NEW BIOSTRATIGRAPHICAL FINDINGS ON THE PADEHA FORMATION BASED ON CONODONT ACCUMULATION IN YAZDANSHAHR, KERMAN, CENTRAL IRAN

NASEHI, E.

Department of Geology, Faculty of Science, Islamic Azad University, Natanz Branch
Natanz, Iran
e-mail: nasehehsan@gmail.com

(Received 9th Jun 2017; accepted 27th Oct 2017)

Abstract. The aim of the study was the biostratigraphical evaluation of Padeha Formation based on conodont accumulation in Yazdanshahr. The section under study is located north of Yazdanshahr in northwestern Zarand County in Kerman, central Iran. After investigating several sections of the Padeha formation in the Kerman area, one fossiliferous section was chosen for study. In terms of lithology, the section is composed mainly of red-colored clastic and evaporative rock with carbonate intercalations. The conodont accumulations indicate two local biozones: the Zieglerodina remscheidensis and Pandorinellina steinhornensis assemblage zones and the Eugenathodontidae-Icriodus assemblage zone. Based on the abundance of Spathognathodontidae and similarities to global biozones, these biozones were found to be of the Late Silurian (Early Pridoli) age. No evidence of the Icriodus genus (especially woschmidtii or post-woschmidtii species) was observed in this assemblage. The latter biozones manifest the appearance of Eugenathodontidae in the Early Devonian; therefore, a sedimentary hiatus exists within the Late Silurian to the start of Early Devonian (Late Pridoli to Pragian). The sediment was deposited in a depositional environment ranging from lagoons to shallow waters (inner carbonate platform). The Yazdanshahr section was the most complete of the Padeha formation because conodonts were found in the lower, middle and upper parts of the section. This function will allow researchers to correlate their sections with these findings based on stratigraphic principles.

Keywords: Icriodus, sedimentary environment, Silurian, Kerman, biozones

Introduction

Devonian deposits in Iran were first reported on a geological map prepared by the National Iranian Oil Company. Located near Gush-Kamar in the Ozbak-Kuh mountains, the type section was studied by Ruttner et al. (1968), Stocklin (1971) and Stocklin et al. (1965, 1991). Late Silurian-Early Devonian sediment has been studied in Kerman province in Iran and reported according to stratigraphic principles (Huckriede et al., 1962). Most recent studies have been based on conodonts, fish remnants, brachiopods, corals and palynomorphs. The following authors have recently worked on conodonts: Ahmadi et al., 2012; Bahrami, 2011, 2013, 2014, 2015; Boncheva et al., 2007; Adhamian, 2003; Ashuri, 2004, 2006; Gholamalian, 2007; Gholamalian and Kebriaei, 2008; Gholamalian et al., 2009; Yazdi, 1999; Weddige, 1984.

Geologically speaking, Iran is divided into five structural units: the Zagros, Alborz, Sanandaj-Sirjan, Eastern Iran and Central Iran (Stocklin et al., 1965; Stocklin, 1968; Stocklin and Nabavi, 1971; Stocklin and Setudehnia, 1991; Heydari et al., 2008). In terms of structure, Central Iran is composed of five blocks: the Lut, Tabas, Kalmard, Posht-Badam, Anar and Dehshir (Alavi, 1991; Heydari et al., 2008; Fig. 1). Devonian sediment has been described in the Jeirud Formation in the Central Alborz (Assereto, 1963), the Khoshyeilagh formation in the northeastern Alborz (Bozorgnia, 1973), the Moli and Ilanjare Formation (unofficial name) in West Azerbaijan and Maku (western
Alborz) (Alavi-Naini and Bolourchi, 1973) and the Pedeha, Sibzar, Bahram and Shisto formations in Central Iran (Ruttner et al., 1968).

The type section of the Pedeha formation is named after the village of Pedeha in the Ozbak-Kuh mountains (Eastern Iran). Lithologically characterized by red sandstone, dolomite and gypsum at Ozbak-Kuh (eastern Central Iran), the Pedeha formation overlies the fossiliferous carbonates of the Niur formation and underlies the Sibzar dolomites. This formation formed in the Early Devonian and exhibits shallow facies related to the Caledonian orogeny (Ruttner et al., 1968; Stocklin, 1971). The Pedeha formation was deposited in an inner platform and extends across all of the Central Iran basin. Based on its stratigraphic position, this formation has been aged back to the Early Devonian.

