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Biostratigraphy and Paleoecology of The Gurpi Formation in Marun Oil Field, Zagros Basin, SW Iran

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Abstract

The Gurpi Formation, one of the geological units of the Zagros Basin, stretches with in the Folded Zagros in the provinces of Khuzestan, Lorestan, and Fars, in southwest Iran. In total 525 samples were collected from the five wells to document the planktonic foraminifera. Overall, 47 species from 23 Planktonic foraminifera genera were recognized in this study. From a biochronostratigraphic point of view, 8 biozones were identified. Also, the age of Gurpi Formation in 21, 41, 43, 45, and 123 wells were determined based on the identified biozones of late Santonian to late Maastrichtian. Some important ecological factors including water level, salinity, and oxygen regime changes during the depositional courses of the formation were analyzed to examine the paleoecology.

Keywords: *Planktonic Foraminifera, Gurpi Formation, Paleoecology, Biostratigraphy, Marun Oil*

Introduction

Development of the Zagros Basin began in the late Cretaceous due to fore deep subsidence ahead of the continental closure along the Zagros Suture (Alavi, 2004). This occurred during the Turonian to Maastrichtian collision of the western Iranian and Afro Arabian plates (Gealey, 1988). In general, the sedimentary record shows that the late Cretaceous represents a period of major change in the area around the Zagros foreland basin (Kamal *et al*., 2011). This time period spans the deposition of the Shiranish (Iraq), Gurpi (Iran), Aruma and Simsima (Kuwait, Saudi Arabia,United Arab Emirates), and Fiqa (United Arab Emirates, Oman) formations, and their regional equivalents (Ziegler, 2001). The Gurpi Formation is one of the most important lithostratigraphic units in the Zagros foreland basin because of its stratigraphic position and its significance in the petroleum geology of Iran as source rock. The Gurpi Formation is extended in the Folded Zagros in the provinces of Khuzestan, Lorestan and Fars. (Fig. 1). The type section of the Gurpi Formation, measured in the Tange-Pabdeh out crop, north of the Lali oil field at the Dezful Zone, by James and Wynd (1965) has a thickness of some 320 m of gray marl and shale. The Gurpi Formation overlies the Ilam Formation and is disconformably overlain by the Pabdeh Formation at the type section. Consequently, many studies have been conducted on the microfauna of the Gurpi Formation in the southwest of Iran (Kalantary, 1976; Vaziri Moghaddam, 2002; Ghasemi-Nejad *et a1*., 2006; Darvishzade *et a1*., 2007; Bieranvand and Ghasemi-Nejad, 2013; Beiranvand *et a1*., 2014; Fereydoonpour *et al*., 2014).The main purpose of this research is to conduct a detailed biostratigraphic planktonic foraminiferal analysis in order to assign an age to the succession.

Geological setting

The study area is located at the Dezful Zone.The Dezful Zone lies across a sharp topographic break to the southwest of the Mountain Front Fault.This Zone consists of a variety of structures of variable sizes and geometric characteristics (Sherkati *et a1*., 2004). The boundary of the Dezful Zone coincides with the Balarud, Kazerun, Zagros Front Fault and Mountain Front Fault. The Izeh and Dezful zones are separated by the Mountain Front Fault (Ghabeishavi *et a1*., 2009). (Fig. 2a).

The Marun oil field is one of the largest oil fields in the southwest of Iran. This oil field is located to the north of the Ramin oil field, east of the Copal oil field, west and northwest of the Ahvaz oil field and southwest of the Ramshir oil field. The Muron oil field is an underground anticline to trend northwest - south and southeast at the north Dezful area which is located 50 kilometers southeast of the city of Ahwaz in southwest Iran (Fig.2b). Five wells were measured in details alongside the well no 45 at N: 1,027,995 and E: 1,904,006; well No 21 at N: 1,025,047 and E : 1,906,678; well No 43 at N: 1,019,431 and E:1,913,026; well No 123 at N:

1,016,665 and E: 1,914,454; and well No 41 at N: 1,011,262 and E:1,921,602 (Fig.3). In total, 525 samples were collected from the five wells to document the planktonic foraminifera. In the study wells, the Gurpi Formation consists of an alternating succession of dark grey calcareous shale, marls, and marly limestones. Massive limestones from the Ilam Formation underlie the Gurpi Formation. The boundary between the two formations is conformable.

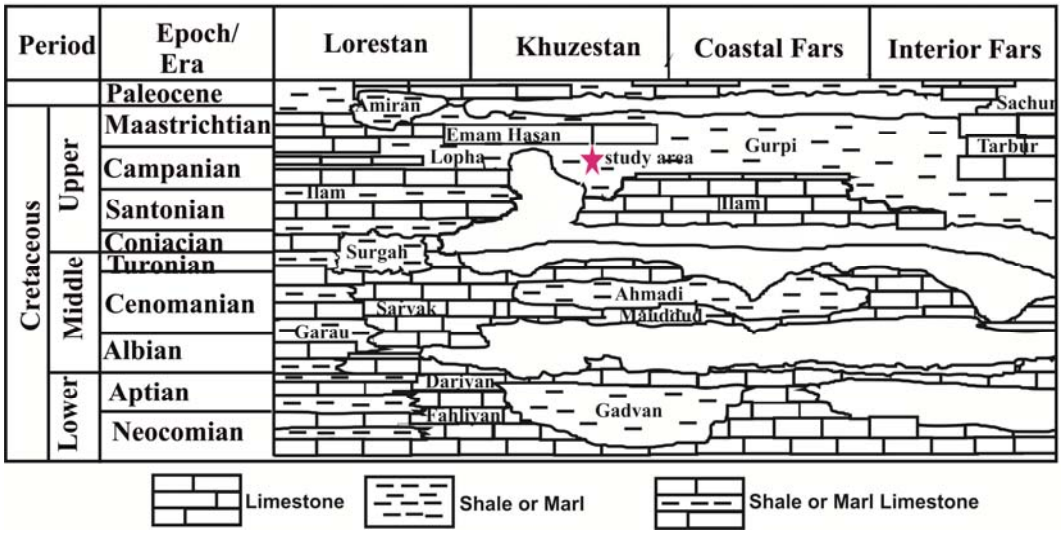

Figure 1. Correlation chart of the Cretaceous deposits of southwest Iran (adopted from James and wynd, 1965).

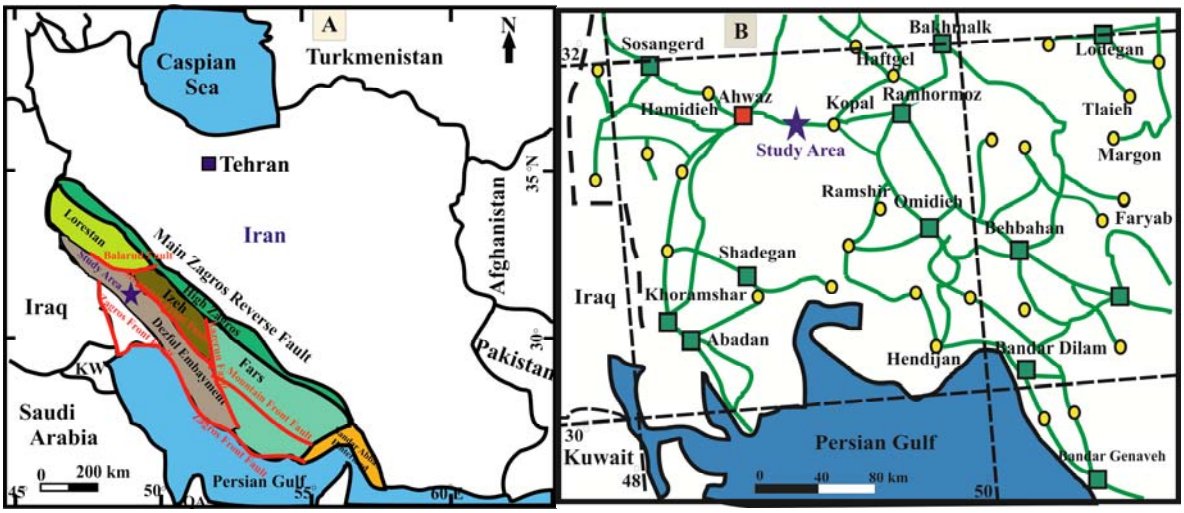

Figure 2. a, b: Principal geological and structural sub-divisions of southwestern Iran; the study area marked as blue color. B. Location map of the studied area (marked as blue color) in Dezful Embayment shown.

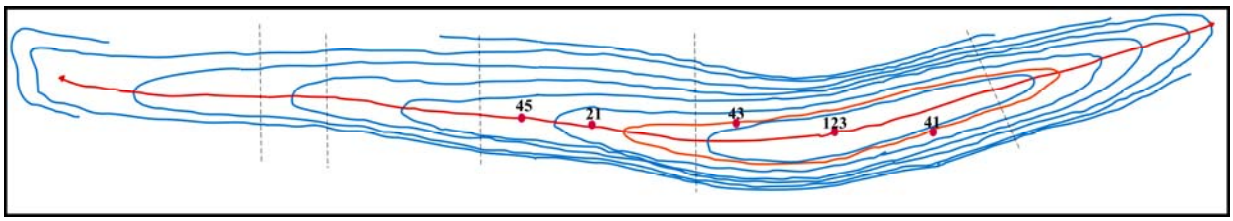

Figure 3. UGC Map showing the location of the study wells in the Maroun Oil field

The Gurpi Formation is overlaid by the Pabdeh Formation. In the study area, the boundary between the Gurpi Formation and Pabeh Formation is unconformable. In most of the outcrops of the Gurpi Formation in southwestern Iran, a hiatus spanning the Cretaceous/Paleocene boundary interval is observed (Ghasemi-Nejad *et al*., 2006; James and Wynd, 1965; Motiei, 2003; Sampo, 1969; Setudehnia, 1972, 1978; Wynd, 1965). In the studied wells, more than 90% of upper Maastrichtian to early Paleocene planktic foraminifera species disappeared abruptly at the boundary. The mass extinctions affected most of the species of planktonic foraminifera, especially the keeled *globotruncanids*, *heterohelicids*, *hedbergellids*, *globigerinelloids*, *Chiloguembelina*, *Subbotina triloculinoides*, *Subbotina triangularis*, *Eoglobigerina edita*, *Praemurica inconstans*, *Eoglobigerina spiralis*, *Praemurica pseudoinconstans*, *Parasubbotina pseudobulloides*, *Globanomalina compressa*, *Globanomalina imitata*, *Morozovella praeangulata*, *Globanomalina planocompressa*, and *Parasubbotina varianta* showing an uncontinuous Cretaceous–Paleogene transition interval. This extinction pattern in the studied wells is similar to those observed in Caravaca, Spain, some areas in Tunisia (Smith 1982, 1999, 2004), and Zagros Area (Ghasemi-Nejad *et al*., 2006; James & Wynd, 1965; Motiei, 2003; Sampo, 1969; Setudehnia, 1972, 1978; Wynd, 1965, Homkeh, 2009).

Materials and method

This study is based on data from five wells drilled in the Marun oil field in the southeast of Dezful, southwest Iran. A number of 525 thin sections were examined to investigate the Santonian - Masstrichtian successions at this field. Sampling intervals were generally between 1 and 1/5 m. The selection of samples was primarily based on changes in colour, lithology, and other sedimentary parameters. The thin sections were provided from the collected samples. Recognition and identification of Cretaceous planktonic foraminiferal were based on Robaszynski and Caron (1984), Caron (1985), Premoli Silva and Sliter (1994), Sliter (1989), Robaszynski *et a1*. (2000), and Premoli Silva and Verga (2004).

Results

Biostratigraphy

In biostratigraphic studies, 47 species belonging to 23 genera of Planktonic foraminifera were identified, which resulted in the determination of eight biozones which are as follows. (Figs. 4, 5, 6, 7, and 8; Table 1; and Plates 1, 2, 3, 4).

Dicarinella asymetrica Zone

The *Dicarinella asymetrica* Taxon Range Zone (TRZ) is defined as biostratigraphic interval from the first occurrence (FO) to the last occurrence (LO) of the nominate taxon, corresponding to the early Santonian to earliest Campanian age (Robaszynski *et a1*., 1984; Caron, 1985: Sliter, 1989; Robaszynski and Caron, l995; Premoli Silva and Sliter, l994; Robaszynski *et a1*., 2000; Premoli Silva and Verga, 2004). Other species identified in this interval include: *Dicarinella conacvata*, *Marginotruncana marginata*, *Globotruncana bulloides*, *Contusotruncana fornicata*, *Globotruncana arca*, *Globotruncana hilli*, *Globotruncana lapparenti*, and *Globotruncana linneiana*, This biozone was recorded from Zagros by Vaziri Moghaddam, 2002 in Sarvestan area; Abrari *et al*., 2012 in Firozabad area; Rahimi *et al*., 2013 in Ramhormoz area; Fereydoonpour *et al*., 2014 in Deh Dasht area; and Solgi *et al*., 2015 in Koramabad area.

Globotruncanita elevata Zone

The *Globotruncanita elevata* Partial Range Zone (PRZ) represents the stratigraphical interval with *Globotruncanita elevata* between the last occurrence (LO) of all *Dicarinella asymetrica* and the first occurrence (FO) of *Globotruncana ventricosa* and corresponds to the early Campanian age (Caron, 1985; Premoli Silva and Sliter, 1994; Robaszynski *et al*., 2000; Premoli Silva and Verga, 2004). This zone is characterized by planktonic foraminiferal species: *Globotruncana hill*, *Globotruncana lapparenti*, *Globotruncana arca*, *Globotruncana bulloides*, *Contusotruncana fornicata*, *Muricohedbergella monmouthensis*, *Globotruncanita stuartiformis*, and *Globotruncanita elevata*. This biozone was recorded from Zagros by Vaziri Moghaddam, 2002 in Sarvestan area; Abrari *et al*., 2011 in Firozabad area; Rahimi *et al*., 2015 in Ramhormoz area; Fereydoonpour *et al*., 2014 in Deh Dasht area; and Solgi *et al*., 2015 in Koramabad area.

