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Research Paper

Evaluation of Gurpi Formation in Section of Pazanan, Fars Province, Southwestern Iran

Geography

KEYWORDS : Foraminifera, Biostratigraphy, Pazanan, Oilfield

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ABSTRACT

The Pazanan section of Northwest of Khonj, near Darolmizan Village of Fars Province, contains one of the most complete Early Campanian to Early Maastrichtian sequences. The majority of the section is made of marl, which is itself overlain by shale of Pabdeh Formation. This formation overlies the sediment of the Ilam Formation. As a result of this study, 11 species and 7 genera of planktonic foraminifera and 4 genera of benthonic foraminifera have been identified. This confirms the existence of bio zones Globotruncantia elevata, Globotruncana ventricosa, Globotruncanella havanensis, Globotruncana aegyptiaca, Gansserina gansseri and bio zones Globotruncanita elevate, Globotruncanita Stuarti - Pseudotextularia varians which suggests the age of Early Campanian to Early Maastrichtian.

1. INTRODUCTION

The Zagros basin is composed of more than 10,000 m of Mesozoic and Cenozoic strata in northwest southeast trend (Darvishzadeh, 1992). The area is part of a foreland basin deposited dominantly with thick sedimentary sequences of carbonate and clastic composition, which was formed in the Late Triassic. Based on lateral variations, the Zagros Folded belt is divided into three different stratigraphic provinces: the Fars Provinces, the Khuzestan Province and the Lurestan Province (Motiei, 2003). On the other hand, the Zagros basin is one of the largest oilfields in the world, the area known as Agreement Area since 1954. The Gurpi Formation is exposed throughout most of the Agreement Area along the Fars Province of southwestern Iran. This formation has changed laterally in Zagros basin. Gurpi Formation at the type section (E49°13′47″, N32°26′50″- North of Lali Oil Field at NE of Masjed Solayman) is composed of 320 m marl and shale beds and occasionally thin beds of argillaceous limestones (James and Wynd, 1965; Darvishzadeh, 1992). Most of palaeontological studies on the Cretaceous of the folded Zagros have been performed using foraminifera (Wynd, 1965; Kalantari, 1986; Hobi, 2002; Kameliazan et al., 2004; Ghasemi-Nejad et al., 2006; Darvishzadeh et al., 2007). These micro palaeontologists defined the Santonian–Maastrichtian age of the formation based on various localities in the faulted Zagros. The Pazanan section discussed in this paper is located in NW of Khonj in the Fars Province, about 60 km North of Taheri Port, which covers the area with longitude 52° 29' 4" E and latitude 27° 59' 20" N (Figure 1). The Gurpi Formation consists of 50m thick succession of olive marl, which is itself overlain by Pabdeh Formation. The main scope of this research is investigate foraminifera assemblages, biostratigraphic zonation, defines the age of the formation and identification of palaeoenvironment in Fars Province.

"Figure 1 is about here"

Figure1. Geographical location and Stratigraphy of Pazanan section.

2. MATERIAL AND METHODS

The present study is based on the research of planktonic foraminifera assemblages in samples of the 50m succession, were collected up to the contact with the Pabdeh Formation. Samples were planktonic foraminifer free forms were prepared following a picking standard method (Caron, 1985). For this work, all outer surfaces of the samples were trimmed with a razor blade to obtain a new level. Then, the sediments were placed in water for a few hours. If the sediment is hard and microfossils are not separated, it must be placed in peroxide hydrogen solution for a time. After washing, we dried the residue on an oven. The sediments were placed on a meshed stopple and microfossils were separated by a needle and then were studied by reflective microscope. Finally, the genus and species of foraminifera were selected for photography. Planktonic Foraminifera taxonomy and nomenclature follows Wynd (1965), Caron (1985), Premoli Silva and Verga (2004).

3. RESULTS AND DISCUSSION

As a result of this study, seven genera and eleven species of planktonic foraminifera and four genera of benthonic foraminifera have been identified in Northwest of Khonj of Fars Province, which corresponds to zones *Globotruncantia elevata, Globotruncana ventricosa, Globotruncanella havanensis, Globotruncana aegyptiaca* and *Gansserina gansseri* of Permoli Silva and Verga (2004) zonation. Also, foraminifera assemblages corresponds to zones *Globotruncanita elevata* and *Globotruncanita Stuarti - Pseudotextularia varians* of Wynd (1965) zonation.

