-	-	-
90.00	-	-	-	-	-	-	-	-
84.58	-	-	-	-	-	-	-	-
78.00	1	-	-	-	1	-	-	-
70.90	-	-	-	-	-	-	-	-
61.90	-	-	-	-	-	-	-	-
55.86	-	-	-	-	-	-	-	-
53.00	-	1	-	-	1	3	1	1
42.15	-	-	1	24	14	13	7	10
34.59	4	4	2	41	14	26	18	19
31.50	-	1	-	-	-	-	-	-
16.60	-	-	-	5	-	-	-	2
11.89	-	-	-	-	-	-	-	1
7.69	-	-	-	16	19	21	15	18
0.87	-	-	-	14	14	26	30	27

25 Oulodus? kentuckyensis (c)	26 Oulodus? kentuckyensis (e)	27 Oulodus? kentuckyensis (f)	28 Oulodus? kentuckyensis (g)	29 Ozarkodina confluens (a)	30 Ozarkodina confluens (alpha g)	31 Ozarkodina confluens (b)	32 Ozarkodina confluens (c)	33 Ozarkodina confluens (e)	34 Ozarkodina confluens (f)	35 Ozarkodina confluens (gamma g)	36 Ozarkodina confluens (indet. g)	37 Ozarkodina excavata excavata (a)	38 Ozarkodina excavata excavata (b)
89	71	78	12	15	11	17	33	9	12	8	47	45	
4	5	-	-	-	-	-	-	-	-	-	7	7	
-	-	-	-	-	-	-	-	-	-	-	-	-	
-	-	-	-	-	-	-	-	-	-	-	-	-	
-	-	-	-	-	-	-	-	-	-	-	-	-	
-	-	-	-	-	-	-	-	-	-	-	-	1	
-	-	-	-	-	-	-	-	-	-	-	-	-	
-	-	-	-	-	-	-	-	-	-	-	-	-	
-	-	-	-	-	-	-	-	-	-	-	-	-	
-	-	-	-	-	-	-	-	-	-	-	-	-	
-	-	-	-	-	-	-	-	-	-	-	-	1	
-	-	-	-	-	-	-	-	-	-	-	-	1	
3	1	1	-	-	-	1	-	-	-	-	4	2	
13	7	10	4	-	-	-	1	-	-	-	-	-	
26	18	19	6	-	-	2	14	1	3	-	6	10	
-	-	-	-	2	-	-	-	-	-	-	2	-	
-	-	2	-	7	1	7	8	3	3	1	6	3	
-	-	1	-	-	1	-	-	-	-	1	7	2	
21	15	18	2	-	1	2	3	1	4	-	10	14	
26	30	27	-	6	8	5	7	4	2	6	12	11	

32 Ozarkodina confluens (c)	33 Ozarkodina confluens (e)	34 Ozarkodina confluens (f)	35 Ozarkodina confluens (gamma g)	36 Ozarkodina confluens (indet. g)	37 Ozarkodina excavata excavata (a)	38 Ozarkodina excavata excavata (b)	39 Ozarkodina excavata excavata (c)	40 Ozarkodina excavata excavata (e)
33	9	12	8	47	45	11	54	11
–	–	–	–	7	7	2	5	–
–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–
–	–	–	–	–	1	–	–	–
–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–
–	–	–	–	–	1	1	–	–
–	–	–	–	–	1	–	–	–
–	–	–	–	4	2	–	3	–
1	–	–	–	–	–	–	4	–
14	1	3	–	6	10	5	16	6
–	–	–	–	2	–	–	–	–
8	3	3	1	6	3	–	3	–
–	–	–	1	7	2	1	–	–
3	1	4	–	10	14	4	8	–
7	4	2	6	12	11	–	20	5

	41 Ozarkodina excavata excavata (f)	42 Ozarkodina excavata excavata (g)	43 Ozarkodina gulletensis (a)	44 Ozarkodina gulletensis (b)	45 Ozarkodina gulletensis (c)	46 Ozarkodina gulletensis (e)	47 Ozarkodina gulletensis (f)	48 Ozarkodina gulletensis (g)
999.00	12	17	15	23	25	15	3	61
126.50	-	1	1	2	2	-	-	2
123.00	-	-	-	-	-	-	-	-
108.30	-	-	-	-	-	-	-	-
101.00	-	-	-	-	-	-	-	-
94.69	-	-	-	-	-	-	-	-
90.00	-	-	-	-	-	-	-	-
84.58	-	-	-	-	-	-	-	-
78.00	-	-	-	-	-	-	-	-
70.90	-	-	-	-	-	-	-	-
61.90	1	-	-	-	-	-	-	-
55.86	-	-	-	-	-	-	-	-
53.00	-	-	-	-	-	2	-	1
42.15	2	2	2	6	5	3	2	4
34.59	4	9	7	16	14	8	1	39
31.50	-	-	-	-	-	-	-	-
16.60	1	1	-	1	1	-	-	1
11.89	1	-	1	-	1	1	-	-
7.69	-	2	5	-	-	2	-	1
0.87	3	3	-	-	2	1	-	15

45 Ozarkodina gulletensis (c)	46 Ozarkodina gulletensis (e)	47 Ozarkodina gulletensis (f)	48 Ozarkodina gulletensis (g)	49 Ozarkodina hadra (g)	50 P. aff. Pterospathodus celloni (e)	51 Panderodus gibber (a)	52 Panderodus recurvatus (a)	53 Panderodus recurvatus (b)	54 Panderodus recurvatus (c)	55 Panderodus unicostatus (ar.)	56 Panderodus unicostatus (cm.)	57 Panderodus unicostatus (gr.)	58 Pseudooneotodus beckmanni
25	15	3	61	2	1	4	-	9	10	91	76	562	
2	-	-	2	-	-	2	1	2	1	101	114	562	
-	-	-	-	-	-	-	-	-	-	-	-	-	
-	-	-	-	-	-	-	-	-	-	-	-	-	
-	-	-	-	-	-	-	-	-	-	-	-	-	
-	-	-	-	-	-	-	-	-	-	-	-	-	
-	-	-	-	-	-	-	-	-	-	-	-	-	
-	-	-	-	-	-	-	-	-	-	-	-	4	
-	-	-	-	-	-	-	-	-	-	6	8	26	
-	-	-	-	-	-	-	-	-	-	1	-	2	
-	-	-	-	-	-	-	-	-	-	-	2	23	
-	-	-	-	-	-	-	-	-	-	-	-	1	
2	-	-	1	-	-	-	-	-	-	-	10	11	
5	3	2	4	2	-	-	-	5	9	26	-	-	
14	8	1	39	-	-	2	-	1	-	33	33	254	
-	-	-	-	-	-	-	-	-	-	-	-	23	
1	-	-	1	-	-	-	-	-	-	-	-	-	
1	1	-	-	-	-	-	-	1	-	2	1	9	
-	2	-	1	-	-	2	-	2	1	23	22	174	
2	1	-	15	-	1	-	-	-	-	-	-	35	

	53 Panderodus recurvatus (b)	54 Panderodus recurvatus (c)	55 Panderodus unicostatus (ar.)	56 Panderodus unicostatus (cm.)	57 Panderodus unicostatus (gr.)	58 Pseudooneotodus beckmanni	59 Pterospathodus amorphognathoides (c)	60 Pterospathodus amorphognathoides (g)	61 Pterospathodus? ceragnathoides (a)
	9	10	91	76	562	5	1	3	28
	2	1	101	114	562	1	-	-	-
	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	4	-	-	-	-
-	-	-	6	8	26	-	-	3	-
-	-	-	1	-	2	-	-	-	-
-	-	-	-	2	23	-	-	-	-
-	-	-	-	-	1	-	-	-	-
-	-	-	-	10	11	-	-	-	-
-	5	9	26	-	-	-	-	-	1
-	1	-	33	33	254	4	-	-	4
-	-	-	-	-	23	-	-	-	-
-	-	-	-	-	-	-	-	-	2
-	1	-	2	1	9	-	-	-	-
-	2	1	23	22	174	-	-	-	1
-	-	-	-	-	35	1	-	-	20

	62 Pterospathodus? ceragnathoides (c)	63 Pterospathodus? ceragnathoides (e)	64 Pterospathodus? ceragnathoides (e)	65 Pterospathodus? ceragnathoides (g)	66 Walliserodus curvatus (b)	67 Z TOTAL ELEMENTS PER SAMPLE	68 ZZ TOTAL ELEMENTS PER SECTION	
999.00	14	3	7	90	1	–	1803	999
126.50	1	–	2	34	–	880	–	126
123.00	–	–	–	–	–	–	–	123
108.30	–	–	–	–	–	–	–	108
101.00	–	–	–	–	–	–	–	101
94.69	–	–	–	–	–	1	–	94.
90.00	–	–	–	–	–	–	–	90.
84.58	–	–	–	–	–	4	–	84.
78.00	–	–	–	–	–	47	–	78.
70.90	–	–	–	–	–	3	–	70.
61.90	–	–	–	2	–	28	–	61.
55.86	–	–	–	–	–	3	–	55.
53.00	–	–	–	–	–	41	–	53.
42.15	–	1	–	1	–	153	–	42.
34.59	4	–	–	18	–	681	–	34.
31.50	–	–	–	–	–	28	–	31.
16.60	2	1	–	6	–	65	–	16.
11.89	–	–	–	5	–	35	–	11.
7.69	–	–	2	58	–	436	–	7.6
0.87	8	1	5	–	–	278	–	0.8

66 Walliserodus curvatus (b)	67 Z TOTAL ELEMENTS PER SAMPLE	68 ZZ TOTAL ELEMENTS PER SECTION		
1	-	1803	999.00 :	TOTAL
-	880	-	126.50 :	102717
-	-	-	123.00 :	102716
-	-	-	108.30 :	102715
-	-	-	101.00 :	102714
-	1	-	94.69 :	102713
-	-	-	90.00 :	102712
-	4	-	84.58 :	102711
-	47	-	78.00 :	102710
-	3	-	70.90 :	102709
-	28	-	61.90 :	102708
-	3	-	55.86 :	102707
-	41	-	53.00 :	102706
-	153	-	42.15 :	102705
-	681	-	34.59 :	102704
-	28	-	31.50 :	102703
-	65	-	16.60 :	102702
-	35	-	11.89 :	102701
-	436	-	7.69 :	102700
-	278	-	0.87 :	102699

BONAVENTURE RIVER SECTION
SECTION II
ABSOLUTE ABUNDANCE CHARTS

		1 Apsidognathus sulcatus ("5")	2 Apsidognathus sulcatus (e)	3 Apsidognathus sulcatus (f)	4 Apsidognathus sulcatus (g1)	5 Apsidognathus sulcatus (g2)	6 Carniodus carnulus (g)	7 Digitodontus bellistriatus (a)
999.00 :	TOTAL	2	3	15	32	13	1	1
218.60 :	102690	-	-	-	-	-	1	-
215.60 :	102689	-	-	2	1	-	-	-
206.00 :	102688	-	-	-	1	-	-	-
198.88 :	102687	-	1	2	7	9	-	-
193.69 :	102686	-	-	-	-	-	-	-
186.60 :	102685	-	-	-	-	-	-	-
177.69 :	102684	-	-	-	-	-	-	-
168.50 :	102683	1	-	-	1	-	-	-
159.50 :	102682	-	-	-	-	-	-	-
151.52 :	102681	-	-	-	-	-	-	-
143.88 :	102680	-	-	-	-	-	-	-
141.50 :	102679	-	-	-	-	-	-	-
130.69 :	102678	-	-	-	-	-	-	-
120.08 :	102677	-	-	-	-	-	-	-
111.58 :	102676	-	-	1	2	-	-	-
101.19 :	102675	-	-	-	-	-	-	-
94.48 :	102674	-	-	-	-	-	-	-
86.00 :	102673	-	-	-	-	-	-	-
75.08 :	102672	-	-	-	-	-	-	-
66.94 :	102671	1	2	10	20	4	-	-
58.20 :	102670	-	-	-	-	-	-	-
56.09 :	102669	-	-	-	-	-	-	1
38.20 :	102667	-	5	13	3	4	-	1

4 Apsidognathus sulcatus (g1)	5 Apsidognathus sulcatus (g2)	6 Carniodus carnulus (g)	7 Digitodontus bellistriatus (a)	8 Digitodontus bellistriatus (b)	9 Digitodontus bellistriatus (c)	10 Distomodus staurognathoides (a)	11 Distomodus staurognathoides (b)	12 Distomodus staurognathoides (c)	13 Distomodus staurognathoides (e)	14 Distomodus staurognathoides (f)	15 Distomodus staurognathoides (g)	16 Johnognathus huddlei	17 Kockelella ranuliformis (g)
32	13	1	1	4	4	11	17	16	7	7	7	6	10
-	-	1	-	-	-	-	-	-	-	-	-	-	-
1	-	-	-	-	-	-	-	-	1	-	-	-	-
1	-	-	-	-	-	-	-	-	-	-	-	-	-
7	9	-	-	-	-	3	1	8	-	1	1	1	1
-	-	-	-	-	-	-	1	-	1	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	2	1	1	-	-	-	-
1	-	-	-	-	-	2	-	-	-	1	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	1	1	-	-
-	-	-	-	-	-	1	2	2	-	-	1	1	-
-	-	-	-	-	-	-	2	-	2	-	1	1	-
-	-	-	-	-	-	1	3	1	-	-	1	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-	-	-	-	-	-	
-	-	-	-	-	-	-	1	2	-	2	1	-	
-	-	-	-	-	-	-	1	-	2	1	-	-	
-	-	-	-	-	-	-	-	-	-	-	-	-	
-	-	-	-	-	-	-	-	-	-	-	-	-	
20	4	-	-	-	-	2	3	2	-	1	1	1	
-	-	-	-	1	2	2	1	-	-	-	-	1	
-	-	-	1	3	2	-	-	-	-	-	-	1	
3	4	-	1	2	1	-	-	-	-	-	-	-	

No.	Species	Total																							
12	Distomodus staurognathoides (c)	16	-	-	-	8	-	-	1	-	-	-	2	-	1	-	-	2	-	-	-	2	-	-	-
13	Distomodus staurognathoides (e)	7	-	1	-	-	1	-	1	-	-	-	-	2	-	-	-	-	2	-	-	-	-	-	-
14	Distomodus staurognathoides (f)	7	-	-	-	1	-	-	-	1	-	1	-	-	-	-	-	2	1	-	-	1	-	-	-
15	Distomodus staurognathoides (g)	7	-	-	-	1	-	-	-	-	-	1	1	1	1	-	-	1	-	-	-	1	-	-	-
16	Johnognathus huddlei	6	-	-	-	1	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	1	1	1	-
17	Kockelella ranuliformis (g)	10	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9	-	-	-
18	Oulodus? flugeli (c)	4	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1	-	-	-	-	1	-	1	-
19	Oulodus? flugeli (g)	3	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1	-	-	-	-	-	1	-	-

	41 Ozarkodina gulletensis (c)	42 Ozarkodina gulletensis (e)	43 Ozarkodina gulletensis (f)	44 Ozarkodina gulletensis (g)	45 Ozarkodina hadra (g)	46 P. aff. Pterospathodus celloni (b)	47 P. aff. Pterospathodus celloni (f)	48 P. aff. Pterospathodus celloni (g)
999.00	40	11	22	57	6	1	4	4
218.60	-	-	-	-	-	-	-	-
215.60	-	-	-	-	-	-	-	-
206.00	-	-	-	-	-	-	-	-
198.88	-	-	-	1	-	-	-	-
193.69	1	-	1	2	-	-	-	-
186.60	-	-	-	-	-	-	-	-
177.69	-	-	1	3	-	-	-	-
168.50	-	1	-	-	-	-	-	-
159.50	-	-	-	-	1	-	-	-
151.52	4	1	-	1	-	-	-	-
143.88	1	-	3	8	2	-	-	-
141.50	-	-	2	2	1	-	-	-
130.69	3	3	-	2	-	-	-	-
120.08	3	-	2	4	2	-	-	-
111.58	6	-	2	1	-	-	-	-
101.19	-	-	-	10	-	-	-	-
94.48	7	1	-	3	-	1	4	4
86.00	-	-	1	6	-	-	-	-
75.08	2	-	-	-	-	-	-	-
66.94	10	4	7	12	-	-	-	-
58.20	3	1	3	1	-	-	-	-
56.09	-	-	-	1	-	-	-	-
38.20	6	2	-	3	-	-	-	-