Globotrnucana ventricosa Zone

The *Globotrnucana ventricosa* Partial Range Zone (IZ) is defined as biostratigraphic interval from the

first occurrence (FO) of *Globotruncana ventricosa* at the base to the first occurrence (FO) of *Radotruncana calcarata* at the top and corresponds to the middle to late Campanian age (Caron, 1985; Premoli Silva and Sliter, 1994; Robaszynski *et al*., 2000; Premoli Silva and Verga, 2004). The assemblage includes: *Globotruncana lapparenti*, *Globotruncana hilli*, *Rugoglobigerina rugosa*, *Macroglobigerinelloides ultramicrus*, and *Radotruncana subspinosa*, This biozone was recorded from Zagros by Vaziri Moghaddam, 2002 in Sarvestan area; Kamli Azan,2004 in Lali area; Hemati-Nassab, 2008 in Darreh Shar area; Moradi, 2010 in Darreh Shar area; Abrari *et al*., 2011 in Firozabad area; Rahimi *et al*., 2015 in Ramhormoz area; Fereydoonpour *et al*., 2014 in Deh Dasht area; and Solgi *et al*., 2015 in Koramabad area.

Table 1. Correlation of the proposed biostratigraphic zonal scheme at this study with other accepted standard biozones of other parts of the world.

<table>
<tr><th>Stage
M.Y
65</th><th>James and Wynd (1965)</th><th>Caron (1985)</th><th>Sliter (1989)</th><th>Robaszynki and Caron (1995)</th><th>Premoli Silva and Verga (2004)</th><th>This study</th></tr>
<tr><td rowspan="11">Maastrich.

713</td><td>Zagros</td><td>Tethys</td><td>Tethys</td><td></td><td></td><td></td></tr>
<tr><td>Abathomphalus mayaroensis Zone</td><td>Abathomphalus mayaroensis Zone</td><td>Abathomphalus mayaroensis Zone</td><td>Abathomphalus mayaroensis Zone</td><td>Abathomphalus mayaroensis Zone</td><td></td></tr>
<tr><td rowspan="4">Globotruncana stuarti
+
Pesudotextularia varians Zone</td><td>Gansserina gansseri Zone</td><td>Gansserina gansseri Zone</td><td rowspan="3">Contusotruncana contusa
– Racemiguembelina fructicosa Zone</td><td rowspan="3">Contusotruncana contusa
–
Racemiguembelina fructicosa Zone</td><td rowspan="3">Contusotruncana contusa
Zone</td></tr>
<tr><td>Globotruna aegyptiaca Zone</td><td>Globotruna aegyptiaca Zone</td></tr>
<tr><td rowspan="2">Globotruncanella havanensis Zone</td><td>Globotruncanella</td></tr>
<tr><td>havanensis Zone</td><td>Gansserina gansseri Zone</td><td>Gansserina gansseri Zone</td><td>Gansserina gansseri Zone</td></tr>
<tr><td rowspan="6">Campanian

835</td><td rowspan="5">Globotruncanita elevata Zone</td><td rowspan="3">Radotruncana calcarata Zone</td><td rowspan="3">Radotruncana calcarata Zone</td><td>Globotruna aegyptiaca Zone</td><td></td><td></td></tr>
<tr><td>Globotruncanella havanensis Zone</td><td>Globotruna aegyptiaca Zone</td><td>Globotruna aegyptiaca Zone</td></tr>
<tr><td>Radotruncana calcarata Zone</td><td>Globotruncanella havanensis Zone</td><td>Globotruncanella havanensis Zone</td></tr>
<tr><td>Globotruncana ventricosa Zone</td><td>Globotruncana ventricosa Zone</td><td>Globotruncana ventricosa Zone</td><td>Radotruncana calcarata Zone</td><td>Radotruncana calcarata Zone</td></tr>
<tr><td>Globotruncana ventricosa Zone</td><td>Globotruncana ventricosa Zone</td><td>Globotruncana ventricosa Zone</td><td>Globotruncana ventricosa Zone</td></tr>
<tr><td>Globotruncanita elevata Zone</td><td>Globotruncanita elevata Zone</td><td>Globotruncanita elevata Zone</td><td>Globotruncanita elevata Zone</td><td>Globotruncanita elevata Zone</td></tr>
<tr><td>Santonian

855</td><td>Globotruncana cocavata
+
Carinata Zone</td><td>Dicarinella asymetrica Zone</td><td>Dicarinella asymetrica Zone</td><td>Dicarinella asymetrica Zone</td><td>Dicarinella asymetrica Zone</td><td>Dicarinella asymetrica Zone</td></tr>
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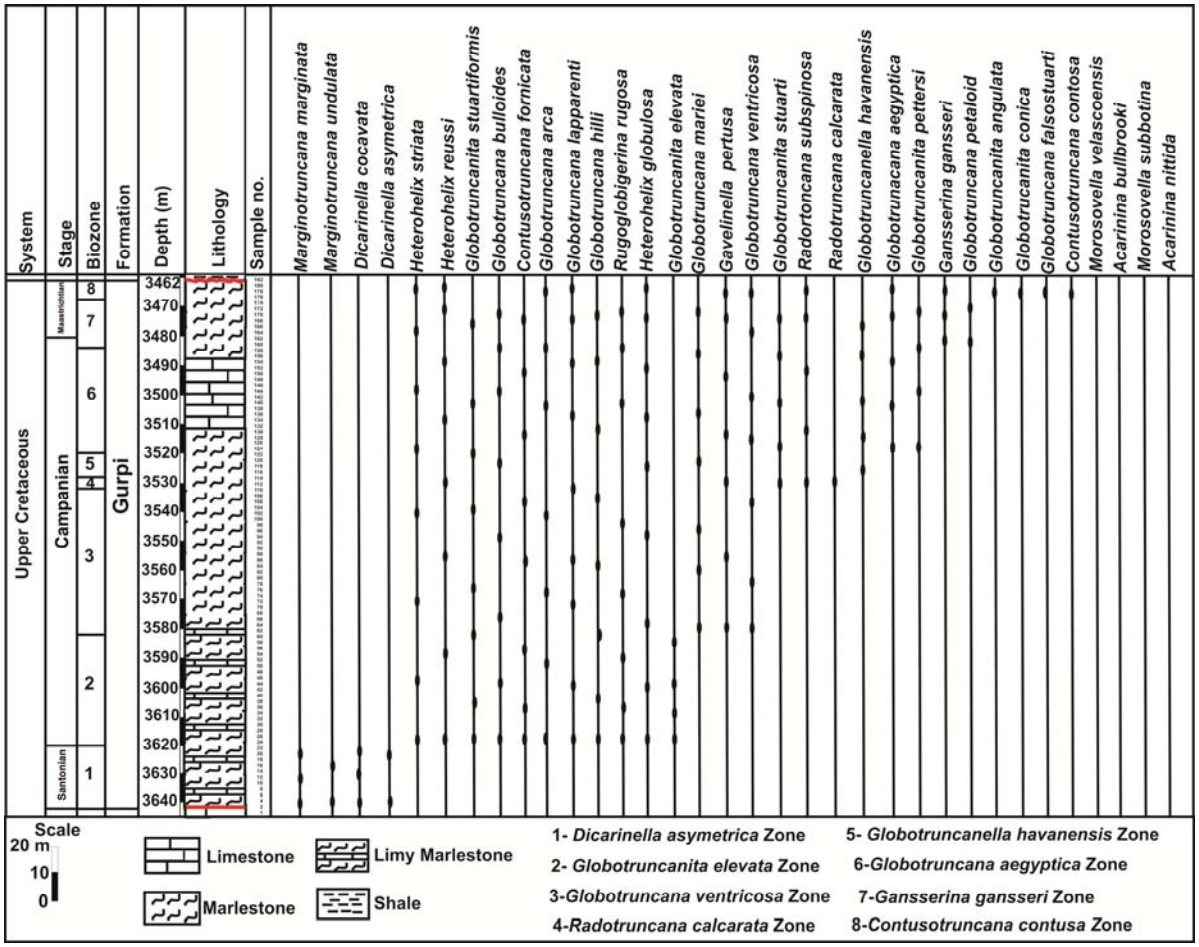

Figure 4. Biostratigraphic Colum of the Gurpi Formation in well no 45.

Radotruncana calcarata Zone

The *Radotruncana calcarata* Taxon Range Zone (TRZ) is defined as biostratigraphic interval from the first occurrence (FO) to the last occurrence (LO) of the nominate taxon, and corresponds to the early late Campanian age (Caron, 1985; Premoli Silva and Sliter, 1994; Keller *et al*., 1995; Li and Keller, 1998a,b; Li *et al*., 1999; Robaszynski *et al*., 2000; Tentaway *et al*., 2001; Premoli Silva and Verga, 2004). The predominant planktonic foraminifera are: *Archaeoglobigerina cretacea*, *Globotruncana arca*, *Globotruncana bulloides*, *Contusotruncana fornicata*, *Muricohedbergella monmouthensis*, and *Globotruncanita stuartiformis*. This biozone was recorded from Zagros by Vaziri Moghaddam, 2002 in Sarvestan area; Kamli Azan, 2004 in Lali area; Hemmati-Nasab, 2008 in Darreh Shar area; Moradi, 2010 in Darreh Shar area; Abrari *et al*., 2011 in Firozabad area; Bieranvand and Ghasemi-Nejad, 2013 in Izeh area; Rahimi *et al*., 2015 in Ramhormoz area; Fereydoonpour *et al*., 2014 in Deh Dasht area; and Solgi *et al*., 2015 in Koramabad area.

Globltruncanella havanensis Zone

The *Globotruncanella havanensis* Partial Range Zone (PRZ) represents the stratigraphic interval with *G. havanensis* between the last occurrence (LO) of *Radotruncana calcarata* to the first occurrence (FO) of *Globotruncana aegyptiaca*, and corresponds to the late Campanian age (Caron, 1985; Permoli Silva and Verga, 2004). The predominant planktonic foraminifera are: *Globotruncana orientalis*, *Globotruncana insignis*, *Globotruncanita stuartiformis Rugoglobigerina hexacamerata* and *Macroglobigerinelloides ultramierus*. This biozone was recorded from Zagros by Hemmati-Nasab, 2008 in Darreh Shar area; Moradi, 2010 in Darreh Shar area; Abrari *et al*., 2011 in Firozabad area; Bieranvand and Ghasemi-Nejad, 2013 in Izeh area; Rahimi *et al*., 2015 in Ramhormoz area; Fereydoonpour *et al*.,

2014 in Deh Dasht area; and Solgi *et al*.,2015 in Koramabad area.

Globotruncana aegyptica Zone

The *Globotruncana aegyptiaca* Interval Zone (IZ) is defined as the interval from the first occurrence (FO) of *G. aegyptiaca* to the first occurrence (FO) of *Gansserina gansseri*, and indicates the late Campanian age (Keller *et al*., 1995; Li and Keller, 1998a,b; Li *et al*., 1999; Robaszynski *et al*., 1995; Tentaway *et al*., 2001; Premoli Silva and Verga, 2004). The predominant planktonic foraminifera are *Rugoglobigerina rugosa*, *Heterohelix* sp, *Globotrncanita stuartiformis*, *Globotruncana falsostuarti*, *Contusotruncana patelliformis*, and *Globotruncanita stuarti*. This biozone was recorded from Zagros by Hemmati-Nasab, 2008 in Darreh Shar area; Moradi, 2010 in Darreh Shar area; Abrari et al., 2011 in Firozabad area; Bieranvand and Ghasemi-Nejad, 2013 in Izeh area; Rahimi et al., 2015 in Ramhormoz area; Fereydoonpour et al., 2014 in Deh Dasht area; and Sulgi et al., 2015 in Koramabad area.

Gansserina gansseri Zone

The *Gansserina gansseri* Interval Zone (IZ) has been defined as an interval between the first appearance (FO) of *Gansserina gansseri* to the first appearance (FO) of *Contusotruncana contusa* and *Racemiguembelina fructicosa*. It indicates the latest Campanian to the end of early Maastrichtian (Robaszynski *et al*., 1984; Caron, 1985; Sliter, 1989; Nederbraght, 1991; Robaszynski and Caron, 1995; Keller *et al*., 1995; Li and Keller, 1998a, b; Li *et al*., 1999; Robaszynski *et al*., 2000; Tentaway *et al*., 2001; Premoli Silva and Verga, 2004). The predominant planktonic foraminifera are: *Contusotruncana fornicata*, *Contusotruncana patelliformis*, *Globotruncana lapparenti*, *Globotruncana arca*, *Globotruncana insignis*, *Globotruncana orientalis*, *Globotruncana falsostuarti*, *Globotruncanita angulata* and *Radotruncana subspinosa*.

