



Review papers

Middle Jurassic organic-walled dinoflagellate cysts and palynofacies from Telma-Dareh, south of Sari, northern Iran



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ABSTRACT

Analyses of organic-walled dinoflagellates and palynofacies from the marly Unit 3 of the Dalichai Formation in the Telma-Dareh section of the Central Alborz Mountains, northern Iran, have been carried out. Our palynological study has revealed diverse and well-preserved dinoflagellate cyst assemblages, comprising 49 taxa. Based on the first and last appearance datums of dinoflagellate index species, this marly part can be correlated with the north-west European *Nannoceratopsis gracilis* Biozone of Aalenian to early Bajocian age. Dinoflagellate cyst assemblage data allow the placement of the Aalenian/Bajocian boundary and correlation with the range of the belemnite *Brevibelus breviformis*. The Aalenian age of the Dalichai Formation at Telma-Dareh contrasts to the Bajocian age attribution by previous authors. Similarities of dinoflagellate cyst assemblages to those from northwest Europe and the northwest Tethys indicate marine connections between the two areas. The palynofacies predominance of land-derived phytoclasts reflects deposition on a proximal oxic shelf with high terrestrial and freshwater influx. Dinoflagellate cyst assemblages that are dominated by representatives of *Nannoceratopsis* presumably reflect brackish conditions.

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1. Introduction

Dinoflagellate cyst stratigraphy and palynofacies analysis can be used as tools for dating marine formations and for reconstructing sedimentary palaeoenvironments. Dinoflagellate cysts are often the only microfossils applicable to stratigraphy, especially in sedimentary

sequences in which macrofauna is lacking. The dinoflagellate cyst distribution in the Middle Jurassic of Iran is poorly known.

Ghasemi-Nejad et al. (2012) described late Bajocian–late Callovian dinoflagellate cyst associations from the Dalichai Formation in the Central Alborz Mountains at Kuh-e-Rahband, south of Mahdishahr, northern Iran. The Dalichai Formation is a very characteristic lithostratigraphic unit in the Alborz Basin, having been considered to have been laid down in a shelf to slope environment (Seyed-Emami et al., 2001). The Dalichai Formation yields ammonites and belemnites

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of Aalenian age in the Telma–Dareh section (Parent et al., 2013). The Aalenian age of the lower part of the Dalichai Formation at Telma–Dareh contrasts with the Bajocian date attributed to it by previous authors (Fürsich et al., 2009a,b; Wilmsen et al., 2009 and references therein; Ghasemi-Nejad et al., 2012).

The aim of the present study is to date the marly part of the Telma–Dareh section on the basis of analyses of organic-walled dinoflagellates and to test the Aalenian age inferred from macrofauna. Simultaneously, the present work is supplemented by palaeoenvironmental interpretation of dinoflagellate cyst assemblages and palynofacies analysis.

2. Geological setting

In the Alborz Zone of northern Iran, Jurassic rocks were deposited in two major sedimentary–tectonic cycles (Aghanabati, 2004; Fürsich et al., 2009a,b), separated by the mid-Cimmerian unconformity (Davies et al., 1999). The rocks of the first (lower) cycle are included in the Shemshak Group, while those of the second cycle are assigned to the Dalichai and Lar formations (Seyed-Emami et al., 2005). A different lithostratigraphical classification and detailed studies of regional geodynamics have been presented by Wilmsen et al. (2009), Fürsich et al. (2009a,b; and references therein). In the first cycle siliciclastic sediments predominate; these were laid down in lagoonal and shore to river environments. The second cycle consists of marine sediments. At its type locality, the Dalichai Formation consists of about 107 m of light-grey to bluish-grey limestones with thin marl intercalations. According to Steiger (1966), the thickness of the Dalichai Formation is about 50 to 120 m, averaging 100 m, but reaching more than 300 m in the Eastern Alborz. The Dalichai Formation is thicker in the Eastern Alborz than in Central and Western Alborz (Shafeizad and Seyed-Emami, 2005). The lower part of the unit is of late Bajocian age in most outcrops of the Alborz Mountains and dominant lithofacies comprise marls, marly limestones and green to grey marly shales (Aghanabati, 2004).

The Dalichai Formation at Telma–Dareh (co-ordinates 36°12'34" N and 53°45'33" E; see Fig. 1) consists of five successions (Table 1; Figs. 2, 3).

The Dalichai Formation overlies about 60 m of fine- to coarse-grained brownish-grey sandstones of the Shemshak Formation; no discontinuity has been observed between the Shemshak and Dalichai formations in this area. The Dalichai Formation is conformably overlain by thick-bedded limestones of the Lar Formation.