[illegible]	46 P. aff. Pterospathodus celloni (b)	47 P. aff. Pterospathodus celloni (f)	48 P. aff. Pterospathodus celloni (g)	49 Panderodus gibber (a)	50 Panderodus gibber (b)	51 Panderodus panderi (a/b)	52 Panderodus panderi (b/c)	53 Panderodus recurvatus (a)	54 Panderodus recurvatus (b)	55 Panderodus recurvatus (c)	56 Panderodus unicostatus (ar.)	57 Panderodus unicostatus (cm.)	58 Panderodus unicostatus (gr.)
6	1	4	4	1	1	1	1	6	11	10	166	151	7
-	-	-	-	-	-	-	-	-	-	-	-	-	
-	-	-	-	-	-	-	-	-	-	-	1	3	
-	-	-	-	-	-	-	-	-	-	-	-	-	
-	-	-	-	-	-	-	-	-	-	-	6	2	
-	-	-	-	-	-	-	-	-	3	2	3	4	
-	-	-	-	-	-	-	-	-	-	-	-	-	
-	-	-	-	-	-	-	-	-	-	-	8	10	
-	-	-	-	-	-	-	-	1	1	-	4	5	
1	-	-	-	-	-	-	-	-	-	-	-	-	
-	-	-	-	-	-	-	-	-	-	-	-	1	
2	-	-	-	-	-	-	-	-	-	-	-	-	
1	-	-	-	-	-	-	-	-	-	-	3	4	
-	-	-	-	-	-	-	-	-	-	-	-	-	
2	-	-	-	-	-	-	-	-	-	-	-	-	
-	-	-	-	-	-	-	-	-	-	-	6	2	
-	-	-	-	-	-	-	-	-	-	-	4	10	
-	1	4	4	1	1	1	1	4	5	5	63	53	
-	-	-	-	-	-	-	-	-	-	-	4	3	
-	-	-	-	-	-	-	-	-	-	2	4	2	
-	-	-	-	-	-	-	-	1	2	1	35	37	
-	-	-	-	-	-	-	-	-	-	-	10	10	
-	-	-	-	-	-	-	-	-	-	-	5	5	
-	-	-	-	-	-	-	1	-	-	-	68	59	

53 Panderodus recurvatus (a)
54 Panderodus recurvatus (b)
55 Panderodus recurvatus (c)
56 Panderodus unicostatus (ar.)
57 Pander--dus unicostatus (cm.)
58 Panderodus unicostatus (gr.)
59 Pseudooneotodus beckmanni
60 Pseudooneotodus pyramis
61 Pterospathodus amorphognathoides (b)

1	6	11	10	166	151	797	27	1	1
-	-	-	-	-	-	-	-	-	1
-	-	-	-	1	3	21	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	6	2	28	5	-	-
-	-	3	2	3	4	33	-	-	-
-	-	-	-	-	-	2	-	-	-
-	-	-	-	8	10	47	4	-	-
-	1	1	-	4	5	33	8	-	-
-	-	-	-	-	-	6	1	-	-
-	-	-	-	-	1	13	-	-	-
-	-	-	-	-	-	3	-	-	-
-	-	-	-	3	4	28	-	-	-
-	-	-	-	-	-	-	2	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	6	2	40	-	-	-
-	-	-	-	4	10	32	-	-	-
1	4	5	5	63	53	229	-	-	-
-	-	-	-	4	3	17	-	-	-
-	-	-	2	4	2	23	-	-	-
-	1	2	1	35	37	136	7	-	-
-	-	-	-	10	10	93	-	-	-
-	-	-	-	5	5	13	-	1	-
-	-	-	-	68	59	257	-	-	-

	20 Oulodus? kentuckyensis (a)	21 Oulodus? kentuckyensis (b)	22 Oulodus? kentuckyensis (c)	23 Oulodus? kentuckyensis (e)	24 Oulodus? kentuckyensis (f)	25 Oulodus? kentuckyensis (g)	26 Ozarkodina confluens (alpha g)	27 Ozarkodina confluens (b)	28 Ozarkodina confluens (c)
999.00	60	28	41	33	26	10	7	4	
218.60	-	-	-	-	-	-	-	-	
215.60	-	-	-	-	-	-	-	-	
206.00	-	-	-	-	-	-	-	-	
198.88	3	2	6	1	-	1	2	1	
193.69	3	1	-	1	1	-	-	-	
186.60	1	1	-	-	-	-	-	-	
177.69	5	-	6	-	-	-	-	-	
168.50	-	1	3	-	-	-	-	-	
159.50	-	-	-	-	-	-	-	-	
151.52	3	2	-	-	1	1	2	1	
143.88	-	1	1	2	3	4	-	-	
141.50	1	-	1	-	1	-	3	-	
130.69	6	1	-	-	2	2	-	1	
120.08	-	1	-	-	-	-	-	-	
111.58	3	3	-	-	1	-	-	-	
101.19	7	-	3	1	1	-	-	-	
94.48	8	4	5	3	-	-	-	-	
86.00	9	1	4	10	3	1	-	1	
75.08	-	-	-	2	1	-	-	-	
66.94	5	6	8	10	7	-	-	-	
58.20	6	2	2	1	4	1	-	-	
56.09	-	2	2	2	1	-	-	-	
38.20	12	8	9	7	4	3	-	-	

24	25	26	27	28	29	30	31	32	33	34	35	36	37
Oulodus? kentuckyensis [illegible]	Oulodus? kentuckyensis (g)	Ozarkodina confluens (alpha g)	Ozarkodina confluens (b)	Ozarkodina confluens (c)	Ozarkodina confluens (e)	Ozarkodina confluens (f)	Ozarkodina confluens (gamma g)	Ozarkodina confluens (indet. g)	Ozarkodina excavata excavata (a)	Ozarkodina excavata excavata (b)	Ozarkodina excavata excavata (c)	Ozarkodina excavata excavata (e)	Ozarkodina excavata excavata (f)
26	10	7	4	4	1	7	4	19	30	4	20	1	1[illegible]
-	-	-	-	-	-	-	-	-	-	-	-	-	
-	-	-	-	-	-	-	-	-	-	-	-	-	
-	-	-	-	-	-	-	-	-	-	-	-	-	
-	1	2	1	-	-	2	-	3	6	1	1	1	
1	-	-	-	-	-	-	-	2	2	-	3	-	
-	-	-	-	-	-	-	-	-	1	-	-	-	
-	-	-	-	-	-	-	-	-	7	-	2	-	
-	-	-	-	-	-	-	-	-	-	-	-	-	
-	-	-	-	-	-	-	-	-	-	-	-	-	
1	1	2	1	-	-	1	-	2	3	-	-	-	
3	4	-	-	-	-	-	-	-	-	-	1	-	
1	-	3	-	-	-	-	1	6	-	-	-	-	
2	2	-	1	3	1	4	-	5	-	-	-	-	
-	-	-	-	-	-	-	-	-	-	-	-	-	
1	-	-	-	-	-	-	-	-	-	-	4	-	
1	-	-	-	-	-	-	-	-	-	-	-	-	
-	-	-	-	-	-	-	-	-	3	-	-	-	
3	1	-	1	1	-	-	3	-	3	1	2	-	
1	-	-	-	-	-	-	-	-	-	-	1	-	
7	-	-	-	-	-	-	-	-	5	2	4	-	
4	1	-	-	-	-	-	-	1	-	-	2	-	
1	-	-	-	-	-	-	-	-	-	-	-	-	
4	3	-	-	-	-	1	-	8	10	3	11	4	

	32 Ozarkodina confluens (indet. g)	33 Ozarkodina excavata excavata (a)	34 Ozarkodina excavata excavata (b)	35 Ozarkodina excavata excavata (c)	36 Ozarkodina excavata excavata (e)	37 Ozarkodina excavata excavata (f)	38 Ozarkodina excavata excavata (g)	39 Ozarkodina gulletensis (a)	40 Ozarkodina gulletensis (b)
4	19	30	4	20	1	16	32	19	24
-	-	-	-	-	-	-	1	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	3	6	1	1	1	3	-	-	-
-	2	2	-	3	-	3	-	-	3
-	-	1	-	-	-	1	-	-	-
-	-	7	-	2	-	-	-	3	1
-	-	-	-	-	-	-	-	1	-
-	-	-	-	-	-	-	3	-	-
-	2	3	-	-	-	1	2	-	1
-	-	-	-	1	-	-	1	-	1
1	6	-	-	-	-	-	-	2	-
-	5	-	-	-	-	-	-	-	2
-	-	-	-	-	-	-	-	-	3
-	-	-	-	4	-	1	2	2	3
-	-	-	-	-	-	-	-	-	-
-	-	3	-	-	-	1	-	-	4
3	-	3	1	2	-	4	3	-	-
-	-	-	-	1	-	-	1	1	1
-	-	5	2	4	-	2	17	8	6
-	1	-	-	2	-	-	2	1	1
-	-	-	-	-	-	-	-	1	-
-	8	10	3	11	4	1	6	-	4

	62 Pterospathodus amorphognathoides (c)	63 Pterospathodus amorphognathoides (f)	64 Pterospathodus amorphognathoides (g)	55 Pterospathodus pennatus pennatus (g)	66 Pterospathodus? ceragnathoides (a)	67 Pterospathodus? ceragnathoides (c)	68 Pterospathodus? ceragnathoides (e)	69 Pterospathodus? ceragnathoides (e)	70 Pterospathodus? ceragnathoides (g)
999.00	1	4	2	1	3	1	3	2	1
218.60	1	2	2	-	-	-	-	-	
215.60	-	1	-	1	-	-	-	-	
206.00	-	-	-	-	-	-	-	-	
198.88	-	1	-	-	-	-	-	-	
193.69	-	-	-	-	-	-	-	-	
186.60	-	-	-	-	-	-	-	-	
177.69	-	-	-	-	-	-	-	-	
168.50	-	-	-	-	-	-	-	-	
159.50	-	-	-	-	-	-	-	-	
151.52	-	-	-	-	-	-	-	-	
143.88	-	-	-	-	-	-	-	-	
141.50	-	-	-	-	1	-	-	-	
130.69	-	-	-	-	1	-	-	-	
120.08	-	-	-	-	-	-	-	-	
111.58	-	-	-	-	-	-	3	-	
101.19	-	-	-	-	-	-	-	-	
94.48	-	-	-	-	-	-	-	-	
86.00	-	-	-	-	-	-	-	-	
75.08	-	-	-	-	-	-	-	-	
66.94	-	-	-	-	-	-	-	-	
58.20	-	-	-	-	-	-	-	2	
56.09	-	-	-	-	1	1	-	-	
38.20	-	-	-	-	1	-	-	-	

66 Pterospathodus? ceragnathoides (a)	67 Pterospathodus? ceragnathoides (c)	68 Pterospathodus? ceragnathoides (e)	69 Pterospathodus? ceragnathoides (e)	70 Pterospathodus? ceragnathoides (g)	71 Z TOTAL ELEMENTS PER SAMPLE	72 ZZ TOTAL ELEMENTS PER SECTION		
3	1	3	2	187	-	2074	999.00	TOTAL
-	-	-	-	-	8	-	218.60	102690
-	-	-	-	-	31	-	215.60	102689
-	-	-	-	-	1	-	206.00	102688
-	-	-	-	-	111	-	198.88	102687
-	-	-	-	-	70	-	193.69	102686
-	-	-	-	-	7	-	186.60	102685
-	-	-	-	-	103	-	177.69	102684
-	-	-	-	-	68	-	168.50	102683
-	-	-	-	-	11	-	159.50	102682
-	-	-	-	1	44	-	151.52	102681
-	-	-	-	-	38	-	143.88	102680
1	-	-	-	6	68	-	141.50	102679
1	-	-	-	4	48	-	130.69	102678
-	-	-	-	-	15	-	120.08	102677
-	-	3	-	1	85	-	111.58	102676
-	-	-	-	10	85	-	101.19	102675
-	-	-	-	63	476	-	94.48	102674
-	-	-	-	30	107	-	86.00	102673
-	-	-	-	9	49	-	75.08	102672
-	-	-	-	43	432	-	66.94	102671
-	-	-	2	9	163	-	58.20	102670
1	1	-	-	11	54	-	56.09	102669
1	-	-	-	23	540	-	38.20	102667

PETITE PORT DANIEL RIVER SECTION
SECTION III
ABSOLUTE ABUNDANCE CHARTS

	1 A Barren Sample	2 Apsidognathus sulcatus ("5")	3 Apsidognathus sulcatus (e)	4 Apsidognathus sulcatus (f)	5 Apsidognathus sulcatus (g1)	6 Apsidognathus sulcatus (g2)	7 Carniodus carnulus (a)
999.00 : TOTAL	3	4	4	9	11	10	6
89.18 : 102646	-	-	-	-	-	-	-
85.48 : 102645	1	-	-	-	-	-	-
82.68 : 102644	-	-	-	-	-	-	-
79.68 : 98116	-	-	-	-	-	-	-
79.18 : 102642	1	-	-	-	-	-	-
77.68 : 98115	-	-	-	-	-	-	-
76.68 : 98114	-	-	-	-	-	-	-
74.18 : 98113	-	-	-	-	-	-	-
72.68 : 98112	-	-	-	-	-	-	-
67.68 : 98111	-	-	-	-	-	-	-
65.68 : 98110	-	-	-	1	-	1	-
64.68 : 98109	-	2	2	6	5	5	
63.38 : 98108	-	-	-	-	-	-	
62.47 : 98107	-	-	-	-	-	-	
61.47 : 98106	-	-	-	-	-	-	
60.27 : 98105	-	-	-	-	-	-	
58.97 : 98104	-	1	1	1	3	3	
58.47 : 98103	-	-	-	-	-	-	
56.88 : 98102	-	-	-	-	-	-	

3 Apsidognathus sulcatus (e)	4 Apsidognathus sulcatus (f)	5 Apsidognathus sulcatus (g1)	6 Apsidognathus sulcatus (g2)	7 Carniodus carnulus (a)	8 Carniodus carnulus (b)	9 Carniodus carnulus (c)	10 Carniodus carnulus (e)	11 Carniodus carnulus (f)	12 Carniodus carnulus (g)	13 Dapsilodus sp. (a)	14 Dapsilodus sp. (a)	15 Digitodontus bellistriatus (a)	
4	4	9	11	10	6	2	1	1	1	4	4	4	8
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	1	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	
-	-	-	-	-	-	-	-	-	-	-	-	-	
-	-	1	-	1	-	-	-	-	-	-	-	-	
2	2	6	5	5	-	-	-	-	-	-	-	-	
-	-	-	-	-	-	-	-	-	-	-	-	-	
-	-	-	!	-	-	-	-	-	-	-	1	-	
-	-	-	-	-	-	-	-	-	-	-	-	1	
-	-	-	-	-	-	-	-	-	-	-	-	2	
1	1	1	3	3	-	-	-	-	-	-	-	-	
-	-	-	-	-	-	-	-	-	-	-	-	-	
-	-	-	-	-	-	-	-	-	-	-	3	-	