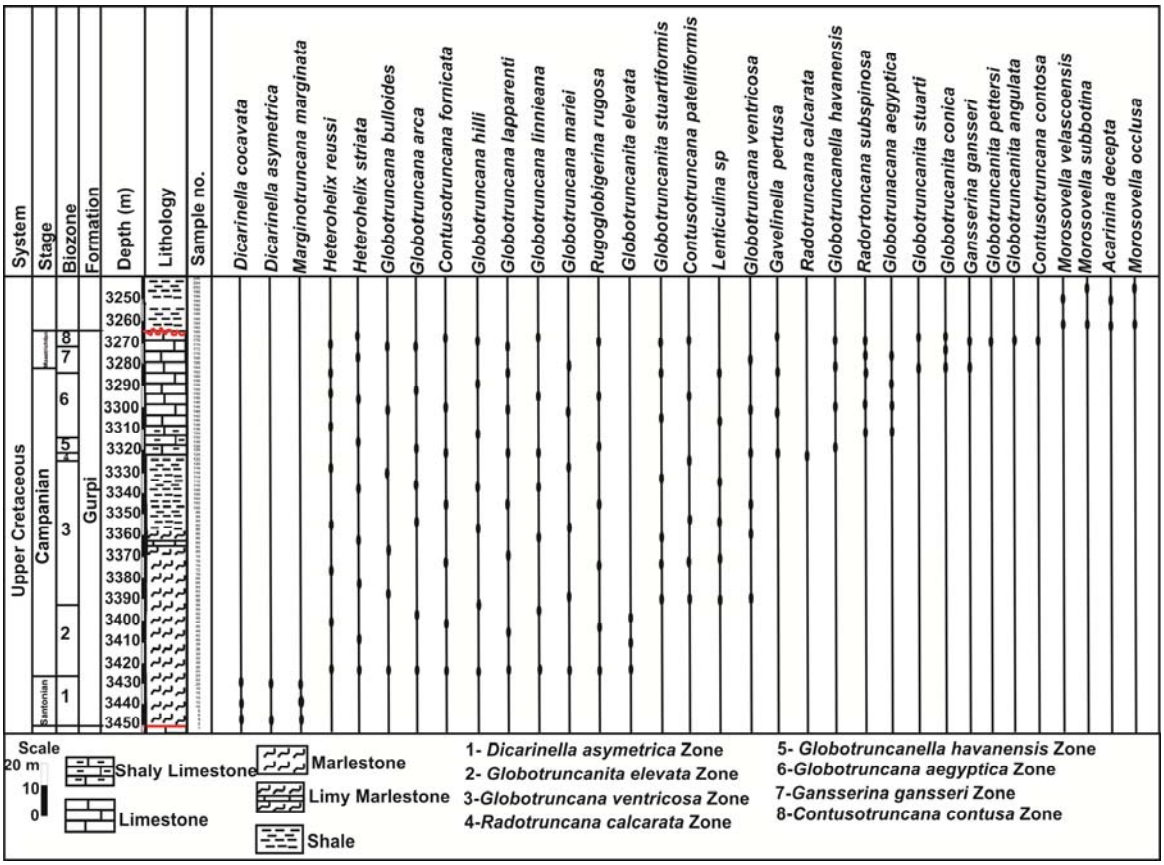

Figure 5. Biostratigraphic Colum of the Gurpi Formation in well no 21.

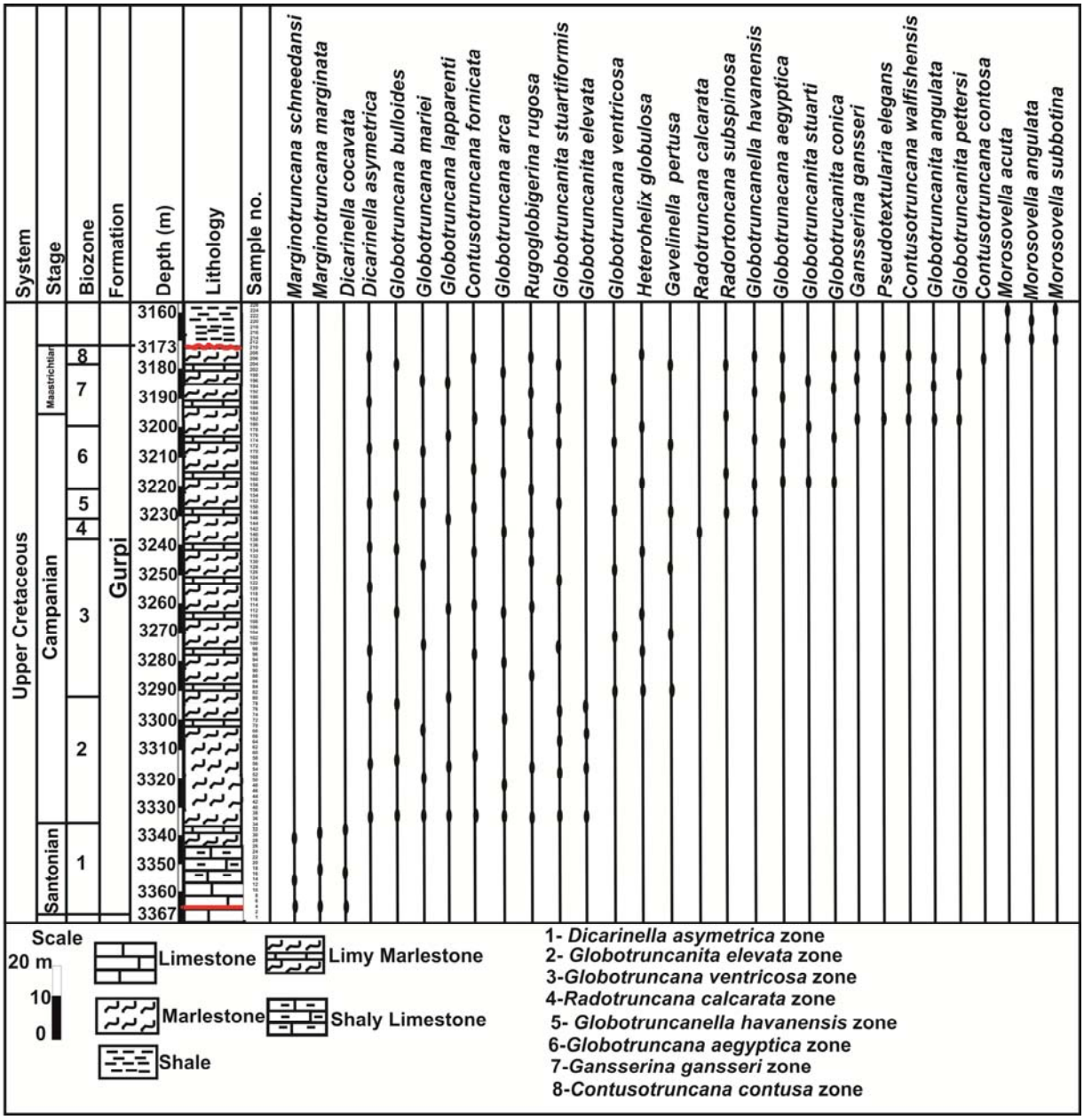

Figure 6. Biostratigraphic Colum of the Gurpi Formation in well no 43.

This biozone was recorded from Zagros by Vaziri Moghaddam, 2002 in Sarvestan area; Kamli Azan, 2004 in Lali area; Hemmati-Nasab, 2008 in Darreh Shar area; Moradi, 2010 in Darreh Shar area; Abrari *et al*., 2011 in Firozabad area; Bieranvand and Ghasemi-Nejad, 2013 in Izeh area; Rahimi *et al*., 2015 in Ramhormoz area; Fereydoonpour *et al*., 2014 in Deh Dasht area; and Solgi *et al*., 2015 in Koramabad area.

Contusotruncana contusa Zone

This concurrent range zone represents the stratigraphic interval that includes simultaneous occurrences of *Contusotruncana contusa* and *Globotruncana linneiana* between the first appearance of *Contusotruncana contusa* to the last occurrence (LO) of *Globotruncana linneiana*.It indicates the middle to late Maastrichtian (Robaszynski *et al*., 1984; Caron, 1985; Sliter, 1989; Nederbraght, 1991; Robaszynski and Caron, 1995; Keller *et al*., 1995; Li and Keller, 1998a,b; Li *et al*., 1999; Robaszynski *et al*., 2000; Tentaway *et*

al., 2001; Premoli Silva and Verga, 2004). The predominant planktonic foraminifera are: *Globotruncana lapparenti*, *Contusotruncana fornicata*, *Globotruncana arca*, *Globotruncana insignis*, *Globotruncana orientalis*, *Globotruncana arca*, *Globotruncana falsostuarti*, *Contusotruncana patelliformis*, and *Globotruncanita angulata*. This biozone was recorded from Zagros by Hemmati Nasab, 2008 in Darreh Shar area; Moradi, 2010 in Darreh Shar area; Abrari *et al*., 2011 in Firozabad area; Bieranvand and Ghasemi-Nejad, 2013 in Izeh area; Rahimi *et al*., 2015 in Ramhormoz area; and Solgi *et al*., 2015 in Koramabad area.The *Racemiguembelina fructicosa* zone and *Abathomphalus mayaroensis* zone (late Maastrichtian) are absent in these sections of the Marun oil filed.

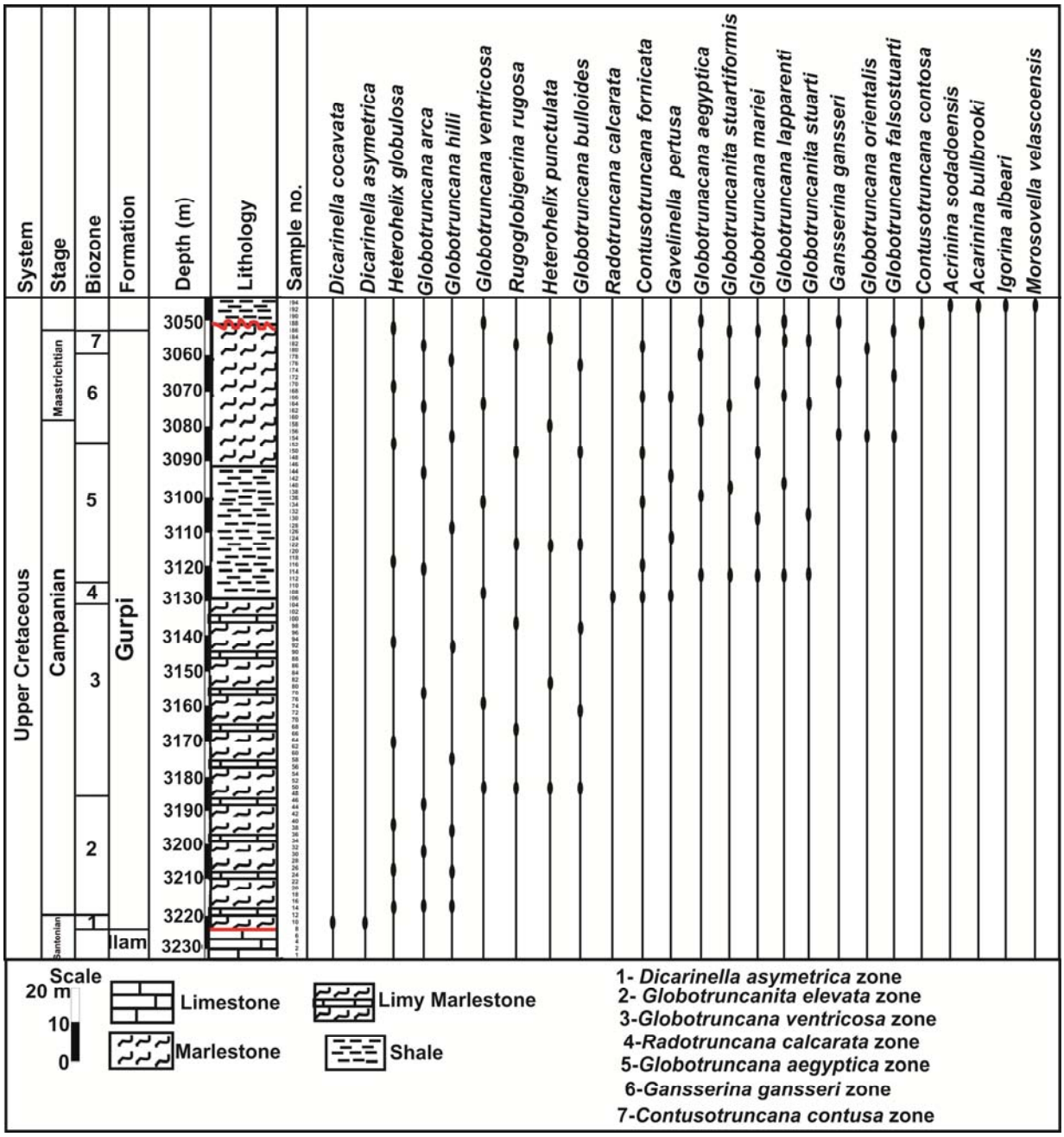

Figure 7. Biostratigraphic Colum of the Gurpi Formation in well no 123.

