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CALCAREOUS NANNOFOSSILS EVENTS OF NEPHROLITHUS FREQUENS ZONE TO MARKALIUS INVERSUS ZONE IN SECTION OF KAZERUN, ZAGROS (IRAN)

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ABSTRACT

One of the most complete Late Maastrichtian to Early Danian sequences contains the Kazerun section of West Fars Province, Zagros basin of Southwestern Iran. The present investigation identifies index species, 15 Genera and 22 Species of nannofossils in this boundary. Calcareous nannofossils, which observe in Cretaceous-Paleogene boundary strata, are believed to be appropriate means for biostratigraphical study. The majority of Cretaceous-Tertiary boundary (K/Pg) strata are made up of grey shale and then purple shale, respectively. The acquired nannofossils show continuity in K/Pg boundary in Western part of Fars Province. This agrees with the existence of Nephrolithus frequens zone, which predicts the age of late Late Maastrichtian and Markalius inversus zone which describes the age of Early Paleocene (Early Danian). Also, the examination of calcareous nannofossils of the Kazerun section at Zagros basin enabled us to recognize standard biozones defined in Mediterranean regions, especially Tethysian domain.

Keywords: Nannofossil, Cretaceous, Kazerun, Paleogene, Zonation, Biostratigraphy.

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Contribution/ Originality

This study is one of very few studies which have investigated based on calcareous nannofossils in Zagros. Stratification Cretaceous-Paleogene series indicate the samples in relation to Neotethys basin. Also, the environmental conditions of succession that are a part of Neotethys indicate marine and tropical environment in intervals of K/Pg at low latitudes.

1. INTRODUCTION

In order to investigate the Cretaceous-Paleogene boundary (K/Pg) by the calcareous nannofossils, the upper part of Cretaceous succession is selected in Northeast of Kazerun. This reaserch is due to the response of the calcareous nannofossils to global change across the K/Pg that is poorly known in this area.This succession has been investigated from different aspects of paleontology in the Zagros basin (Ghasemi-Nejad *et al*., 2006; Khosrowtehrani, 2008). Since the few studies on K/Pg boundary of calcareous nannofossils have been carried out in Southwest of Iran (Hadavi and Ezadi, 2007; Hadavi *et al*., 2007; Senemari and Sohrabi Molla, 2012) therefore in this study we investigated the Cretaceous to Paleogene transition (K/Pg) based on calcareous nannofossils. The aim of this research is to determine the calcareous nannofossil assemblages and the possibility of using the biostratigraphic standard zonation in K/Pg, Northeast of Kazerun city.

2. GEOLOGICAL SETTING

The Zagros basin is composed of a folded rocks succession. The sediments were deposited in a gradually subsiding trough formed in the Late Triassic. It comprises of more than 10,000m of Mesozoic to Cenozoic strata (Setudehnia, 1978). The Zagros Folded belt is divided into three stratigraphic provinces that one of them is the Fars province (Motiei, 1995). The Cretaceous-Paleogene succession is exposed along the Northeast of the Kazerun of the Dashtak anticline in Fars Province (Fig. 1). The study section is located in the about 8km Northeast of Kazerun city. This section consists of 385 m thick succession of Santonian (Upper Cretaceous) together with the lower part of Paleogene strata and covers the area between longitudes 51°40′ -51°43′ E and latitudes 29°39′-29°41′ N. In fact, the majority of the section consisted of Upper Cretaceous grey shale and is itself overlain by the purple shale of Pabdeh Formation. The samples were collected from the top of Upper Cretaceous and base of Pabdeh Formation.