Devonian deposits in Iran (Pedeha, Sibzar, etc.) are not well known and a large deal of uncertainty is associated with them. In general, Early Paleozoic Devonian deposits in Iran precipitated in separate geological units. Few studies have been done on the effect of sea level at the time the Late Silurian and Early Devonian rock formed. Evidence indicates the effect of Caledonian movement (Ruttner et al., 1968; Stocklin, 1971). Sea transgression covered most of Iran in the Middle and Late Devonian. In the present research, an attempt is made to determine the age of the sediment based on conodont accumulation.

Methodology and study area

The structural units of Iran were investigated and the Kalmard block was selected for study. The study area is located about 18 km from Zarand and 70 km to the northeast of Kerman. The measured section was delimited as 31°3′55″N and 30°2′40″N latitude and 56°17′5″E and 56°15′10″E longitude (Fig. 1).

![Figure 1. Structural units of Iran located in the studied section](image-url)
Field sampling and length measurements were undertaken systematically wherever a change in the lithology was identified to carefully investigate the biostratigraphy of the study area. If needed, more than one sample (+4 kg) was taken from the corresponding bedding. The samples were studied carefully after undergoing the following preparation steps: crushing (to dimensions of 3 cm), acid treatment (10% acetic acid), washing, sieving (75, 125, 250 and 710 mesh), picking (with a needle) and photography.

Discussion

An investigation on Late Silurian and Devonian deposits (Padeha, Sibzar, and Bahram) in the Central Iran microplate indicates that, during the Late Silurian, most of Central Iran was exposed out of water. The Devonian deposits in Central Iran formed in separate basins. Evidence indicates a radical variation in thickness even at short distances. For instance, the Hur section is 280 m thick (Ahmadi et al., 2012), the Varkamar section is 210 m thick and the Neqeleh section is about 200 m thick. The Nachf section is about 120 m thick and the Shomal-Tar section is about 200 m (near Isfahan) (Bahrami et al., 2015). The Shahmirzad section is 450 m thick (Heydari et al., 2008) and the Soh section is 88 m thick (Adhamian, 2003).

These radical changes in thickness can be attributed to horst and graben basins from the Caledonian and Hercynian epirogenic phases in Central Iran (Soffel and Forster, 1980; Weddige, 1984). The presence of gypsum as evaporative facies in the section base along with carbonate intercalations containing Spathognathodontidae indicate a lagoon on an inner carbonate platform (Table 1) (Sweet, 1988; Flugel, 2010). The presence of evaporative facies in the Late Silurian can be attributed to the Ardenian orogeny. The Early Devonian red-colored clastic facies with carbonate intercalations can be attributed to the Earian orogeny.

Lithostratigraphy of Yazdanshahr section

The study area is located in the northern Shabjereh mountains near Khorramabad (northeastern Kerman, Central Iran; Fig. 2). The local sedimentary rock were different types of clastic, colloidal carbonate and evaporative rock. The lower boundary is covered by alluvial deposits. The two local members were identified as follows:

Member I

Lithozone I
1. 20 m of grey, reddish and white gypsum with clay or gypsum-bearing clay intercalations.
2. 6.8 m of olive green lime and the fresh grayish green colour (argillaceous micrite or sandy mudstone becoming pelmicrite or wackestone in the upper layers).
3. 58 m of white to red gypsum with grey-coloured shaley limestone intercalations.
4. 32.8 m of brick-coloured sandstone in alternation with limestone in fresh red color with layering thickness of 0.5-1 m. The penetration of ferrous compounds into the rocks caused their red appearance (sample 3).
5. 4.5 m of light grey and creamy light-grey limestone. This limestone encompasses gypsum beddings in the form of two 1-m thick hard beddings (sample 5).
### Table 1. Distribution of conodont species in Yazdanshahr column

