Monosaccate pollen and Bisaccate pollen, and the spore genera *Cadiospora, Angulisporites* and *Columinisporites* are practically absent from the Stephanian to Early Permiam of northwestern Eyrope, the Cantabrian Mountains and the Stephanian (*Potoniesporites* Zone of Hacquebard, 1997) of the Pictou Group, Canada.

These data have helped refine the stratigraphical correlation of the upper part of the Dobrudzha Coal Basin succession. The continental strata of the Gurkovo Formation is assigned to the *Thymospora* spp. Zone and sees the first regular occurrence of *Thymospora thiessenii* and *T. pseudothiessenii*. Dimitrova (1997) divided the Zone into two subzones at the level of the appearance of the genera *Candidispora, Polymorphisporites, Maculatasporites, Spackmanites, Cadiospora* and *Angulisporites*, and of the species *Spinosporites spinosus* and *S. exiguus*. Using miospore biostratigraphical data from western Europe (Cleal *et al.*, 2003) several of these taxa have been identified as being important indices for the Westphalian - Stephanian boundary, and this has allowed more precise stratigraphical correlations to be achieved for the Dobrudzha succession. The palynological associations are quite similar to those of the OT-ST palynozones of the uppermost Westphalian – lower Stephanian in the scheme of Clayton *et al.* (1997) and for parts of NW Spain (Coquel & Rodriguez, 1994). The Cantabrian part of the succession contains some of the best-preserved adpression floras with cuticles (Dimitrova & Uzunova, 1996) and pollen/spores.

There has been considerable confusion in the past over the positioning of the lower boundary of the Stephanian Series in non-marine sequences. The present study demonstrates the critical importance of palynological biostratigraphy for identifying this boundary.

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COQUEL, R., RODRIGUEZ, R. 1994. Palynology of the Picos de Europa and Puentelles Formations in the Picos de Europa area (Upper Carboniferous, northwest Spain). – *Palaeobot. Rev. Palynol.*, 80, 65-74.

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DIMITROVA, T. 1997. Palynological assemblages of the Makedonka Formation., Dobrudzha coal basin. - *Rev. Bulgarian Geol. Soc.*, 1, 25-30.

HACQUEBARD, P.A. 1997. Contributions of palynology to Carboniferous biostratigraphy and coal geology of the Atlantic provinces of Canada. – *Palaeobot. Rev. Palynol.* 95, 7-19.

Poster session g5

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

Detailed morphology of *Vallatisporites arcuatus* (Marques-Toigo) Archangelsky and Gamerro, 1979 from the Early Permian of Arabia

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The zonate spore taxon, *Vallatisporites arcuatus*, first described from the Carboniferous–Permian of Argentina is occasionally present in large numbers in Early Permian sediments of the Arabian Peninsula. The last uphole appearance of the taxon corresponds quite closely to the boundary between the glacigene Jawb Member (Juwayl Formation) and the postglacial Unayzah Formation. Detailed light microscope study has shown that it is strongly camerate, with a distinct intexinal body and a complex zona. The latter's inner part bears a line of minute proximal pits, and displays a well-developed cuniculus. In the Arabian specimens the cuniculus conforms exactly to Sullivan's (1964) definition in that it is positioned at the"..equator of the spore cavity.." and is interpreted to represent 'the space between the margin of the spore cavity and the inner surface of the equatorially expanded exoexine'. The row of pits was first noted by Hacquebard (1957) in *Vallatisporites*. Arabian specimens present a row of pits in the proximal exoexine of the zona. Some pits are open to the proximal surface, while others are wholly internal vacuoles. When the row is composed of closely spaced and large pits, the consequent increased transparency of the zona manifests a narrow 'light band', adjacent to the equatorial camera. The remainder of the zona is dominated by large distinctive oval or rectangular, radially elongate hollows or depressions delimited by distally protuberant arch-shaped or radial thickenings. These hollows or depressions are demonstrably not internal vacuoles. Most Arabian specimens of *V. arcuatus* possess distal galeae, spinae, coni and irregularly shaped (sometimes bifurcant) processes up to 10µm long and 1-2µm wide. The latter elements frequently fuse with the underside of the zona to form radial zonal struts. In the most heavily ornamented specimens, zonal struts are attached to the distally protuberant mid zonal thickening.

SULLIVAN, H. J. 1964. Miospores from the Drybrook Sandstone and associated measures in the Forest of Dean basin, Gloucestershire. **Palaeontology**, 7, 351-392.

