

Sedimentological and palynological evidence indicates a predominantly continental depositional environment together with a weak marine influence testified by the presence of scarce acritarchs (*Deusilites tenuistriatus*).

Palynological correlation of the Permian Gharif to lower Khuff formations in Oman, and extension of surface sedimentological-palynological models of reservoir heterogeneity into subsurface reservoirs

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The Gharif Formation of Oman includes important oil and gas reservoirs which contain over 2800 million barrels oil equivalent or approximately 15% of the country's ultimate expected recoverable hydrocarbon reserves. However, the non-marine facies of much of the continental Gharif Formation is complex with great lateral and vertical heterogeneity and consequent difficulties in understanding hydrocarbon fluid flow and yield within its reservoirs. Correlation within the Gharif and the overlying Khuff formations has also been a challenge: large parts are barren of fossils with palyniferous intervals usually stratigraphically and geographically isolated.

The recent development of an integrated Permian palynozonation for Saudi Arabia and Oman (Stephenson et al. 2003) has permitted accurate correlation of sequences throughout most of the Lower Permian. However, parts of the Middle Permian, particularly the Middle and Upper Gharif members and the Gharif - Khuff transition, could hitherto only be correlated rather imprecisely. This is because the standard biozones relating to that part of the sequence (OSPZ4, 5 and 6) are rather broad, and their bases not formally defined.

Recent intensive work on several cores from the Barik Field in central Oman has allowed the erection of a standard palynological section for the hydrocarbon reservoirs of the Middle and Upper Gharif members and lower Khuff Formation. This enables high-resolution correlation to the surface Huqf Outcrop area, 100 km to the east, in which these reservoir rocks outcrop; and may allow subdivisions of the OSPZ regional biozonation scheme of Stephenson et al. (2003).

A valuable consequence of the close correlation between surface and subsurface in this interval is that sedimentological-palynological models of reservoir heterogeneity developed in the Huqf Outcrop area can be extended into the subsurface oil bearing strata. For example Unit B of the Upper Gharif member, defined at the surface by Bureau de Recherches Géologiques et Minières (BRGM), is interpreted as a floodplain complex of point bar sands and clay plugs probably formed in oxbows and crevasse splays. Although the sands are good reservoirs, the clays are baffles to hydrocarbon fluid flow, and strongly affect yield and flow directions. Very detailed surface palynological work has shown that the plugs are distinguished by their autochthonous algal spore content. This may be due to local water chemistry variation between floodplain waterbodies. These autochthonous algal 'fingerprints' will enable thin mudstone bodies to be distinguished in field scale subsurface borehole studies. Mudstone units in adjacent boreholes with radically different autochthonous algal 'fingerprints' are not likely to be laterally continuous baffles to fluid flow, while those at similar levels with similar algal 'fingerprints' are more likely to be laterally continuous field wide barriers.

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PRE-JURASSIC PALYNOLOGY OF THE ARABIAN PLATE AND THE ADJACENT REGIONS (CIMP/SAUDI ARAMCO)

New record of primitive vegetation in the middle Ordovician of Saudi Arabia, and originality of the associated marine microphytoplankton

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Core samples and cuttings from the shallow drillcore QSIM-801 in the Qasim region of central Saudi Arabia were investigated palynologically. The studied interval corresponds to the Qasim and Saq formations, and yielded well preserved and abundant palynomorph assemblages comprising cryptospores, acritarchs, and chitinozoans. Palynological dating (acritarchs and chitinozoans) points to a late Arenig to Llanvirn age for the investigated interval, as confirmed also by graptolite data.

The lowermost cored levels, consisting of marine, shallow water, fine grained sandstones are palynologically dominated by rich and diversified cryptospore assemblages comprising permanent tetrads, diads, monads, and possibly cuticle-like phytoclasts. These findings confirm previous reports of palynological evidence for early land plants in Saudi Arabia and the interest and importance of this area for the study of the evolution of primitive vegetation.

Palynological assemblages from the upper part of the drillcore are richer in marine elements (acritarchs and chitinozoans), although recurrences of cryptospore-dominated levels indicate shoreline proximity throughout the sequence. The acritarchs are very well preserved and comprise few examples of previously unreported morphologies, probably belonging to new taxa.