3.1. Biostratigraphy

The Planktonic Foraminifera assemblages were largely investigated as a useful tool for biostratigraphic zonation. Biozonation of the studied section is based on the stratigraphic distribution of foraminifera (Wynd, 1965; Premoli Silva and Verga, 2004). The assemblages recorded in the Cretaceous strata are believed to be appropriate means for biostratigraphic studies (Caron, 1985). The importance of this fossil group for correlation has been discussed at length by Postoma (1971), Caron (1985), Loeblich and Tappan (1988), Premoli Silva and Verga (2004). Eleven planktonic foraminifer species from seven genera and 4 genera of benthonic foraminifera were identified in the course of this study. The species planktonic foraminifera are *Muricohedbergella holmdelensis, Rugoglobigerina rugosa, Globotruncana bulloides, Globotruncana lapparanti, Globotruncana ventricosa, Globotruncanita elevata, Globotruncanita stuarti, Globotrucanita stuartiformis, Heterohelix striata.* The benthonic foraminifera are *Rotalia sp., Lenticulina sp., Gavelinella sp., Marssonella oxycona.* The examination of foraminifera of the Gurpi Formation at Zagros basin (Fars Province) enabled us to recognize most of the standard bio zones defined in Mediterranean regions, especially Tethysian domain. The paleoecology of the sedimentary basin can be explained using the index species of planktonic foraminifera. The presence of the species mentioned above in the studied samples could indicate a deep basin conditions. In fact, from the records diversity of the low-latitude species, which are known to be very useful indexes for the Late Cretaceous, we concluded that the sedimentary basin was located in low latitude, tropical environment and deep basin (James and Wynd, 1965; Premoli Silva and Verga, 2004). In the Early Campanian to Early Maastrichtian age, the bio zones *Globotruncantia elevata, Globotruncana ventricosa, Globotruncanella havanensis, Globotruncana aegyptiaca* and

Gansserina gansseri (zones of Permoli Silva and Verga 2004) and *Globotruncanita elevata* zone and *Globotruncanita Stuarti - Pseudotextularia varians* zone (Wynd, 1965) were identified using the zonal scale that subdivides the upper Cretaceous to bio zones. The identified bio zones in Gurpi Formation of Pazanan section are as follows in comparison with Premoli Silva and Verga (2004) and Wynd (1965) bio zonations.

3.1.1. Comparison with Premoli Silva and Verga (2004) bio zonation:

Globotruncanita elevata Zone (Interval Zone)

The first bio zone of the section (7 m thick) is that from the last occurrence (LO) of *Dicarinella asymetrica* to the first occurrence (FO) of *Globotruncana ventricosa.* The dominant taxa in this zone are *Muricohedbergella holmdelensis, Heterohelix* sp. Due to lack of *Dicarinella asymetrica* in the section, the lower border was identified by the occurrence of *Globotruncana elevata* from sample number Mq2643 and the upper border was identified with the occurrence of *Globotruncana ventricosa* from sample number Mq2645. This interval is similar to Premoli Silva and Verga (2004) partial range zone distinguished in the Early Campanian.

Globotruncana ventricosa Zone (Interval Zone)

The next bio zone recorded from the marls of the Gurpi Formation (5 m thick) is the *Globotruncana ventricosa* zone defined as the interval from the FO of *Globotruncana ventricosa* to the FO of *Radotruncana calcarata.* The dominant taxa in this zone are *Globotruncanita elevata, Globotruncana ventricosa, Muricohedbergella holmdelensis.* This interval is similar to Premoli Silva and Verga (2004) interval zone distinguished in the Middle Campanian to Late Campanian. Due to lack of *Radotruncana calcarata* in the section, the upper border was identified by the occurrence of *Globotruncanella havanensis.* In fact, *Radotruncana calcarata* was not recognized due to lack of microfossils, this may be due to the lack of sediment. The lower border was identified by the occurrence of *Globotruncana ventricosa* from sample number Mq2645, and the upper border was identified by the occurrence of *Globotruncanella havanensis* from sample number Mq2647. *Globotruncanella havanensis* indicated Late Campanion.