No.	Taxon	Total																			
12	Carniodus carnulus (g)	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13	Dapsilodus sp. (a)	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14	Dapsilodus sp. (a)	4	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	3
15	Digitodontus bellistriatus (a)	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	2	-	-	-
16	Digitodontus bellistriatus (b)	8	-	-	-	-	-	-	-	-	-	-	-	5	-	-	1	-	-	-	-
17	Digitodontus bellistriatus (c)	9	-	-	-	-	-	-	-	-	-	-	-	3	1	-	1	-	-	-	-
18	Distomodus staurognathoides (a)	10	-	-	-	-	-	-	-	-	-	-	-	1	1	-	1	1	-	-	-
19	Distomodus staurognathoides (b)	29	-	-	-	-	-	-	-	1	-	-	-	2	-	2	-	23	-	-	-
		49	-	-	-	-	-	1	-	2	2	-	4	2	-	1	-	17	3	2	-

55.18 : 98101	–	–	–	–	–	–	–
54.08 : 98100	–	–	–	–	–	–	–
53.18 : 98099	–	–	–	–	–	–	–
52.77 : 98098	–	–	–	–	–	–	–
50.29 : 98097	–	–	–	–	–	–	–
48.68 : 98096	–	–	–	–	–	–	–
47.88 : 98095	–	–	–	–	–	–	[illegible]
45.47 : 98094	–	–	–	–	–	–	[illegible]
42.18 : 98093	–	–	–	–	–	–	[illegible]
41.68 : 98092	–	–	–	–	–	–	[illegible]
39.68 : 98091	–	–	–	–	–	–	[illegible]
34.20 : 102638	–	–	1	1	1	1	[illegible]
33.20 : 102637	–	–	–	–	–	–	
32.29 : 102636	1	–	–	–	–	–	
29.37 : 102635	–	–	–	–	1	–	
29.25 : 102634	–	1	–	–	1	–	
25.37 : 102633	–	–	–	–	–	–	

–	–	–	–	–	–	–	–	–	–	–	–	–	–	1
–	–	–	–	–	–	–	–	–	–	–	–	1	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	6	2	1	–	–	3	–	–	–	2
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	2	1
–	1	1	1	1	–	–	–	–	1	1	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	1	–	–	–	–	–	–	–	–	–	–	–
1	–	–	1	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

–	–	–	–	–	1	1		[illegible]
–	–	–	1	–	–	–	–	1
–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	1
–	–	–	–	–	–	–	–	6
–	3	–	–	–	2	4	1	2
–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–
–	–	–	–	2	1	1	–	–
1	1	–	–	–	–	–	–	1
–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	1
–	–	–	–	–	–	–	–	–

	20 Distomodus staurognathoides (c)	21 Distomodus staurognathoides (e)	22 Distomodus staurognathoides (f)	23 Distomodus staurognathoides (g)	24 Johnognathus huddlei	25 Kockelella ranuliformis (g)	26 O. aff. Ozarkodina pirata (b)	27 O. aff. Ozarkodina pirata (c)
999.00	21	53	24	50	13	2	1	1
89.18	-	-	-	-	-	-	-	-
85.48	-	-	-	-	-	-	-	-
82.68	-	-	-	-	-	-	-	-
79.68	-	-	-	-	-	-	-	-
79.18	-	-	-	-	-	-	-	-
77.68	-	1	-	-	-	-	-	-
76.68	-	-	-	-	-	-	-	-
74.18	-	-	-	-	-	-	1	-
72.68	-	-	-	2	-	-	-	1
67.68	-	-	-	-	-	-	-	-
65.68	1	2	-	1	-	-	-	-
64.68	2	1	1	5	1	-	-	-
63.38	-	-	1	-	-	-	-	-
62.47	1	2	1	-	-	-	-	-
61.47	2	-	4	-	-	-	-	-
60.27	4	34	10	37	11	1	-	-
58.97	2	4	1	-	-	-	-	-
58.47	-	-	-	-	-	-	-	-
56.88	-	2	2	-	-	-	-	-
55.18	1	1	-	2	-	-	-	-

	24 Johnognathus huddlei	25 Kockelella ranuliformis (g)	26 O. aff. Ozarkodina pirata (b)	27 O. aff. Ozarkodina pirata (c)	28 O. aff. Ozarkodina pirata (g)	29 Oulodus? flugeli (c)	30 Oulodus? flugeli (f)	31 Oulodus? flugeli (g)	32 Oulodus? kentuckyensis (a)	33 Oulodus? kentuckyensis (b)	34 Oulodus? kentuckyensis (c)	35 Oulodus? kentuckyensis (e)	36 Oulodus? kentuckyensis (f)
)	13	2	1	1	5	8	2	6	135	64	66	44	47
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	1	-
-	-	-	1	-	2	-	-	1	-	-	2	1	-
2	-	-	-	1	3	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	1	-	-
L	-	-	-	-	-	-	-	-	3	1	1	-	-
5	1	-	-	-	-	-	-	-	14	5	16	2	14
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	8	2	1	-	-
7	11	1	-	-	-	5	2	3	34	22	17	7	16
-	-	-	-	-	-	-	-	-	2	2	1	-	2
-	-	-	-	-	-	-	-	-	2	1	-	-	-
-	-	-	-	-	-	-	-	-	3	1	1	-	-
2	-	-	-	-	-	2	-	-	6	5	3	3	-

	32 Oulodus? kentuckyensis (a)	33 Oulodus? kentuckyensis (b)	34 Oulodus? kentuckyensis (c)	35 Oulodus? kentuckyensis (e)	36 Oulodus? kentuckyensis (f)	37 Oulodus? kentuckyensis (g)	38 Ozarkodina confluens (a)	39 Ozarkodina confluens (alpha g)	40 Ozarkodina confluens (b)
6	135	64	66	44	47	16	36	5	17
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	1	-	-	-	-	-
1	-	-	2	1	-	-	-	-	-
-	-	-	-	-	-	-	1	-	-
-	-	-	1	-	-	1	-	-	-
-	3	1	1	-	-	-	-	-	3
-	14	5	16	2	14	4	3	2	3
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	1	-	1
-	8	2	1	-	-	-	1	-	1
3	34	22	17	7	16	5	2	-	2
-	2	2	1	-	2	-	2	-	-
-	2	1	-	-	-	-	1	-	-
-	3	1	1	-	-	-	7	-	1
-	6	5	3	3	-	-	-	-	-

54.08	–	–	–	–	–	–	–
53.18	–	–	–	–	–	–	–
52.77	–	–	–	–	–	–	–
50.29	–	–	–	–	–	–	–
48.68	2	4	1	3	–	–	–
47.88	6	2	2	–	–	1	–
45.47	–	–	–	–	–	–	–
42.18	–	–	–	–	–	–	–
41.68	–	–	–	–	–	–	–
39.68	–	–	–	–	–	–	–
34.20	–	–	–	–	1	–	–
33.20	–	–	–	–	–	–	–
32.29	–	–	–	–	–	–	–
29.37	–	–	–	–	–	–	–
29.25	–	–	1	–	–	–	–
25.37	–	–	–	–	–	–	–

–	–	–	–	–	–	–	–	–	–	3	3	–
–	–	–	–	–	–	–	–	–	–	11	5	–
–	–	–	–	–	–	–	–	–	–	20	3	3
–	–	–	–	–	–	–	–	–	–	7	–	1
1	3	–	–	–	–	–	–	–	–	5	3	3
2	–	–	1	–	–	–	1	–	–	11	4	10
–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	1	–
–	–	–	–	–	–	–	–	–	2	5	5	6
–	–	1	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–
1	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	1	1	–

–	3	3	–	–	–	–	1	–	–
–	11	5	–	3	8	–	2	1	–
–	20	3	3	18	3	2	–	–	1
–	7	–	1	1	–	–	4	1	2
–	5	3	3	–	–	–	2	–	–
–	11	4	10	6	3	3	4	–	2
–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–
–	–	1	–	2	–	–	–	–	–
2	5	5	6	–	1	1	2	1	1
–	–	–	–	–	–	–	3	–	–
–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–
–	1	1	–	–	–	–	–	–	–

	41 Ozarkodina confluens (c)	42 Ozarkodina confluens (e)	43 Ozarkodina confluens (f)	44 Ozarkodina confluens (gamma g)	45 Ozarkodina confluens (indet. g)	46 Ozarkodina excavata excavata (a)	47 Ozarkodina excavata excavata (b)
999.00	19	11	19	19	148	60	19
89.18	-	-	-	-	-	-	-
85.48	-	-	-	-	-	-	-
82.68	-	-	-	-	-	-	-
79.68	-	-	-	-	-	-	-
79.18	-	-	-	-	-	-	-
77.68	-	-	-	-	-	-	-
76.68	2	-	-	-	-	-	-
74.18	-	-	-	-	4	-	-
72.68	-	-	-	-	-	4	1
67.68	-	-	-	-	-	-	-
65.68	2	-	1	-	9	3	1
64.68	3	-	-	1	12	7	1
63.38	-	-	-	-	-	-	-
62.47	1	1	-	2	-	-	-
61.47	1	-	1	-	14	-	-
60.27	2	-	1	10	38	8	3
58.97	1	-	-	-	-	-	-
58.47	-	-	-	-	6	-	-
56.88	1	3	-	-	9	-	-
55.18	-	-	2	-	5	3	1

		9	–	–	–	–	–	–	–	–	–	–	1	–	–	–	1	1	–	–	–	2
44	Ozarkodina confluens (gamma g)																					
		19	–	–	–	–	–	–	–	–	–	–	–	1	–	2	–	10	–	–	–	–
45	Ozarkodina confluens (indet. g)																					
		148	–	–	–	–	–	–	–	4	–	–	9	12	–	–	14	38	–	6	9	5
46	Ozarkodina excavata excavata (a)																					
		60	–	–	–	–	–	–	–	–	4	–	3	7	–	–	–	8	–	–	–	3
47	Ozarkodina excavata excavata (b)																					
		19	–	–	–	–	–	–	–	–	1	–	1	1	–	–	–	3	–	–	–	1
48	Ozarkodina excavata excavata (c)																					
		67	–	–	–	–	–	1	–	–	2	–	3	11	–	–	–	12	–	–	–	–
49	Ozarkodina excavata excavata (e)																					
		23	–	–	–	–	–	–	–	–	–	–	–	2	–	–	–	4	–	–	–	3
50	Ozarkodina excavata excavata (f)																					
		40	–	–	–	–	–	1	–	–	–	–	1	8	–	–	2	6	–	–	1	2
51	Ozarkodina excavata excavata (g)																					
		84	–	–	–	–	–	–	–	–	1	–	1	5	–	4	6	16	–	–	2	3
52	Ozarkodina gulletensis (a)																					
		11	–	–	–	–	–	–	–	–	–	2	–	–	–	3	–	–	1	–	–	–
53	Ozarkodina gulletensis (b)																					
		22	–	–	–	–	–	–	–	–	–	–	–	3	–	2	1	13	–	–	–	–
54	Ozarkodina gulletensis (c)																					
		49	–	–	–	–	–	–	–	–	–	1	–	2	–	3	5	12	1	3	–	–
55	Ozarkodina gulletensis (e)																					
		10	–	–	–	–	–	–	–	–	–	1	–	1	–	2	–	–	–	–	–	–
56	Ozarkodina gulletensis (f)																					
		19	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	6	–	–	–	–

[illegible]	[illegible]	11	-	-	-	-	-	-	-	-	-	2	-	-	-	3	-	-	1	-	-
53	Ozarkodina gulletensis (b)	22	-	-	-	-	-	-	-	-	-	-	-	3	-	2	1	13	-	-	-
54	Ozarkodina gulletensis (c)	49	-	-	-	-	-	-	-	-	-	1	-	2	-	3	5	12	1	3	-
55	Ozarkodina gulletensis (e)	10	-	-	-	-	-	-	-	-	-	1	-	1	-	2	-	-	-	-	-
56	Ozarkodina gulletensis (f)	19	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	6	-	-	-
57	Ozarkodina gulletensis (g)	37	-	-	-	-	-	-	-	-	-	-	-	3	-	5	1	8	1	1	-
58	Ozarkodina hadra (g)	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
59	Ozarkodina n.sp. A (a)	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
60	Ozarkodina n.sp. A (b)	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
61	Ozarkodina n.sp. A (f)	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

54.08	1	–	–	1	6	1	–	3
53.18	–	3	4	2	12	–	–	–
52.77	–	–	1	–	–	10	6	20
50.29	1	1	1	2	4	6	–	1
48.68	–	–	1	–	6	4	–	2
47.88	3	1	6	–	17	9	3	8
45.47	–	–	–	–	–	1	–	–
42.18	–	–	–	–	–	2	–	1
41.68	–	–	–	–	–	–	–	–
39.68	1	2	1	1	3	–	–	–
34.20	–	–	–	–	3	–	–	2
33.20	–	–	–	–	–	–	–	–
32.29	–	–	–	–	–	–	–	–
29.37	–	–	–	–	–	–	–	–
29.25	–	–	–	–	–	2	2	1
25.37	–	–	–	–	–	–	1	–

1	6	1	–	3	5	–	–	–	1	1	1	–	4
2	12	–	–	–	–	–	1	–	–	5	3	–	6
–	–	10	6	20	–	6	2	–	1	14	–	8	–
2	4	6	–	1	–	2	4	–	–	–	–	–	–
–	6	4	–	2	–	1	4	–	–	–	–	–	–
–	17	9	3	8	7	7	23	–	–	–	–	1	1
–	–	1	–	–	2	–	1	–	–	–	–	1	1
–	–	2	–	1	–	1	–	1	1	–	1	–	2
–	–	–	–	–	–	–	–	2	–	1	1	1	2
1	3	–	–	–	–	–	–	–	–	–	–	–	–
–	3	–	–	2	–	–	10	–	–	–	–	–	–
–	–	–	–	–	–	–	1	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	1	–	1	–	–	–	–	–
–	–	2	2	1	–	1	–	–	–	1	–	–	1
–	–	–	1	–	–	–	–	1	–	–	–	1	1

–	1	1	1	–	4	–			–
–	–	5	3	–	6	6	–	–	–
–	1	14	–	8	–	–	1	2	1
–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–
–	–	–	–	1	1	–	–	–	–
–	–	–	–	1	1	–	–	–	–
1	1	–	1	–	2	–	–	–	–
2	–	1	1	1	2	–	–	–	–
–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–
1	–	–	–	–	–	–	–	–	–
–	–	1	–	–	1	–	–	–	–
1	–	–	–	1	1	–	–	–	–

	62 P. aff. Pterospathodus celloni (f)	63 P. aff. Pterospathodus celloni (g)	64 Panderodus gibber (a)	65 Panderodus gibber (c)	66 Panderodus panderi (a/b)	67 Panderodus recurvatus (a)	68 Panderodus recurvatus (b)	69 Panderodus recurvatus (c)
999.00	1	1	50	9	2	7	9	
89.18	-	-	-	-	-	-	-	
85.48	-	-	-	-	-	-	-	
82.68	-	-	-	-	-	-	-	
79.68	-	-	-	-	-	-	-	
79.18	-	-	-	-	-	-	-	
77.68	-	-	2	-	-	-	-	
76.68	-	-	-	-	-	-	-	
74.18	-	-	1	-	-	-	-	
72.68	-	-	-	-	-	-	-	
67.68	-	-	4	-	-	-	-	
65.68	-	-	-	-	-	-	-	
64.68	-	-	19	-	-	-	-	
63.38	-	-	-	-	-	-	-	
62.47	-	-	2	-	-	-	-	
61.47	-	-	-	-	-	-	-	
60.27	-	-	13	7	1	2	4	
58.97	-	-	6	2	-	-	-	
58.47	-	-	-	-	-	-	-	
56.88	-	-	-	-	-	-	-	
55.18	-	-	-	-	-	-	-	