| Taxa                                      | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 40 | 42 | 49 | 50 | 51 | 53 | 61 | 62 | 67 | 69 | 70 | 73 | 74 | 76 | 80 | 89 | 90 | 91 | Total |
|-------------------------------------------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|-------|
| Bipennatus Philip, 1965                    |    |    |    |    |    |    |    |    | 3  | 4  | 2  | 3  | 2  | 3  | 1  | 3  | 2  | 1  | 2  |    |    |    |    |    | 29 |
| Bipennatus bipennatus Bischoff and Ziegler, 1957 |    |    |    |    |    |    |    |    | 2  |    |    | 3  | 21 | 2  |    |    |    |    |    |    |    |    |    | 28 |
| B.bipennatus bipennatus Bischoff and Ziegler, 1957 |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    | 0  |
| Distomodus sp, Branson and Mehl 1947      |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    | 2  |
| Hindeodella compressa Huddle, 1934        |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    | 1  |
| Hindeodella equidentata Rhodes, 1953      |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    | 2  |
| Icriodus sp, Branson and Mehl 1934        |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    | 12 |
| Icriodus brevis, Stauffer, 1940           |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    | 7  |
| Icriodus brevis brevis Stauffer, 1940     |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    | 1  |
| I.c. brevis spicatus Youngquist and Pelerson, 1947 |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    | 4  |
| Icriodus regulariceps Bultynck, 1970      |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    | 7  |
| I. struvei Weddige, 1977                  |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    | 3  |
| Ligonodina Ulrich and Bassler 1926        |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    | 8  |
| Ligonodina elegans Walliser 1964          |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    | 0  |
| Lonchodina Bassler, 1925                  |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    | 22 |
| Neopripniodus Rhodes and Muller, 1956    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    | 15 |
| Neopripniodus bicusulatus Branson and Mehl, 1933 |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    | 9  |
| Ozarkodina Branson and Mehl, 1933         |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    | 18 |
| Ozarkodina confluens Branson and Mehl, 1933 |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    | 20 |
| Ozarkodina denckmanni Ziegler, 1956       |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    | 6  |
| Ozarkodina media Walliser, 1957           |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    | 1  |
| Ozarkodina typical Branson and Mehl, 1933 |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    | 15 |
| Ozarkodina Ziegleri Walliser, 1964        |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    | 10 |
| Panderodius simplex Branson and Mehl, 1933 |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    | 5  |
| Pandorinellina exigua Philip, 1966        |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    | 25 |
| Pandorinellina steinhornensis Ziegler, 1956 |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    | 18 |
| Plectospathodus Branson and Mehl, 1933    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    | 9  |
| Trichonodella symmetrica Branson and Mehl, 1933 |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    | 21 |
| Wurmiella excavata Branson and Mehl, 1933 |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    | 5  |
| Zieglerodina remschiedensis Ziegler, 1960  |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    | 21 |
| Total                                    | 22 | 45 | 47 | 49 | 37 | 23 | 9  | 8  | 11 | 4  | 3  | 2  | 3  | 1  | 3  | 2  | 4  | 23 | 5  | 4  | 8  | 2  | 7  | 3  | 0  | 1  | 997 |
Figure 2. Lithostratigraphic section of Yadanshahr, Iran
6. 88.4 m of soft gypsum with thinly-beded intercalations of pease-coloured limestone.

Lithozone II

7. 13 m of light- to dark-grey limestone together with shell fragments (sandy bioclast lime wackestone/pelbioclast lime wackestone or sandy biomicrite/pelbiomicrite (light- to dark-grey limestone)). Solution breccia from the dissolution of gypsum can be observed in the base of this rock unit. The identified conodonts include:
   a. Ozarkodina confluens (Branson and Mehl, 1933)
   b. Spatognathodus primus (Branson and Mehl, 1933)
   c. Pandorinellina steinhornensis (Ziegler, 1956)
   d. O. confluens (Branson and Mehl, 1933)
   e. P. exigua (Philip, 1966)
   f. Zieglerodina remscheldensis (Ziegler, 1960)
   g. Distomodus (Branson and Mehl, 1947)
   h. Hindeodella equidentata (Rhodes, 1953)
   i. Ligonomina (Ulrich and Bassler, 1926)
   j. L. elegans (Walliser, 1964)
   k. Lonchodina (Bassler, 1925)
   l. Neopripniodus bicusvatus (Branson and Mehl, 1933)
   m. O. denckmanni (Ziegler, 1956)
   n. O. ziegleri (Walliser, 1964)
   o. Panderodus simplex (Branson and Mehl, 1933)
   p. Trichonodella symetrica (Branson and Mehl, 1933)

8. 17.4 m of yellow to grey limestone, creamy with no fossil which gradually turns to red.

Member II

Lithozone III

9. 10.2 m of red-white-brick-coloured sandstone containing siliceous cement with quartz and feldspar.

10. 1 m of thinly-beded red to white dolomitic sandy limestone (dolograinstone or sandy dolosparite).