HACQUEBARD, P. A. 1957. Plant spores in coal from the Horton group (Mississippian) of Nova Scotia. **Micropaleontology**, 3, 301-324.

Late Eifelian to earliest Givetian miospore assemblages from central northern Saudi Arabia

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Miospore assemblages from a cored section of shaley sandstones of the Hammamiyat Member, the uppermost part of the Jauf Formation in a borehole located in the central northern part of Saudi Arabia are documented. The full sequence in the borehole which is thought to represent one of the most complete Devonian sections in the northern part of the Kingdom has revealed the presence of well preserved Siegenian to Eifelian or even earliest Givetian miospores.

The composition of the assemblages from this cored interval includes representatives of *Calamospora* sp., *Retusotriletes* spp., *Dibolisporites echinaceus, D.* cf *gibberosus, Emphanisporites spinaeformis, Emphanisporites* sp., *Craspedispora ghadamisensis* and *Geminospora lemurata* and suggests correlation with at least part of the interval between the upper part of the Oppel Zone AD and the overlying Oppel Zone TA of the standard West European zonation of Streel et al. 1987.

Correlations will be suggested with data from the Ghawar Field of central Saudi Arabia (Al-Hajri et al., 1999) and other neighbouring areas.

A new Middle Devonian megaspore from Saudi Arabia

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A morphologically complex Middle Devonian megaspore was recovered from an exploration well located south of the Ghawar oil field, Eastern Province, Saudi Arabia. The palynomorph-bearing material is from a cored siliciclastic interval that contains abundant dispersed megascopic carbonaceous plant fragments and lies

above a prominent paleosol. Occurring with the megaspores, are representatives of *Aneurospora* spp., *Emphanisporites* spp., aff. *Geminospora* sp., and *Verruciretusispora magnifica*. The megaspores were first recovered from palynological residues prepared for scanning electron microscope examination. Only fragmentary remains of the reticulum were identified on strewn slides. The megaspores are radial and trilete, with a subcircular amb. They are 300 to 350 µm in diameter. The proximal surface is more flattened than the distal. The trilete laesurae are slightly raised and extend to the ambitus of the megaspore forming a variably developed curvatura perfecta. The interradial areas are laevigate to granulate. The distal surface is irregularly reticulate, becoming more coarsely reticulate at the distal pole.

The megaspore displays similarities with *Duosporites* described from the Famennian of Pennsylvania. That species, although considerably larger, is distally reticulate but bears inwardly projecting verrucae on the proximal face. Because of the thermal maturity of Arabian material, it has not yet been possible to establish the presence of internal proximal verrucae.

Hiama Supergroup of Oman: Biostratigraphy and paleoenvironments

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The Cambrian to Lower Silurian Haima Supergroup of Oman forms the late syn-to post-rift siliciclastic infill of a northeast-southwest trending Precambrian to Palaeozoic graben system. It reaches a thickness of up to 6 km along the central axis of the Ghaba Salt Basin. Significant gas/condensate discoveries have been made recently in the Barik, Miqrat and Amin clastic formations of the Mahatta Humaid Group in the Haima. There is an increasing demand to improve the existing stratigraphic resolution of the Supergroup and to develop further correlation constraints. Biostratigraphy (palynostratigraphy) has proved to be one of the most useful and cost-effective correlation tools in the marine sequences. Prior to the year 2000, four major assemblage zones incorporating acritarchs, chitinozoans and cryptospores had been identified and used to characterize the lithostratigraphic units: Late Cambrian- Late Tremadocian 1108 Zone (Andam Formation), ? Late Arenig-Llanvirn 1098 Zone (Saih Nihayda Formation), Caradoc- Early Ashgill 1005 Zone (Hasirah Formation) and Llandovery 1003 Zone (Sahmah Formation). However, recent studies have shown that there is further scope for refining this palynozonation scheme (Molyneux 2001a, b; Mohiuddin, 2004; unpublished PDO internal reports). During these studies, palaeoenviromental controls on the palynomorph abundance and diversity were evaluated. At least six marine flooding events/incursions were identified from the Late Cambrian-Silurian which were correlated with the flooding events recorded in Sharland *et al.* 2000. The depositional setting was initially continental becoming progressively more marginal marine to deltaic in nature towards the upper part of the Haima. In the Caradoc-Llandovery, extremely marginal marine sediments were identified which yielded assemblages completely dominated by cryptospores.