Globotruncanella havanensis Zone (Interval Zone)

The next bio events recorded from the marls of the Gurpi Formation (6 m thick) is the *Globotruncanella havanensis* zone defined as the interval from the LO of *Radotruncana calcarata* to the FO of *Globotruncana aegyptiaca.* The dominant taxa in this zone are *Muricohedbergella holmdelensis, Heterohelix striata, Globotruncanita elevata, Globotruncana vetricosa, Globotruncana falsostuarti, Gavelinella* sp. This interval is similar to Premoli Silva and Verga (2004) partial range zone distinguished in the Late Campanian. Due to lack of *Radotruncana calcarata* in the section, the lower border was identified by the occurrence of *Globotruncanella havanensis.* The upper border was identified by the occurrence of *Globotruncana aegyptiaca* from sample number Mq2652. *Globotruncanella havanensis* indicated Late Campanion.

Globotruncana aegyptiaca Zone (Interval Zone)

The next bio zone recorded from the Gurpi Formation (19 m thick) is the *Globotruncana aegyptiaca* zone defined as the interval from the FO of *Globotruncana aegyptiaca* to the FO of *Gansserina gansseri.* The dominant taxa in this zone are *Muricohedbergella holmdelensis, Heterolehix striata, Globotruncana ventricosa, Globotruncana lapparanti, Globotruncana falsostuarti, Globotruncanella havanensis, Globotruncanita stuarti. Gavelinella* sp. This interval is similar to Premoli Silva and Verga (2004) interval zone distinguished in the late Late Campanian. The lower border was identified by the occurrence of *Globotruncana aegyptiaca* from sample number Mq2652, and the upper border was identified by the occurrence of *Gansserina gansseri* from sample number Mq2655.

Gansserina gansseri Zone (Total Range)

The last bio zone recorded from the marls of the Gurpi Formation (15 m thick) is the *Gansserina gansseri* zone that defined as the interval from the FO of *Gansserina gansseri* to the FO of *Contusotrancana Contusa.* The dominant taxa in this zone are *Globotruncana aegyptiaca, Globotruncanita stuarti, Globotruncana arca.* This interval is similar to Premoli Silva and Verga

(2004) interval zone distinguished in the Late Campanian and Early Maastrichtian. The lower border was identified by the occurrence of *Gansserina gansseri* from sample number Mq2655. Due to lack of *Contusotrancana Contusa* in the section, the upper border was identified by the occurrence of *Gansserina gansseri* from sample number Mq2663.

3.1.2. Comparison with Wynd (1965) bio zonation:

Globotruncanita elevata Zone (Total Range)

The *Globotruncanita elevata* zone (15m thick) spans the interval from the FO of *Globotruncanita elevata* from sample number Mq2643 to the last occurrence (LO) of *Globotruncanita elevata* from sample number Mq2647. This bio zone compares with Wynd (1965) bio zone number 33. The dominant taxa in this zone are *Muricohedbergella holmdelensis, Heterohelix striata, Globotruncana venticosa, Globotruncana lapparanti, Rugoglobigerina rugosa.* The age of biozone is Campanian.

Globotruncanita stuarti, Pseudotextularia varians Zone (Assemblage Zone)

The next bio event (from total range zone type), recovered toward the top of section is the FO of *Globotruncanita stuarti* from sample number Mq2655 to the LO *Globotruncanita stuarti* to number Mq2659. This bio zone compares with Wynd (1965) bio zone number 39. The dominant taxa in this zone are *Globotruncana aegyptiaca, Globotruncanita stuarti, Globotruncana arca.* The age of bio zone is Maastrichtian.

Two bio zones of Premoli Silva and Verga (2004), Wynd (1965) are compared in Table 1. As you see, the bio zones of Wynd (1965) were general and only one bio zone was introduced for each Campanian and Maastrichtian stage; while the bio zones of Premoli Silva and Verga (2004) introduced *Globotruncanita elevata*, *Globotruncana ventricosa, Radotrumcana calcarata*, *Globotruncanella havanensis* and *Globotruncana aegyptiaca* for Campanian and *Gansserina gansseri, Abathomphalus mayaroensis* and *Contusotrancana Contusa* for Maastrichtian. The bio zones of Wynd (1965) such as *Globotruncanita elevata* is comparable with bio zones of *Globotruncanita elevata*, *Globotrunacana ventricosa*, *Radotrumcana calcarata*, *Globotruncanella havanensis*, and *Globotruncana aegyptiaca* (Premoli Silva and Verga, 2004) and the bio zone of *Globotruncana Stuarti* (Wynd, 1965) is comparable with bio zones of *Gansserina gansseri, Abathomphalus mayaroensis*, and *Contusotrancana Contusa* (Premoli Silva and Verga, 2004) (Figures 2-5).