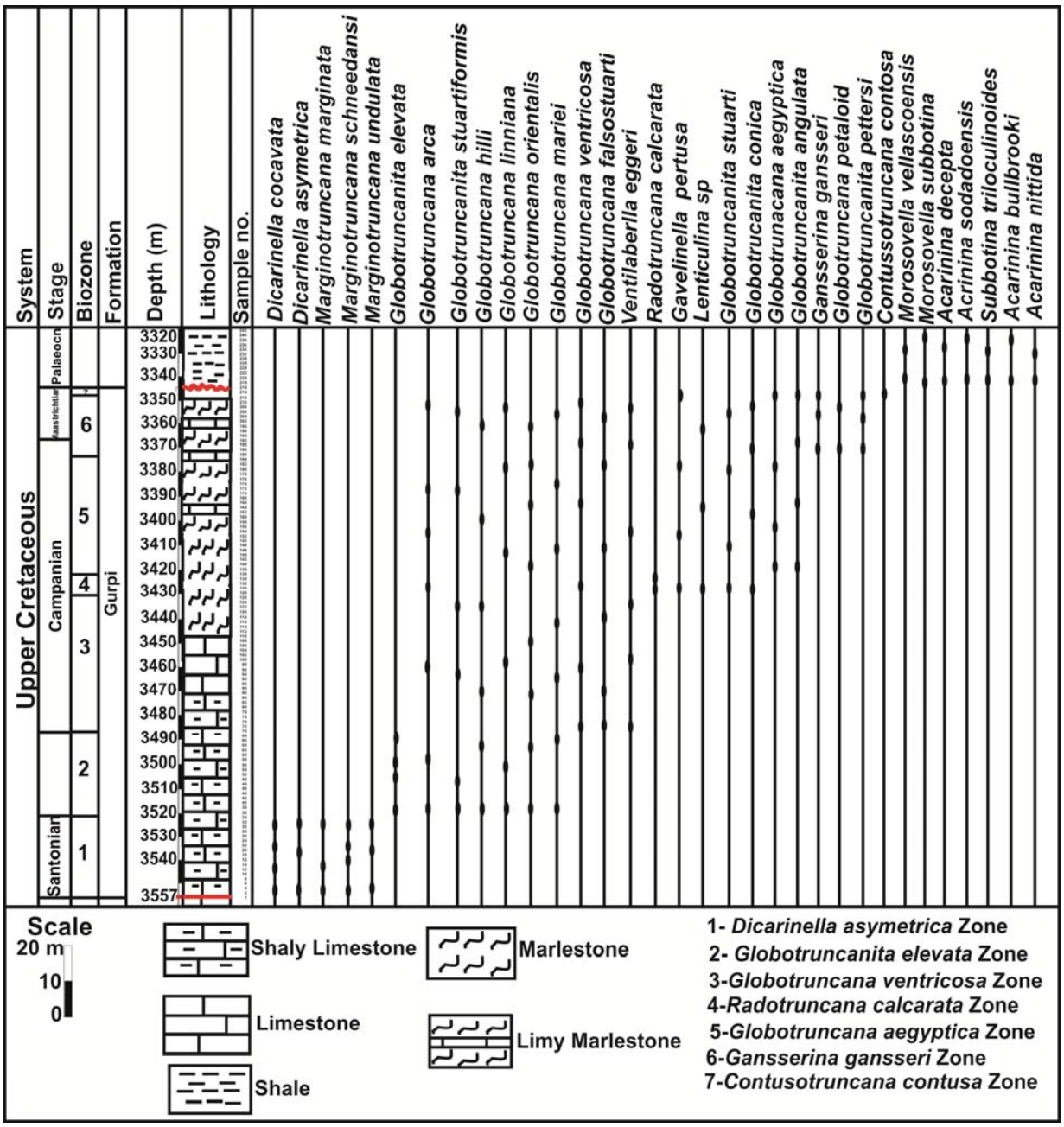

Figure 8. Biostratigraphic Colum of the Gurpi Formation in well no 41.

Paleoecology

Planktonic foraminifera can be useful indicators of ancient sea level changes because of their depth stratification. Shell morphology is intimately related to differing depths, each occupied by distinct foraminiferal morphogroups. It is believed (Caron, 1985) that vertical migration or distribution of planktonic foraminifers is directly related to ontogeny. Each morphogroup of planktonic foraminifera has their own bathymetric restrictions to their life cycle (Bé, 1977; Caron, 1985; Leckie, 1987; Boersma and Premoli Silva, 1989; Premoli Silva and Sliter, 1994; Petrizzo, 2002; Gallala *et al*., 2010).

According to morphologic and taxonomic similarity at the generic level, three groups of identified planktic foraminiferan taxa were recognized by (Hart and Baily 1979; Hart 1980a,

1980b; Wonder 1980):

1) Morphotype Type 1 or Fauna of Shallow waters (0 to 50 m): This form is non-keeled test as in the genera *Hedbergella*, *Globigerinelloides*, *Pseudogumbelina*, *Pseudotextularia*, *Heterohelix*, *Rugoglobigerina*, *Guembelitria* and *Whiteinella*.

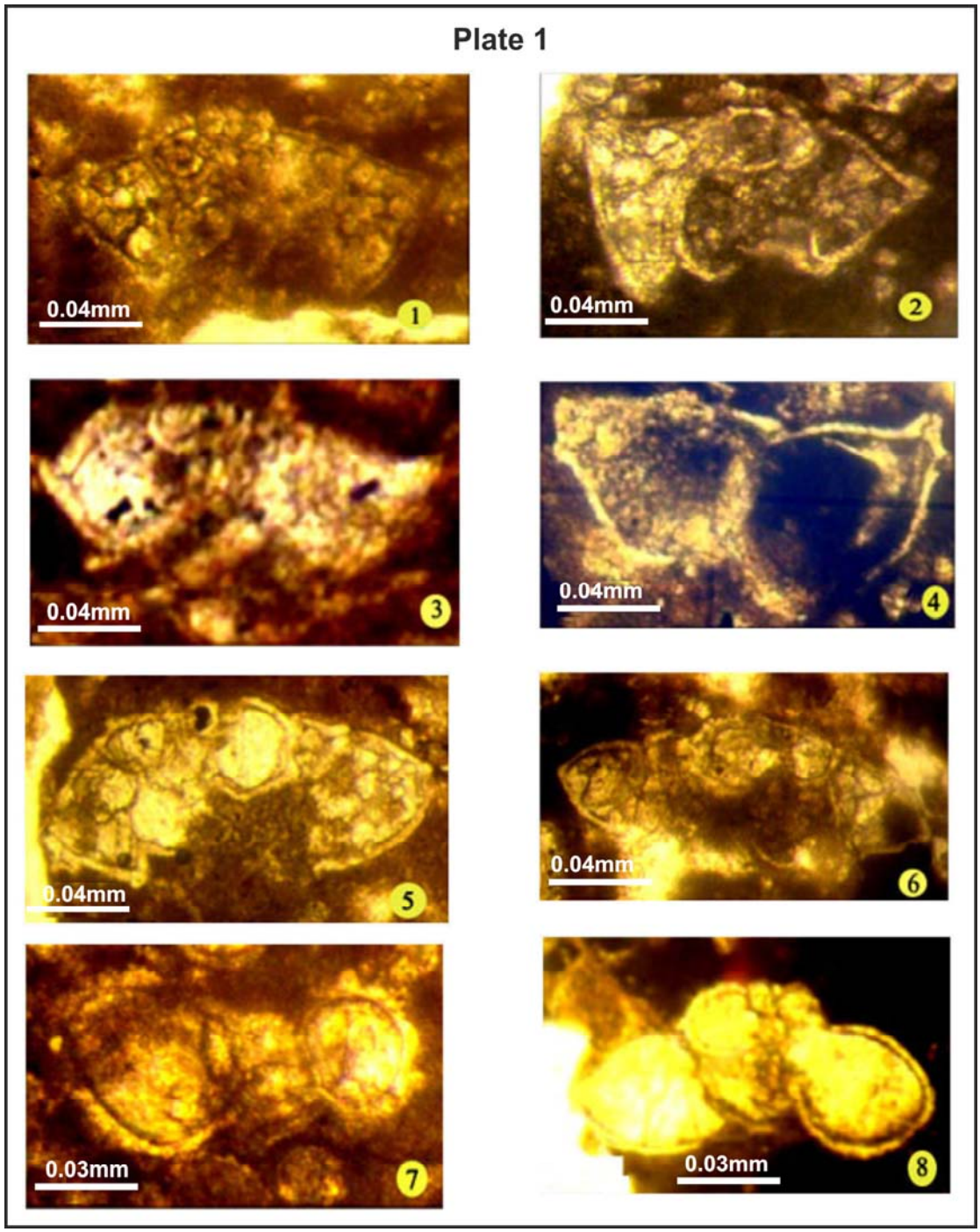

Plate 1. 1: *Globotruncanita elevata* (Brotzen), 1934, sample no. MN#41, 2: *Globotruncanita elevata* (Brotzen), 1934, sample no. MN#21, 3: *Radotruncana calcarata* (Cushman), 1927, sample no. MN#43, 4: *Dicarnella cocavata* (Brotzen), 1934, sample no. MN#21, 5: *Cotusotruncana fornicata* (Plummer), 1931, sample no. MN#21, 6: *Marginotruncana undolata* (Lehmann),1963, sample no. MN#45, 7: *Trinitella scotti* (Bronnimann),1952, sample no. MN#45, 8:*Globotruncanella havanensis*(Voorwijk), 1937, sample no. MN#123

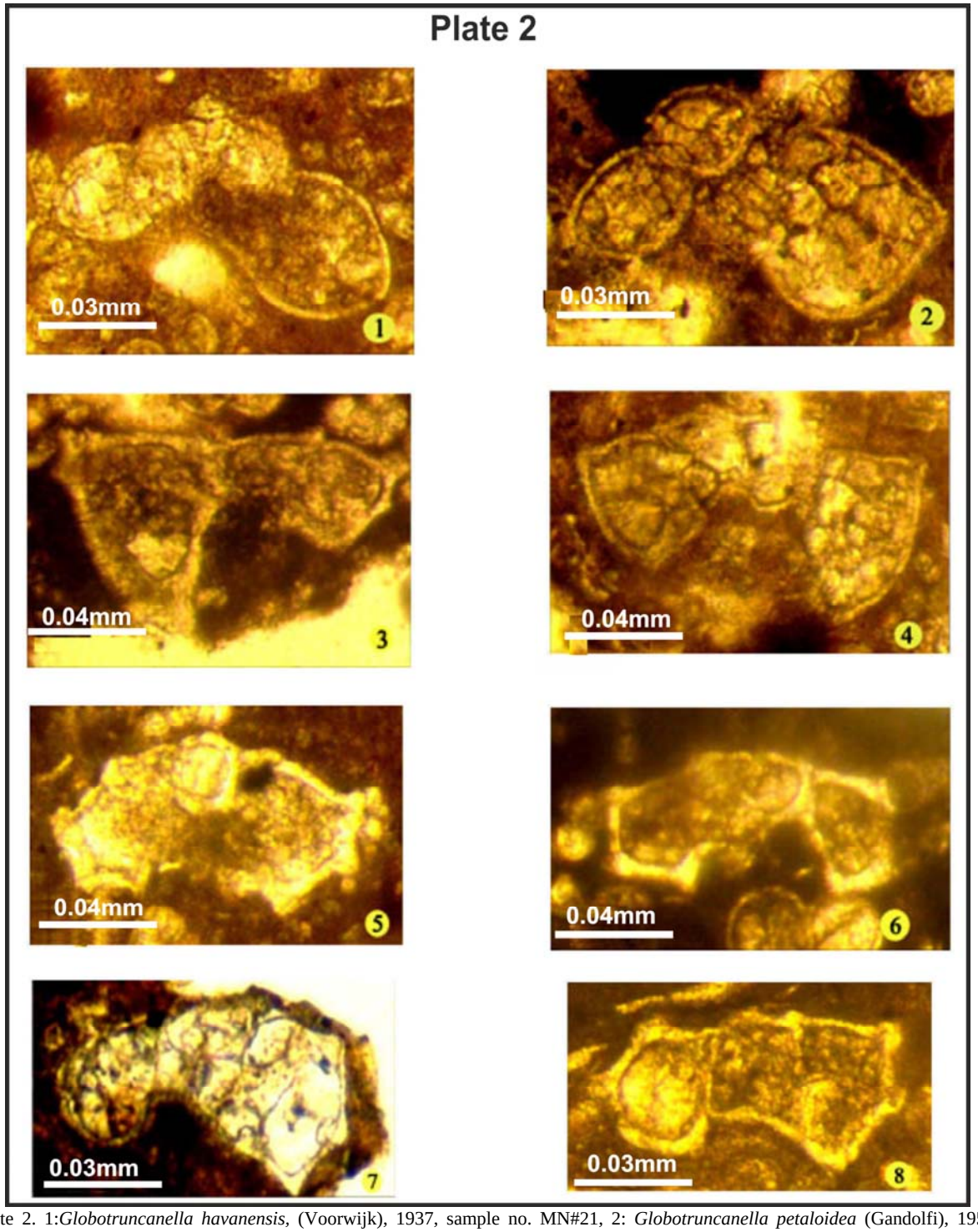

Plate 2. 1:*Globotruncanella havanensis,* (Voorwijk), 1937, sample no. MN#21, 2: *Globotruncanella petaloidea* (Gandolfi), 1955, sample no. MN#45, 3: *Globotruncana ventricosa* White, 1928, sample no. MN#43, 4: *Globotruncanita angulata* (Tilev), 1951, sample no. MN#21, 5: *Globotruncana arca* Cushman, 1926, sample no. MN#41, 6: *Globotruncana lapparenti* Brotzen,1936, sample no. MN#123, 7: *Globotruncana hilli pessagno,*1967, sampel no. MN#43, 8: *Globotruncana hilli pessagno,*1967, sample no. MN#123