Chitinozoa study of five wells from northern Oman has improved the understanding of the distribution and age ranges of this palynomorph group. Up to seven assemblages were recognized of which Assemblage 2 is the most consistent and significant. It is probably equivalent to the North Gondwana *Tanuchitina fistulosa* chitinozoan biozone, which is Late Caradoc in age. Index Ashgill taxa are absent in Oman, however, an earliest Ashgill age cannot be ruled out due to the presence of *Velatachitina* sp. A and very rare *Acanthochitina barbata*. The latter is an index species of the Caradoc-Ashgill boundary (Paris, 2002; unpublished internal PDO report). Further study on conventional and side-wall core samples is ongoing. It is estimated that a chitinozoan biozonation scheme of up to 12 zones can be erected for the Haima sequence of Oman.

There is a discrepancy between acritarch and chitinozoan data with respect to the timing of the Late Ordovician glaciation and the presence of Ashgill sediments in Oman. Further work is ongoing to resolve this issue. A major genetic boundary has been identified at the base of the Ghudun Formation which is represented by a sudden colour change in all the palynomorph taxa. This boundary is probably linked to the absence of Arenig sediments in Oman.

MOHIUDDIN, M. 2004. Palynostratigraphy and palaeoenvironmental interpretation for the Haima Supergroup in the borehole Nibras-1 and correlation with Kauther, Harmal and Fakhr. **PDO internal Exploration Lab. Note.** In-prep.

MOLYNEUX, S. 2001. Palynostratigraphy of the Safiq Group and upper Mahatta Humaid Group (Ghudun and Andam Formations), Haima Supergroup, North Oman. **PDO internal BGS report.** CR/01/08, 76pp.
PARIS, F. 2002. Chitinozoans from wells Abu Thaylah-2H1, Al Husain-1, Ramlat Rawl-5H1, Saih Nihayda NE-1H2 and Sinaw-1H1. **PDO internal Exploration report.** 66 pp.
SHARLAND, P. R.; ARCHER, R.; CASEY, D. M; DAVIES, R. B; HALL, S. H; HEWARD, A. P; HORBURY A. D AND SIMMONS, M. D. 2001. Arabian Plate Sequence Stratigraphy. **GeoArabia.** Special Publication 2, 371pp.

Poster session g6

MESOZOIC PALYNOLOGY

Tuvalian palynological associations from the Southern Alps

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Palynological Tuvalian analyses from the Southern Alps provide details on the assemblage distribution, and permit the correlation of different successions.

The Tuvalian sediments at Cave del Predil (ex Raibl) area are divided into: Tor Formation (Upper Julian - Lower Tuvalian), Portella Dolomite, Carnitza Formation (Middle and Upper Tuvalian), and Dolomia Principale (Upper Tuvalian - Norian) (Lieberman, 1978, De Zanche, 2000).

The rich microfloras are mainly composed by azonotrilete spores, monosaccates, bisaccates, Circumpolles, polyplicate and alete pollen. The stratigraphically most important species recorded are: Lagenella martini and Ricciisporites tuberculatus, which are present in the upper part of the Tor Formation; and Granuloperculatipollis rudis and Paracirculina quadruplicis, which first occurs in the Carnitza Formation. This latter formation, well constrained in age with ammonoids and conodonts, is rich in alete forms, as Porcellispora longdonensis, Spheripollenites spp., and Ricciisporites spp., all forms of uncertain paleobotanical affinity.

The miospore assemblage recorded allow us to correlate the Cave del Predil section with other Tuvalian sequences, from the Julian Alps to the Dolomites.

DE ZANCHE V., GIANOLLA P. & ROGHI, G. 2000, Carnian stratigraphy in the Raibl/Cave del Predil area (Julian Alps, Italy). Eclogae geol. Helv., 93, 331-347.
LIEBERMAN, H.M. 1978 - Carnitza Formation - ein neuer Begriff für oberkarnische Beckenkalke der südlichen Kalkalpen bei Raibl (Cave del Predil, Italien). Mitt. Ges. Geol. Bergbaustud. Österr., 25, 35-60.

Palynomorph analysis from the upper Anisian (Middle Triassic) of the Dolomites (Italy): new biostratigraphic and palaeoclimatic data

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The aim of this study is to improve the knowledge of the biostratigraphic distribution of palynomorphs during the upper Anisian of the Dolomites (Southern Alps, Italy). Besides, quantitative analysis allows us a better definition of the paleoclimate during this time interval.