65 Panderodus gibber (c)	66 Panderodus panderi (a/b)	67 Panderodus recurvatus (a)	68 Panderodus recurvatus (b)	69 Panderodus recurvatus (c)	70 Panderodus unicostatus (ar.)	71 Panderodus unicostatus (cm.)	72 Panderodus unicostatus (gr.)	73 Pseudooneotodus beckmanni	74 Pterospathodus amorphognathoides (f)	75 Pterospathodus amorphognathoides (g)	76 Pterospathodus pennatus pennatus (g)	77 Pterospathodus pennatus procerus (g)
9	2	7	9	8	322	371	2870	36	1	2	1	5
-	-	-	-	-	-	2	1	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	1	-	-	-	-	-
-	-	-	-	-	-	-	5	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	2	8	27	1	1	1	-	-
-	-	-	-	-	2	-	14	2	-	-	-	-
-	-	-	-	-	2	4	38	-	-	-	-	-
-	-	-	-	-	3	2	8	1	-	1	-	-
-	-	-	-	-	11	12	233	10	-	-	-	-
-	-	-	-	-	7	5	57	4	-	-	-	-
-	-	-	-	-	46	42	353	9	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	4	8	62	-	-	-	-	-
-	-	-	-	-	5	4	36	-	-	-	-	-
7	1	2	4	2	50	72	563	7	-	-	-	-
2	-	-	-	-	5	5	52	-	-	-	-	-
-	-	-	-	-	3	3	64	-	-	-	-	-
-	-	-	-	-	2	8	50	-	-	-	-	-
-	-	-	-	-	4	5	26	-	-	-	-	-

	73 Pseudooneotodus beckmanni	74 Pterospathodus amorphognathoides (f)	75 Pterospathodus amorphognathoides (g)	76 Pterospathodus pennatus pennatus (g)	77 Pterospathodus pennatus procerus (g)	78 Pterospathodus? ceragnathoides (a)	79 Pterospathodus? ceragnathoides (c)	80 Pterospathodus? ceragnathoides (e)	81 Pterospathodus? ceragnathoides (g)	82 Walliserodus curvatus (e)
	36	1	2	1	5	25	9	5	282	1
	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-
7	1	1	1	-	-	-	-	-	-	-
4	2	-	-	-	-	-	-	-	-	-
3	-	-	-	-	-	-	-	-	-	1
3	1	-	1	-	-	-	-	-	3	-
3	10	-	-	-	-	-	-	-	1	-
7	4	-	-	-	-	1	-	-	3	-
3	9	-	-	-	-	6	1	-	52	-
-	-	-	-	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-	-	6	-
6	-	-	-	-	-	3	3	1	23	-
3	7	-	-	-	-	-	-	-	23	-
2	-	-	-	-	-	1	-	-	-	-
4	-	-	-	-	-	4	-	-	3	-
0	-	-	-	-	-	-	-	-	-	-
6	-	-	-	-	-	-	-	-	2	-

54.08	-	-						
53.18	-	-	2	-	-	-	-	-
52.77	-	-	-	-	-	-	-	-
50.29	-	-	-	-	-	-	-	-
48.68	-	-	-	-	-	-	-	3
47.88	1	-	-	-	-	5	3	1
45.47	-	-	-	-	-	-	-	-
42.18	-	-	-	-	-	-	-	-
41.68	-	-	-	-	-	-	-	-
39.68	-	-	-	-	-	-	2	1
34.20	-	1	-	-	-	-	-	-
33.20	-	-	-	-	-	-	-	-
32.29	-	-	-	-	-	-	-	-
29.37	-	-	-	-	1	-	-	-
29.25	-	-	1	-	-	-	-	1
25.37	-	-	-	-	-	-	-	-

				–	[illegible]	[illegible]	[illegible]						
–	–	–	–	–	8	5	70	–	–	–	–	–	–
–	–	–	–	–	42	50	325	–	–	–	–	–	–
–	–	–	–	–	8	10	75	–	–	–	–	–	1
–	–	–	–	3	18	16	140	–	–	–	–	–	–
–	–	5	3	1	67	68	430	2	–	–	1	2	8
–	–	–	–	–	–	–	5	–	–	–	–	–	–
–	–	–	–	–	1	–	6	–	–	–	–	–	–
–	–	–	–	–	–	–	8	–	–	–	–	–	–
–	–	–	2	1	14	15	48	–	–	–	–	–	1
–	–	–	–	–	3	8	65	–	–	–	–	3	–
–	–	–	–	–	2	1	1	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	1	–	–	–	3	3	1	–	–	–	–	–	–
–	–	–	–	1	4	7	45	–	–	–	–	–	–
–	–	–	–	–	3	6	34	–	–	–	–	–	–

–	–	–	–	–	–			1	–
–	–	–	–	–	–	–	–	57	–
–	–	–	–	–	1	1	–	20	–
–	–	–	–	–	–	–	–	10	–
2	–	–	1	2	8	2	1	66	–
–	–	–	–	–	–	1	–	–	–
–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	3	2	–
–	–	–	–	–	1	1	–	9	–
–	–	–	–	3	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–

	83 Z TOTAL ELEMENTS PER SAMPLE	84 ZZ TOTAL ELEMENTS PER SECTION	
999.00	-	5472	999.00 : TOTAL
89.18	3	-	89.18 : 102646
85.48	-	-	85.48 : 102645
82.68	1	-	82.68 : 102644
79.68	5	-	79.68 : 98116
79.18	-	-	79.18 : 102642
77.68	46	-	77.68 : 98115
76.68	21	-	76.68 : 98114
74.18	61	-	74.18 : 98113
72.68	35	-	72.68 : 98112
67.68	277	-	67.68 : 98111
65.68	116	-	65.68 : 98110
64.68	694	-	64.68 : 98109
63.38	3	-	63.38 : 98108
62.47	115	-	62.47 : 98107
61.47	133	-	61.47 : 98106
60.27	1135	-	60.27 : 98105
58.97	104	-	58.97 : 98104
58.47	93	-	58.47 : 98103
56.88	96	-	56.88 : 98102
55.18	84	-	55.18 : 98101

54.08	66		54.08	98100
53.18	158	-	53.18	98099
52.77	596	-	52.77	98098
50.29	154	-	50.29	98097
48.68	234	-	48.68	98096
47.88	820	-	47.88	98095
45.47	12	-	45.47	98094
42.18	16	-	42.18	98093
41.68	23	-	41.68	98092
39.68	130	-	39.68	98091
34.20	106	-	34.20	102638
33.20	5	-	33.20	102637
32.29	-	-	32.29	102636
29.37	11	-	29.37	102635
29.25	70	-	29.25	102634
25.37	49	-	25.37	102633

GASCONS ROAD CUT SECTION
SECTION IV
ABSOLUTE ABUNDANCE CHARTS

	1 A Barren Sample	2 Apsidognathus sulcatus ("g")	3 Apsidognathus sulcatus (e)	4 Apsidognathus sulcatus (f)	5 Apsidognathus sulcatus (g1)	6 Apsidognathus sulcatus (g2)	7 Aulacognathus bullatus (g)
999.00 : TOTAL	3	1	1	15	67	27	
52.00 : 98172	-	-	-	-	-	-	
51.50 : 98171	-	-	-	-	-	-	
51.00 : 98170	-	-	-	-	-	-	
50.20 : 98169	-	-	-	-	-	-	
49.70 : 98168	-	-	-	-	-	-	
48.50 : 98167	-	-	-	-	-	-	
48.00 : 98166	-	-	-	-	-	-	
47.50 : 98165	-	-	-	-	-	-	
47.00 : 98164	-	-	-	-	-	-	
46.70 : 98163	-	-	-	-	-	-	
46.20 : 98162	-	-	-	-	-	-	
45.59 : 98161	-	-	-	-	-	-	
45.00 : 98160	-	-	-	-	1	-	
44.50 : 98159	-	-	-	-	-	-	
44.00 : 98158	-	-	-	-	-	-	
43.50 : 98157	-	-	-	-	-	-	
43.00 : 98156	-	-	-	-	-	-	
42.50 : 98155	-	-	-	-	1	1	
42.20 : 98154	-	-	-	-	1	-	

3 Apsidognathus sulcatus (e)	4 Apsidognathus sulcatus (f)	5 Apsidognathus sulcatus (g1)	6 Apsidognathus sulcatus (g2)	7 Aulacognathus bullatus (g)	8 Carniodus carnulus (a)	9 Carniodus carnulus (c)	10 Carniodus carnulus (e)	11 Carniodus carnulus (f)	12 Carniodus carnulus (g)	13 Digitodontus ballistriatus (a)	14 Digitodontus ballistriatus (b)	15 Distomodus staurognathoides (a)	16 Distomodus staurognathoides (b)
1	15	67	27	1	2	1	1	4	2	4	5	4	36
–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	1	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	1
–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	1	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	1
–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	1
–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	1	–	–	–	–	–	–	–	–	–	–	1
–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	3
–	–	–	–	–	–	–	–	–	–	–	–	–	1
–	–	–	–	–	–	–	–	–	–	–	–	–	1
–	–	1	1	–	–	–	–	–	–	–	–	–	3
–	–	1	–	–	–	–	–	–	–	–	–	–	2

11 Carniodus carnulus (f)	12 Carniodus carnulus (g)	13 Digitodontus ballistriatus (a)	14 Digitodontus ballistriatus (b)	15 Distomodus staurognathoides (a)	16 Distomodus staurognathoides (b)	17 Distomodus staurognathoides (c)	18 Distomodus staurognathoides (e)	19 Distomodus staurognathoides (f)
4	2	4	5	4	36	30	25	10
–	–	–	–	–	–	–	1	–
–	–	–	–	–	–	–	–	–
–	1	–	–	–	–	–	–	–
–	–	–	–	–	1	–	–	1
–	–	–	–	–	–	1	–	–
–	1	–	–	–	–	–	–	–
–	–	–	–	–	–	1	–	–
–	–	–	–	–	–	1	–	–
–	–	–	–	–	1	–	–	–
–	–	–	–	–	–	–	1	–
–	–	–	–	–	1	1	–	1
–	–	–	–	–	–	–	1	–
–	–	–	–	–	1	–	–	–
–	–	–	–	–	–	–	–	–
–	–	–	–	–	3	–	–	–
–	–	–	–	–	1	2	4	1
–	–	–	–	–	1	2	1	–
–	–	–	–	–	3	1	1	–
–	–	–	–	–	2	1	1	–

[illegible]							
37.29	98151		–	–			
34.20	98150	–	–	–	–	–	–
33.00	98149	–	–	–	–	–	–
30.00	98148	–	–	–	1	1	–
27.20	98147	–	–	–	–	–	–
24.79	98146	1	–	–	–	–	–
23.60	98145	–	–	–	1	1	1
23.00	98144	1	–	–	–	–	–
21.20	98143	–	–	–	–	–	–
20.79	98142	–	–	–	–	–	–
20.20	98141	–	–	–	–	1	–
19.29	98140	–	–	1	1	8	5
18.60	98139	–	–	–	–	–	–
17.79	98138	–	–	–	–	–	–
17.00	98137	–	–	–	–	–	–
16.00	98136	–	–	–	–	–	–
15.00	98135	–	–	–	–	–	–
14.00	98134	–	–	–	–	–	–
13.18	98133	–	–	–	1	1	1
12.60	98132	–	–	–	–	3	–
11.68	98131	–	–	–	2	4	1
11.30	98130	–	–	–	1	4	1
10.60	98129	–	–	–	–	–	3
10.50	98128	–	–	–	–	–	–
9.89	98127	–	–	–	–	–	–
9.89	98126	–	1	–	–	–	–
9.50	98125	–	–	–	–	–	–
9.00	98124	–	–	–	–	1	–
8.60	98123	–	–	–	–	–	–
8.14	98122	–	–	–	5	28	9
7.80	98121	–	–	–	–	2	2
6.80	98120	–	–	–	3	9	3
5.19	98119	1	–	–	–	–	–
4.80	98118	–	–	–	–	–	–

–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	1	1	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–
1	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	1	1	1	–	–	–	–	–	–	–
1	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	1	–	–	–	–	–	–	–	–
–	–	1	1	8	5	–	–	–	–	–	–	–
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–	–	–	1	1	1	–	–	–	–	–	–	–
–	–	–	–	3	–	–	–	–	–	–	–	–
–	–	–	2	4	1	–	–	–	–	–	–	–
–	–	–	1	4	1	–	1	–	1	3	–	–
–	–	–	–	–	3	1	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–
–	1	–	–	–	–	–	1	1	–	1	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	1	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	5	28	9	–	–	–	–	–	–	–
–	–	–	–	2	2	–	–	–	–	–	–	–
–	–	–	3	9	3	–	–	–	–	–	–	–
1	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	4

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–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	1	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	1	–	–	–	–	–
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–	–	–	–	–	–	–	2	–	1	–
–	–	–	–	–	–	–	1	1	–	2
–	–	–	–	–	–	–	3	1	–	–
–	–	–	–	–	–	1	1	2	3	–
–	–	–	–	–	–	–	3	4	1	–
–	–	–	–	–	1	–	–	–	–	–
–	–	–	–	–	–	–	1	4	–	–
–	–	–	–	–	–	–	–	1	–	–
–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	1	–	–	–
–	–	–	–	–	–	1	2	1	1	2
–	1	3	–	–	–	–	–	2	2	–
–	–	–	–	–	–	–	–	–	–	–
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–	–	–	–	–	–	–	–	–	–	–
1	–	1	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	2	1	–	1
–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	3	–	2	1
–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	4	1	–	–	–	–	–

	20 Distomodus staurognathoides (g)	21 Johnognathus huddlei	22 Kockelella ranuliformis (g)	23 O. aff. Ozarkodina pirata (g)	24 Oulodus? flugeli (g)	25 Oulodus? kentuckyensis (a)	26 Oulodus? kentuckyensis (b)	27 Oulodus? kentuckyensis (c)	28 Oulodus? kentuckyensis (e)
999.00	15	6	4	4	9	72	30	27	
52.00	1	-	-	1	-	-	-	-	
51.50	-	-	-	-	-	-	-	-	
51.00	-	-	-	-	-	-	-	-	
50.20	1	-	-	-	-	1	-	-	
49.70	-	-	-	-	-	-	-	-	
48.50	-	-	-	-	-	-	-	-	
48.00	-	-	-	-	-	-	-	-	
47.50	-	-	-	-	-	-	-	-	
47.00	-	-	-	-	-	-	-	-	
46.70	-	-	-	-	-	-	-	-	
46.20	-	-	-	-	-	-	-	-	
45.59	-	-	-	-	-	-	-	-	
45.00	1	1	-	2	-	-	-	-	
44.50	-	-	-	-	-	-	-	-	
44.00	-	-	-	-	-	-	-	-	
43.50	1	-	-	-	-	-	-	2	
43.00	1	-	-	-	-	3	-	2	
42.50	-	1	-	-	-	-	1	-	
42.20	2	-	-	-	1	13	2	2	
41.00	-	1	-	-	-	-	-	-	

22	Kockelella ranuliformis (g)	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23	O. aff. Ozarkodina pirata (g)	4	1	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-
24	Oulodus? flugeli (g)	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
25	Oulodus? kentuckyensis (a)	72	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	3	-	13	-
26	Oulodus? kentuckyensis (b)	30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	2	-
27	Oulodus? kentuckyensis (c)	27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	2	-	2	-
28	Oulodus? kentuckyensis (e)	35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
29	Oulodus? kentuckyensis (f)	17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	2	-
30	Oulodus? kentuckyensis (g)	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-
31	Ozarkodina confluens (a)	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	2	-
32	Ozarkodina confluens (alpha g)	11	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	1	-	2	1
33	Ozarkodina confluens (b)	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	-
34	Ozarkodina confluens (c)	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	-
35	Ozarkodina confluens (e)																					