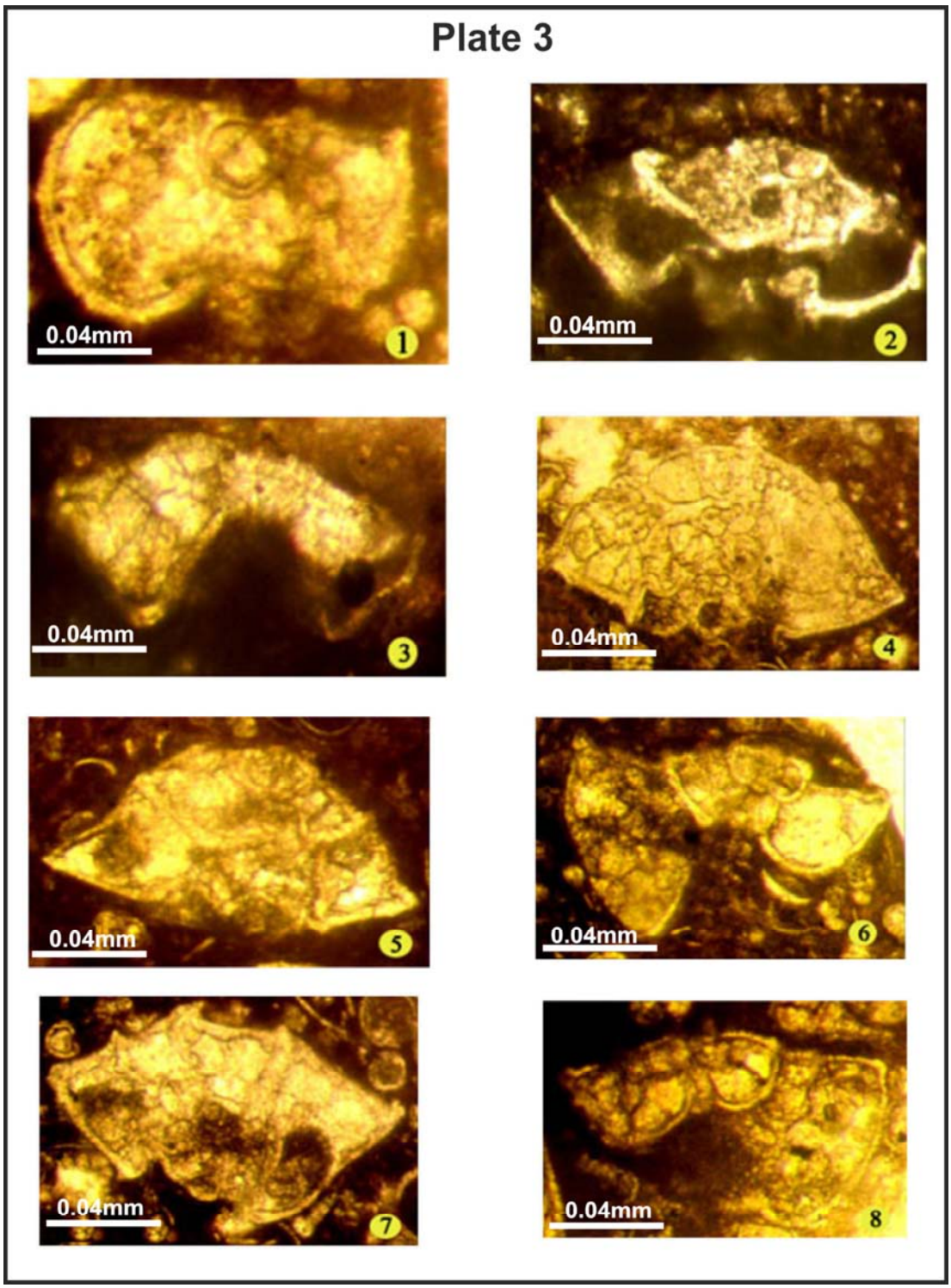

Plate 3. 1: *Gansserina gansseri* Bolli, 1951, sample no. MN#123, 2: *Globotruncana orientalis* EL Naggar, 1966, sample no. MN#123 3: *Globotruncana ventricosa* White, 1928, sample no. MN#123, 4: *Globotruncanita conica* (white), 1928, sample no. MN#45, 5: *Globotruncanita conica* (white), 1928, sample no. MN#41, 6: *Globotruncanita pettersi* (Gandolfi), 1955, sample no. MN#123, 7: *Globotruncanita stuarti* (de Lappatent), 1918, sample no. MN#21, 8: *Gansserina gansseri* Bolli, 1951, sample no. MN#123

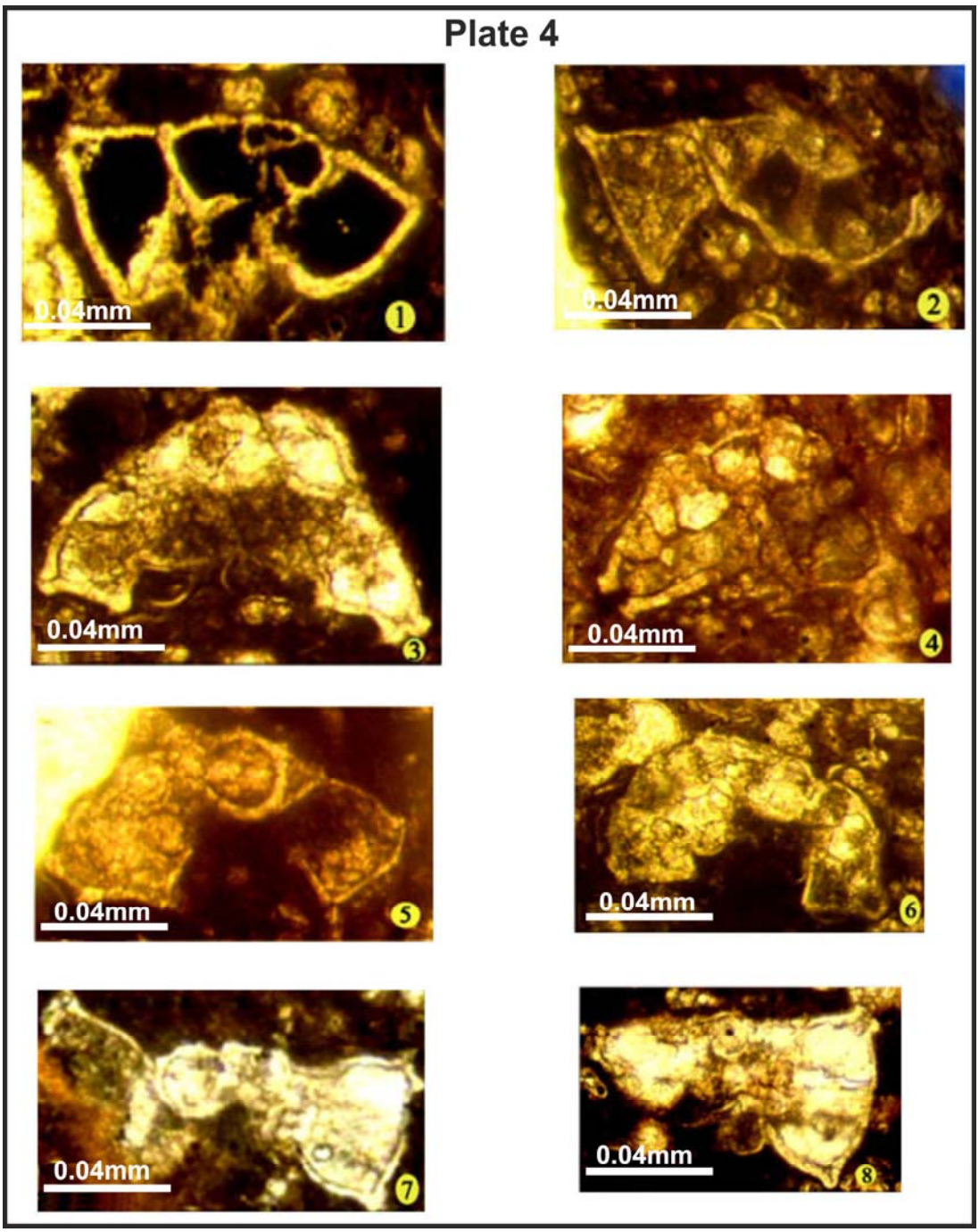

Plate 4. 1: *Globotruncanita stuartiformis* (Dalbiez), 1955, sample no. MN#41, 2: *Globotruncanita stuartiformis* (Dalbiez), 1955, sample no. MN#45, 3: *Contusotruncana contusa (Cushman),* 1926, sample no. MN#123, 4: *Contusotruncana contusa* (Todd), 1970, samle no. MN#43, 5: *Cotusotruncana fornicata* (Plummer), 1931, sample no. MN#123, 6: *Contusotruncana walfischensis* (Todd), 1970, samle no. MN#123, 7: *Dicarinella asymetrica* (Sigal), 1952, sample no. MN#21, 8: *Dicarinella asymetrica* (Sigal), 1952, sample no. MN#4

2) Morphotype Type 2 or Intermediate water fauna (50–100 m): This form is single keeled as in the genera *Dicarinella concavata*, *Rotalipora*, *Praeglobotruncana*, *Globotruncanella*, *Globotruncanita*.

3) Morphotype Type 3 or Deeper-water fauna (more than 100 m): The deep water fauna have double keeled test as in *Marginotruncana*, *Abathomphalus*, *Rugotruncana* and *Globotruncana*.

The wells studied, *Dicarinella asymetrica* Zone and *Globotruncanita elevata* Zone (samples no 43, 69, 17, 23, 41, and of 45, 21, 43,123 and 41 wells, respectively) of lower part of the Gurpi Formation, are represented by high abundance of morphotype 3 and (P/B) ratio that reflects a rise in the depth water, thus indicating a decrease in temperature, salinity and oxygen amount. (Tables 2, 3, 4, 5, 6).

Tabel 2. Percentage of Morphptype 3, Number of Benthic foraminifera, Number of Planktonic, ratio Planktonic/ Benthic (P/B), of the Gurpi Formation in the well no 45.

Sample No.	o/o Morphotype 3	Number of Benthic	Number of Planktonic	(Planktonic/ Benthic)
1	12	17	85	5
3	15	15	85	5.66
5	13	21	87	4.14
7	12	20	88	4.4
9	12	18	88	4.88
11	11	21	89	4.23
13	13	22	87	3.95
15	13	24	87	3.62
17	12	25	88	3.52
19	14	20	86	4.3
21	14	19	86	4.52
23	15	18	85	4.72
25	15	19	85	4.52
27	13	22	87	3.95
29	12	24	88	3.66
31	12	26	85	3.26
33	11	28	89	3.17
35	13	19	80	4.21
37	17	17	87	5.11
39	19	15	88	5.86
41	19	16	84	5.25
43	20	16	86	5.37
45	13	19	87	4.57
47	12	20	88	4.4
49	12	18	88	4.88
51	11	22	89	4.04
53	13	17	87	5.11
55	13	19	87	4.57
57	13	20	87	4.35
59	12	24	88	3.66
61	14	16	86	5.37
63	12	19	88	4.63
65	12	17	86	5.05

67	13	20	87	4.35
69	13	17	85	5
71	14	14	88	6.25
73	14	15	86	6.14
75	15	17	89	5.25
77	17	16	88	5.5
79	19	15	88	5.86
81	18	16	86	5.37
83	21	13	87	6.69
85	20	15	84	5.6
87	24	14	85	5.66
89	23	17	85	5
91	22	19	83	4.88
93	23	16	82	5.12
95	24	15	86	5.73
97	8	25	92	3.68
99	8	27	92	3.40
101	9	21	93	4.42
103	6	24	95	3.95
105	6	22	89	3.86
107	7	24	90	3.75
109	7	22	93	4.22
111	9	22	95	4.31
113	9	18	93	5.16
115	13	16	87	5.43
117	12	17	88	5.17
119	14	15	86	5.73
121	14	17	86	5.05
123	25	14	79	5.64
125	24	14	78	5.57
127	25	19	77	4.05
129	25	21	77	3.66
131	23	18	78	4.33
133	24	15	76	5.06
135	20	16	76	4.75
137	17	17	82	4.82
139	19	15	88	5.86
141	19	12	70	5.83
143	20	15	75	5
145	22	15	79	5.25
147	22	14	79	5.64
149	23	13	77	5.92
151	20	15	78	5.2
153	23	16	77	4.81
155	24	13	76	5.84
157	24	16	76	4.75
159	25	15	75	5
161	25	12	72	6
163	9	21	81	3.85

Table 2. To be continued

165	8	24	80	3.33
167	9	19	75	3.94
169	15	17	87	5.11
171	18	15	88	5.86
173	18	13	86	6.61
175	19	12	77	6.41
175	20	12	79	6.58
177	20	14	81	5.75
179	23	16	85	5.31
179	21	15	88	5.86
181	19	19	77	4.05
183	17	19	75	3.94

Table 3. Percentage of Morphptype 3, Number of Benthic foraminifera, Number of Planktonic, ratio Planktonic/ Benthic (P/B), of the Gurpi Formation in the well no 21.

Sample No.	o/o Morphotype 3	Number of Benthic	Number of Planktonic	(Planktonic/ Benthic)
1	26	17	74	4.35
3	27	15	73	4.86
5	27	13	73	6.61
7	28	16	72	4.5
9	28	14	72	5.14
11	27	12	73	6.08
13	27	12	73	6.08
15	26	13	74	5.69
17	28	11	72	6.54
19	28	13	72	3.78
21	27	14	73	5.21
23	27	12	73	6.08
25	26	14	74	5.28
27	27	17	73	5.53
29	27	16	73	4.56
31	27	12	73	6.08
33	27	14	73	5.21
35	28	12	72	6
37	28	14	72	4.8
39	27	15	73	4.86
41	27	16	73	4.56
43	25	21	75	3.57
45	25	18	75	4.16
47	24	21	76	3.61
49	23	23	77	3.34
51	23	22	77	3.5
53	23	20	77	3.85
55	24	16	76	4.75
57	24	16	76	4.75
59	28	15	72	4.8
61	28	16	72	4.5
63	29	15	71	4.73
65	28	16	72	4.8
67	29	14	71	5.07
69	30	13	70	5.38
71	30	12	70	5.83
73	30	15	70	4.66

Table 3. To be continued

75	30	13	70	5.38
77	31	15	69	4.6
79	30	15	70	5
81	32	10	68	6.8
83	32	10	68	6.8
85	31	12	69	5.75
87	31	11	69	6.27
89	33	13	67	5.15
91	32	14	68	4.85
93	32	13	68	5.23
95	33	12	67	5.58
97	30	13	70	5.83
99	30	14	70	5
101	31	11	69	6.27
103	31	10	69	6.9
105	32	13	68	5.23
107	30	13	70	5.38
109	30	11	70	6.36
111	30	10	70	7
113	26	15	74	4.93
115	15	20	85	4.25
117	15	19	85	4.47
119	13	20	87	4.35
121	12	20	88	4.4
123	12	18	88	4.88
125	11	21	89	4.23
127	13	19	87	4.57
129	13	17	87	5.11
131	12	20	88	4.4
133	14	20	86	4.3
135	14	21	86	4.09
137	26	11	74	6.27
139	26	13	74	5.69
141	25	14	75	5.35
143	25	15	75	5
145	24	15	76	5.06
147	24	11	76	6.90
149	24	12	76	6.33
151	8	27	92	3.40
153	8	25	92	3.68
155	9	22	93	4.22
157	9	19	93	4.89
159	10	18	90	5
161	33	11	67	6.09
163	33	14	67	4.78
165	26	14	74	5.28
167	26	15	74	4.93
169	11	24	89	3.70
171	13	20	87	4.35
173	13	22	87	3.95
175	12	25	88	3.52
175	14	16	86	5.37
177	12	17	88	5.17
179	12	18	88	4.88

Table 4. Percentage of Morphptype 3, Number of Benthic foraminifera, Number of Planktonic, ratio Planktonic/ Benthic (P/B), of the Gurpi Formation in the well no 43.