The quantitative analysis of relative abundances and representativity of the main morphological groups of acritarchs and the calculation of *t/m* index are tentatively used to track changes in palaeoenvironmental conditions. Common occurrence of teratological forms, of cysts at various stages of maturity, and frequently observed local over-representation of specific form-groups (e.g., galeates, *Frankea*), are interpreted as evidence of highly stressed palaeoecological conditions, probably linked to coastal palaeoenvironmental dynamics. On the basis of this observations, we tentatively discuss the influence of fluctuations in hydrographic processes on acritarch cyst development.

Northern Gondwana chitinozoans and acritarchs from the Ordovician of Turkey

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Early Palaeozoic strata are represented in southern Turkey, both on the Anatolian microplate (outcrops of the Seydisehir, Ovacik, Kozan and Sariz areas in the Taurus Range) and on the northern part of the Arabian plate (Border Folds region with the outcrops and subcrops of the Derik-Mardin area). These Anatolian and

Arabian palaeogeographic units were part of the northern Gondwana margin during the Early Palaeozoic as documented on palaeontological evidence. In the Taurus Range, the Palaeozoic sedimentary succession starts with calcareous Cambrian rocks (Cal Tepe Formation), conformably overlain by shaly to silty deposits of the Seydisehir Formation of Mid Cambrian to late Arenig age. Early Darriwilian acritarchs are recorded in the upper part of this formation. The succeeding Kilgen Lake Formation is composed of a thin calcareous and sandy Lower Member (mid Darriwilian), overlain by dark siltstones and mudstones of the Upper Member (late Darriwilian - early Caradoc age). This member yields chitinozoan (e.g. *Linochitina pissotensis*), and acritarchs. An unconformity separates this Kilgen Lake Formation from the overlying Halevickdere Formation corresponding to glacially related Late Ordovician deposits. The latter yield numerous chitinozoans of Ashgill age (i.e., *Armoricochitina nigerica*, *Calpichitina lenticularis*). In the Sariz area, however, the Sort Tepe Formation intercalates between the Seydisehir and the Halevickdere formations. The Sort Tepe siltstones are partly contemporaneous with the Kilgen Lake Formation. They yield acritarchs genera (*Peteinosphaeridium* S. *tefferidium*, *Orthosphaeridium*...) and a few chitinozoans.

In the Mardin region, which is located in the Border folds area and therefore belongs to the Arabian palaeoplate, the lithostratigraphic succession is slightly different as the glacially related Halevickdere Formation overlies unconformably the shales of the Bedinian Formation. Samples from the lowest part of this formation contain well-preserved chitinozoans of early Caradoc age (e.g. *Armoricochitina granulata*, *Hercocochitina* ssp.). Similar assemblages have been identified in the subsurface, above strata yielding early to late Darriwilian chitinozoans and acritarchs. Ashgill acritarchs and chitinozoans (e.g. *Armoricochitina nigerica*, *Acanthochitina* cf. *barbata*) are common in the Halevickdere Formation of south-eastern Turkey. On a palaeobiogeographic ground, the Mid and Late Ordovician chitinozoans and acritarchs recorded in southern Turkey display obvious affinities with those from the Qasim Formation, which is widespread all over the Arabian platform. However, among these typical northern Gondwana assemblages, some Baltic taxa are noticed in the Turkish material.

Palynology of the Silurian/Devonian boundary interval at the northern margin of the Arabian Plate (Hazro area, SE Turkey)