3. MATERIAL AND METHODS

A total of 66 samples representing of the 22 m thick at interval K/Pg were obtained. The most detailed sampling was performed in the intervals at 18 m below and 4m above K/Pg boundary of the section. Samples were prepared using the smear slide technique (Young and Bown, 1998). All slides were studied under crossed-polarized and phase-contrast light microscope at ×1000 magnification. The Late Cretaceous (late Late Masstrichtian) /Early Paleocene (Early Danian) boundary nannofossil species considered in this paper are referenced in Perch – Nielsen (1985a ;1985b). Abbreviations used in this study are the FO (first occurrence) and the LO (last occurrences). The NP (Nannoplankton Paleogene) zonation of Martini (1971) the CP (Coccolith Paleogene) zonation of Okada and Bukry (1980) and the CC (Coccolith Cretaceous) nannofossil zonation of Sissingh (1977) are used in the present research. The number of calcareous nannofossil species was calculated through semi quantitative analysis, with abundance code defined as follows; R = rare (1 specimen per field of view [FOV] 11-100), F = few (1 specimen per 2-10 FOV), C = common (1-10 specimens per FOV), A = abundant (>10 specimens per FOV).

4. RESULTS

In this study, stratification series of Cretaceous-Paleogene show the samples in relation to K/Pg. As a result of this study, for the first time, 15 genera and 22 species of nannofossils have been identified. From set of slides and assemblage species, the late Late Maastrichtian (CC26 zone) to Early Danian (NP1 zone) was identified and the species ranges were determined. Marker species and the most common species are illustrated in Plate (Fig. 2). These zonal schemes are shown in Table 1. In addition, we can also learn about the environmental conditions of the succession that are in fact a part of Neotethys basin with the existence of indexed species calcareous nannofossils that indicate deep marine and tropical environment in intervals of K/Pg at low latitudes, such as the Zagros .

5. DISCUSSION

A) Nannostratigraphy and Bioevent

The calcareous nannofossils due to their wide geographic spread and fast evolutionary rate provide one of the most complete biostratigraphic zonation for Mesozoic and Cenozoic times (Bown, 1991; Burnett, 1998). The importance of these calcareous nannofossils for zonation has been discussed at length by Martini (1971);Sissingh (1977) and Perch – Nielsen (1985a ;1985b). Also these group an excellent proxy to past environmental changes from Late Cretaceous to Early Paleocene Epoch strata (Sissingh, 1977; Perch – Nielsen, 1985a; Dunkley and Bown, 2007). The most Cretaceous nannofossil taxa became extinct below the first purple shale strata, a bio event that is synchronous with the Cretaceous/Paleocene boundary (K/Pg) event in low–mid-latitude areas (Perch –Nielsen, 1985b; Lees, 2002). The evolution of various forms of calcareous nannofossil assemblages during the 1.4 million years of the late Late Maastrichtian/ equivalent with beginning of CC26 zone to Early Danian/ equivalent with beginning of NP1 zone, has enabled the recognition of two biostratigraphic zonal units on the basis of the relative ranges of index species (Perch – Nielsen, 1985a; Gradstein *et al*., 2004). As previously mentioned, the calcareous nannofossils discussed in this research are obtained from the succession K/Pg boundary of Northeast of Kazerun. The absence of a good fundamental paleontological study based on calcareous nannofossil is the best motivation for investigating in the Kazerun section. Twenty two calcareous nannofossil species from fifteen genera were found in the course of this study. Moderatly diversity and low abundance of calcareous nannofossil were found in the section and allowed recognition of the CC26 of zonation of Sissingh (1977) and NP1 of zonation of Martini (1971) or subzone CP1a of zonation of Okada and Bukry (1980). In addition, the reliability of any age determine by means of calcareous nannofossils depends on the preservation of the coccoliths (Perch –Nielsen, 1985b). In this section, the preservation of calcareous nannofossil assemblages was good. Also, the examination of calcareous nannofossils of the Northeast Kazerun section at Zagros basin enabled us to recognize standard bio zones defined in Mediterranean regions, especially Tethysian domain (Watkins, 1996). Therefore according to our biostratigraphic data, the K/Pg boundary bio zones are introduced as follows:

B) Nephrolithus Frequens Zone (CC26)