Sample No.	o/o Morphotype 3	Number of Benthic	Number of Planktonic	(Planktonic/ Benthic)
1	12	14	49	3.5
3	13	13	50	3.8
5	13	14	52	3.71
7	14	12	52	4.33
9	15	14	54	3.85
11	15	17	57	3.35
13	16	16	56	3.5
15	35	12	59	4.91
17	35	14	60	4.28
19	35	14	58	4.14
21	32	13	55	4.23
23	31	15	59	3.93
25	31	12	56	4.66
27	29	14	61	4.35
29	25	16	63	3.93
31	25	15	57	4.07
33	25	13	55	4.23
35	23	17	63	3.70
37	21	19	60	3.15
39	21	12	51	4.25
41	22	13	53	4.07
43	22	11	49	4.45
45	23	9	48	5.33
47	21	11	50	4.54
49	21	12	53	4.41
51	21	14	48	3.42
53	20	14	46	3.28
55	20	14	45	3.21
57	19	15	45	3
59	18	16	47	2.93
61	18	16	45	3.21
63	17	12	43	3.58
65	17	15	43	2.86
67	17	13	42	3.23
69	15	15	42	2.8
71	15	14	41	2.92
73	14	14	40	2.85
75	12	16	40	2.5
77	12	16	39	2.43
79	11	17	35	2.05
81	10	16	33	2.06
83	13	15	33	2.2
85	14	15	34	2.26
87	14	12	33	2.53
89	15	14	36	2.57
91	16	14	37	2.64
93	16	15	40	2.66
95	20	14	50	3.57
97	21	12	52	4.33
99	21	14	52	3.71

101	22	13	55	4.23
103	25	12	57	4.75
105	25	15	58	3.86
107	27	12	58	4.83
109	27	13	59	4.53
111	30	14	65	4.64
113	30	14	67	4.78
115	30	15	66	4.4
117	28	15	63	4.2
119	28	15	65	4.33
121	26	17	61	3.58
123	26	15	60	4
125	25	13	60	4.61
127	22	16	57	3.56
129	23	15	58	3.86
131	23	16	59	3.68
133	22	19	59	3.10
135	20	18	55	3.05
137	20	17	53	3.11
139	17	16	50	3.12
141	16	15	48	3.2
143	15	18	48	2.66
145	11	22	45	2.04
147	9	21	44	2.02
149	9	23	40	1.73
151	8	22	38	1.72
153	7	25	38	1.52
155	7	25	35	1.4
157	7	22	30	1.36
159	10	18	33	1.83
161	11	16	33	2.06
163	12	15	35	2.33
165	14	14	34	2.42
167	18	14	37	2.64
169	19	15	39	2.6
171	19	13	39	3
173	20	12	36	3
173	20	12	36	3
175	23	12	37	3.08
175	17	16	41	2.56
177	15	19	41	2.15
179	15	22	44	2
181	16	19	45	2.36
183	17	17	44	2.58
185	21	15	48	3.2
187	20	17	51	3
189	16	13	36	2.76
191	15	15	37	2.46
193	13	14	33	2.35
195	13	13	35	2.69
197	12	15	34	2.66
199	11	13	32	2.26

Table 4. To be continued

201	11	12	32	2.66
203	10	14	31	2.21
205	9	15	30	2

Table 5. Percentage of Morphptype 3, Number of Benthic foraminifera, Number of Planktonic, ratio Planktonic/ Benthic (P/B), of the Gurpi Formation in the well no 123.

Sample No.	o/o Morphotype 3	Number of Benthic	Number of Planktonic	(Planktonic/ Benthic)
1	7	9	24	2.66
3	8	9	25	2.77
5	9	10	27	2.7
7	9	7	29	3
9	10	11	30	2.72
11	11	9	30	3.3
13	12	9	31	3.44
15	13	10	33	3.3
17	13	9	33	3.66
19	15	8	35	4.37
21	18	8	37	4.62
23	20	8	38	4.75
25	19	10	40	4
27	17	9	33	3.63
29	17	12	43	3.58
31	13	11	38	3.45
33	12	12	38	3.34
35	12	10	34	3.4
37	11	12	36	3
39	10	11	32	2.9
41	8	12	30	2.5
43	5	12	27	2.25
45	6	10	24	2.4
47	7	7	24	2.42
49	9	10	28	2.8
51	11	10	31	3.1
53	13	8	30	3.75
55	13	8	31	3.87
57	14	9	35	3.88
59	15	10	35	3.5
61	16	10	38	3.8
63	17	9	36	4
65	17	9	37	4.11
67	17	11	40	3.63
69	16	10	34	3.4
71	16	9	34	3.77
73	16	9	39	4.33
75	15	12	41	3.41
75	15	12	41	3.41
77	15	17	45	2.81
79	15	11	37	3.36
81	15	10	37	3.7
83	17	10	41	4.1

85	17	13	44	3.38
87	17	13	42	3.23
89	16	15	45	3
91	16	12	45	3.75
93	16	14	43	3.07
95	15	14	39	2.7
97	14	13	37	2.84
99	13	12	34	2.83
101	5	13	14	1.07
103	1	12	10	0.83
105	1	9	10	1.11
107	1	5	9	1.8
109	1	7	9	1.28
111	2	8	15	1.87
113	2	11	17	1.54
115	2	17	22	1.29
117	2	17	20	1.17
119	3	15	24	1.6
121	3	18	24	1.33
123	1	9	7	0.77
125	1	10	8	0.8
127	1	14	11	0.78
129	1	12	13	1.08
131	1	13	13	1
133	1	10	9	0.9
135	1	10	7	0.7
137	1	8	10	1.25
139	1	10	10	1
141	1	15	12	0.8
143	1	9	12	1.33
145	1	9	11	1.22
147	1	10	11	1.1
149	9	21	44	2.02
151	11	17	44	2.58
153	15	18	50	2.77
155	6	9	19	2.11
157	7	11	19	1.72
159	8	11	22	2
161	9	12	25	2.08
163	10	10	21	2.1
165	11	12	24	2
167	11	9	22	2.44
169	12	14	31	2.21
171	14	13	34	2.61
173	15	17	45	2.64
175	12	16	38	2.37
177	9	15	33	2.2
179	7	14	30	2.14
181	5	15	29	1.93
183	4	13	21	1.61
185	2	13	17	1.30

Table 5. To be continued

187	1	10	13	1.3
189	1	10	11	1.1
191	1	9	10	0.9

Table 6. Percentage of Morphptype 3, Number of Benthic foraminifera, Number of Planktonic, ratio Planktonic/ Benthic (P/B), of the Gurpi Formation in the well no 41.

Sample No.	o/o Morphotype 3	Number of Benthic	Number of Planktonic	(Planktonic/ Benthic)
1	18	14	35	2.5
3	19	15	39	2.6
5	19	14	39	2.78
7	20	13	37	2.84
9	21	16	48	3
11	22	14	50	3.57
13	22	15	55	3.66
15	25	14	54	3.85
17	26	15	58	3.86
19	22	13	49	3.76
21	23	12	46	3.83
23	23	16	59	3.68
25	22	14	45	3.21
27	20	18	56	3.11
29	21	12	52	4.33
31	21	14	52	3.71
33	23	13	55	4.23
35	24	12	57	4.75
37	25	15	58	3.86
39	27	14	59	4.21
41	27	13	57	4.38
43	20	12	39	3.25
45	23	12	44	3.66
47	25	17	61	3.58
49	26	15	60	4
51	25	13	58	4.46
53	22	14	57	4.07
55	23	15	58	3.86
57	24	16	59	3.68
59	22	17	59	3.47
61	22	18	58	3.22
63	20	19	59	3.10
65	25	14	55	3.92
67	23	17	63	3.70
69	21	16	57	3.56
71	21	15	51	3.4
73	22	13	52	4
75	22	14	49	3.5
77	23	11	48	4.36
79	25	12	56	4.66
81	26	15	58	3.86
83	27	12	55	4.58

85	27	13	59	4.53
87	28	11	50	4.54
89	27	15	65	4.33
91	30	14	65	4.64
93	30	15	69	4.6
95	30	14	66	4.71
97	25	17	74	4.35
99	27	15	71	4.73
101	27	17	75	4.41
103	28	16	72	4.5
105	28	14	70	5
107	27	15	65	4.33
109	27	15	70	4.66
111	21	16	57	3.56
113	23	14	53	3.78
115	23	16	59	3.68
117	21	17	59	3.47
119	21	18	56	3.11
121	20	17	52	3.05
123	18	16	50	3.12
125	16	15	49	3.26
127	15	18	48	2.66
129	11	21	45	2.14
131	9	21	43	2.04
133	8	23	41	1.78
135	8	22	37	1.68
137	7	19	31	1.63
139	7	25	35	1.4
141	10	21	39	1.85
143	9	23	36	1.56
145	8	24	37	1.54
147	8	25	38	1.52
149	7	25	35	1.4
151	7	22	30	1.36
153	6	18	25	1.38
155	6	17	23	1.35
157	6	16	22	2.37
159	7	25	38	1.52
161	7	24	35	1.45
163	9	22	37	1.68
165	10	18	39	2.16
167	11	13	33	2.53
169	12	15	36	2.4
171	14	14	34	2.42
173	18	14	37	2.64
175	18	15	39	2.6
175	19	13	40	3.07
177	20	14	43	3.07
179	22	12	37	3.08
181	17	15	40	2.66
183	15	18	41	2.27

Table 6. To be continued

185	15	20	44	2.2
187	18	19	45	2.36
189	25	13	51	4.92
191	25	15	58	3.86
193	27	15	58	3.86
195	29	13	59	4.53
197	29	14	65	4.64
199	30	13	64	4.92
201	30	15	66	4.4
203	27	17	61	3.58
205	22	14	37	2.64
207	19	15	35	2.33
209	19	16	35	2.18
211	20	14	36	2.57
213	23	13	37	2.84

During the late Companian, the percentage of the morphothype 3 and (P/B) ratio decreased in *Radotruncan calcarata* Zone and *Globotroncanella havanensis* Zone (samples no 105, 125, 157, 105, 135, and of 45, 21, 43,123 and 41 wells, respectively), reflecting low depth water. Meanwhile, *Globotruncana aegyptica* Zone (samples no 129, 161, 141, 153, 177, and of 45, 21, 43,123 and 41 wells, respectively) is represented by high abundance of morphotype 3 and (P/B) ratio which again represents an increase in the depth water during the late Companian. (Fig. 10 and Tables 2, 3, 4, 5, 6). Low abundance of morphptype 3 and (P/B) ratio between *Globotruncana aegyptica* to *Gansserina gasseri* Zones(samples no 165, 169, 163, 173, 185, and of 45, 21, 43,123 and 41 wells, respectively) reflects a decrease in the depth water and therefore, indicates an increase in temperature, salinity and oxygen amount, Meanwhile, an increase in the diverse morphptype 3 between *Gansserina gansseri* and *Contusotrunca contusa* Zones (samples no 179, 175, 185, 181, 199, and of 45, 21, 43,123 and 41 wells, respectively) was shown. Finally, abundant morphotype 3 and (P/B) ratio indicated relative gradual decrease at the end of the Cretaceous period in *Contusotruncana contusa* Zone (Fig. 10 and Tables 2, 3, 4, 5, 6). Based on planktonic foraminiferal morphotypes, we have compiled an interpreted sea - level curve for the entire basin (Figs. 10 and Tables 2, 3, 4, 5, 6).

The studied successions are marked by distinct short term alternating intervals of high and low abundance of and diverse morphotypes deepwater.Thus, three short-term intervals characterized by low abundance and diversity of morphotypes deepwater along with another three typified by high abundance and diverse of morphotypes deepwater have been recognized in the study area (Figs. 10 and Tables 2, 3, 4, 5, 6). The three intervals indicated by low abundance of and diverse morphotypes deepwater have reflected a lowered water depth, whereas those indicated by high abundance and diversity of morphotypes deepwater have reflected an increased water depth level.