31 Ozarkodina confluens [illegible]	32 Ozarkodina confluens (alpha g)	33 Ozarkodina confluens (b)	34 Ozarkodina confluens (c)	35 Ozarkodina confluens (e)	36 Ozarkodina confluens (f)	37 Ozarkodina confluens (gamma g)	38 Ozarkodina confluens (indet. g)	39 Ozarkodina excavata excavata (a)	40 Ozarkodina excavata excavata (b)
3	11	7	7	3	10	3	62	65	19
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	2	-
-	-	-	-	-	-	-	-	1	-
-	-	-	-	-	-	-	-	2	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	1
-	1	-	-	-	-	-	-	-	-
-	1	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	1	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
1	-	-	-	-	-	-	2	-	-
-	1	-	-	-	-	1	11	-	-
-	-	-	-	-	-	-	1	-	-
2	2	4	5	1	5	-	6	5	2
-	1	-	-	-	-	-	8	-	1

37.70	1	–	–	–	–	2	1	–	–
37.29	–	–	–	–	–	2	1	1	–
34.20	–	–	–	–	–	–	–	–	–
33.00	–	–	–	–	–	1	–	–	–
30.00	–	–	–	–	–	–	–	–	–
27.20	–	1	–	–	1	3	3	–	2
24.79	–	–	–	–	–	–	–	–	–
23.60	–	–	–	–	–	–	–	–	–
23.00	–	–	–	–	–	–	–	–	–
21.20	–	–	–	–	–	–	–	–	–
20.79	–	–	–	–		–	–	–	–
20.20	–	–	–	–	–	–	1	1	1
19.29	1	–	1	–	2	12	2	7	–
18.60	–	–	–	–	–	3	1	2	1
17.79	1	–	2	–	–	8	–	3	2
17.00	1	1	–	–	–	–	2	–	2
16.00	–	–	–	1	–	1	–	–	–
15.00	2	–	–	–	2	6	2	–	6
14.00	–	1	–	–	–	1	–	–	–
13.18	–	–	–	–	–	–	–	–	–
12.60	–	–	–	–	–	–	–	–	–
11.68	1	–	–	–	–	2	1	1	3
11.30	–	–	–	–	2	6	3	1	[illegible]
10.60	–	–	–	–	–	1	2	1	[illegible]
10.50	–	–	–	–	–	–	–	–	[illegible]
9.89	1	–	–	–	–	–	–	1	[illegible]
9.89	–	–	–	–	–	3	2	–	
9.50	–	–	–	–	–	1	2	–	
9.00	–	–	–	–	–	–	–	–	
8.60	–	–	–	–	–	–	–	–	
8.14	–	–	–	–	1	–	2	3	
7.80	–	–	–	–	–	–	1	–	
6.80	1	–	–	–	–	3	1	–	
5.19	–	–	–	–	–	–	–	–	
4.80	–	–	1	–	–	–	–	–	

	–	–	–	–	2	1	–	–	3	–		1	
	–	–	–	–	2	1	1	–	–	–	–	1	–
	–	–	–	–	–	–	–	–	–	–	–	–	–
	–	–	–	–	1	–	–	–	–	1	–	–	–
	–	–	–	–	–	–	–	–	–	–	–	–	–
	1	–	–	1	3	3	–	2	–	–	–	–	1
	–	–	–	–	–	–	–	–	–	–	–	–	–
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	–	–	–	–	–	1	1	1	–	–	–	–	–
	–	1	–	2	12	2	7	–	–	–	–	–	–
	–	–	–	–	3	1	2	1	–	–	–	1	–
	–	2	–	–	8	–	3	2	1	–	–	–	–
	1	–	–	–	–	2	–	2	2	–	–	2	2
–	–	–	1	–	1	–	–	–	–	–	–	–	–
–	–	–	–	2	6	2	–	6	1	–	–	–	–
–	1	–	–	–	1	–	–	–	–	–	–	–	–
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–	–	–	–	–	–	–	–	–	–	–	–	–	–
1	–	–	–	–	2	1	1	3	–	–	–	–	–
–	–	–	–	2	6	3	1	7	–	–	–	–	–
–	–	–	–	–	1	2	1	3	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–
1	–	–	–	–	–	–	1	–	–	–	–	–	–
–	–	–	–	–	3	2	–	3	–	–	–	–	–
–	–	–	–	–	1	2	–	1	1	–	–	–	–
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–	–	–	–	1	–	2	3	2	2	–	–	–	–
–	–	–	–	–	–	1	–	1	3	–	–	–	–
1	–	–	–	–	3	1	–	1	1	–	–	–	–
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–	–	1	–	–	–	–	–	–	–	–	–	–	–

	1		1						
–	1	–	–	–	–	–	9		–
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–	–	–	–	–	–	–	–	–	2
–	–	–	–	–	–	–	–	1	1
–	–	1	–	1	2	–	4	4	2
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–	–	–	–	–	–	–	–	–	–
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–	–	–	–	–	–	–	–	1	–
–	–	–	–	–	–	–	–	1	–
–	–	–	–	–	–	–	–	5	1
–	1	–	1	–	–	–	–	2	1
–	–	–	–	–	–	–	–	1	–
–	2	2	–	1	3	2	7	4	–
–	–	–	–	–	–	–	–	1	–
–	–	–	–	–	–	–	2	–	–
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–	–	–	–	–	–	–	–	3	–
–	–	–	–	–	–	–	–	4	–
–	–	–	–	–	–	–	–	4	2
–	–	–	–	–	–	–	3	6	2
–	–	–	–	–	–	–	–	3	1
–	–	–	–	–	–	–	2	1	–
–	–	–	–	–	–	–	2	–	–
–	–	–	–	–	–	–	–	4	3
–	–	–	–	–	–	–	–	1	–
–	–	–	–	–	–	–	1	1	–
–	–	–	–	–	–	–	–	1	–
–	–	–	–	–	–	–	–	3	–
–	–	–	–	–	–	–	–	1	–
–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	1	–	–

	41 Ozarkodina excavata excavata (c)	42 Ozarkodina excavata excavata (e)	43 Ozarkodina excavata excavata (f)	44 Ozarkodina excavata excavata (g)	45 Ozarkodina gulletensis (a)	46 Ozarkodina gulletensis (b)	47 Ozarkodina gulletensis (c)	48 Ozarkodina gulletensis (e)
999.00	41	10	55	153	17	15	22	[illegible]
52.00	-	-	-	-	-	-	-	
51.50	-	-	-	-	-	-	-	
51.00	-	-	-	-	-	-	-	
50.20	-	-	2	4	-	-	-	
49.70	-	-	-	-	-	-	-	
48.50	1	-	-	1	-	-	-	
48.00	-	-	1	1	-	1	-	
47.50	-	-	-	-	-	-	-	
47.00	-	-	-	1	-	-	-	
46.70	-	-	-	-	-	-	1	
46.20	1	1	1	1	-	-	-	
45.59	1	-	-	1	2	-	-	
45.00	-	-	-	-	1	1	2	
44.50	-	-	-	-	-	-	-	
44.00	-	-	-	-	1	-	-	
43.50	-	-	-	-	1	-	2	
43.00	1	-	1	2	1	-	1	
42.50	-	-	-	-	-	2	2	
42.20	3	1	1	3	-	-	4	
41.00	-	-	-	1	1	1	2	

43 Ozarkodina excavata excavata (f)	44 Ozarkodina excavata excavata (g)	45 Ozarkodina gulletensis (a)	46 Ozarkodina gulletensis (b)	47 Ozarkodina gulletensis (c)	48 Ozarkodina gulletensis (e)	49 Ozarkodina gulletensis (f)	50 Ozarkodina gulletensis (g)	51 Ozarkodina hadra (g)	52 Ozarkodina n.sp. A (a)	53 Ozarkodina n.sp. A (b)	54 Ozarkodina n.sp. A (c)	55 P. aff. Pterospathodus celloni (f)	56 P. aff. Pterospathodus celloni (g)
55	153	17	15	22	6	12	62	7	3	1	2	1	2
–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–
2	4	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	1	–	–	–	–	–	–	–	–	–	–	–	–
1	1	–	1	–	–	–	–	2	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	1	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	1	–	–	–	–	–	–	–	–	–
1	1	–	–	–	–	–	1	–	–	–	–	–	–
–	1	2	–	–	–	–	2	–	–	–	–	–	–
–	–	1	1	2	–	–	3	–	–	–	–	–	–
–	–	–	–	–	1	–	–	2	–	–	–	–	–
–	–	1	–	–	–	–	2	–	–	–	–	–	–
–	–	1	–	2	–	–	–	–	–	–	–	–	–
1	2	1	–	1	–	–	2	–	–	–	–	–	–
–	–	–	2	2	–	–	–	–	–	–	–	–	–
1	3	–	–	4	1	1	–	–	–	–	–	–	–
–	1	1	1	2	–	1	–	–	–	–	–	–	–

	53 Ozarkodina n.sp. A (b)	54 Ozarkodina n.sp. A (c)	55 P. aff. Pterospathodus celloni (f)	56 P. aff. Pterospathodus celloni (g)	57 Panderodus gibber (a)	58 Panderodus gibber (c)	59 Panderodus panderi (a/b)	60 Panderodus recurvatus (a)	61 Panderodus recurvatus (b)
3	1	2	1	2	22	3	1	13	20
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	1
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	1	-	-	-	-
-	-	-	-	-	1	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	10	-	-	-	2
-	-	-	-	-	-	-	-	-	-

37.29	1	–	7	1	–	–	–
34.20	–	1	–	–	–	–	–
33.00	–	–	1	1	–	–	–
30.00	2	–	2	–	–	1	–
27.20	3	1	–	6	–	–	–
24.79	–	–	–	–	–	–	–
23.60	1	–	1	3	–	–	–
23.00	–	–	–	–	–	–	–
21.20	–	–	–	–	1	–	–
20.79	–	–	1	1	1	–	1
20.20	1	–	–	3	–	–	–
19.29	–	1	5	10	1	2	–
18.60	2	–	1	3	4	–	1
17.79	–	–	–	–	–	–	–
17.00	–	–	4	2	–	–	–
16.00	2	–	–	1	–	2	–
15.00	1	–	–	4	–	–	–
14.00	–	–	–	–	–	–	–
13.18	1	–	1	2	–	–	–
12.60	–	–	–	–	–	–	1
11.68	4	–	–	20	1	1	–
11.30	7	1	17	29	–	–	–
10.60	1	–	2	14	1	1	1
10.50	1	–	–	2	–	–	–
9.89	–	–	–	2	–	–	–
9.89	3	2	–	6	–	–	–
9.50	–	–	1	1	1	–	–
9.00	1	–	–	1	–	–	–
8.60	–	–	–	1	–	–	–
8.14	1	–	–	11	–	1	3
7.80	–	–	2	5	–	–	–
6.80	–	–	–	4	–	1	1
5.19	–	–	–	–	–	–	–
4.80	1	1	–	2	–	1	–

		1											
1	–	–	–	–	–	–	–	–	–	–	–	–	–
–	1	1	–	–	–	–	–	–	–	–	–	–	–
–	2	–	–	1	–	–	–	1	–	–	–	–	–
1	–	6	–	–	–	–	–	2	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	1	3	–	–	–	–	1	2	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	1	–	–	–	–	–	–	–	–	–	–
–	1	1	1	–	1	1	–	1	–	–	–	–	–
–	–	3	–	–	–	–	–	1	–	–	–	–	–
1	5	10	1	2	–	–	–	–	2	–	–	–	–
–	1	3	4	–	1	1	–	3	–	–	–	–	–
–	–	–	–	–	–	–	2	–	–	–	–	–	–
–	4	2	–	–	–	–	–	–	–	–	–	–	–
–	–	1	–	2	–	–	–	–	–	–	–	–	–
–	–	4	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	2	–	–	–	–	–
–	1	2	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	1	–	–	–	–	–	–	–	–
–	–	20	1	1	–	–	2	6	–	–	–	–	–
1	17	29	–	–	–	–	–	–	–	3	1	2	–
–	2	14	1	1	1	2	–	10	–	–	–	–	–
–	–	2	–	–	–	–	–	–	–	–	–	–	1
–	–	2	–	–	–	–	–	–	–	–	–	–	–
2	–	6	–	–	–	–	–	–	–	–	–	–	–
–	1	1	1	–	–	–	–	–	–	–	–	–	–
–	–	1	–	–	–	–	–	–	–	–	–	–	–
–	–	1	–	–	–	–	–	–	–	–	–	–	–
–	–	11	–	1	3	–	2	4	–	–	–	–	–
–	2	5	–	–	–	–	–	–	–	–	–	–	–
–	–	4	–	1	1	–	2	12	1	–	–	–	–
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1	–	2	–	1	–	–	1	8	–	–	–	–	–

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1	–	–	–	–	–	–	–	–	–	–	–
2	–	–	–	–	–	–	–	–	–	1	1
–	–	–	–	–	–	–	–	–	–	–	–
2	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–
1	–	–	–	–	–	–	–	–	–	–	–
1	–	–	–	–	–	–	–	–	–	–	–
–	2	–	–	–	–	–	3	1	–	–	1
3	–	–	–	–	–	2	–	–	–	–	–
–	–	–	–	–	–	–	2	2	–	–	1
–	–	–	–	–	–	–	–	–	–	2	1
–	–	–	–	–	–	–	–	–	–	–	1
–	–	–	–	–	–	–	–	–	–	–	1
2	–	–	–	–	–	–	–	–	–	–	–
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–	–	–	–	–	–	–	–	–	–	–	–
6	–	–	–	–	–	–	–	–	1	3	3
–	–	3	1	2	–	–	–	–	–	4	4
0	–	–	–	–	–	–	1	–	–	–	–
–	–	–	–	–	1	–	–	–	–	–	–
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4	–	–	–	–	–	–	3	–	–	3	2
–	–	–	–	–	–	–	–	–	–	–	–
2	1	–	–	–	–	–	1	–	–	–	2
–	–	–	–	–	–	–	–	–	–	–	–
8	–	–	–	–	–	–	–	–	–	–	–

	62 Panderodus recurvatus (c)	63 Panderodus unicostatus (ar.)	64 Panderodus unicostatus (sm.)	65 Panderodus unicostatus (gr.)	66 Phosphanulus universalis	67 Pseudooneotodus beckmanni	68 Pseudooneotodus pyramis	69 Pterospathodus amorphognathoides (a)
999.00	13	223	261	1625	1	10	1	
52.00	–	1	1	4	–	–	–	
51.50	–	–	–	4	–	–	–	
51.00	–	–	–	6	–	–	–	
50.20	–	2	1	12	–	1	–	
49.70	–	–	–	9	–	–	–	
48.50	–	–	1	10	–	–	–	
48.00	–	–	–	4	–	–	–	
47.50	–	–	1	3	–	–	–	
47.00	–	–	–	1	–	–	–	
46.70	–	1	–	1	–	–	–	
46.20	–	1	1	7	–	–	–	
45.59	–	1	1	14	–	–	–	
45.00	–	–	1	18	–	–	–	
44.50	–	1	–	11	–	–	–	
44.00	–	–	1	4	–	1	–	
43.50	–	2	–	8	–	–	–	
43.00	–	1	1	17	–	–	–	
42.50	–	–	–	4	–	–	–	
42.20	–	7	7	92	–	1	1	
41.00	–	1	–	4	–	–	–	