11. 10 m of red sandstone with siliceous cement and abundant quartz and feldspar grains. It turns gradually to micrite and microsparite. The identified conodonts include:
   a. I. struvie (Weddige, 1977)
   b. I. regularicresens (Bultynck, 1970)
   c. I. brevis (Staulfer, 1940)
   d. I. brivis spicatus (Youngquist and Peterson, 1947)
   e. Bipennatus bipennatus (Bischoff and Ziegler, 1957)

12. 8.7 m of thinly bedded clay-bearing red sandstone containing trace fossils.

13. 1 m of gray marl limestone (micrite to microcrystalline matrix, laterally becoming bioclastic lime wackestone or biomicrite)

14. 7 m of coarse-grained red lime sandstone with weak carbonate cement and abundant clastic grains of quartz and feldspar

15. 2 m of light green dolomitic limestone (packstone-dolosparite) with sparicalcrite cement and abundant rhombohedral calcite
16. 4 m of red to white sandstone with medium to coarse grains of quartz and feldspar and siliceous cement

Lithozone IV (Sibzar formation)

17. 15 m of grey to dark limestone to dolostone with sparicalcic cement and abundant rhombohedra of dolomite. Organic remnants of crinoid debris, fish teeth and conodonts are as follows:
   a. *I. brevis* (Stauffer, 1940)
   b. *B. bipennatus sub sp.*

18. 20.2 m of red sandstone (quartz arenite), medium- to coarse-grained quartz along with nodules of iron oxide (opaque minerals, feldspar and siliceous cement)

19. 0.2 m of dark gray limestone (biosparite-grainstone) with sparicalcite cement and calcite rhombohedra. The only conodont is *Ozarkodina* sp.

20. 17 m of red sand with argillaceous matrix together with three light-grey dolostone beddings

21. 6.7 m of yellowish grey dolostone (dolostongoose-dolospalrite). The identified conodonts include:
   a. *Icriodus sp.*, *I. struvei* (Weddige, 1977)
   b. *I. brevis* (Stauffer, 1940)
   c. *I. brevis brevis* (Stauffer, 1940)
   d. *Bipennatus sp.*, *B. bipennatus* (Bischol and Ziegler, 1957)
   e. *Ozarkodina* sp.

22. 4.5 m of white to red quartzose sandstone

23. 20.4 m of light-grey to yellow dolomite (dolospalrite dolograinstone) with three layers of red sandstone.

24. 8 m of light grey to yellow dolostone with quartzose grains and sparite calcite cement. Identified conodonts include:
   b. *Bippenatus sp.*

25. 20.63 m of white to red quartzose sandstone

26. 6 m of light-gray dolomite (dolograinstone dolospalrite)

27. 2 m of marl containing trilobite, ostracoda, Ecinid spine and bryozoan Bahram grey brachiopoda limestone (Bahram Formation)

**Biozonation of Yazdanshahr section**

The conodont collections in this section contain 15 genus, 20 species and 5 subspecies were identified (Fig. 3). Together, these identify two biozones as follows:

1. Zieglerodina remscheidensis, Pandorinellina steinhornensis assemblage zone. The elements collected in this part relate to *Spathognathodontidae* and include the following:
   - *O. confluence* (Branson and Mehl, 1933) (*Spathognathodus primus*; Branson and Mehl, 1933)
   - *P. exigius* philipi (Klapper, 1969)
Figure 3. Biostratigraphic section of Yadanshahr, Iran
The collected elements were comparable to the following:

- Murphy et al. (2004) (from Nevada, Spain, Germany and Czech Republic)
- Farrel (2004) (from Camelford limestone, Australia)
- Corradini et al. (2014) (from Cellon section)
- Corriga et al. (2011) (from Malinfier section, Italy)
- Mathieson et al. (2016) (from Cobra Supergroup in Western New South Wales, Australia)
- Drygant and Szaniawski (2012) (from Podolia, Ukraine)
- Corriga et al. (2014) (from Tafilalt, southeastern Morocco)
- Ziegler (1975, 1991)

As such, the age of this biozones is Pridoli.