Discussion

The present study is a biostratigraphic and Palecology analysis of the Gurpi Formation (late Santonian – late Maastrichtian) in the Marun oil field, the Zagros Basin, southwest of Iran. Distribution of the identified species based on the planktonic foraminiferal zonal schemes established for the Tethyan Realm, was the main basis for the biostratigraphic studies. *Dicarinella asymetrica* TRZ (thicknesses 5, 23, 31, 36, and 23 meters of the thick grey marly limestone in 123, 45, 43, 41, and 21 wells, respectively, early Santonian to earliest Campanian), *Globotruncanita elevata* PRZ (thicknesses 34, 38, 36, 33, and 35 meters of thick grey marly limestone in 123, 45, 43, 41, and 21 wells, respectively.early Campanian), *Globotruncana ventricosa* IZ (thicknesses 68, 50, 57, 57, and 67 meters of thick limestone in 123, 45, 43, 41, and 21 wells, middle to late Campanian), *Radotruncana calcarata* TRZ (thicknesses 6, 4, 7, 9, and 4 meters of thick grey marly limestone and marlestone in 123, 45, 43, 41, and 21 wells,

respectively, early late Campanian), *Globotruncanella havanensis* PRZ (thicknesses 6, 10, and 7 meters of thick grey marly limestone and shale in 45, 43 and 21 wells, respectively, late Campanian), *Globotruncana aegyptiaca* IZ (thicknesses of 40, 38, 21, 48, and 30 meters of thick limestone in 123, 45, 43, 41, and 21 wells, respectively, late Campanian), and lower part of the *Gansserina gansseri* IZ (thicknesses 36, 16, 29, 25, and 13 meters of marly limestone in 123, 45, 43, 41 and 21 wells, respectively., latest Campanian) belong to the late Campanian. (Fig.9). Upper part of the *Gansserina gansseri* IZ belongs to early Maastrivhtian The early-late Maastrichtian is defined here based on the lowest occurrence of *Contusotruncana contusa*. It consists of *C. contusa* IZ (thicknesses 4, 8, 6, 4, and 7 meters of thick marl and limestone in 123, 45, 43, 41, and 21 wells, respectively, early late Maastrichtian).(Fig. 9).

The evolution of planktonic foraminifera and sedimentological data allows the reconstruction of depositional environments in this study. The early – middle Campanian is represented by increasing relative abundance of morphotype 3 and increased ratio of Planktonc/Bentic (samples no 43, 69, 17, 23, 41, and of 45, 21, 43,123 and 41 wells, respectively) related to dysoxic anoxic conditions and low-energy environments. (Tables 2, 3, 4, 5, 6). The increased abundance of keeled species planktonic foraminifera is interpreted as an open marine deep water habitat. This condition (anoxic) is as shown a transgression in basin during this time. This transgression is correlated to MFS Cam 2 and, Cam3, which is a major eustatic sea level rise in the early Campanian (Haq and Shutter, 2008).

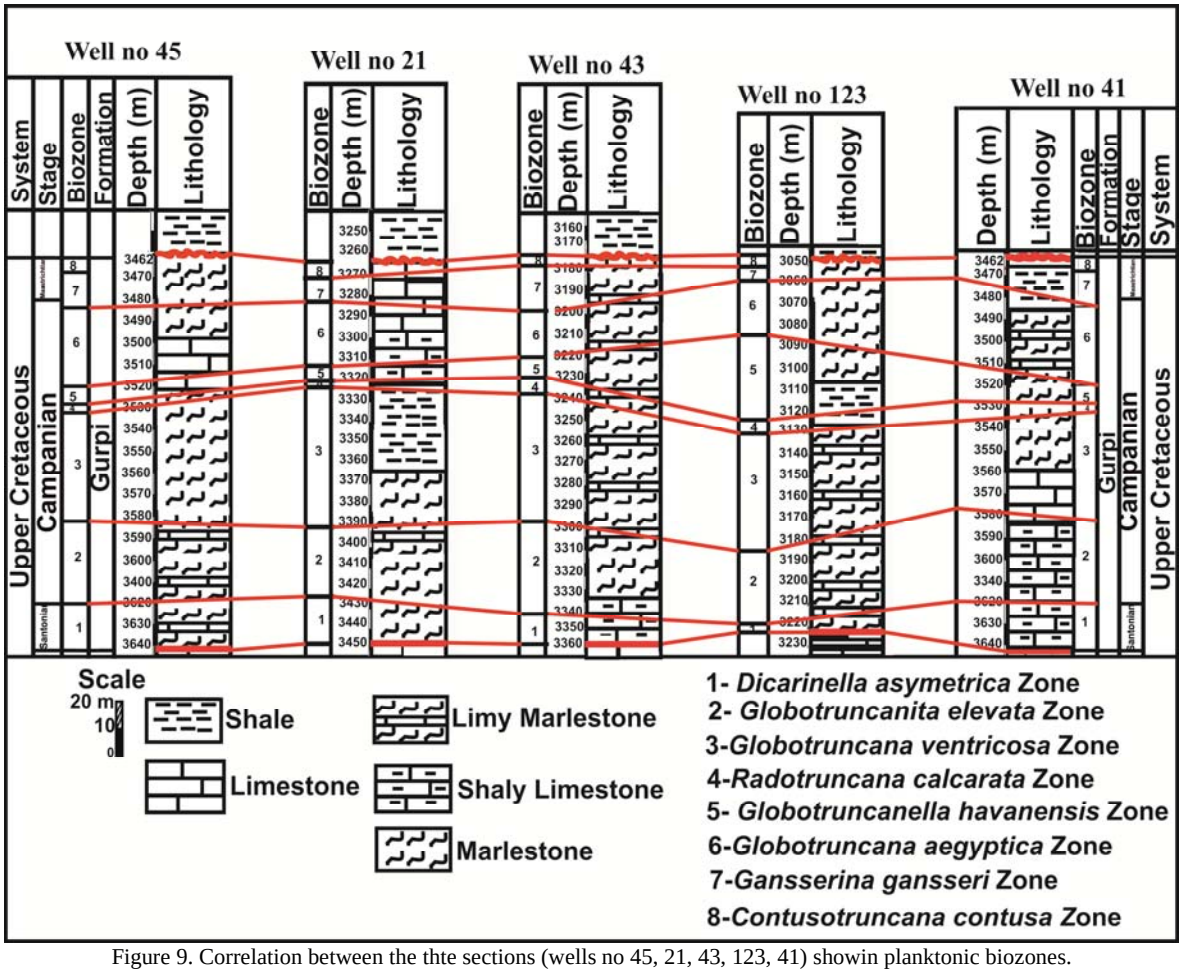

Figure 9. Correlation between the thte sections (wells no 45, 21, 43, 123, 41) showin planktonic biozones.

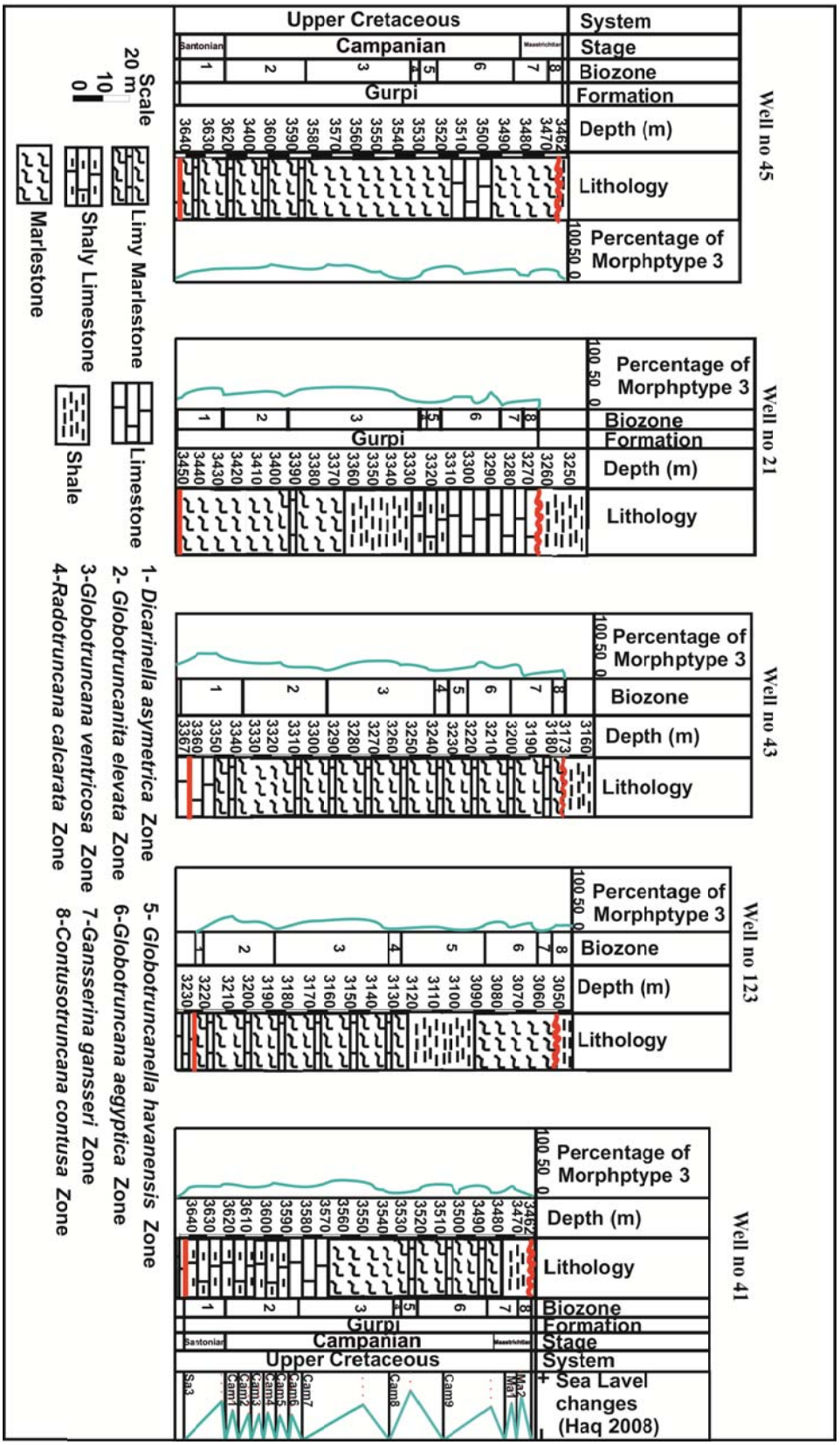

Figure 10. Comparison of change sea level of the Gurpi Formation in this study with curve of Haq and and Shutter (2008).

Near the end of the Campanian, due to the decrease at abundance of morphotype 3 in *Radotruncan calcarata* Zone and *Globotroncanella havanensis* Zone of the middle part of the Gurpi Formation, a decrease in depth water has been shown. This decrease in depth was recorded from southeast Turkey, northeast Iraq and western Iran (Aqra, Tayarat and Gurpi Formation) by (Jassim and Buday, 2006; Ozer *et al*., 2012; Karim and Surdashy, 2005; Karim *et al*., 2006; Zariei and Ghasemi-Nejad, 2014). This fact represents the prevailing of the same tectonic and environmental conditions with some time elapse along the border of Arabian platform in foreland bulge from Turkey to Iran (Ozer *et al*., 2012; Alavi 2004; Jassim and Buday, 2006; Karim *et al*., 2006). This time interval is entirely influenced by the compressional regime of the foreland basin creation (Alavi 2004; Homke *et al*., 2009). This decrease in depth water is correlated to SB Cam8, and Cam 9 (Snedden and Liu, 2011), KCa7 (Haq, 2014), and Cam 8 (Haq and Shutter, 2008) which is a major eustatic sea level drop in the late Campanian. This is followed by an abrupt deepening and the deposition of pelagic marls in maximum flooding surface (MFS) in Latest Campanian. The abundance of mprphotype 3 (samples no 129, 161, 141, 153, 177, and of 45, 21, 43,123 and 41 wells, respectively) as well as the presence of glauconite is evidence of surface water productivity and anoxic condition due to sea level rise that favored accumulation and preservation of morphotype 3 in pelagic environment latest Campanian. (Tables 2, 3, 4, 5, 6). This condition has shown a transgression in basin during this time. The relative sea level curve is not well in accord with Haq and Shutter (2008).

During early to late Maastrichtian, an increase in the diverse morphptype 3 was shown between *Gansserina gansseri* Zone and *Contusotrunca contusa* Zone, indicating an increase in the depth water and a transgression the basin. This transgression is correlated to MFS Cam 9 and Ma1, which is a major eustatic sea level rise in the Masstrichtian (Haq and Shutter, 2008). Finally, abundance and diversity of morphotype 3 indicated relative gradual decrease at the end of the Cretaceous period in *Contusotruncana contusa* Zone.(Fig.10 and Tables 2, 3, 4, 5, 6). The comparison of changed sea level during the deposition of the Gurpi Formation in this study with eustasy curve of Haq and Shutter (2008) in early Campanian to late Masstrichtian indicates the great effect of eustasy and tectonic on relative sea level changes within these time periods (Fig. 10).These tectonic events are reflected in the significant changes in the depositional environment of the late Cretaceous.

Conclusions

A microbiostratigraphy study of samples from five wells of the Gurpi Formation in the Marun oil field indicates that the deposition of the Gurpi Formation continued in the Late Santonian - Late Maastrichtian period.

About 47 species belonging to 23 genus of Planktonic foraminifera were identified from the Gurpi Formation and divided into five wells. Based on the stratigraphic distribution of well-known foraminifers, eight biozones from the base to the top were established. They consisted of: 1) *Dicarinella asymetrica* Zone (Late Santonian), 2) *Globotruncanita elevata* Zone (Early Campanian) 3) *Globotrnucana ventricosa* Zone(Middle to Late Campanian), 4) *Radotruncana calcarata* Zone (Late Campanian), 5) *Globltruncanella havanensis* Zone (Late Campanian), 6) *Globotruncana aegyptica* Zone (Latest Campanian), 7) *Gansserina gansseri* Zone (Latest Companian- Early Massrtistian), and 8) *Contusotruncana contusa* Zone (Early to Late Massrtistian).