The first bio events recorded from grey shale of the top of Cretaceous/ late Late Maastrichtian (K/Pg) is the zone CC26 defined as the interval from the first occurrence (FO) to last occurrences (LO) of *Nephrolithus frequens* (Perch –Nielsen, 1985b). However, in low latitudes, *Nephrolithus frequens* is not recognizable or absent but here the FO of *Micula murus* and *Micula prinsii* can be used to determine the interval between CC25 and CC26 bio zones boundary of the Upper Cretaceous (Late Maastrichtian), respectively. In other words, both species are very rare or absent in high latitudes, but are useful markers for the Late Maastrichtian in low latitudes. The assemblage in this zone is characterized by *Chiastozygus platyrhethus*, *Rhagodiscus angustus*, *Micula concava*, *Micula decussata*, *Lucianorhabdus cayeuxii*, *Lithraphidites carniolensis*, *Eiffellithus turriseiffelii*, *Eiffellithus gorkae*, *Lithraphidites quadratus*, *Micula murus*, *Micula prinsii*, *Ceratolithoides aculeus*, *Arkhangelskiella cymbiformis*, *Thoracosphaera operculata*, *Microrhabdulus decoratus*,*Braarudosphaera bigelowii*, *Arkhangelskiella maastrichtiana*, *Watznaueria biporta*, *Watznaueria barnesae*.

C) Markalius Inversus Zone (NP1)

The other unit recorded in the formation is the *Markalius inversus* zone that is synchronous with K/Pg boundary in low latitude areas. This zone is defined as the interval from the last occurrences (LO) of Cretaceous coccoliths or FO of acme of *Thoracosphaera* (*T. operculata*) bloom to FO of *Cruciplacolithus primus*. These species have been recorded slightly above the K/Pg boundary in the Early Paleocene (Early Danian). The NP1 assemblage is characterized by *Biantholithus sparsus*, *Markalius inversus*, *Cruciplacolithus primus*, *Arkhangelskiella cymbiformis*, *Micula decussata*, *Thoracosphaera operculata*, *Micula prinsii*, *Braarudosphaera bigelowii*.

6. CONCLUSION

The Plate illustrates the calcareous nannofossils diversity data for the K/Pg boundary in the Northeast of Kazerun city. The species include: *Eiffellithus turriseiffelii*, *Micula decussata*, *Cruciplacolithus primus*, *Biantholithus sparsus*, *Watznaueria barnesae*, *Watznaueria biporta* are the major components and abundance.*Ceratolithoides aculeus*, *Micula murus*, *Arkhangelskiella cymbiformis*, *Arkhangelskiella maastrichtiana*, *Thoracosphaera operculata*, *Micula prinsii* and *Braarudosphaera bigelowii* are relativelyabundant. *Lucianorhabdus cayeuxii*, *Chiastozygus platyrhethus*, *Rhagodiscus angustus*, *Micula concava*, *Microrhabdulus decorates*, *Markalius inversus*, *Lithraphidites carniolensis*, *Lithraphidites quadratus* are rare. Based on the nannofossils are listed, age the studied upper section is late Late Maastrichtian that corresponding to CC26 Zones (Sissingh, 1977) to zone NP1 of zonation of Martini (1971). Species *Biantholithus sparsus*, *Markalius inversus*, *Cruciplacolithus primus*, *Micula prinsii*, *Braarudosphaera bigelowii* obtained in the upper cretaceous layers, in across the Cretaceous-Tertiary boundary, which to explain beginning of Paleocene.

