Poster sessión g7

TERTIARY PALYNOLOGY

Late Pliocene palynoflora of Yangyi, Yunnan, SW China

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Yangyi coalmine (24°57'N, 99°15'E, 1,521m a.s.l.) is located in Baoshan County of western Yunnan, SW China. The measured profile at Yangyi coalmine exposure is about 60.0m thick and overlain by sediments of Quaternary laterite. The underlying bed is not exposed. The lower and middle part of the section is characterized by lignite alternations, and includes several mudstone layers with various thickness, siltstone and mudstone occur alternately in the upper part of the section. The studied section is divided into 15 layers lithologically. Twenty-two palynological samples were collected from the measured profile.

The Late Pliocene palynoflora of Yangyi, covering 52 palynomorphs assigned to 32 natural families, consists of angiosperms (61.5%), gymnosperms (9.6%), ferns (25.0%) and algae (3.9%). Angiosperms include 31 palynomorphs, which belong to 22 families. Gymnosperms consist of 5 genera of Pinaceae and 1 genus of Podocarpaceae. Pteridophytes include 13 palynomorphs assigned to 7 families. The algal spores include two genera of Zynemataceae.

Pollen diagrams are constructed for the more abundant taxa to show the change of their relative abundance through the section. Abundant spores and pollen grains are found in the samples collected from the base of the profile at 60.1m to 22.9m, the palynological data of this phase will be used to discuss the palaeovegetation and palaeoclimate of this area, and four pollen zones can be recognized according to the relative abundance of major floristic components.

According to the floristic components, the spatial pattern of altitudinal zonation of palaeovegetation is consistent during the deposit time. The mixture of deciduous plants, broad-leaved evergreen plants and conifers is characteristic of the Yangyi palylnoflora. We may infer that montane broad-leaved forests distributed around the deposit site, evergreen coniferous forests still occurred at the slopes or high lands far from the deposit site. Palaeovegetation features indicate that montane subtropical climate dominated in the Yangyi area through the deposit time. Take at the face value, the difference of floristic components and palynomorph percentages between four periods may suggest that slight fluctuations of warm/cool (relative) and dry/humid (relative) were present throughout the deposit time.

Reconstruction of palaeovegetation as derived from the palynological study of Lower Tertiary coals in Central Colombia

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Sediments of the Amaga Formation crop out principally in an area located south of the city of Medellin between the Western and Central Cordilleras. They were deposited in different basins elongated in a north-south direction east of the Rio Cauca valley. They correspond essentially to continental sediments deposited in a relatively flat floodplain associated with meandering rivers, although brackish conditions may also have existed locally. The lithology is principally constituted of an alternation of sandy clays and sandstones with abundant traces of vegetation and locally coal beds of economic interest. Age determinations are based essentially on

continental palynology (e.g. CARMONA LOPEZ, 1997) and are poorly constrained between the Late Paleocene and Early Miocene. The aim of this research is to attempt a reconstruction of the palaeovegetation based upon the palynological investigation of a specific coal interval and complemented by pyrolysis and sedimentological data

Amaga sediments were divided by GROSSE (1926) into three lithological units constituted essentially of sandstones and clays. The lower unit also contains conglomerates, whereas coal beds are encountered in the three units, but only those in the middle unit are of economic value. This study is based upon the detailed sampling of a 1.5 m thick coal bed within the middle unit in the Los Palomos area. This bed is locally referred to as Manto M1.

Samples were examined using both Rock-Eval pyrolysis and palynological methods. Palynological slides were prepared using a new technique devised for coals and carbon-rich rocks (BLANDON MONTES et al., in prep.). Rock-Eval pyrolysis provides a rapid evaluation of the amount and type of organic matter. Total organic carbon (TOC) content within the bed varies between 65 and 75% wt. Some minor clay intercalations with TOC's of less than 20% prove that the coal bed corresponds to different phases of deposition. Most of the studied samples have hydrogen indices of less than 200 mgHC/gTOC, pointing to organic matter of type III and thereby confirming that it is essentially derived from continental plants. Finally, Tmax values of less than 440°C show that coal is thermally immature.