Based on the stratigraphic distribution of the well-known planctonic foraminifers morphotype 3, three rises in the depth water peaks were recognized in the study area, which are correspond to high abundance and highly diverse of morphotype 3.

The comparison of the changed sea level during the deposition of the Gurpi Formation in this study with eustasy curve of Haq and Shutter (2008) in early Campanian to late Masstrichtian revealed the great effect of eustasy and tectonic on relative sea level changes during these time periods.

References

Abrari, N., Vaziri-Moghaddam, H., Taheri, A., Seyrafian, A., 2011. Biostratigraphy and bathymetry of Gurpi Formation in southwest of Firozabad. Geology of Iran, 17: 49-60 (in Persian).

Alavi, M., 2004. Regional stratigraphy of the Zagros fold-thrust belt of Iran and its proforeland evolution. American Journal of Science, 304:1–20. doi: 10.2475/ ajs.304.1.1.

Bé, A .W. H., 1977. An ecological, zoogeographic and taxonomic review of recent planktonic foraminifera. In: Ramsey, A .T. S. (Ed.), Oceanic Micropaleontology. Academic Press, London, 1: 1-100.

Beiranvand, B., Ghasemi-Nejat, E., 2013. High resolution planktonic foraminiferal biostratigraphy of the Gurpi Formation, K/Pg boundary of the Izeh Zone, SW Iran. Revista Brasileira de Paleontologia, 16(1): 2–26.

Beiranvand, B., Ghasemi-Nejad, E., Kamali, M. R., Ahmadi, A., 2014. Sequence stratigraphy of the Late Cretaceous - Palaeocene Gurpi Formation in southwest Iran. GeoArabia, 19(2): 89-102.

Boersma, A., Premoli – Silva, I., 1989. Pleoceneplanktic foraminiferal biogeography and paleoceanography of the Atlantic Ocean. Micropaleontology, 29: 355-386.

Caron, M., 1985. Cretaceous planktonic foraminifera, In: Bolli, H. M., Saunders, J. B., Perch Nielsen, K.(Editors). Plankton Stratigraphy; Cambridge University, 17-87 P.

Darvishzad, B., Ghasemi-Nejad, E., S. Ghourchaei, S., Keller, G., 2007. Planktonic foraminiferal biostratigraphy and faunal turnover across the Cretaceous-Tertiary boundary in southwestern Iran. Journal of Sciences, Islamic Republic of Iran, 18 (2): 139-149.

Fereydoonpour, M., Vaziri-Moghaddam, H., Taheri, A., 2014. Biostratigraphy and sequence Stratigraphy of the Gurpi Formation at Deh Dasht Atea, Zagros Basin, SW Iran. Acta Geologica Sinica (English Edition), 88(6): 1681-1695.

Gallalal, N., Zaghbib – Turki, D., 2010. High resolution biostratigraphy based on planktic foraminifera across the Cretaceous –Paleogene transition at the Bidart section (SW France), Journal of Acta Geologica polonica, 60: 243-255.

Gealey, W. K., 1988. Plate tectonic evolution of the Mediterranean Middle East Region. Tectonophysics, 155: 285-306.

Ghabeishavi, A.,Vaziri.Moghaddam, H., Taheri, A., 2009. Facies distribution and sequence stratigraphy of the Coniacian - Santonian succession of the Bangestan Palaeohigh in the Bangestan Anticline.SW Iran. Facies.55: 243-257.

Ghasemi-Nejad, E., Hobbi, M. H., Schioler, P., 2006. Dinoflagellate and foraminiferal biostratigraphy of the Gurpi Formation (upper Santonian–upper Maastrichtian), Zagros Mountains, Iran. Cretaceous Research, 27(6): 828-835.

Haq, B. U., Schutter, S. R., 2008. A chronology of Paleozoic sea-level changes: Science, 322: 64– 68, doi: 10 .1126/science.1161648.

Haq, B. U., 2014. Cretaceous eustasy revisited. National Science Foundation,Washington, DC, USA, and Université Pierreet MarieCurie, Paris, France, journal homepage, 15: 44-58.

Hart, B. M., and Baily, H. W., 1 979. The distribution of planktonic foraminiferidae in the Mid Cretaceous of the new Europe. Aspekt der Kriede. IUGS series A. 6: 527-542.

Hart, B. M., 1980a. The recognition Of Mid Cretaceous sea level changes by means of foraminifera.Cretaceous Research.1: 289-297.

Hart, B. M., 1980 b. A water depth model for the evolution ofthe planktonic foraminifera. Nature, 289: 252-254.

Hemmati-Nasab, M., 2008. Microbiostratigraphy and sequence stratigraphy of the Gurpi Formation in Kaaver section, south of Kabir-kuh, MSc thesis, University of Tehran, 190 P.

Homke, S., Vergés, J., Serra –Kiel, J., Bernaola, G., Sharp, I., Garcés, M., Montero – Ver, d. I., Karpuz, R., Goodarzi, M. H., 2009. Late Cretaceous–Paleocene formation of the proto – Zagros foreland basin, Lurestan Province, SW Iran. Geological Society of America Bulletin, 121 (7, 8): 963- 978.

James, G. A., Wynd, J. G., 1965. Stratigraphic nomenclature of the Iranian oil Consortium Agreement. American Association of Petroleum Geologists, Bulletin, 49 (12): 2182- 2245.

Jassim, S. Z., Buday, T., 2006 .Chapter 11 (Late Tithonian -Early Turonian Megasequence AP 8) in Jassim and Goff (edts.), Geology of Iraq, Dolin, Pregue and Moravian Museum, 341pp.

Kalantari, A., 1976. Microbiostratigraphy of the Sarvestan area, soutwestern Iran.National Iranian Oil Company.Report 5:130.

Kamal, G. M., Anwar, F., Hussain, A. I., Sarri, N., Ashraf, M. Y., 2011. Yield and chemical compositi on of Citrusessential oils as affected by drying pretreatment of peels. International Food Research Journal 18(4): 1275-1282

Kameli Ozan, A., 2004. Biostratigraphy of Gurpi Formation in Lali Area, Kuzestan, MScthesis, University of Isfahan,126 pp.

Karim, K. H., Surdashy, A. M., 2005. Tectonic and depositional history of Upper Cretaceous Tanjero Formation in Sulaimanyia area, NE-Iraq. Journal of Zankoy Sulaimani, 8(1): 47–62.

Karim, K. H., Sharbazery, K., Ameen, B. M., 2006. Stratigraphic study of the contact between Kometan and Shiranish Formation(Upper Cretaceous) from Sulaimanyia Governorate, Kurdistan Region, NE -Iraq. Iraqi Geological Journal, 12: 1 -39.

Keller, G., Li, L., MacLeod, N., 1995. The Cretaceous/Tertiary boundary stratotype section at El Kef, Tunisia: How catastrophic was the mass extinction? Palaeogeography, Palaeoclimatology, Palaeoecology, 119: 221-254.

Leckie, R. M.,1987. Paleoecology of mid-Cretaceous planktonic foraminifera: A comparison of open ocean and epicontinental sea assemblages, Micropaleontology, 33: 164 – 176.

Li, L., Keller, G., 1998a. Maastrichtian climate, productivity and faunal turnovers in planktic foraminifera in South Atlantic DSDP Sites 525 and 21. Marine Micropaleontology, 33:55-86.

Li, L., Keller, G., 1998b. Maastrichtian diversifi cation of planktic foraminifera at El Kef and Elles, Tunisia. Eclogae Geologicae Helvetiae, 91: 75-102.

Li, L.,Keller, G., Stinnesbeck, W., 1999. The Late Campanian and Maastrichtian in northwestern Tunisia: paleoenvironmental inferences from lithology, macrofauna and benthic foraminifera. Cretaceous Research, 20: 231-252.

Moradi, M., 2010. Biostratigraphy and paleoecology of Gurpi Formatio n in Farhadabad, west of Darreh - Shahr, MScthesis, University of Tehran, 187pp.

Motiei, H., 2003. Stratigraphy of Zagros, Treatise on the geology of Iran. Tehran, Iran, Geology Survey Press, 583pp.

Nederbragt, A., 1991. Late Cretaceous biostratigraphy and development of Heterohelicidae (planktic foraminifera). Micropaleontology, 37: 329-372.

Ozer, S., Karimi, K. H., Khazaei, A. R., 2012. The Campanian - Maastrichtian sequence along the Zagros belt (SE Turky- NE Iraq –SW Iran): Stratigraphy, Depositional setting and Paleogeography, 65 the Geological congress of Turkey.2-6.

Premoli Silva, I., Sliter, W. V., 1994. Cretaceous planktic foraminiferal biostratigraphy and evolutionary trends from the Bottacione section, Gubbio, Italy. Palaeontographia Italica, 81: 2-90.

Premoli Silva, I., Verga, D., 2004. Practical Manual of Cretaceous Planktonic Foraminifera, In: Verga, D. and Rettori, R., (Eds): International School on Planktonic Foraminifera, Universities of Perugia and Milano, Tipografia Pontefelcino, 1-Perugia, 283 pp.

Petrizzo, M. R., 2002. Palaeoceanographic and palaeoclimatic inferences from Late Cretaceous planktonic foraminiferal assemblages from the Exmouth Plateau (ODP Sites 762 and 763, eastern Indian Ocean). Marine Micropaleontology, 45: 11 7 -150.

Rahimi, S., Sadeghi, A., Partoazar, M.R., 2015. Biostratigraphy of the Gurpi Formation in Kuh-e-Sefid Section, East of Ramhormoz. Geosciences, 94: 3-10 (in Persian).

Robaszynski, F., Caron, M., Gonzalez Donoso, J. M.,Wonders, A. A. H., 1984. Atlas of late Cretaceous Globotruncanids, Journal of Micropaleontology, 26: 145-305.

Robaszynski, F., Caron, M., 1995. Planktonic foraminifera of the Cretaceous: commentary on the Europe-Mediterranean zonation. Bulletin of the Geological Society of France, 166: 681-692.

Robaszynski, F., Gonzales Donoso, J. M., Linares, D., Amédro, F., Caron, M., Dupuis, C.V., Dhondt, A., Gartner, S., 2000. The Upper Cretaceous of the Kalaat Senan region, Central Tunesia. Integrated Lithobiostratigraphy: zones of ammonites, planktonic foraminifers and nannofossils of the Upper Turonian at Maastrichtian. Bulletin of the Research Center Elf Exploration-Production,
22: 359-490.

Sampo, M., 1969. Microfacies and microfossils of the Zagros Area, southwestern Iran (from pre-Permian to Miocene), International Sedimentary Petrographical Series 12(74): 105pp.

Snedden, J. W. and C. Liu 2011. Recommendations for a uniform chronostratigraphic designation system for Phanerozoic depositional sequences. American Asssociation of Petroleum Geologists Bulletin, 95(7): 1095-1122.

Setudehnia, A., 1972. Stratigraphic Lexicon of Iran. Union International des Sciences Geologiques, vol. 3., ASIE, southwest Iran.

Setudehnia, A. 1978. The Mesozoic sequence in southwest Iran and adjacent areas. Journal of Petroleum Geology, 1(1): 3-42.

Sherkati, S., Letouzey, J., 2004. Variation of structural style and basin evolution in the central Zagros (Izeh zone and Dezful Embayment), Iran. Marine and Petroleum Geology, 21(5): 535-554.

Sliter, W.V., 1989. Biostratigraphic zonation for cretaceous planktonic foraminifers examined in thin section. Journal of foraminiferal research, 19(1): 1-19.

Smit, J., 1982. Extinction and evolution of planktic foraminifera after a major impact at the Cretaceous/Tertiary boundary. Earth and Planetary Science Letters, 74: 155-170.

Smit, J., 1999. The global stratigraphy of the Cretaceous-Tertiary boundary impact ejecta. Annual Reviews of Earth and Planetary Science, 27: 75-113.

Smit, J., 2004. The section of the Barranco del Gredero (Caravaca, SE Spain): a crucial section for the Cretaceous/Tertiary boundary impact extinction hypothesis. Journal of Iberian Geology, 31:181-193.

Solgi, Z., Magfori Moghadam, I., Darabi, G. H., 2015. Biostratigraphy of Gurpi Formation in southwest Koramabad, intrnational Applied Geological Congress. 209pp.

Tantawy, A. A., Keller, G., Adatte, T., Stinnesbeck, W., Kassab, A., Schulte, P., 2001. Maastrichtian to Paleocene (Dakhla Formation) depositional environment of the Western Desert in Egypt: sedimentology, mineralogy and integrated micro and macrofossil biostratigraphies. Cretaceous Research, 22: 795-827.

Vaziri-Moghaddam, H., 2002. Biostratigraphic study the Ilam and the Gurpi Formations based on planktonic foraminifera in SE of Shiraz, Iran. Journal of Sciences, Islamic Republic of Iran, 13(4): 339-356.

Wonders, A. A., 1980. Middle and Late Cretaceous planktonic foraminifera of the westem Mediterranean area.Utrecht Micropaleontology Bulletin, 24:1-158.

Wynd, J.G. 1965. Biofacies of the Iranian Oil Consortium Agreement area. Iranian Oil Operating Companies, Geological and Exploration Division, Report 1082, 89 pp.

Zarei, E., Ghasemi-Nejad, E., 2014. Sequence stratigraphy of the Gurpi Formatio (Campanian–Paleocene) in southwest of Zagros, Iran, based on palynomorphs and foraminifera. Arabian Journal of Geosciences, 8: 4011-4023.

Ziegler, M. A., 2001. Late Permian to Holocene Paleofacies Evolution of the Arabian Plate and its Hydrocarbon Occurrences. GeoArabia, 6(3): 445-504.