64 Panderodus unicostatus (sm.)	65 Panderodus unicostatus (gr.)	66 Phosphannulus universalis	67 Pseudooneotodus beckmanni	68 Pseudooneotodus pyramis	69 Pterospathodus amorphognathoides (g)	70 Pterospathodus pennatus pennatus (f)	71 Pterospathodus pennatus pennatus (g)	72 Pterospathodus? ceragnathoides (c)	73 Pterospathodus? ceragnathoides (e)	74 Pterospathodus? ceragnathoides (g)	75 Walliserodus curvatus (a)	76 Walliserodus curvatus (b)
261	1625	1	10	1	9	1	1	3	4	112	1	
1	4	–	–	–	1	–	–	–	–	–	–	
–	4	–	–	–	2	–	–	–	–	–	–	
–	6	–	–	–	–	–	–	–	–	–	–	
1	12	–	1	–	1	–	–	–	–	–	–	
–	9	–	–	–	2	–	–	–	–	–	–	
1	10	–	–	–	1	–	–	–	–	–	–	
–	4	–	–	–	–	–	–	–	–	–	–	
1	3	–	–	–	–	–	–	–	–	–	–	
–	1	–	–	–	–	–	–	–	–	–	–	
–	1	–	–	–	–	–	–	–	–	–	–	
1	7	–	–	–	–	–	–	–	–	–	–	
1	14	–	–	–	1	–	–	–	–	1	–	
1	18	–	–	–	–	–	–	–	–	–	–	
–	11	–	–	–	–	–	–	–	–	–	–	
1	4	–	1	–	–	–	–	–	–	–	–	
–	8	–	–	–	–	–	–	–	–	–	–	
1	17	–	–	–	–	–	–	–	–	3	–	
–	4	–	–	–	–	–	–	–	–	–	–	
7	92	–	1	1	–	–	–	–	–	10	–	
–	4	–	–	–	–	–	–	–	–	1	–	

	73 Pterospathodus? cerагnathoides (e)	74 Pterospathodus? ceragnathoides (g)	75 Walliserodus curvatus (a)	76 Walliserodus curvatus (b)	77 Z TOTAL ELEMENTS PER SAMPLE	78 ZZ TOTAL ELEMENTS PER SECTION		
3	4	112	1	1	3263	3336	999.00 :	TOTAL
-	-	-	-	-	9	-	52.00 :	98172
-	-	-	-	-	6	-	51.50 :	98171
-	-	-	-	-	7	-	51.00 :	98170
-	-	-	-	-	28	-	50.20 :	98169
-	-	-	-	-	14	-	49.70 :	98168
-	-	-	-	-	16	-	48.50 :	98167
-	-	-	-	-	12	-	48.00 :	98166
-	-	-	-	-	5	-	47.50 :	98165
-	-	-	-	-	4	-	47.00 :	98164
-	-	-	-	-	4	-	46.70 :	98163
-	-	-	-	-	18	-	46.20 :	98162
-	-	1	-	-	25	-	45.59 :	98161
-	-	-	-	-	34	-	45.00 :	98160
-	-	-	-	-	16	-	44.50 :	98159
-	-	-	-	-	12	-	44.00 :	98158
-	-	-	-	-	27	-	43.50 :	98157
-	-	3	-	-	53	-	43.00 :	98156
-	-	-	-	-	18	-	42.50 :	98155
-	-	10	-	-	205	-	42.20 :	98154
-	-	1	-	-	24	-	41.00 :	98153
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

37.29		2		11			
34.20	–	–	–	–	–	–	–
33.00	–	–	–	–	–	–	–
30.00	–	–	–	5	–	–	–
27.20	–	5	5	15	–	–	–
24.79	–	–	–	–	–	–	–
23.60	–	2	7	4	–	–	–
23.00	–	–	–	–	–	–	–
21.20	–	–	–	–	–	–	–
20.79	–	–	1	5	–	–	–
20.20	–	1	4	2	–	–	–
19.29	2	36	31	179	–	3	–
18.60	–	10	11	52	–	–	–
17.79	2	15	22	59	1	–	–
17.00	–	10	10	58	–	2	–
16.00	1	2	3	8	–	–	–
15.00	2	3	2	30	–	–	–
14.00	–	–	–	–	–	–	–
13.18	–	1	2	15	–	–	–
12.60	–	2	2	17	–	–	–
11.68	–	10	9	105	–	–	–
11.30	4	46	49	358	–	–	–
10.60	–	12	10	86	–	–	–
10.50	–	2	3	10	–	1	–
9.89	–	1	2	10	–	–	–
9.89	–	12	18	11	–	–	–
9.50	–	2	9	12	–	1	–
9.00	–	1	2	7	–	–	–
8.60	–	1	1	8	–	–	–
8.14	2	18	12	114	–	–	–
7.80	–	2	8	34	–	–	–
6.80	–	7	19	169	–	–	–
5.19	–	–	–	–	–	–	–
4.80	–	–	2	3	–	–	–

2		11											
–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	5	–	–	–	–	–	–	–	1	4	–	–
5	5	15	–	–	–	–	–	–	–	–	8	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–
2	7	4	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	1	5	–	–	–	–	–	–	–	–	–	–	–
1	4	2	–	–	–	–	–	–	–	–	–	–	–
36	31	179	–	3	–	–	–	–	–	–	7	–	–
10	11	52	–	–	–	–	–	–	–	1	–	–	–
15	22	59	1	–	–	–	–	–	–	–	7	–	–
10	10	58	–	2	–	–	–	–	–	–	6	–	–
2	3	8	–	–	–	–	–	–	–	–	–	–	–
3	2	30	–	–	–	–	–	–	1	–	12	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–
1	2	15	–	–	–	1	–	–	–	–	1	–	–
2	2	17	–	–	–	–	–	–	–	–	1	–	–
10	9	105	–	–	–	–	–	–	–	–	–	–	–
46	49	358	–	–	–	–	–	–	1	1	32	1	1
12	10	86	–	–	–	–	–	1	–	–	4	–	–
2	3	10	–	1	–	–	–	–	–	–	–	–	–
1	2	10	–	–	–	–	–	–	–	–	–	–	–
12	18	11	–	–	–	–	–	–	–	–	–	–	–
2	9	12	–	1	–	–	–	–	–	–	2	–	–
1	2	7	–	–	–	–	–	–	–	–	–	–	–
1	1	8	–	–	–	–	–	–	–	–	–	–	–
18	12	114	–	–	–	–	–	–	–	–	–	–	–
2	8	34	–	–	–	–	–	–	–	–	–	–	–
7	19	169	–	–	–	–	–	–	–	–	3	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	2	3	–	–	–	–	–	–	1	1	8	–	–

				42		[illegible]	98151
–	–	–	–	1	–	34.20	98150
–	–	–	–	6	–	33.00	98149
1	4	–	–	21	–	30.00	98148
–	8	–	–	71	–	27.20	98147
–	–	–	–	–	–	24.79	98146
–	–	–	–	27	–	23.60	98145
–	–	–	–	–	–	23.00	98144
–	–	–	–	1	–	21.20	98143
–	–	–	–	13	–	20.79	98142
–	–	–	–	20	–	20.20	98141
–	7	–	–	334	–	19.29	98140
1	–	–	–	107	–	18.60	98139
–	7	–	–	140	–	17.79	98138
–	6	–	–	132	–	17.00	98137
–	–	–	–	24	–	16.00	98136
–	12	–	–	80	–	15.00	98135
–	–	–	–	5	–	14.00	98134
–	1	–	–	30	–	13.18	98133
–	1	–	–	31	–	12.60	98132
–	–	–	–	193	–	11.68	98131
1	32	1	1	563	–	11.30	98130
–	4	–	–	162	–	10.60	98129
–	–	–	–	23	–	10.50	98128
–	–	–	–	19	–	9.89	98127
–	–	–	–	70	–	9.89	98126
–	2	–	–	35	–	9.50	98125
–	–	–	–	15	–	9.00	98124
–	–	–	–	12	–	8.60	98123
–	–	–	–	235	–	8.14	98122
–	–	–	–	61	–	7.80	98121
–	3	–	–	250	–	6.80	98120
–	–	–	–	–	–	5.19	98119
1	8	–	–	36	–	4.80	98118

RAILWAY CUT SECTION
SECTION V
ABSOLUTE ABUNDANCE CHARTS

	1 ?Astropentagnathus irregularis (g)	2 A Barren Sample	3 Apsidognathus sulcatus ("S")	4 Apsidognathus sulcatus (e)	5 Apsidognathus sulcatus (f)	6 Apsidognathus sulcatus (g1)	7 Apsidognathus sulcatus (g2)
999.00 : TOTAL	1	6	5	5	3	22	1
43.00 : 98215	-	1	-	-	-	-	
42.29 : 98214	-	-	-	-	-	-	
42.00 : 98213	-	-	-	-	-	-	
41.00 : 98212	-	-	-	-	-	1	
40.00 : 96211	-	-	1	-	-	-	
39.40 : 98210	-	-	-	-	-	-	
39.00 : 98209	-	1	-	-	-	-	
38.59 : 98208	-	-	-	-	-	-	
38.00 : 98207	-	-	-	-	-	-	
36.00 : 98206	-	1	-	-	-	-	
35.00 : 98205	-	1	-	-	-	-	
34.00 : 98204	-	-	-	-	-	-	
33.00 : 98203	-	1	-	-	-	-	
32.00 : 98202	-	-	-	-	-	-	
31.00 : 98201	-	-	-	-	-	-	
30.00 : 98200	-	-	-	-	-	-	
29.00 : 98199	-	-	-	-	-	-	
28.00 : 98198	-	-	-	-	-	-	
27.00 : 98197	-	1	-	-	-	-	
26.00 : 98196	-	-	-	-	-	-	
25.00 : 98195	-	-	-	-	-	-	
24.00 : 98194	-	-	-	-	-	-	

2 A Barren Sample	3 Apsidognathus sulcatus ("S")	4 Apsidognathus sulcatus (e)	5 Apsidognathus sulcatus (f)	6 Apsidognathus sulcatus (g1)	7 Apsidognathus sulcatus (g2)	8 Carniodus carnulus (a)	9 Carniodus carnulus (b)	10 Carniodus carnulus (c)	11 Carniodus carnulus (e)	12 Carniodus carnulus (f)	13 Carniodus carnulus (g)	14 Dapsilodus sp. (a)	15 Digitodontus bellistriatus (b)
6	5	5	3	22	11	1	2	1	1	1	5	1	2
1	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	1	-	-	-	-	-	-	1	-	-
-	1	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
1	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
1	-	-	-	-	-	-	-	-	-	-	-	-	-
1	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
1	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
1	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-

[illegible]	[illegible]	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12	Carniodus carnulus (f)	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13	Carniodus carnulus (g)	5	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14	Dapsilodus sp. (a)	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15	Digitodontus bellistriatus (b)	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16	Digitodontus bellistriatus (c)	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
17	Distomodus staurognathoides (a)	17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18	Distomodus staurognathoides (b)	33	-	-	-	1	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1	-	-
19	Distomodus staurognathoides (c)	40	-	-	1	1	-	-	-	1	-	-	-	1	-	-	-	-	-	-	-	-	1	-

23.00 : 98193	-	-	-	-	-	-
22.00 : 98192	-	-	2	1	-	7
21.50 : 98191	-	-	1	3	-	5
20.50 : 98190	-	-	-	-	-	-
19.50 : 98189	-	-	-	-	-	-
18.50 : 98188	-	-	-	-	-	-
17.50 : 98187	-	-	-	-	-	-
16.50 : 98186	-	-	-	-	-	-
3.00 : 98185	-	-	-	-	-	3
2.00 : 98184	1	-	1	1	3	6
1.00 : 98183	-	-	-	-	-	-
0.00 : 98182	-	-	-	-	-	-

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–	–	2	1	–	7	4	–	–	–	–	–	–	–
–	–	1	3	–	5	4	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–
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–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	1	–	–	–	–	–	–
–	–	–	–	–	3	–	–	–	–	–	–	–	–
1	–	1	1	3	6	3	–	2	1	1	1	4	1
–	–	–	–	–	–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	–	–	–	–	–	–	–	–

–	–	–	–	–	–	10	10	14
–	–	–	–	–	–	1	1	2
–	–	–	–	–	–	–	2	–
–	–	–	–	–	–	–	2	2
–	–	–	–	1	–	–	1	–
–	–	–	–	–	–	–	–	–
–	–	–	–	–	–	5	10	13
–	–	–	–	–	–	–	1	1
1	1	4	1	1	1	–	2	–
–	–	–	–	–	–	–	1	–
–	–	–	–	–	–	1	–	3

	20 Distomodus staurognathoides (e)	21 Distomodus staurognathoides (f)	22 Distomodus staurognathoides (g)	23 Johnognathus huddlei	24 Kockelella ranuliformis (g)	25 O. aff. Ozarkodina pirata (g)	26 Oulodus? flugeli (c)	27 Oulodus? flugeli (g)
999.00	36	15	26	4	2	1	4	9
43.00	-	-	-	-	-	-	-	-
42.29	-	-	1	-	-	-	-	-
42.00	-	-	-	-	-	-	-	-
41.00	-	-	1	-	-	-	-	-
40.00	-	-	-	-	-	-	-	-
39.40	-	-	-	-	-	-	-	-
39.00	-	-	-	-	-	-	-	-
38.59	-	-	-	-	-	-	-	-
38.00	-	-	-	-	-	-	-	-
36.00	-	-	-	-	-	-	-	-
35.00	-	-	-	-	-	-	-	-
34.00	-	-	1	-	-	-	-	-
33.00	-	-	-	-	-	-	-	-
32.00	-	-	-	-	-	-	-	-
31.00	-	-	-	-	-	-	-	-
30.00	-	-	-	-	-	1	-	-
29.00	-	-	-	-	-	-	-	-
28.00	-	-	-	-	-	-	-	-
27.00	-	-	-	-	-	-	-	-
26.00	-	-	-	-	-	-	-	-
25.00	-	-	-	-	-	-	-	-
24.00	1	-	1	-	-	-	-	-

23 Johnognathus huddlei	24 Kockelella ranuliformis (g)	25 O. aff. Ozarkodina pirata (g)	26 Oulodus? flugeli (c)	27 Oulodus? flugeli (g)	28 Oulodus? kentuckyensis (a)	29 Oulodus? kentuckyensis (b)	30 Oulodus? kentuckyensis (c)	31 Oulodus? kentuckyensis (e)	32 Oulodus? kentuckyensis (f)	33 Oulodus? kentuckyensis (g)	34 Ozarkodina confluens (a)	35 Ozarkodina confluens (alpha g)
4	2	1	4	9	98	41	74	30	31	12	12	20
-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	1	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	1	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	1	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	2	1	-	-	-	-	1	-
-	-	-	-	-	1	-	1	-	-	-	1	3

31 Oulodus? kentuckyensis (e)	32 Oulodus? kentuckyensis (f)	33 Oulodus? kentuckyensis (g)	34 Ozarkodina confluens (a)	35 Ozarkodina confluens (alpha g)	36 Ozarkodina confluens (b)	37 Ozarkodina confluens (c)	38 Ozarkodina confluens (e)	39 Ozarkodina confluens (f)	40 Ozarkodina confluens (gamma g)
30	31	12	12	20	31	29	7	4	81
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
-	-	-	1	-	1	-	-	-	1
-	-	-	1	3	1	-	2	-	-

23.00	1	–	1	–	–	–	–	–	–
22.00	9	8	11	4	–	–	2	5	22
21.50	–	2	–	–	–	–	–	–	2
20.50	1	–	–	–	–	–	–	–	3
19.50	1	–	–	–	–	–	–	–	1
18.50	–	–	–	–	–	–	–	–	1
17.50	–	–	–	–	–	–	–	–	6
16.50	17	4	6	–	–	–	–	–	47
3.00	1	–	–	–	–	–	–	–	2
2.00	3	–	2	–	2	–	1	4	7
1.00	2	–	1	–	–	–	1	–	2
0.00	–	1	1	–	–	–	–	–	1

