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## Middle to Late Eocene ostracod paleoecology: A multivariate statistical analysis

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A detailed study of the Middle to Late Eocene outcropping series of an onshore well in central Tunisia (PK1) yielded ostracod species in 45 samples from the Souar formation. The ostracod assemblage of the entire section belongs to the Southern Tethyan Type showing distinct changes up section. An R-mode hierarchical cluster analysis of the total association of ostracod was computed using the Jaccard coefficient of similarity (the paired group average method); species were statistically discriminated into four different clusters each of them with its particular paleoenvironments: Group I characterized by the presence of species *Loculicytheretta cavernosa, Reticulina proteros, Isobuntonia pseudotuberata* and *Costa libyaensis* indicators of shallow waters; groups II and III mainly composed of species common in deep environments like *Paleocosta makattamensis, Cytherella angulata, Loxoconcha vetustopunctatella* and S*oudanella laciniosa reticulata*; group IV made by species typical of deep with low dissolved oxygen environments such *Hermanites libyaensis, Bairdia tarabulusensis, Cytheropteron sp., Xestoleberis kenawyi, Soudanella laciniosa triangulate* and *Buntonia ramosa*. Detrended correspondence analyses (DCA) applied to the same data led to the distinction of two important environmental factors affecting the distribution of these ostracod assemblages in the study area: Water depth and oxygenation of water. Paleoecological model based on ostracods associations were developed, identifying respectively characteristics associations for neritic zones and external platform for the Middle and Upper Eocene deposits of PK1.

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## Methodology for predicting internal fractures and relationship to grain geometry: Case study on low permeable core samples

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Selecting an ideal well or low permeable zone for fracturing has for long been a million dollar question. Limited understanding and sparse subsurface data many times dragged the focus of operators worldwide. To overcome the data gaps and to ease the decision making, the authors have undertaken a study to quickly predict the properties of cores. The objective was to predict the internal microfracture using conventional, simple geometrical technique and fracture mechanics. Several experiments were conducted on the core plugs of a low permeability sandstone and shale formation. The fracture was created using the universal testing machine with the help of core sleeve and then tested for prediction. Around 30 sidewall core samples of a sandstone formation was used for testing, density 2.65-2.67 gm/cc, having different permeability and porosity. The microscopic study was conducted to analyze grain geometry of the core sample. The ultimate aim is to compare and predict the grain geometry and internal fracture; The patterns and observations are then statistically classified. Subsequent experiments for predicting fracture connectivity had been undertaken using dye and imprinting it on a paper by rolling. Such paper imprints were analyzed to predict fracture connectivity (though tortuous). These experiments are a new concept in the petroleum industry and these experiments had substantially helped in predicting fracture orientation. Further refinements are definitely needed. However author's views are discussed in this paper. The results of the research showed that this techniques may be used to predict the internal fracture in a sandstone and shale core sample. It has also been inferred with higher certainty that the grain geometry can be classified and it has directly affected the fracture pattern. This technique will help to understand the direction of minimum horizontal stress which is the most important factor in designing the fracturing job. Since this methodology was applied to low permeability sandstone and shale formation there is further scope to validate it on a wider range of other rock types. This method may reduce uncertainty by great extent and may support a paradigm shift in exploiting low permeable formations.

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