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During the Silurian to Lower Devonian, SE Turkey was part of the Gondwana continent located at the northern margin of the Arabian Plate. In general, sediments of that time in SE Anatolia are mostly covered by younger rocks, but in the Hazro anticline parts of the Upper Silurian Dadas Formation (presumably including the lowermost Devonian) and the Lower Devonian Hazro Formation are exposed. The Dadas Formation is mainly composed of fine grained siliciclastic and minor calcareous marine sediments, whereas the Hazro Formation consists of coarser siliciclastics with sandstones and few siltstones of predominantly terrestrial origin. Recently, Upper Silurian to Lower Devonian outcrop and core sections from Fetlika (SE Turkey) have been studied palynologically in detail. Investigations of both, surface and subsurface material provided organic matter of low maturity (> 0,8 % vitrinite reflection) with exceptionally well preserved acritarchs, prasinophytes, chitinozoans, scolecodonts, spores, and cryptospores. A few layers are enriched in cuticles and tissue fragments which are clearly derived from landplants. The ongoing studies are concentrated on core material from the Middle and Upper Dadas Formation and the lower Hazro Formation. Parts of the Dadas Formation yield highly diverse assemblages of acritarchs and chitinozoans which are used for palynofacies and biostratigraphy. Due to the lack of other stratigraphical index fossils like graptolites or conodonts, acritarchs and chitinozoans may serve to define the Silurian/Devonian boundary in this area. However, diagnostic chitinozoans which occur at the GSSP (e.g., *Urnocochitina urna*, *Linochitina klonkensis*, *Angochitina chlupaci*, *Eisenackitina bohémica*) have not yet been found and the acritarchs still need to be studied in more detail. Additional information is expected from spores and cryptospores, especially for higher parts of the Dadas Fm. and the overlying Hazro Fm. Spore morphotypes resemble species of e.g. *Ambitisporites* and cf. *Archaeozonitretes* but index taxa for the Lower Devonian like *Streelispora newportensis* or *Emphanisporites* and *Retusotriletes* are missing so far. Cryptospores are mainly represented by *Dyadispora*, *Tetraletes* and cf. *Cymbosporites*. In general, the Dadas assemblages are very rich in

prasinophytes like *Dictyotidium*, *Cymatosphaera* and cf. *Pterosphaeridia* (*Orygmopsis* sensu Colbath 1987). Some horizons predominantly consist of huge prasinophycean phycocombs (> 200 µm) which are assigned to Tasmanitaceae (e.g., *Tasmanites*). They can easily be detected by magnification glasses on bedding planes. Such mass occurrences („blooms“) could reflect specific facies conditions (e.g. low salinity) in a shallow water environment, probably controlled by sea level fluctuations. Usually, prasinophytes are considered to be of restricted stratigraphical value, but detailed taxonomical and systematical studies of their representatives in the Fetlika material may provide supplementary data at least for the regional S/D boundary correlation. Interestingly, mass occurrences of specific prasinophytes from the Upper Silurian-Lower Devonian interval have also been described from other places, e.g. in North America and Europe (Colbath, 1987). Spores and cryptospores are present throughout the sequence, but more frequent at the base of the core (lower Middle Dadas Fm.). The same is particularly true for the uppermost Dadas Fm. to lower Hazro Fm where marine elements are restricted to specific acritarchs and prasinophytes. Chitinozoans and scolecodonts are rare or absent where spores and cryptospores are common. In each of these two intervals cuticles/tissues of landplants and spores are accumulated in a specific layer which is otherwise characterised by a lack of any marine palynomorphs. These layers may be interpreted as representing short-term terrestrially derived pulses in a generally coastal/near shore environment. This is supported by specific biomarkers of supposed landplant origin.

Palynology of the Lithostratigraphical units B1 and B2 of West and Central Algerian Synclines, Sahara Algeria: geological implications and evidence for Late Homeric to Early and early Late Lochkovian

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Abundant organic-walled microfossils are moderately well preserved in shallow sea in intertidal conditions of the uppermost Middle Silurian to the Lower Devonian successions. The microfossils are composed of sporomorphs, acritarchs, chitinozoa, microplant remains and rare scolecodonts. The microfossils from these sequences are characteristics of the Upper Homeric to the Lower and early late Lochkovian. Six new miopore species (*Retusotriletes* D sp. nov., *Scylaspora* C sp. nov., *Scylaspora* D sp. nov., *Scylaspora* R sp. nov., *Scylaspora* U sp. nov. and *Cymbosporites* T sp. nov.) are described. Three more possibly new miopore forms are described but not specifically named. The occurrence and range of these species as well as other miopore taxa provide the basis for recognising five miopore assemblage biozones, of these biozones two assemblage biozone and one sub-biozone are proposed as new. The biozones and sub-biozones allow inter-regional correlation with latest Middle Silurian to Earliest Devonian strata. Comparison with the zonal sub-zonal division of Mid-Palaeozoic sequences from the Western Europe and Gondwanan regions show the significant difference in distribution of spore flora within Gondwanan and Laurasian regions during Pridoli and Early to early Late Lochkovian sequences.

Keywords: Silurian, Devonian, Tidikelt Plateau, Triassic Province, Sahara Algeria; spores; taxonomy; palynostratigraphy.