"Table 1 is about here"

Table1. Comparison of Wynd (1965), Permoli Silva and Verga (2004) bio zonation

4. CONCLUSION

- The study of succession of Gurpi formation in the section of Pazanan showed that this formation is made of marl.
- As a result of this study, seven genera and eleven species of planktonic foraminifera and four genera of benthonic foraminifera have been identified in Northwest of Khonj of

Fars Province, which corresponds to zones *Globotruncantia elevata, Globotruncana ventricosa, Globotruncanella havanensis, Globotruncana aegyptiaca* and *Gansserina gansseri* of Permoli Silva and Verga (2004) zonation. Also, foraminifera assemblages corresponds to zones *Globotruncanita elevata* and *Globotruncanita Stuarti - Pseudotextularia varians* of Wynd (1965) zonation.

- Based on the obtained zonation, the age of the Gurpi Formation of Pazanan section is defined as Early Campanian to Early Maastrichtian.
- Results of the present study indicate that planktonic foraminifera reach their highest species diversity in intervals of Campanian to Early Maastrichtian.
- In addition, we can also learn about the predominant conditions of the sedimentary environment of Kuh-E- Pazanan of Fars Province that are in fact a part of Neo Tethys basin with the existence of indexed species planktonic foraminifera that indicate warm climate and high depth of the basin in Campanian to Early Maastrichtian, in low latitudes.

"Figures 2-5 is about here"

Figure 2: 1a,1b,1c. *Globotruncanita elevata*, (Brotzen, 1934); X.145,1a.view dorsal, 1b. View Lateral, 1c.view ventral, Sample No. Mq 2644, 2655. 2a,2b,2c.*Globotruncana ventricosa*, (White, 1928); X.160, 2a.view dorsal, 2b. View Lateral, 2c.view ventral, Sample No. Mq 2646, 2647. 3a,3b,3c.*Globotruncanella havaensis*, (Voorwijk, 1937); X.270,3a.view dorsal, 3b. View Lateral, 3c.view ventral, Sample No. Mq 2650, 2655. 4a,4b,4c. *Globotruncana aegyptiaca*, (Nakkady, 1950); X.170,4a.view dorsal, 4b. View Lateral, 4c.view ventral, Sample No. Mq 2654, 2656.

Figure 3: 1a,1b,1c. *Globotruncanita stuarti*, X.138,1a.view dorsal, 1b. View lateral, 1c.view ventral, Sample No. Mq 2657, 2658. 2a,2b,2c. *Gansserina gansseri*, (Bolli, 1951); X.160, 2a.view dorsal, 2b. view lateral, 2c.view ventral, Sample No. Mq 2658, 2659. 3a,3b,3c. *Globotruncana falsosturti*, (Sigal 1952); X.155,3a.view dorsal, 3b. View lateral, 3c.view ventral, Sample No. Mq 2647, 2648. 4a,4b,4c. *Globotruncana linneianad Orbigny*, (Caron, 1985); X.154, 4a.View dorsal, 4b. View lateral, 4c.view ventral.

Figure 4: 1a,1b,1c. *Globotruncana bulloides*, (Vogler, 1941); X. 140, 1a. View dorsal, 1b. View lateral, 1c.View ventral, Sample No. Mq 2646, 2647, 2a, 2b, 2c. *Globotruncana arca*, (Cashman, 1926); X. 155, 2a. View dorsal, 2b. View lateral, 2c.view ventral, Sample No. Mq 264. 3a,3b,3c. *Globotruncana lapparanti*, (Brotzen, 1936), X. 160, 3a. View dorsal, 3b. View lateral, 3c.View ventral, Sample No. Mq 2647, 2648. 4a,4b. *Muricohedbergella holmdelensis*, (Olsson, 1964); X. 160, 4a. View dorsal, 4b.view ventral, Sample No. Mq 2652, 2653.

Figure 5: 1. *Rugoglobiogerina rugosa*, X.140, Sample No.Mq 2655. 2. *Heterohelix striata*, (Ehrenberg, 1840); X.145, Sample No.Mq 2645. 3. *Lenticulina* sp., (Lamark, 1804); X.127, Sample No. Mq 2643. 4. *Gavellinella* sp., (Brotzen, 1942); X. 165, 4a.view dorsal, 4b. View ventral Sample No. Mq 2647. 5. *Marssonella* sp., (Cushman, 1933); X.110, Sample No.Mq 2643.

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