2. *Eugenathodontidae-Icriodus* assemblage zone

The elements collected in this part are related to *Eugenathodontidae* and include the followings genus:

- *Bipennatus* (Philip, 1965)
- *B. bipennatus* (Bischoff and Ziegler, 1957)
- *B. bipennatus bipennatus* (Bischoff and Ziegler, 1957)
- *Icriodus sp.*
- *I. struvei* (Weddig, 1977)
- *I. brevis* (Stauffer, 1940)
- *I. brevis brevis* (Stauffer, 1940)
- *I. brevis spicatus* (Youngquist and Peterson, 1947)

As such, the age of this biozone is Pragian to Emsian with the collected elements being comparable to those in the following work:

- Mathieson et al. (2016) (from Cobra Supergroup in Western New South Wales, Australia); Murphy (2005) (from Nevada)
- Murphy (2005) (from Nevada)
- Corriga et al. (2014) (from Podolia, Ukraine)
- Clark et al. (1966) (from Nevada)
- Nasehi (1996) (from Central Iran)
- Ziegler (1975, 1991)

It is difficult to identify the contact between the Silurian and Devonian. The studied section exhibit a stratigraphic hiatus between the Late Pridoli and Early Pragian. Lochkovian deposits have not been observed in Iran; therefore, Central Iran was exposed out of water.

**Conclusion**

The studied section indicates that the Padeha Formation has two members across this area. The lower part (evaporative deposits with carbonate intercalations) has been aged back to the Late Silurian, while the upper part of Padeha Formation (clastic deposits
Nasehi: New biostratigraphical findings on the Padeha formation based on conodont accumulation in Yazdanshahr, Kerman, central Iran
- 1002 -

with carbonate intercalations) is reported to be formed in the Early Devonian. The contact between the lower and upper parts exhibits a sedimentary hiatus (Late Pridoli to Late Emsian). Stratigraphists and geologists can correlate the stratigraphic column with this section. Using stratigraphic principles, it will be possible to solve the problem of age determination in Central Iran.

Within this time window, present-day Iran formed on the northern margin of the Gondwana Supercontinent, which later divided into separate structural units under the effect of Caledonian epirogenic movement (from faulting and formation of horst and graben basins). In the Late Silurian and Early Devonian, sea transgression and regression occurred, respectively. Note that the transgression at this time extended to limited parts of Iran. The evidence presented herein confirms the hypothesis of a horst and graben basin along the paleo faults in Central Iran in the Early Paleozoic.

REFERENCES


**APPENDIX**

**Plate 1**

1. *Bipennatus* Philip, 1965
2. *B. bipennatus bipennatus* Bischoff and Ziegler, 1957
3. *B. bipennatus bipennatus* Bischoff and Ziegler, 1957
4. *B. bipennatus bipennatus* Bischoff and Ziegler, 1957
5. *B. bipennatus bipennatus* Bischoff and Ziegler, 1957
6. *Bipennatus bipennatus* Bischoff and Ziegler, 1957
7. *Bipennatus bipennatus* Bischoff and Ziegler, 1957
8. *Bipennatus bipennatus* Bischoff and Ziegler, 1957
9. *Bipennatus sp.aff B. palethorpei* Telfond, 1975 (Plate 2: 4, 8)
10. *Bipennatus* Philip, 1965
11. *Bipennatus* Philip, 1965
12. *Bipennatus bipennatus* Bischoff and Ziegler, 1957
13. *Bipennatus bipennatus* Bischoff and Ziegler, 1957
Nasehi: New biostratigraphical findings on the Padeha formation based on conodont accumulation in Yazdanshahr, Kerman, central Iran.

Plate 1
Plate 2

1. Ozarkodina ziegleri Walliser, 1964
2. Ozarkodina ziegleri Walliser, 1964
3. Trichonodella symetrica Branson and Mehl, 1933
4. Ozarkodina ziegleri Walliser, 1964
5. Ozarkodina ziegleri Walliser, 1964
6. Ozarkodina Branson and Mehl, 1933
7. Ozarkodina ziegleri Walliser, 1964
8. Trichonodella symetrica Branson and Mehl, 1933
9. Ozarkodina Branson and Mehl, 1933
10. Trichonodella symetrica Branson and Mehl, 1933
11. Trichonodella symetrica Branson and Mehl, 1933
12. Trichonodella symetrica Branson and Mehl, 1933
13. Trichonodella symetrica pinnula Philip, 1966
Plate 2
### Plate 3

