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Palynostratigraphy of the Dalichai Formation in Darjazin section, North of Semnan

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Abstract

The Dalichai Formation in Darjazin section in NE Semnan with a thickness of 631 meters consisting of an alternation of bulish-gray was studied. This formation overlies the Shemshak formation disconformity with conglomerate bed and it has gradually been covered by the thick-bedded limestones of the Lar formation. Based on the presence and stratigraphic distribution of the most dominant miospore, *Klukisporites variegatus* and *Callialasporites dampieri* of pollen are identified in the Dalichai (late Bajocian - Callovian) and Presence of some index dinoflagellate species led to identification of three biozones in the Dalichai Formation. These include in ascending order, *Cribroperidinium crispum* Total Range Biozone (late Bajocian), *Dichadogonyaulax sellwoodii* Interval Biozone (Bathonian - early Callovian), *Ctenididinium continuum* Interval Biozone (early to middle Callovian). This biozonation corresponds largely to those established in Northwest Europe and Northwestern Tethys and reveals the marine connection between North of Iran with Northwest Europe and the Northwestern Tethys during the Middle Jurassic.

Keywords: Palynostratigraphy, Dalichai Formation, Dinocyst, Spore and Pollen

Introduction

The Dalichai Formation in Darjazin section in northeast Semnan with a thickness of 631 meters consisting of an alternation of bulish-gray shale was studied. This formation overlies the Shemshak Group disconformity with conglomerate bed and it has gradually been covered by the thick-bedded limestones of the Lar Formation. Darjazin section is located in the central part of Alborz Mountains (northeast of Semnan). The grid coordinates for the base of the section is 53° 35' 14" eastern longitude and 35° 46' 10" northern latitude. The formation contains a very rich ammonite fauna, sponge spicules, belemnites, bryozoans, bivalves, echinoderm debris, ostracods, benthic foraminifers, and the trace fossil *Zoophycos*.

Material & Methods

Sixty one rock samples were collected systematically from the formation under study and prepared in the palynology laboratory. The preparation method of Traverse (2007) was used. Cold hydrochloric (20 %) and hydrofluoric acids were used to dissolve carbonate sand silicates, respectively. The residue was neutralized and centrifuged in ZnCl₂ with specific gravity (1.9 g/cm³). The materials were then sieved using a 15-µm nylon mesh and mounted on microscope slides using liquid Canada balsam.

Discussion of Results & Conclusions

The present study shows that the Dalichai Formation is rich

in terrestrial (spores and pollen grains) and marine palynomorphs (dinoflagellate cysts, acritarchs, and scolecodonts). Based on the presence and stratigraphic distribution of the most dominant miospore, *Klukisporites variegatus* and *Callialasporites dampieri* of pollen are identified in the Dalichai Formation (Late Bajocian–Callovian). In addition to spores and pollens, dinoflagellate and fungus bodies form the palynomorphs assemblages in these strata. Presence of some index dinoflagellate species led to identification of three biozones in the Dalichai Formation. These include in ascending order, *Cribroperidinium crispum* Total Range Biozone, *Dichadogonyaulax sellwoodii* Interval Biozone, *Ctenididinium continuum* Interval Biozone. *Cribroperidinium crispum* total range biozone

The interval between the FAD and LAD of *Cribroperidinium crispum*. This biozone encompasses 115 m of the base of the Dalichai Formation from samples 1 to 17. The zone differentiated here is equivalent to the *Cribroperidinium crispum* zone of Poulsen and Riding (2003) for sub-boreal northwest Europe. There are a few proximate dinoflagellate cysts in this zone. *Carpathodinium predae*, *Chytroeisphaeridia chytrooides*, *Cleistosphaeridium* sp., *Ctenidodinium cornigera*, *Endoscrinium luridum*, *Nannoceratopsis pellucida*, *Valensiella ovulum*, *Gonyaulacysta pectinigera*, *Nannoceratopsis tricerat*, *Perisseiasphaeridium* sp., *Sentusidinium* sp., *Downiesphaeridium* sp., *Cribroperidinium* sp., *Meiourgonyaulax valensii*, *Lisabeldinium* sp.,

Carpathodinium sp., *Meiourogonyaux* *caytonensis*, *Pareodinia* *ceratophora*, *Rhynchodiniopsis* *cladophora*, *Dictyotidium* sp., *Chytroeisphaeridia* *pocockii*, *Gonyaulacysta* sp., *Meiourogonyaux* sp. *Meiourogonyaux* *valensii* is also relatively common in the Late Bajocian and many important FADs occur within this substage. These are considered to indicate an age of Late Bajocian for the zone.

Dichadogonyaulax sellwoodii interval biozone

The interval between the LAD *Cribroperidinium crispum* and the LAD of *Ctenidodinium combazii*. This biozone encompasses 315m of the Dalichai Formation above the *Cribroperidinium crispum* zone (from samples 17 to 35). The *Dichadogonyaulax sellwoodii* zone (Riding and Thomas 1992) is equivalent to the *Ctenidodinium sellwoodii* zone of Poulsen and Riding (2003). The dinoflagellate cyst assemblages tend to be relatively diverse, with forms having epicystal archaeopyles, especially *Ctenidodinium* spp. dominant. Riding et al. (1985) recorded levels of *Ctenidodinium* spp. in excess of 90% of the dinoflagellate cyst assemblages in the Bathonian strata of southwest England. *Ctenidodinium* sp., *Kalpteia stegasta*, *Tubotuberella* sp. cf. *T. dangeardii*, *Endoscrinium* sp., *Preodinia* sp., *Korystocysta gochtii*, *Pareodinia prolongata*, *Pareodinia antennata*, *Gonyaulacysta jurassica*, *Rhynchodiniopsis* sp.,

Tubotuberella sp., *Tubotuberella dangeardi*. These are considered to indicate an age of Bathonian to Early Callovian for this zone.

Ctenidodinium continuum interval biozone

The interval between the LAD of *Ctenidodinium combazii*, and the FAD of *Scriniodinium crystallinum*. This zone encompasses 166 m of the Dalichai Formation above the *Dichadogonyaulax sellwoodii* zone (from samples 35 to 49) and is marked by the LAD of *Ctenidodinium combazii*. There are many proximate and proximochorate dinoflagellate cysts recorded in this zone. Common taxa include *Gonyaulacysta jurassica*, *Rhynchodiniopsis* sp., *Tubotuberella* sp., *Tubotuberella dangeardii*, *Chytroeisphaeridia* sp., *Gonyaulacysta centriconnata*, *Valensiella* sp., *Ctenidodinium ornatum*, *Leptodinium* sp., *Scriniodinium crystallinum*, *Atopodinium* sp., *Cometodinium jurassicum*, *Pareodinia halsa*, *Tubotuberella apatela*, *Voodooia tabulate*, *Walldinium laganum* are seen. These are considered to indicate an age of Middle to Late Callovian for this zone.

This biozonation corresponds largely to those established in northwest Europe and northwestern Tethys and reveals the marine connection between north of Iran with northwest Europe and the northwestern Tethys during the Middle Jurassic.