Palynological investigations confirm the purely continental nature of the coal deposit, there being no indications of a brackish influence. Palynomorph associations are dominated by pollen of *Mauritiidites franciscoi*, a palm tree growing in marshy environments associated with high rates of precipitations. This species is encountered in large concentrations so as to give its name to a floral association called locally "Morichales". It reflects an ecosystem with seasonal changes, where turf is abundant and soils permanently flooded or where the water table is high. Other species of spores and pollen adapted to this palaeoenvironment are abundant: *Verrucatomonosporites usmensis*, a fern frequently associated with the large forests of "Morichales" and various species of the genera *Retitricolpites* and *Psilamonoletes*.

Therefore, this interpretation fits with the sedimentological data which point to a large floodplain with numerous marshes associated with the divagation of meandering rivers. On this very flat topography grew large forests of palm trees mixed with ferns and adapted to a very humid tropical climate.

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BLANDON MONTES, A., PARRA SANCHES, L.N., GORIN, G.E. & ARANGO ARIAS, F. (in prep.). A new preparation method for the study of palynofacies constituents in coals and carbon-rich rocks.

CARMONA LOPEZ, I. 1997. Estudio de la petrografía y palinología de los carbones de la Formación Amaga localizados en la zona de Palomos, Municipio de Fredonia. **Tesis de post-grado, Univ. Nacional de Colombia (Medellin), Facultad de Minas**, 146p.

GROSSE, E. 1926. El Terciario Carbonifero de Antioquia. **Reimer, Berlin**, 361p.

Clorophyta from the Middle and Late Miocene Calchaquí Valleys, Northwestern Argentina. Taxonomy, paleoecology and biostratigraphic considerations

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The San José and Chiquimil Formations (Middle and Upper Miocene, Santa Maria Group) and the Palo Pintado Formation (Upper Miocene, Payogastilla Group) outcrop extensively in the so called Calchaquí Valleys, (provinces Salta, Tucumán and Catamarca), in northwestern Argentina (25°30'/27°S–66°W). These sedimentary units represent mainly fluvial systems with many lacustrine episodes. At least 16 fossil species of Clorophyte spores and thalli accompanying the continental palynological assemblages are described and illustrated. Common and frequent in other assemblages in Argentina are *Ovoidites parvus* (Cookson & Dettman) Nakoman, *Pediastrum simplex* (Meyen) Lemmerman, *Pediastrum boryanum* (Turpin) Meneghini, and *Botryococcus braunii* Kutzin; *Cymatiosphaera* sp. had already been recorded in the Oligocene of Argentina. Taxa as: *Sphaeroplea* sp. (probably a new species), *Lecaniella foveata* Singh; *Lecaniella irregularis* Zippi, *Lecaniella* sp. (probably a new species), *Oedogonium cretaceum* Zippi, *Coelastrum* sp., *Ovoidites spriggi* (Cookson & Dettmann) Zippi, *Ovoidites grandis*

Zippi, *Schizosporis sp.* and a indeterminate form are mentioned for the first time for the Upper Tertiary of Argentina. Comparisons with recent fresh-water Clorophyta show that these fossils lived in open, shallow, eutrophic, eventually temporary fresh-water bodies, with temperatures around 20°-21°C. *Sphaeroplea* sp. (probably a new species) is exclusive to the San José Formation, while *Ovoidites grandis, Ovoidites* sp. *Lecaniella* sp. (probably a new species), *Pedistrum simplex* and *P. boryanum*, characterize the Palo Pintado Formation. The Chiquimil Formation has no exclusive taxa. *Lecaniella foveata, Ovoidites parvus, O. spriggi* and *Botryococcus braunii* are common to the three assemblages.