Palynology of the Devonian Jauf Formation from the northern part of Saudi Arabia

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A series of shallow cores has been drilled through the Devonian deposits on the Arabian Platform in the northern part of Saudi Arabia. The Devonian deposits of this area are represented by the Tawil, Jauf and Jubah formations. This study reports on palynological analysis of samples from the Jauf Formation. This formation exhibits large regional scale changes in facies, from marine in north-western Saudi Arabia to shallow marine and continental in central and southern regions. An Emsian to Frasnian age has been previously assigned to the Jauf and Jubah Formations. The palynological assemblages from four different boreholes are dominated by miospores, with trilete spores dominant and cryptospores rare. An exception is the samples collected in the D3B event, which are characterised by a sudden bloom of a monospecific leiosphaerid. This event is known in many boreholes through a large part of the Arabian Platform. It seems to be more or less isochronous, and is thought to reflect peculiar environmental condition associated with a marine transgression. In the other samples the miospores are remarkably abundant and well preserved. Despite their abundance, biodiversity is low. The miospore assemblage seems to be similar in all four boreholes, and is largely dominated by simple forms such as *Retusotriletes* spp., *Apiculiretusispora* spp. etc. The presence of rare biostratigraphically valuable miospore taxa such as *Rhabdosporites minutus*, *Acinosporites lindlensis*, *Dictyotriletes subgranifer*, *Samarisporites praetervisus*, *Verrucosporites dubia*, *Emphanisporites annulatus*, *Camarozonotriletes sextantii* indicates that most of the section studied is Emsian in age. However, the presence of *Retusotriletes rugulatus* in the upper part of the sequence suggests that the Eifelian may have been reached.

Palynostratigraphy and Palaeobiogeography of Devonian strata (Padeha, Sibzar and Bahram formations) from Anarak city, Central Iran

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The Devonian strata are well exposed and developed near the Anarak city, in Central Iranian Basin. The Devonian sediments have a thickness of 915 m. and consists of alternation of shale, limestone, dolomitic limestone and so on.

The Devonian strata have been divided in ascending stratigraphic order into the Padeha, Sibzar and Bahram formations. A total 107 of surface samples were prepared from these rock units in order to study their palynomorph entities as well as foraminifers for their aged relationships. The majority surface samples contain well-preserved and abundant palynomorphs (acritarch and miospore taxa) and foraminifers.

In this study, 52 palynomorph taxa were encountered (29 acritarch and 17 miospore species). The palynomorph taxa consists of:

Gorgonisphaeridium abatum, *Cymatiosphaera adaiochorata*, *Chomotriletes vedugensis*, *Gorgonisphaeridium carnavonense*, *Diexallophasis remota*, *Veryhachium downiei*, *Dictyotidium torosum*, *Solisphaeridium spinoglobosum*, *Dictyotidium granulosum*, *Cymatiosphaera perimembrana*, *Duvernaysphaera tenuicincta*, *Deltotosoma intonsum*, *Gorgonisphaeridium discissum*, *Gorgonisphaeridium condensum*, *Gorgonisphaeridium abstrusum*, *Lophosphaeridium segregum*, *Maranhites perplexus*, *Multiplicisphaeridium amium*, *Navifusa exilis*, *Papulogobata annulata*, *Saharidia lusca*, *Stellinium comptum*, *Stellinium octoaster*, *Unellium winslowae*, *Veryhachium colemani*, *Ammonidium loriferum*, *Solisphaeridium inaffectum*, *Calamospora pannuceae*, *Leitotriletes liebigenis*, *Ancyrospora ampulla*, *Ancyrospora ancyrea*, *Ancyrospora longispinosa*, *Hystricosporites grandis*, *Samarisporites triangulatus*, *Retusotriletes distinctus*, *Retusotriletes rotundus*, *Diducites mucronatus*, *Densosporites devonicus*, *Geminosporea lenurata*, *Geminosporea antaxios*, *Grandispora echinata*, *Grandispora mamillata*, *Calyptosporites* sp.

The above-mentioned palynomorph taxa were arranged in two assemblage zones, suggesting the Frasnian-Famenian age. Likewise, six microfossil species were encountered such as:

Umbella rotunda, *Umbella shahrudensis*, *Umbella hemisphaerica*, *Umbella baschirica*, *Endothyra* sp. and *Kamaena* sp.

These foraminifer species also suggest a Frasnian-Famenian age for the Padeha, Sibzar and Bahram formations, in the Anarak area, Central Iran.