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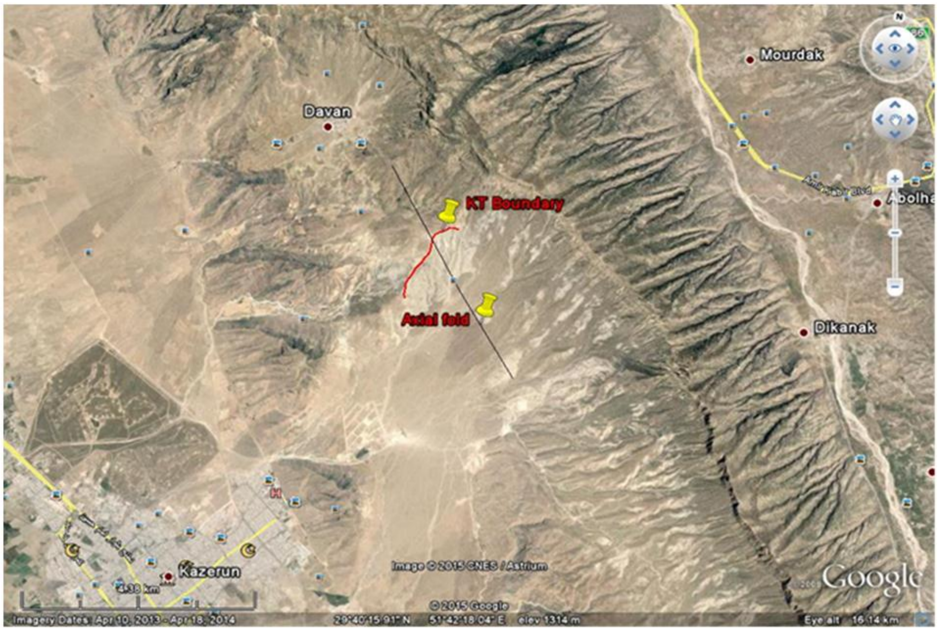

Figure-1. Geographical location of anticlinal, after Google (2014)

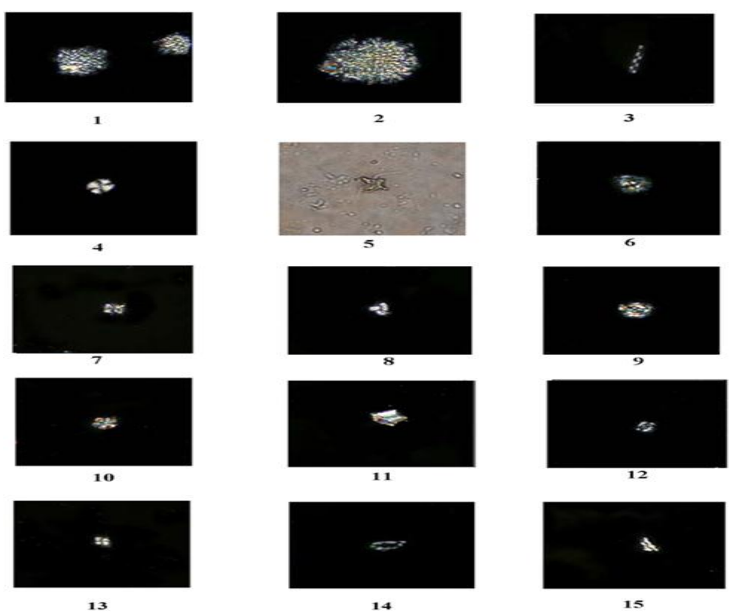

Figure-2. Plate: All figures in XPL except fig.5 in PPL, light microghraphs×1000; the taxa considered in the present Figure is referenced in (Perch – Nielsen, 1985a ;1985b). 1, 2: *Thoracosphaera operculata*; 3: *Microrhabdulus decoratus*; 4: *Watznaueria biporta*; 5: *Micula concava* (Stradner in; 6: *Markalius inversus*; 7: *Micula decussata*; 8: *Miculaprinsii*; 9: *Cruciplacolithus primus*; 10: *Biantholithus sparsus*; 11: *Braarudosphaera bigelowii*; 12: *Cruciplacolithus primus*; 13: *Micula murus*; 14:*Rhagodiscus angustus*; 15: *Lucianorhabdus cayeuxii*.

Table-1. The chart of Nanno stratigraphic K/Pg boundary (Northeast of Kazerun)