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## Palynofacies and Sporomorph EcoGroups-based paleoecology implications for the Dalichai Formation, Andariyeh, central Alborz

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### Abstract

The Dalichai Formation at the Andariyeh stratigraphic section in the northeast of Andariyeh village, central Alborz Mountains, was studied by using analyses of the Sporomorph EcoGroups (SEGs) data and associated plant communities and palynofacies in order to determine its paleoecology conditions. The Sporomorph EcoGroups data from the Dalichai Formation's palynological assemblages, declination of miospores representing Upland/Lowland plant communities and proliferation of those characterizing Lowland/Coastal-Tidal plant associations interpreted to signify relatively low sea level and deposition in a marginal marine setting. Furthermore, the ratios of wetter/drier and warmer/cooler elements suggest deposition of the host strata under a moist, ±warm climate prevailing during the Middle Jurassic in central Alborz Mountains. The results of drawing diagrams of the palynofacies in the Andariyeh stratigraphic section, indicates that the Dalichai sediments accumulated in a dysoxic shallow marine environment with low sedimentation rate that corresponds well with its SEGs graphs.

**Keywords:** Palaeoecology, Dalichai Formation, Sporomorph EcoGroups (SEGs), palynofacies, Andariyeh village, central Alborz Mountains.

### Introduction

The Dalichai Formation is represented by greenish-grey color shales, calcareous shales, marls, and richly ammonitiferous limestones (Steiger 1966), being widely distributed in the Alborz Mountain, northern Iran. It disconformably overlies the dark, siliciclastic coal bearing Shemshak Formation and underlies gradually by the light colored, more uniform Lar Limestone containing chert concretions. The Dalichai Formation is represented the first rock unit of the Jurassic marine sediments of the Alborz Mountain. This formation includes a diverse fauna as ammonites, belemnites, bivalves, brachiopods, echinoderms, sponges, bryozoans and foraminifera (Stöcklin 1972; Sussli 1976; Nabavi & Seyed-Emami 1977; Alavi-Naini et al. 1982; Schairer et al. 1991; Shahrabi 1994; Seyed-Emami et al. 1985, 1989, 1995, 1996; Makvandi 2000; Tutunchi 2001; Shafeizad et al. 2002; Shafeizad & Seyed-Emami 2005; Alvani 2006; Niknahad 2007; Shams 2007; Vaziri et al. 2008, 2011). Due to presence of shale and marl layers, this formation has been the subject of many palynological studies. (e.g. Wheeler & Sarjeant 1990; Ghasemi-Nejad & Khaki 2002; Farisi Kermani 2003; Ghasemi-Nejad et al. 2008; Sajjadi et al. 2009; Sabbaghiyan 2009; Orak 2010; Boroumand et al. 2011, 2013;

Ghasemi-Nejad et al. 2012; Dehbozorgi 2013; Dehbozorgi et al. 2013; Mafi et al. 2013; Navidi 2013; Saadati Jafarabadi et al. 2013; Hashemi-Yazdi et al. 2015; Skupien et al. 2015; Hashemi-Yazdi 2008, 2015).

The purpose of this study was to determine the palaeoenvironmental interpretation of the Dalichai Formation based on SEGs data, and quantitative analysis of the palynofacies in the Dalichai Formation at the Andariyeh stratigraphic section, central Alborz.

### Material & Methods

Totally 29 palynologically samples collected from the Dalichai Formation at the Andariyeh stratigraphic section, northeast of Andariyeh village, central Alborz Mountains. All samples were prepared following standard palynological processing procedures (Phipps & Playford 1984), including HCl (10–50%) and HF (40%) utilized for dissolution of carbonates and silicates, respectively. Then the residues were saturated with ZnCl<sub>2</sub> solution (specific gravity 1.9 g/ml) for density separation. All the residues were sieved with a 20 µm mesh sieve prior to making strew slides. Three slides of each preparation examined by transmitted light microscope. The

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slides are stored in the collection of Faculty of Geology, Tehran University, Iran. For quantitative study of the prepared slides, 15 field views were randomly selected from each slide and studied with a 16 x microscope magnification lens. The particles were counted for each sample to determine palynodebries and palynofacies. An examination of facies including identification of palynomorphs, plant remains and amorphous particles, ratios of different particles and their size range in determination the paleoenvironment is very much important. Three main parameters including percentage of palynomorphs, phytoclasts, and organic matter (AOM) transferred to Tyson triple diagram (Tyson 1993) for plotting and interpretations. In addition, The Sporomorph Ecogroup Model (SEG model) of Abbink et al. (2001, 2004a) was applied to the Dalichai Formation. In this model, the miospores are classified as SEGs each, with reference to their parent plants, indicating particular palaeoecological specifications.

#### **Discussion of Results & Conclusions**

Palynofacies data and SEGs used to draw palaeoecological and palaeoenvironmental inferences for the Dalichai Formation at the Andariyeh stratigraphic section in central Alborz Mountains. Diverse and well preserved palynofloras embracing miospores, dinoflagellate cysts, tasmanites,

scolecodont, acritarchs, and foraminiferal test linings are retrieved from the host strata. Miospores typifying all the six plant communities are retrieved from the material examined. The least and most abundant miospores taxa are those related to Pioneer and Lowland SEGs., respectively, The wet/dry curve (ratio of wetter vs drier elements) reflects variations in humidity and precipitation while the warm/cool curve (ratio of warmer against cooler elements) indicates temperature fluctuations.

Quantitative analysis of the SEGs tends to suggest that the host strata accumulated under a moist, warm climate during the Middle Jurassic. Also based on palynofacies studies, a palynofacies of Tyson (1993) (II) was determined that proposed domination of a dysoxic shallow marine environment throughout the deposition of Dalichai Formation. Palynological evidence such as high proportion of the equidimensional opaque palynomaceral to the blade-shape opaque palynomaceral; the high ratio of phytoclasts to marine palynomorphs, and the abundance of transparent amorphous organic matter in comparison to the opaque amorphous organic matter, all indicates that the Dalichai sediments, accumulated in a dysoxic-anoxic shallow marine environment at the Andariyeh stratigraphic section, central Alborz Mountains.