A palynological classification and correlation of Late Tertiary I and Late Tertiary II in the Northern Upper Rhinegraben (Germany)

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The Lower Miocene Hydrobia Beds in the Northern Upper Rhinegraben are overlain by a thick non-marine sequence which, because of its unclear stratigraphic classification, has been denoted as Late Tertiary I in the footwall and as Late Tertiary II in the hanging wall. The character of the boundary between those two lithological units is not well known. Samples from various deep drills (Biebesheim 2, Gross-Gerau 4, Weiterstadt 1, and Gross-Rohrheim 1) of the oil industry were used for investigating the stratigraphical position of that boundary zone by palynology and to correlate the findings with the surrounding region in 1984/85 and in 1992/93. Detailed results of this campaign have not been published until now. The method of pollen ratios (as introduced by H.D. Pflug, Giessen) was used as principal tool, mainly by observing the ratio between the *Momipites punctatus* group (*Engelhardia*) and the *Triatriopollenites rurensis* group (Myricaceae). Plotting of these ratios for Late Tertiary I/II results in a curve (C/R curve) with two maximums and one minimum between them. The lower maximum lasts throughout a substantial part of Late Tertiary I, the transition to the minimum lies about 20 m below its upper boundary. The decline continues into the lower part of Late Tertiary II. Then, the values sharply increase towards the second *Engelhardia* maximum. After an additional decline both families disappear and typical Pliocene assemblages evolve, marking the hanging wall of Late Tertiary II. Further palynological characteristics are, among others, the ratios between *Pterocarya* and *Carya*: Because of an increase of *Pterocarya* they distinctively rise right below the upper boundary of Late Tertiary I, compared to small values in the footwall. A comparison with profiles from the Hanau Basin yields the following correlation:

Hanau Basin und surrounding areas	Age	Upper Rhinegraben
Pliocene Beds (Klaerbecken Beds)	Pliocene	Late Tertiary II
Salzhausen Beds (in the Vogelsberg area)	Middle Miocene (middle/late)	
Bockenheim Beds (Bockenheim-Formation)	Middle Miocene (early)	
Maintrapp (basalt)		
Congeria Beds (Staden-Formation)		
Prososthenia Beds (Praunheim-Formation)	Lower Miocene	Late Tertiary I
Landsnail Marls (Niederrad-Formation)		
Hydrobia Beds		*Hydrobia* Beds

In the Hanau Basin the boundary between *Prososthenia* Beds and *Congeria* Beds is an unconformity which corresponds to the boundary Late Tertiary I/II in the graben. Radiometric dating of a basaltic rock contained in the hanging wall at the Hanau Basin (and thus belonging to the base of Late Tertiary II) yields a Middle Miocene age. The sequence with the second *Engelhardia* maximum (in Late Tertiary II) doesn't exist in the Hanau Basin, there are, however, beds with comparable microfloras in sedimentary interbeds in the volcanic Vogelsberg area. The disappearance of typically Miocene palynomorphs (such as *Engelhardia*) and the rise of Pliocene microfloras indicate a marked gap within Late Tertiary II (between Middle Miocene and Pliocene sediments). Further to the south of the Upper Rhinegraben, Miocene contents of Late Tertiary II are missing.

Vegetation change during the Miocene in the European Alpine area

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A palynological study has been carried out in several boreholes and sections along the Alpine arc during the Miocene. This study shows that the dominant vegetation was quite similar to the forest in present day South-Eastern China. Therefore a subtropical-temperate climate is inferred during the Miocene for the european area. A comparison of the pollen spectra from different sites has been done. This comparison shows that samples from the middle Miocene age are richer in megathermic and mega-mesothermic elements (such as *Avicennia* (mangrove), Caesalpiniaceae, Melastomataceae, Rubiaceae, Euphorbiaceae, *Buxus bahamensis* type, Acanthaceae, *Bombax*, Arecaceae, Chloranthaceae, *Platycarya*, *Engelhardia*, Sapotaceae, Celastraceae, Taxodiaceae, etc.) than the ones from Serravallian-Tortonian age. The development of the mangrove (rich in *Avicennia*) in North-Eastern Spain, Southern France and Switzerland during the Miocene can be interpreted as corresponding to the Miocene climate optimum comparable to the lowest value of the $\delta^{18}O$ in Miller & Feigenson (1991). Therefore, cooler climate conditions are inferred for the Late Miocene.

MILLER K.G. & FEIGENSON M.D. 1991. Miocene isotope reference section, DSDP Site 608: an evaluation of isotope and biostratigraphic resolution. Paleoceanography 6, 1, 33-52.