Fürsich et al. (2009a, b) indicated that the Dalichai Formation was of late Bajocian age; Wilmsen et al. (2009) referred it to the Bathonian to Callovian. The former authors also stated that Dalichai Formation was detached by the mid-Cimmerian event from the underlying Shemshak or Dansirit formations which contain Aalenian ammonites. No evidence for a mid-Cimmerian unconformity is present. Moreover, both Assereto

Table 1
The lithological succession of the Dalichai Formation in the Telma–Dareh section.

Succession	Thickness	Characteristic
Unit 5	31,5 m	Pale to cream coloured limestone with calcareous concretions abundant throughout the unit. Fossils were not observed.
Unit 4	16 m	Grey to greenish brown marly limestone. Trace fossils of <i>Zoophycos</i> at its top layers.
Unit 3	29 m	Grey to greenish marls. Belemnites <i>Brevibelus breviformis</i> .
Unit 2	30 m	Marly limestone with gypsum and calcareous sideritic concretions with limonitic weathering surface.
Unit 1	7.5 m	Light to pale coloured sandy limestone. Fossils scarce, only a single specimen of ammonite <i>Ludwigia</i> cf. <i>murchisonae</i> .

(1966) and Allenbach (1966) believed that the contact between the Shemshak and Dalichai formations was conformable. The Dalichai Formation yields ammonites and belemnites of Aalenian age in the Telma–Dareh section (Parent et al., 2013).

3. Palaeogeography

After the closure of Palaeotethys during the Late Triassic, the Iranian Plate (central and northern Iran) occupied a position along the southern margin of Eurasia (see Seyed-Emami et al., 2008, and references therein). According to palaeogeographic maps for the Early Jurassic (Dercourt et al., 2000; Golonka, 2002), the Alborz Mountains occupied a latitudinal position of approximately 44°N at the northeastern margin of the Western Tethys (Fig. 4). During the Middle Jurassic (middle Callovian) they shifted to lower latitudes of about 30°N. The close palaeobiogeographic links of ammonite faunas with those from northwest Europe and northwestern Tethys during the Jurassic indicate the existence of direct, albeit episodic, marine connections and faunal exchange between these two areas (Seyed-Emami, 1988). The belemnite fauna, studied by Parent et al. (2013), indicates similar affinities. The faunal migration routes during the Early Jurassic and earliest Middle Jurassic most probably followed epicontinental platforms along the southern margin of the Eurasian landmass. The transgressive phases were controlled mainly by local and regional synsedimentary tectonic activities (Fürsich et al., 2005, 2009a,b) and probably by local effects of eustatic changes.

4. Material and methods

The section studied is located in the Telma–Dareh area, south of Sari, east of the central Alborz Mountains, northern Iran (Fig. 1). The main road between the cities of Sari and Damghan is the best way to access the section.

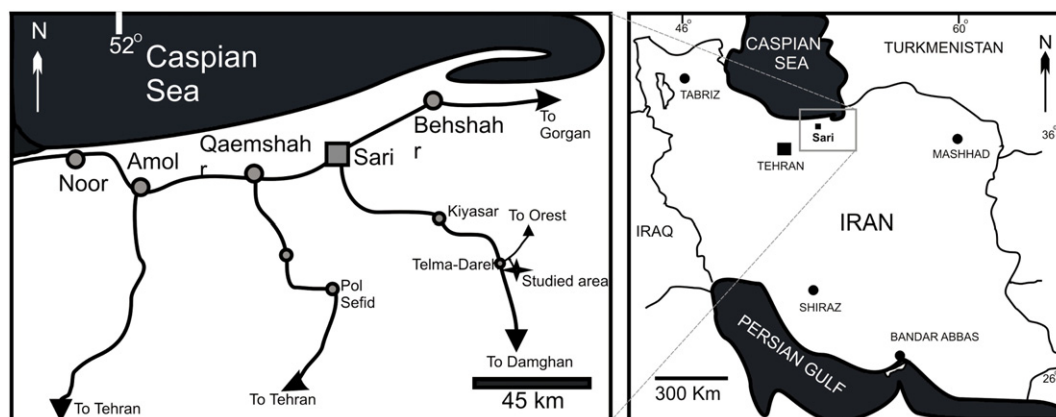


Fig. 1. Location of the Telma–Dareh section (co-ordinates 36°12'34" N and 53°45'33" E).

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