–	–	1	–	–	–	–	–	–	–	–	1	1	–
4	–	–	2	5	22	20	34	9	14	9	–	7	20
–	–	–	–	–	2	1	1	2	–	–	–	–	1
–	–	–	–	–	3	–	–	1	2	–	2	2	5
–	–	–	–	–	1	2	–	–	–	–	1	–	1
–	–	–	–	–	1	–	–	–	1	–	1	1	–
–	–	–	–	–	6	–	–	1	–	–	–	–	–
–	–	–	–	–	47	9	30	11	8	1	2	3	2
–	–	–	–	–	2	1	1	–	–	–	–	1	–
–	2	–	1	4	7	6	4	5	6	1	–	–	–
–	–	–	1	–	2	–	3	1	–	1	3	2	–
–	–	–	–	–	1	–	–	–	–	–	–	–	–

–	–	1	1	–	–	–	1	–
14	9	–	7	20	20	2	2	46
–	–	–	–	1	1	–	–	10
2	–	2	2	5	4	2	–	11
–	–	1	–	1	1	–	1	10
1	–	1	1	–	–	–	–	–
–	–	–	–	–	–	–	–	–
8	1	2	3	2	1	1	–	1
–	–	–	1	–	–	–	–	–
6	1	–	–	–	–	–	–	–
–	1	3	2	–	2	–	–	2
–	–	–	–	–	–	–	–	–

	41 Ozarkodina excavata excavata (a)	42 Ozarkodina excavata excavata (b)	43 Ozarkodina excavata excavata (c)	44 Ozarkodina excavata excavata (e)	45 Ozarkodina excavata excavata (f)	46 Ozarkodina excavata excavata (g)	47 Ozarkodina gulletensis (a)	48 Ozarkodina gulletensis (b)	49 Ozarkodina gulletensis (c)
999.00	44	17	68	20	48	69	2	6	11
43.00	-	-	-	-	-	-	-	-	-
42.29	-	-	-	-	-	-	-	-	-
42.00	1	-	-	-	-	1	-	-	-
41.00	-	-	1	-	-	-	-	-	-
40.00	-	-	-	-	-	-	-	-	-
39.40	-	-	-	-	-	-	-	-	-
39.00	-	-	-	-	-	-	-	-	-
38.59	-	-	-	-	-	-	-	-	-
38.00	-	-	-	-	-	1	-	-	-
36.00	-	-	-	-	-	-	-	-	-
35.00	-	-	-	-	-	-	-	-	-
34.00	-	-	-	-	-	-	-	-	-
33.00	-	-	-	-	-	-	-	-	-
32.00	-	-	-	-	-	-	-	-	-
31.00	-	-	-	-	-	1	-	-	-
30.00	-	-	-	-	1	-	-	-	-
29.00	-	-	-	-	-	-	-	-	-
28.00	-	-	-	-	-	-	-	-	-
27.00	-	-	-	-	-	-	-	-	-
26.00	-	-	-	-	-	-	-	-	-
25.00	-	-	-	-	-	-	-	-	-
24.00	-	-	-	-	-	-	-	-	-

44 Ozarkodina excavata excavata (e)	45 Ozarkodina excavata excavata (f)	46 Ozarkodina excavata excavata (g)	47 Ozarkodina gulletensis (a)	48 Ozarkodina gulletensis (b)	49 Ozarkodina gulletensis (c)	50 Ozarkodina gulletensis (e)	51 Ozarkodina gulletensis (f)	52 Ozarkodina gulletensis (g)	53 Ozarkodina hadra (g)	54 P. aff. Pterospathodus celloni (f)	55 P. aff. Pterospathodus celloni (g)	56 Panderodus gibber (a)	57 Panderodus recurvatus (a)
20	48	69	2	6	11	1	3	54	2	2	2	75	7
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	1	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	1	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	1	-	-	-	-	-	-	-	-	-	-	-
-	1	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	1	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-

53 Uzarkodina naora (g)	54 P. aff. Pterospathodus celloni (f)	55 P. aff. Pterospathodus celloni (g)	56 Panderodus gibber (a)	57 Panderodus recurvatus (a)	58 Panderodus recurvatus (b)	59 Panderodus recurvatus (c)	60 Panderodus unicostatus (ar.)	61 Panderodus unicostatus (cm.)
2	2	2	75	7	20	17	385	545
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	1	2
-	-	-	-	-	-	-	1	2
-	-	-	-	-	-	-	1	2
-	-	-	-	-	-	-	-	1
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	2	1
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	1	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	1	-
-	-	-	-	-	-	-	-	1
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	1	6
-	-	-	-	-	-	-	-	-
-	-	-	1	-	-	-	1	4
-	-	-	-	-	-	-	-	4
-	-	-	-	-	-	-	-	4

23.00	–	–	–	–	–	–	–	–
22.00	11	5	20	11	7	13	–	–
21.50	–	–	2	1	–	2	–	–
20.50	–	–	–	–	2	5	–	–
19.50	–	–	1	–	1	1	–	–
18.50	1	–	2	1	–	–	–	–
17.50	2	–	2	–	–	1	–	2
16.50	8	4	10	2	13	14	2	4
3.00	–	1	–	–	–	1	–	–
2.00	7	4	24	2	14	17	–	–
1.00	6	4	3	1	8	7	–	–
0.00	8	3	3	2	2	5	–	–

–	–	–	–	–	–	–	1	1	–	1	–	–	–
5	20	11	7	13	–	–	–	–	–	–	–	–	–
–	2	1	–	2	–	–	–	–	–	1	–	–	–
–	–	–	2	5	–	–	–	–	–	–	–	–	–
–	1	–	1	1	–	–	–	–	–	–	–	–	–
–	2	1	–	–	–	–	–	–	–	–	–	–	–
–	2	–	–	1	–	2	–	–	–	1	–	–	–
4	10	2	13	14	2	4	5	–	–	26	–	–	–
1	–	–	–	1	–	–	–	–	–	–	–	–	–
4	24	2	14	17	–	–	3	–	3	4	2	2	2
4	3	1	8	7	–	–	2	–	–	11	–	–	–
3	3	2	2	5	–	–	–	–	–	10	–	–	–

1	–	–	–	1	–	–	–	2	8
–	–	–	–	58	–	2	–	92	108
1	–	–	–	–	–	–	–	8	6
–	–	–	–	–	–	–	–	2	5
–	–	–	–	–	–	–	–	1	6
–	–	–	–	–	–	–	–	–	–
1	–	–	–	–	–	–	–	2	4
26	–	–	–	3	4	5	4	124	199
–	–	–	–	–	–	1	1	3	7
4	2	2	2	12	1	6	9	90	123
11	–	–	–	–	2	3	3	26	23
10	–	–	–	–	–	3	–	26	29

	62 Panderodus unicostatus (gr.)	63 Pseudooneotodus beckmanni	64 Pterospathodus amorphognathoides (c)	65 Pterospathodus amorphognathoides (e)	66 Pterospathodus amorphognathoides (f)	67 Pterospathodus amorphognathoides (g)	68 Pterospathodus? ceragnathoides (a)	69 Pterospathodus? ceragnathoides (c)
999.00	2239	36	2	1	4	4	2	1
43.00	-	-	-	-	-	-	-	-
42.29	4	-	-	-	1	-	-	-
42.00	7	-	-	-	-	-	-	-
41.00	7	-	-	-	-	-	-	-
40.00	5	-	-	-	-	-	-	-
39.40	6	-	-	-	-	-	-	-
39.00	-	-	-	-	-	-	-	-
38.59	3	-	-	-	1	1	-	-
38.00	-	-	-	-	-	-	-	-
36.00	-	-	-	-	-	-	-	-
35.00	-	-	-	-	-	-	-	-
34.00	15	-	-	-	2	-	-	-
33.00	-	-	-	-	-	-	-	-
32.00	4	-	-	-	-	-	-	-
31.00	1	-	-	-	-	-	-	-
30.00	2	-	1	1	-	-	-	-
29.00	1	-	-	-	-	-	-	-
28.00	3	-	-	-	-	-	-	-
27.00	-	-	-	-	-	-	-	-
26.00	4	-	1	-	-	2	-	-
25.00	9	-	-	-	-	-	-	-
24.00	35	-	-	-	-	1	-	-

65 Pterospathodus amorphognathoides (e)	66 Pterospathodus amorphognathoides (f)	67 Pterospathodus amorphognathoides (g)	68 Pterospathodus? ceragnathoides (a)	69 Pterospathodus? ceragnathoides (c)	70 Pterospathodus? ceragnathoides (e)	71 Pterospathodus? ceragnathoides (e)	72 Pterospathodus? ceragnathoides (g)	73 Walliserodus curvatus (a)	74 Walliserodus curvatus (b)	75 Z TOTAL ELEMENTS PER SAMPLE	76 ZZ TOTAL ELEMENTS PER SECTION	
1	4	4	2	1	2	2	128	1	1	-	4616	999.00
-	-	-	-	-	-	-	-	-	-	-	-	43.00
-	1	-	-	-	-	-	-	-	-	9	-	42.29
-	-	-	-	-	-	-	-	-	-	13	-	42.00
-	-	-	-	-	-	-	-	-	-	16	-	41.00
-	-	-	-	-	-	-	-	-	-	8	-	40.00
-	-	-	-	-	-	-	-	-	-	6	-	39.40
-	-	-	-	-	-	-	-	-	-	-	-	39.00
-	1	1	-	-	-	-	-	-	-	9	-	38.59
-	-	-	-	-	-	-	-	-	-	1	-	38.00
-	-	-	-	-	-	-	-	-	-	-	-	36.00
-	-	-	-	-	-	-	-	-	-	-	-	35.00
-	2	-	-	-	-	-	-	-	-	21	-	34.00
-	-	-	-	-	-	-	-	-	-	-	-	33.00
-	-	-	-	-	-	-	-	-	-	6	-	32.00
-	-	-	-	-	-	-	-	-	-	3	-	31.00
1	-	-	-	-	-	-	-	-	-	6	-	30.00
-	-	-	-	-	-	-	-	-	-	1	-	29.00
-	-	-	-	-	-	-	-	-	-	10	-	28.00
-	-	-	-	-	-	-	-	-	-	-	-	27.00
-	-	2	-	-	-	-	-	-	-	14	-	26.00
-	-	-	-	-	-	-	-	-	-	19	-	25.00
-	-	1	-	-	-	-	-	-	-	51	-	24.00

	74 Walliserodus curvatus (b)	75 % TOTAL ELEMENTS PER SAMPLE	76 %% TOTAL ELEMENTS PER SECTION		
1	1	-	4616	999.00	TOTAL
-	-	-	-	43.00	98215
-	-	9	-	42.29	98214
-	-	13	-	42.00	98213
-	-	16	-	41.00	98212
-	-	8	-	40.00	98211
-	-	6	-	39.40	98210
-	-	-	-	39.00	98209
-	-	9	-	38.59	98208
-	-	1	-	38.00	98207
-	-	-	-	36.00	98206
-	-	-	-	35.00	98205
-	-	21	-	34.00	98204
-	-	-	-	33.00	98203
-	-	6	-	32.00	98202
-	-	3	-	31.00	98201
-	-	6	-	30.00	98200
-	-	1	-	29.00	98199
-	-	10	-	28.00	98198
-	-	-	-	27.00	98197
-	-	14	-	26.00	98196
-	-	19	-	25.00	98195
-	-	51	-	24.00	98194

24.00	[illegible]	–	–	–	–	1			
23.00	36	–	–	–	–	–	–	–	–
22.00	1283	32	–	–	–	–	–	–	–
21.50	22	–	–	–	–	–	–	–	–
20.50	47	–	–	–	–	–	–	–	–
19.50	14	–	–	–	–	–	–	–	–
18.50	8	–	–	–	–	–	–	–	–
17.50	4	–	–	–	–	–	–	–	–
16.50	370	–	–	–	–	–	–	–	1
3.00	18	–	–	–	–	–	–	–	–
2.00	189	4	–	–	–	–	2	1	1
1.00	99	–	–	–	–	–	–	–	–
0.00	43	–	–	–	–	–	–	–	–

				1								[illegible]		24.00
	–	–	–	–	–	–	–	–	–	–	–	55	–	23.00
	–	–	–	–	–	–	–	1	20	1	1	1957	–	22.00
.	–	–	–	–	–	–	–	–	–	–	–	79	–	21.50
.	–	–	–	–	–	–	–	–	3	–	–	99	–	20.50
.	–	–	–	–	–	–	–	–	–	–	–	46	–	19.50
.	–	–	–	–	–	–	–	–	2	–	–	66	–	18.50
.	–	–	–	–	–	–	–	–	–	–	–	25	–	17.50
.	–	–	–	–	–	–	1	–	63	–	–	1036	–	16.50
.	–	–	–	–	–	–	–	–	2	–	–	69	–	3.00
.	–	–	–	–	2	1	1	1	20	–	–	613	–	2.00
.	–	–	–	–	–	–	–	–	18	–	–	237	–	1.00
.	–	–	–	–	–	–	–	–	–	–	–	141	–	0.00

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
–	55	–	23.00	98193
1	1957	–	22.00	98192
–	79	–	21.50	98191
–	99	–	20.50	98190
–	46	–	19.50	98189
–	66	–	18.50	98188
–	25	–	17.50	98187
–	1036	–	16.50	98186
–	69	–	3.00	98185
–	613	–	2.00	98184
–	237	–	1.00	98183
–	141	–	0.00	98182

ANSE A PIERRE-LOISELLE TYPE SECTION
SECTION VI
ABSOLUTE ABUNDANCE CHARTS

	1 Apsidognathus sulcatus ("S")	2 Apsidognathus sulcatus (e)	3 Apsidognathus sulcatus (f)	4 Apsidognathus sulcatus (g1)	5 Apsidognathus sulcatus (g2)	6 Carniodus carnulus (a)	7 Carniodus carnulus (b)
999.00 : TOTAL	3	4	12	14	11	1	
23.00 : 98252	-	-	-	-	-	-	
20.50 : 98251	-	-	-	-	-	-	
19.00 : 98250	-	-	-	-	-	-	
18.00 : 98249	-	-	-	-	-	-	
17.00 : 98248	-	-	-	1	2	-	
16.00 : 98247	-	-	-	-	-	-	
15.18 : 98246	1	3	2	3	5	-	
14.50 : 98245	-	-	-	-	-	-	
13.50 : 98244	1	-	-	-	-	-	
12.00 : 98243	-	-	-	-	-	-	
11.00 : 98242	-	-	-	-	-	-	
10.00 : 98241	-	1	7	5	2	1	
9.00 : 98240	-	-	-	-	-	-	
7.50 : 98239	-	-	-	-	-	-	
6.50 : 98238	-	-	-	2	1	-	
5.50 : 98237	-	-	-	-	-	-	
4.00 : 98236	1	-	3	3	1	-	
2.50 : 98235	-	-	-	-	-	-	
0.68 : 98234	-	-	-	-	-	-	