1. *Ligonodina elegans* Walliser 1964  
2. *Ligonodina* Bassler, 1925  
3. *Distomodus* Branson and Mehl 1947  
4. *Lonchodina* Bassler, 1925  
5. *Hindeodella equidentata* Rhodes, 1953  
6. *Ozarkodina typica denckmannii* Ziegler, 1956  
7. *Ozarkodina denckmannii* Ziegler, 1956  
8. *Ozarkodina denckmannii* Ziegler, 1956  
9. *Lonchodina* Bassler, 1925  
10. *Ozarkodina typica denckmannii* Ziegler, 1956  
11. *Ozarkodina typica denckmannii* Ziegler, 1956  
12. *Ozarkodina typica denckmannii* Ziegler, 1956  
13. *Ozarkodina typica denckmannii* Ziegler, 1956  
15. *Ozarkodina typica denckmannii* Ziegler, 1956  
16. *Ozarkodina typica denckmannii* Ziegler, 1956
Plate 3
Plate 4

1. *Hindeodella* subtillis N166
2. *Hindeodella equidentata* Rhodes, 1953 N22
3. *Wurmiella excavata* Branson and Mehl, 1933; *Neopripniodus excavatus*
   Branson and Mehl, 1933 N30
4. *Lonchodina* Bassler, 1925 N20
5. *Ligonodina salopina* Rhodes, 1953, N24
7. *Neopripniodus bicuspidatus* Branson and Mehl, 1933 N30
8. *Wurmiella excavata* Branson and Mehl, 1933 *Neopripniodus excavatus*
   (Branson and Mehl)
9. *Wurmiella excavata* Branson and Mehl, 1933 *Neopripniodus excavatus*
   (Branson and Mehl) N
11. *Lonchodina* Bassler, 1925 N21
12. *Wurmiella excavata* Branson and Mehl, 1933; *Neopripniodus excavatus*
    (Branson and Mehl) N20
13. *Lonchodina* Bassler, 1925 N20
14. *Lonchodina* Bassler, 1925 N
15. *Wurmiella excavata* Branson and Mehl, 1933 *Neopripniodus excavatus*
    (Branson and Mehl) N20
Plate 4
Plate 5

1. Ozarkodina confluens Branson and Mehl, 1933 (Spatognathodus primus Branson and Mehl, 1933) N21
2. Ozarkodina confluens Branson and Mehl, 1933 (Spatognathodus primus Branson and Mehl, 1933) N19
7. Ozarkodina confluens Branson and Mehl, 1933 (Spatognathodus primus Branson and Mehl, 1933) N19
8. Ozarkodina confluens Branson and Mehl, 1933 (Spatognathodus primus Branson and Mehl, 1933) N24
17. Pandorinellina sp Muller & Muller 1957
19. Ozarkodina cf confluens Branson and Mehl, 1933 (Spatognathodus primus Branson and Mehl, 1933) N25
Plate 5
Plate 6

2. Ozarkodina confluens Branson and Mehl, 1933 (Spatognathodus primus Branson and Mehl, 1933) N25
5. Ozarkodina confluens Branson and Mehl, 1933 (Spatognathodus primus Branson and Mehl, 1933) N26
8. Ozarkodina confluens Branson and Mehl, 1933 (Spatognathodus primus Branson and Mehl, 1933) N20
17. Pandorinellina steinhornensis Ziegler, 1966 (Spathognathodus steinhornensis Ziegler, 1956) N26
18. Ozarkodina confluens Branson and Mehl, 1933 (Spatognathodus primus Branson and Mehl, 1933) N19
21. Ozarkodina confluens Branson and Mehl, 1933 (Spatognathodus primus Branson and Mehl, 1933) N24
Plate 6
Plate 7

1. *Icriodus brivis spicatus* Youngquist and Peterson, 1947 no. 65
2. *Icriodus brevis brevis* Stauffer, 1940
3. *Icriodus regularicresens* Bultynck, 1970
4. *Icriodus regularicresens* Bultynck, 1970
5. *Icriodus sp* Branson and Mehl, 1934
6. *Icriodus regularicresens* Bultynck, 1970
7. *Icriodus regularicresens* Bultynck, 1970
8. *Icriodus struvei* Weddige, 1977
9. *Icriodus regularicresens* Bultynck, 1970
10. *Icriodus struvei* Weddige, 1977
11. *Icriodus regularicresens* Bultynck, 1970
12. *Icriodus struvei* Weddige, 1977
13. *Icriodus regularicresens* Bultynck, 1970
14. *Icriodus sp*
15. *Icriodus brivis spicatus* Youngquist and Peterson, 1947
16. *Icriodus brivis spicatus* Youngquist and Peterson, 1947
Plate 7