The known palynomorph taxa from the Devonian rock units of study area were compared with those of Devonian sediments from other parts of the world. The comparison indicate broad similarity with those of

northern and southern Iran as well as North Africa and western Australia, suggesting the same palaeophytogeographic province during the Late Devonian.

Miospore contribution to the Lower and early Middle Devonian stratigraphy of Oued Saoura, West Algerian Sahara: geological implications and evidence for stages boundaries.

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The exposed rocks of Oued Saoura between Kerzaz south and Beni Abbes north are a classic area for west Algerian Sahara Devonian stratigraphy. They are including over 1250 m. thick Lower and early Middle Devonian sediments rich in assemblages of miospores, acritarchs, chitinozoans, plant remains and rare scolecodonts. Maturation of these fossils is variable but generally high to very high. Miospores are varying through regressive and transgressive succession but increase in abundance through regressive sequence. The stratigraphic distribution of many distinctive and cosmopolitan key miospores from five sections (Guerzim, Erg Joui, Hadjra el Kitba, Moungar Debad and Saheb el Mekharza) through Zeimlet, Saheb el Djir, Dkhissa and Teferguente Formations used to delimit seven miospore assemblage biozones and ten sub-biozones. In ascending order the biozones are: 1. *Scylaspora* T sp.nov.-*Perotriletes microbaucalatus* (TM) spore assemblage biozone, 2. *Dictyotriletes emsiensis*-*Cymbosporites proteus* (EP) spore assemblage biozone, 3. *Apiculiretusispora arenorugosa*-*Dibolisporites* C sp.nov. (AC) spore assemblage biozone, 4. *Verrucosporites* cf. *polygonalis*-*Dictyotriletes subgranifer* (S) spore assemblage biozone, 5. *Emphanisporites annulatus*-*Dibolisporites echinaceus* (AE) spore assemblage biozone, 6. *Hystricosporites microancyreus*-*Calyptosporites proteus* (MP) spore assemblage biozone, 7. *Calyptosporites velatus*-*Rhabdosporites langii* (VL) spore assemblage biozone. These biozones allow inter-regional correlation with Lower and early Middle Devonian strata. A correlation is proposed between west Algerian Sahara and the Lower and early Middle Devonian of Western Europe and Gondwanan regions. This correlation reveals that regional differences in spore flora are apparent in Early and early Late Lochkovian. In the Pragian and the succeeding strata these are less pronounced.

Key words: Devonian, Oued Saoura, west Sahara Algeria, spores, distribution, palynostratigraphy.

Identifying Devonian global events within the Arabian Plate

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The Devonian sediments of Saudi Arabia are generally represented by an arenaceous siliciclastic succession. However, a number of thin discrete intervals of fine-grained sediments are also present. Significantly one of these intervals caps the Jauf Reservoir. It is also very important in containing a very distinctive palynological assemblage that is dominated by a monospecific leiosphaerid. As such this spheromorph acme is an excellent stratigraphic marker and is used to define Palynosubzone D3B (Al-Hajri et al, 1999). This interval is very extensively developed across Saudi Arabia and represents a key event in understanding and correlating the Devonian of the Arabian Plate with that of Euramerica.

Beds containing Palynosubzone D3B were penetrated during the drilling of the JNDL-4 shallow stratigraphic test well when it was cored in entirety. Wire-line logs were also made available. In order to better understand the development of the reservoir and its associated transgressions a set of close spaced samples (1 foot, 0.305m) were taken. These were initially analysed for TOC content to investigate the apparent cyclicity shown by

the wireline log data. A sub-set of these samples was then taken for quantitative palynofacies. Aspects that were of particular interest were the exact character of the D3B transgression and the speed and symmetry of its development. Does its presence reflect a transgression or is it, in fact, a response to the regression that created the sands of the Jauf Reservoir? In addition to palynofacies a number of analyses were also carried out including atomic H/C ratio of the kerogen and a limited programme of stable isotope determinations in the organic matter. These results will help determine the magnitude of this transgression and whether it can be related to a named 'global' Devonian event.

AL-HAJRI, S. A., FILATOFF, J., WENDER, L. E. & NORTON, A. K. 1999. Stratigraphy and operational palynology of the Devonian system in Saudi Arabia. *GeoArabia*, 4: 53-68.