TYPE SECTION

ꝚTS

	1 Apsidognathus sulcatus ("S")	2 Apsidognathus sulcatus (e)	3 Apsidognathus sulcatus (f)	4 Apsidognathus sulcatus (g1)	5 Apsidognathus sulcatus (g2)	6 Carniodus carnulus (a)	7 Carniodus carnulus (b)	8 Carniodus carnulus (c)	9 Carniodus carnulus (e)	10 Carniodus carnulus (g)	11 Digitodontus bellistriatus (a)	12 Digitodontus bellistriatus (b)	13 Digitodontus bellistriatus (c)	14 Distomodus staurognathoides (a)
	3	4	12	14	11	1	5	1	6	3	2	5	2	1
	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	1	2	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	1	3	2	3	5	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	2	-	-	-	
	1	-	-	-	-	-	-	-	-	-	-	-	-	
	-	-	-	-	-	-	-	-	-	-	-	-	1	
	-	-	-	-	-	-	-	-	-	-	-	-	-	
	-	1	7	5	2	1	4	1	6	1	-	4	1	
	-	-	-	-	-	-	-	-	-	-	-	-	-	
	-	-	-	-	-	-	1	-	-	-	-	-	-	
	-	-	-	2	1	-	-	-	-	-	-	-	-	
	-	-	-	-	-	-	-	-	-	-	-	1	-	
	1	-	3	3	1	-	-	-	-	-	2	-	-	
	-	-	-	-	-	-	-	-	-	-	-	-	-	
	-	-	-	-	-	-	-	-	-	-	-	-	-	

11	Digitodontus bellistriatus (a)	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-
12	Digitodontus bellistriatus (b)	5	-	-	-	-	-	-	-	-	-	-	-	4	-	-	-	1	-	-	-
13	Digitodontus bellistriatus (c)	2	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-
14	Distomodus staurognathoides (a)	1	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
15	Distomodus staurognathoides (b)	6	-	-	-	-	-	-	1	2	1	-	1	-	1	-	-	-	-	-	-
16	Distomodus staurognathoides (c)	21	-	-	-	-	2	1	-	2	4	2	2	4	-	-	1	-	2	-	1
17	Distomodus staurognathoides (e)	9	-	-	-	-	-	-	1	3	-	-	1	-	1	-	2	-	1	-	-
18	Distomodus staurognathoides (f)	6	-	-	-	1	-	-	2	1	-	-	-	1	-	-	1	-	-	-	-
19	Distomodus staurognathoides (g)	6	-	-	-	-	-	-	-	1	1	-	2	1	-	-	1	-	-	-	-

	20 Indeterminate fused cones	21 Johnognathus huddlei	22 Kockelella ranuliformis (g)	23 O. aff. Ozarkodina pirata (a)	24 O. aff. Ozarkodina pirata (b)	25 O. aff. Ozarkodina pirata (c)	26 O. aff. Ozarkodina pirata (g)	27 Oulodus? flugeli (c)
999.00	4	3	5	2	3	1	2	4
23.00	-	-	-	-	-	-	-	-
20.50	-	-	-	-	-	-	-	-
19.00	-	-	1	-	-	-	-	1
18.00	-	-	-	-	-	-	-	-
17.00	-	-	1	-	-	-	-	-
16.00	-	-	1	-	-	-	-	-
15.18	-	1	1	-	-	-	-	1
14.50	-	-	-	-	-	-	-	1
13.50	-	-	1	-	-	-	-	-
12.00	-	-	-	-	-	-	-	-
11.00	-	1	-	2	3	1	2	1
10.00	4	1	-	-	-	-	-	-
9.00	-	-	-	-	-	-	-	-
7.50	-	-	-	-	-	-	-	-
6.50	-	-	-	-	-	-	-	-
5.50	-	-	-	-	-	-	-	-
4.00	-	-	-	-	-	-	-	-
2.50	-	-	-	-	-	-	-	-
0.68	-	-	-	-	-	-	-	-

22 Kockelella ranuliformis (g)	23 O. aff. Ozarkodina pirata (a)	24 O. aff. Ozarkodina pirata (b)	25 O. aff. Ozarkodina pirata (c)	26 O. aff. Ozarkodina pirata (g)	27 Oulodus? flugeli (c)	28 Oulodus? flugeli (g)	29 Oulodus? kentuckyensis (a)	30 Oulodus? kentuckyensis (b)	31 Oulodus? kentuckyensis (c)	32 Oulodus? kentuckyensis (e)	33 Oulodus? kentuckyensis (f)	34 Oulodus? kentuckyensis (g)	35 Ozarkodina confluens (a)
5	2	3	1	2	4	12	74	27	48	19	13	1	5
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
1	-	-	-	-	1	-	-	-	-	-	-	-	1
-	-	-	-	-	-	-	1	-	-	-	1	-	-
1	-	-	-	-	-	-	1	1	2	2	-	-	-
1	-	-	-	-	-	1	5	5	1	2	-	-	-
1	-	-	-	-	1	2	5	6	17	2	5	-	-
-	-	-	-	-	1	-	3	1	3	6	1	-	-
1	-	-	-	-	-	-	3	4	6	-	1	-	-
-	-	-	-	-	-	6	4	1	6	1	1	-	4
-	2	3	1	2	1	2	4	2	3	-	1	-	-
-	-	-	-	-	-	-	12	3	6	3	-	-	-
-	-	-	-	-	-	-	2	-	-	1	2	-	-
-	-	-	-	-	-	1	3	1	1	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	31	3	3	2	1	1	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-

	31 Oulodus? kentuckyensis (c)	32 Oulodus? kentuckyensis (e)	33 Oulodus? kentuckyensis (f)	34 Oulodus? kentuckyensis (g)	35 Ozarkodina confluens (a)	36 Ozarkodina confluens (alpha g)	37 Ozarkodina confluens (b)	38 Ozarkodina confluens (c)	39 Ozarkodina confluens (f)	40 Ozarkodina confluens (gamma g)
7	48	19	13	1	5	2	6	3	2	5
-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	1	-	-	-	-	2
-	-	-	1	-	-	-	1	1	-	-
1	2	2	-	-	-	-	-	-	-	-
5	1	2	-	-	-	-	-	-	-	-
5	17	2	5	-	-	-	-	-	-	-
1	3	6	1	-	-	-	-	-	-	-
4	6	-	1	-	-	2	-	-	2	-
1	6	1	1	-	4	-	5	-	-	-
2	3	-	1	-	-	-	-	-	-	-
3	6	3	-	-	-	-	-	1	-	3
-	-	1	2	-	-	-	-	1	-	-
1	1	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-
3	3	2	1	1	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-

	41 Ozarkodina excavata excavata (a)	42 Ozarkodina excavata excavata (b)	43 Ozarkodina excavata excavata (c)	44 Ozarkodina excavata excavata (e)	45 Ozarkodina excavata excavata (f)	46 Ozarkodina excavata excavata (g)	47 Ozarkodina gulletensis (a)	48 Ozarkodina gulletensis (b)
999.00	104	19	92	43	75	103	2	
23.00	–	–	–	–	–	–	–	
20.50	–	–	–	–	–	–	1	
19.00	1	–	2	–	2	–	–	
18.00	3	–	2	–	2	–	–	
17.00	4	–	–	–	3	1	–	
16.00	7	1	3	–	1	3	–	
15.18	8	–	8	8	7	10	–	
14.50	11	3	2	2	3	9	1	
13.50	4	1	1	–	6	10	–	
12.00	11	1	3	–	2	8	–	
11.00	8	4	7	–	5	7	–	
10.00	4	3	18	7	14	16	–	
9.00	7	3	3	1	–	–	–	
7.50	16	–	17	1	13	5	–	
6.50	9	2	5	2	3	12	–	
5.50	–	–	–	–	–	–	–	
4.00	11	1	21	22	14	22	–	
2.50	–	–	–	–	–	–	–	
0.68	–	–	–	–	–	–	–	

42 Ozarkodina excavata excavata (b)	43 Ozarkodina excavata excavata (c)	44 Ozarkodina excavata excavata (e)	45 Ozarkodina excavata excavata (f)	46 Ozarkodina excavata excavata (g)	47 Ozarkodina gulletensis (a)	48 Ozarkodina gulletensis (b)	49 Ozarkodina gulletensis (c)	50 Ozarkodina gulletensis (e)	51 Ozarkodina gulletensis (f)	52 Ozarkodina gulletensis (g)	53 Ozarkodina n.sp. A (a)	54 P. aff. Pterospathodus celloni (e)	55 P. aff. Pterospathodus celloni (f)
19	92	43	75	103	2	4	6	3	1	33	4	2	
-	-	-	-	-	-	-	-	-	-	1	-	-	
-	-	-	-	-	1	1	-	-	-	3	-	-	
-	2	-	2	-	-	-	-	-	-	-	-	-	
-	2	-	2	-	-	-	-	-	-	-	-	-	
-	-	-	3	1	-	-	1	-	-	1	-	-	
1	3	-	1	3	-	-	-	-	-	4	-	-	
-	8	8	7	10	-	1	-	-	-	2	-	-	
3	2	2	3	9	1	-	1	-	-	6	-	-	
1	1	-	6	10	-	2	2	-	-	6	-	-	
1	3	-	2	8	-	-	-	2	-	2	-	-	
4	7	-	5	7	-	-	1	1	-	2	-	1	
3	18	7	14	16	-	-	1	-	-	-	3	1	
3	3	1	-	-	-	-	-	-	-	-	1	-	
-	17	1	13	5	-	-	-	-	-	2	-	-	
2	5	2	3	12	-	-	-	-	-	3	-	-	
-	-	-	-	-	-	-	-	-	-	-	-	-	
1	21	22	14	22	-	-	-	-	-	-	-	-	
-	-	-	-	-	-	-	-	-	1	-	-	-	
-	-	-	-	-	-	-	-	-	-	1	-	-	

52	Ozarkodina gulletensis (g)	33	1	3	-	-	1	4	2	6	6	2	2	-	-	2	3	-	-	-	1
53	Ozarkodina n.sp. A (a)	4	-	-	-	-	-	-	-	-	-	-	-	3	1	-	-	-	-	-	-
54	P. aff. Pterospathodus celloni (e)	2	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-
55	P. aff. Pterospathodus celloni (f)	1	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
56	P. aff. Pterospathodus celloni (g)	3	-	-	-	-	-	-	-	-	-	-	-	2	1	-	-	-	-	-	-
57	Panderodus gibber (a)	28	-	-	1	-	1	-	4	4	3	2	-	8	-	-	2	-	3	-	-
58	Panderodus gibber (c)	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
59	Panderodus panderi (b/c)	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-
60	Panderodus recurvatus (a)	22	-	-	-	-	-	-	2	1	-	4	-	10	-	-	-	-	5	-	-
61	Panderodus recurvatus (b)	36	-	-	-	1	-	1	3	3	2	3	-	16	1	-	1	-	5	-	-

	62 Panderodus recurvatus (c)	63 Panderodus unicostatus (ar.)	64 Panderodus unicostatus (cm.)	65 Panderodus unicostatus (gr.)	66 Phosphanulus universalis	67 Pseudooneotodus beckmanni	68 Pterospathodus amorphognathoides (g)	69 Pterospathodus pennatus pennatus (g)	70 Pterospathodus pennatus procerus (g)
999.00	24	453	457	1112	2	18	1	2	
23.00	-	1	1	7	-	-	-	-	
20.50	-	1	3	3	-	-	-	-	
19.00	-	1	1	4	-	-	-	-	
18.00	-	18	2	12	-	-	-	-	
17.00	-	11	23	27	-	2	-	-	
16.00	1	25	31	66	-	-	-	-	
15.18	2	121	124	307	-	5	-	-	
14.50	2	55	33	113	-	-	-	-	
13.50	2	42	50	89	-	5	-	-	
12.00	3	34	32	107	-	2	-	-	
11.00	-	-	-	-	-	1	-	-	
10.00	7	29	63	140	1	1	1	-	
9.00	-	14	14	30	-	-	-	-	
7.50	-	-	-	-	-	-	-	-	
6.50	-	8	24	66	-	-	-	1	
5.50	-	1	1	9	-	-	-	-	
4.00	7	92	55	132	1	2	-	1	
2.50	-	-	-	-	-	-	-	-	
0.68	-	-	-	-	-	-	-	-	

	64 Panderodus unicostatus (cm.)	65 Panderodus unicostatus (gr.)	66 Phosphanulus universalis	67 Pseudooneotodus beckmanni	68 Pterospathodus amorphognathoides (g)	69 Pterospathodus pennatus pennatus (g)	70 Pterospathodus pennatus procerus (g)	71 Pterospathodus? ceragnathoides (a)	72 Pterospathodus? ceragnathoides (c)	73 Pterospathodus? ceragnathoides (c)	74 Pterospathodus? ceragnathoides (e)	75 Pterospathodus? ceragnathoides (e)	76 Pterospathodus? ceragnathoides (g)	77 Walliserodus curvatus (a)
53	457	1112	2	18	1	2	2	11	6	2	3	6	252	3
1	1	7	-	-	-	-	-	-	-	-	-	-	-	-
1	3	3	-	-	-	-	-	-	-	-	-	-	-	-
1	1	4	-	-	-	-	-	-	-	-	-	-	-	-
18	2	12	-	-	-	-	-	-	-	-	-	-	-	-
11	23	27	-	2	-	-	-	-	-	-	-	-	-	-
25	31	66	-	-	-	-	-	-	-	-	-	-	2	-
21	124	307	-	5	-	-	-	-	-	-	-	-	20	1
55	33	113	-	-	-	-	-	-	2	2	1	3	1	-
42	50	89	-	5	-	-	-	-	-	-	-	-	19	-
34	32	107	-	2	-	-	1	-	1	-	-	-	10	-
-	-	-	-	1	-	-	-	-	-	-	1	-	50	-
29	63	140	1	1	1	-	1	11	3	-	1	3	83	2
14	14	30	-	-	-	-	-	-	-	-	-	-	5	-
-	-	-	-	-	-	-	-	-	-	-	-	-	17	-
8	24	66	-	-	-	1	-	-	-	-	-	-	-	-
1	1	9	-	-	-	-	-	-	-	-	-	-	-	-
92	55	132	1	2	-	1	-	-	-	-	-	-	45	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

	74 Pterospathodus? ceragnathoides (e)	75 Pterospathodus? ceragnathoides (e)	76 Pterospathodus? ceragnathoides (g)	77 Walliserodus curvatus (a)	78 Walliserodus curvatus (b)	79 Walliserodus curvatus (d)	80 Walliserodus curvatus (e)	81 Z TOTAL ELEMENTS PER SAMPLE
2	3	6	252	3	1	3	2	–
–	–	–	–	–	–	–	–	10
–	–	–	–	–	–	–	–	12
–	–	–	–	–	–	–	–	17
–	–	–	–	–	–	–	–	45
–	–	–	–	–	–	–	–	86
–	–	–	2	–	–	1	–	164
–	–	–	20	1	–	–	–	691
2	1	3	1	–	–	–	–	284
–	–	–	19	–	–	–	–	270
–	–	–	10	–	–	–	–	259
–	1	–	50	–	–	–	2	116
–	1	3	83	2	1	2	–	524
–	–	–	5	–	–	–	–	88
–	–	–	17	–	–	–	–	78
–	–	–	–	–	–	–	–	140
–	–	–	–	–	–	–	–	12
–	–	–	45	–	–	–	–	497
–	–	–	–	–	–	–	–	1
–	–	–	–	–	–	–	–	2

ZZ TOTAL ELEMENTS PER SECTION

82

999.00	3296	999.00	TOTAL
23.00	-	23.00	98252
20.50	-	20.50	98251
19.00	-	19.00	98250
18.00	-	18.00	98249
17.00	-	17.00	98248
16.00	-	16.00	98247
15.18	-	15.18	98246
14.50	-	14.50	98245
13.50	-	13.50	98244
12.00	-	12.00	98243
11.00	-	11.00	98242
10.00	-	10.00	98241
9.00	-	9.00	98240
7.50	-	7.50	98239
6.50	-	6.50	98238
5.50	-	5.50	98237
4.00	-	4.00	98236
2.50	-	2.50	98235
0.68	-	0.68	98234