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## Palynostratigraphy and palaeoecology of the Niur Formation, Tikdar section, northwest of Kerman, Central Iran

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### Abstract

Diverse, moderately to well-preserved palynomorphs including acritarchs (*sensu stricto*), prasinophytes cyst, chitinozoans, scolecodonts, and spores occur in some surface samples (90 meters thereof) of the Niur Formation (200 m thick) at the Tikdar stratigraphic section, northern Kerman, Central Iran. The palynofloras embrace one species of prasinophyte cyst, 25 species (assigned to 14 genera) of acritarchs, 8 species (attributed to 6 genera) of chitinozoans, and 2 species (assigned to 2 genera) of spores. Based on the stratigraphic distribution pattern of acritarchs (*sensu lato*) one local assemblage zone (*Evittia denticulata denticulata* - *Lophosphaeridium papillatum*-*Eupoikilofusa striatifera* assemblage zone) is introduced in the strata investigated herein. The known stratigraphic importance of such acritarchs and chitinozoans as *Eupoikilofusa striatifera*, *Geron amabilis*, *Spinachitina fragilis* and *Ancyrochitina convexa* as well as the lack of Middle and Late Silurian index taxa allow for the host strata to be attributed to the Early Silurian (Llandovery). Notable abundance of transparent AOM in majority of the samples (except those labeled as 318–326 and collected 38–88 above the base) examined indicates sedimentation in a marginal marine setting with relatively low oxygen level. Such palynofacies data as proportion of blade-shaped to equidimensional opaque palynomacerals and AOM/marine palynomorphs ratio in the material studied tend to support such generalizations on the depositional environment.

**Keywords:** Palynostratigraphy, Marine Palynomorphs, Palaeoecology, Niur Formation, Central Iran.

### Introduction

The geographic distribution outline of sediment and extensive emergence in Iran during Silurian tend to support the hypothesis relating such events to the Caledonian orogeny. The Silurian deposits are so far reported from eastern Alborz Ranges, Central Iran, and southeastern Zagros. Nabavi (1976) believed that because of the Caledonian movements, vast areas in north and northwest of Iran emerged while in east and northeast of the country marginal marine deposition continued; boundary between the two is speculated to be along a line extending from Aliabad (east of Gorgan) in the north through Semnan to Zardkuh (Zagros Mountains) in the south.

Another significant characteristic of the Silurian in Iran is the presence of basic submarine volcanic rocks (basalts) reported from many areas indicating a rift in the otherwise coherent Paleozoic cratonic crust, for example, in northeastern Iran (Aghanabati 2008).

The Silurian strata in central Iran, known as the Niur Formation, consist of dark brown coral-bearing limestones with thin shale intercalation and basal dolostones. Occurrence

of abundant diverse fossil content including corals, brachiopods, and conodonts as well as such marine palynomorphs as acritarchs and chitinozoans in sediments of both the type and reference sections allows for recognition of several microfacies types, confirmation of deposition in a marginal marine setting, and attribution of the host strata to the Middle–Late Silurian (Aghanabati 2004; Lotfollahi et al. 2012).

The Niur palynofloras are examined herein in order to determine relative age, stratigraphic distribution pattern of palynomorphs, and depositional setting of the host strata at the Tikdar stratigraphic section, northwest of Kerman. There, the Niur Formation comprises 200m of carbonates, shales, siltstones, and sandstones disconformably positioned between the Padeha and Shirgesht formations.

### Material and Methods

This study is based on palynologically productive surface samples collected from the Niur Formation, at the Tikdar stratigraphic section, northwest of Kerman. All samples prepared using standard palynological processing procedures

(e.g. Phipps and Playford 1984); encompassing initial treatment with HCl (10-50%) and HF (40%) for dissolution of carbonates and silicates, respectively. Then the residue saturated with ZnCl<sub>2</sub> solution (2.0 gr/cm<sup>3</sup>) for mineral separation. All residues are sieved with a 20µm mesh prior to make of strew slides. Three slides for each preparation are made and examined by transmitted light microscope. It should be noted that maceration of the Niur Formation samples executed at palynology laboratory of the Exploration Directorate of the National Iranian Oil Company.

For quantitative studies, 15 field views of each strew slide are randomly examined using x16 objective. Palynological elements counted include marine and terrestrial palynomorphs, dark and bright amorphous organic matter (AOM), and phytoclasts. For determination of the depositional setting, sedimentation rate, and oxygen level fluctuations during deposition of the pertinent material such factors as dark/bright AOM, marine palynomorphs/AOM, spores/marine palynomorphs, dark equidimensional/blade-shaped palynomacerals, and short-/long-processed acritarchs ratios are investigated.

#### **Discussion of Results and Conclusions**

Diverse, moderately to well-preserved palynomorphs including acritarchs (*sensu lato*), scolecodonts, and spores

occur in the Niur Formation's palynofloras at the Tikdar stratigraphic section, northwest of Kerman. The palynofloras embrace one species of prasinophyte cyst, 25 species (assigned to 14 genera) of acritarchs, 8 species (attributed to 6 genera) of chitinozoans, and 2 species (assigned to 2 genera) of spores. Based on the stratigraphic distribution pattern of acritarchs (*sensu lato*) one local assemblage zone (*Evittia denticulata denticulata-Lophosphaeridium papillatum-Eupoikilofusa striatifera* assemblage zone) is introduced in 90 m of the Niur Formation investigated herein. Additionally two barren interval zones, one at the base (65 m) and the second (45 m) at the top of the rock unit are also identifiable. The known stratigraphic importance of such acritarchs and chitinozoans as *Eupoikilofusa striatifera*, *Geron amabilis*, *Spinachitina fragilis*, and *Ancyrochitina convexa* allows for the host strata to be dated as the Early Silurian (Llandovery).

Using a variety of palynological elements such as marine and terrestrial palynomorphs, phytoclasts, and dark/bright AOMs indicates deposition of the Niur sediments at the section examined in a marginal marine setting with mainly low sedimentation rate and relatively low oxygen level.