Late Devonian and early Carboniferous miospore assemblages from Saudi Arabia

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Famennian (Late Devonian) and Tournaisian (Early Carboniferous) miospore assemblages are described from two exploration wells in Saudi Arabia; one located offshore in the Arabian Gulf, the other drilled east of the Ghawar Oilfield, c. 300 km east of Riyadh. The latter section includes assemblages dominated by *Retispora lepidophyta*, the disappearance of which coincides with the Devonian / Carboniferous boundary. However, overlying strata spanning the system boundary have been removed by erosion. Diverse assemblages from the Arabian Gulf well include typical Famennian and Tournaisian miospore taxa. However, *R. lepidophyta* has only been recorded from this well section as recycled specimens in assemblages that are clearly Carboniferous in age, so it appears that latest Devonian rocks have not been preserved. Extensive reworking has led to difficulty in interpreting the age of some of the lower intervals in this section.

Vallatisporites and related Cingulizonate genera from the Late Carboniferous–Early Permian of Saudi Arabia and South America

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Knowledge of Late Carboniferous and Early Permian Gondwanan microfloras has expanded significantly during the past five years as a result of detailed investigations in Saudi Arabia, Oman, Argentina and Brazil (STEPHENSON & FILATOFF, 2000; STEPHENSON et al., 2003; DI PASQUO, 2003; DI PASQUO et al., 2003 a, b). Correlation of the Early Permian sequences between the two regions is presently afforded by a small number of well illustrated spore taxa such as *Convruccosporites confluentis* (Archangelsky & Gamarro) Playford & Dino but many other morphotypes are similar in the two regions, particularly within the cingulizonate group. These spores are, however, complex and poorly illustrated so that comparative taxonomy is difficult. This contribution attempts to present a comparison between species of the genus *Vallatisporites* and other related cingulizonate genera including *Cristatisporites crassilabrus* Archangelsky & Gamarro, which are extensively recorded in the Late Carboniferous – Early Permian assemblages in Saudi Arabia, Oman and Argentina in order to reassess the outline correlations recently proposed by STEPHENSON & FILATOFF (2000).

Data from Saudi Arabia and Oman are derived from the subsurface glaciogene Jawb (Unayzah B) and Al Khlata formations or the surface equivalent Juwayl Formation whilst those from South America were mainly recorded from the Machareti and Mandiyuti Groups in the Tarija Basin as well as from the Paganzo Basin in Argentina and from the Itararé Subgroup in the Paraná Basin of Brazil. The assemblages typically contain variable frequencies of spores and pollen grains (monosaccate, bisaccate and taeniate) from both the Late Carboniferous and Early Permian intervals and represent a predominantly gymnospermous (cordaitalean and coniferalean) vegetation but with significant contributions from lower vascular plants, notably pteridophytes, sphenophylls and lycopods. Taeniate pollen grains which become increasingly prominent in the Early Permian are derived from a glossopterid source.

Species such as *Vallatisporites arcuatus* (Marques Toigo) Archangelsky & Gamarro, *Cristatisporites menendezii* (Menéndez & Azcuy) Playford, *C. inordinatus* (Menéndez & Azcuy) Playford, and *C. crassilabrus* Archangelsky & Gamarro were recorded in both regions and are here critically re-examined in order to confirm both specific and stratigraphic assignments. Other species appear to remain endemic to both regions.

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MESOZOIC PALYNOLOGY

Palynology and paleoenvironment of the Gulailah and Hamlah formations (Triassic) in Qatar, Arabian Gulf

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Palynological and total organic carbon (TOC) analyses have been conducted on core samples recovered from the Gulailah and Hamlah formations of two wells drilled in the Dukhan oil field, western Qatar. Analysis of ⁸⁷Sr/⁸⁶Sr ratio of the studied succession give a chronostratigraphic range of Middle to Late Triassic (Ladinian-Carnian) for the Gulailah and Hamlah formations respectively. Palynological analysis has yielded a rich and fairly well preserved assemblage. Sixty-one palynomorph species have been identified. The assemblages are dominated by monosaccate, bisaccate and Circumpolles pollen. Three palynomorph assemblage zones have been established in the following ascending order: Zone I (Microcachrydites doubingeri - M. fastidiosus - Enzonasporites vigens - Duplicisporites granulatus Assemblage Zone) dated as late Ladinian, Zone II (Patinasporites densus-Partisporites majlawkiniae Assemblage Zone) of Carnian age and Zone III (Corollina meyeriana-Eucommiidites major-