Paleogeographical aspects in the palynological study of Pliocene of Platform Ukraine

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Continental Pliocene deposits depleted with faunistic remains are developed within the most part of the territory of Ukraine. Therefore, mainly paleopedological methods were traditionally applied for paleogeographic reconstruction.

Nevertheless, vegetation responds more dynamically to the environmental changes as compared to other components of animate nature. Changes in the composition of vegetative groups are caused not only by macro-cyclic variations climate but by its minor fluctuations as well.

Paleogeographic reconstruction realized by our research team was based upon results of detailed palynological Study of continental Pliocene deposits of Dnieper-Donets depression. Within given depression Pliocene deposits of Platform Ukraine are presented in full measure, and we pioneered in studying them palynologically.

During paleo-landscape reconstruction we partially used the technique proposed by A.Golbert with co-authors (Golbert et al, 1977) for Mesozoic and Palaeogene of Western Siberia, which was adopted by us for Pliocene of Ukraine. In particular, we proposed criteria for reconstruction of humidity and heat conditions in Pliocene according to palynological data. The applied technique was based on drawing up and analysis of taxonomic composition circograms and ecological structure of spore-pollen complexes, as well as relating of given circograms to topographic map at the reference cuts location with respect to their geomorphologic position. The circograms of spore-pollen complex composition, characterizinng the deposits of each Pliocene horizon for every investigated cut, were drawn up.

The performed studies allowed us to reconstruct the character of landscape changes within Dnieper-Donets Depression in Pliocene, as well as draw up the diagrams of paleoclimate basic parameters changes in Pliocene.

We have also conducted the reconstruction of July and January mean temperatures for Pliocene climatic optimums.

For this purpose the arealogram technique developed by V.P.Grichuk (1969) was applied.

GOLBERT A.V., GRIGORIEVA K.N. et al. 1977. Paleoclimate of Siberia during Crataceous and Palaeogene Periods. Moscow, Nedra, 106 p.

GRICHUK V.P., ZELICSON E.M., BORISOVA O.K. 1987. Reconstruction of climatic indices of Early Cenozoic According to paleofloristic data. In: **Climates of Earth in geological past**. Moscow, Nedra, pp.69-77.

New Oligocene leaf floras and pollen from the volcanic complex of the Evros Mountains Northeastern Greece

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After 20 years of palaebotanical prospecting of North Greece under the guidance of the first of the authors, the oldest leaf floras of Greece have been recovered near the border to Turkey. The volcanic complex of the Evros Mountains, Thrakia, NE Greece, has yielded fossil plant remains at several localities connected with Oligocene lignitebearing volcano-clastic rocks (Provaton Formation). Besides many per mineralized trunks (mostly of the evergreen *Quercus*-type), also several rich local assemblages of leaf fossils have been excavated. The radiometric dating of various magmatic bodies connected with plant – bearing levels indicates an age of 30,6 to 23,6 MA, i.e. late Early to Late Oligocene. The Oligocene age of the Provaton Formation is corroborated by brackish ostracods and mollusks. Local plant assemblages occur at Lagyna, Lyra, Lykofi, Fylakton, and Aetochori. Palms (sabaloid and *Trachycarpus*-type) dominate the assemblage of the later locality. At all the other sites the extinct representative of the Fagaceae-*Eotrigonobalanus furcinervis* prevails and is associated with co-dominant and accessory elements depending partly to various environments. Lagyna reflects a more riparian vegetation type with additional *Pronephrium stiriacum, Alnus* aff. *schmalhausenii, Fagus* aff. *antipofii, Acer* aff. *tricuspidatum* f. *crenatifolium, Cedrela attica* and Lauraceae. Lyra includes besides *Eotrigonobalanus* additional *Calocedrus suleticensis, Pinus palaeostrobus, Comptonia difformis* f. *dryandroides, Myrica longifolia, Platanus neptuni, Lauraceae, Nyssa* aff. *altenburgensis, Ziziphus ziziphoides* and more undetermined dicotyledons. At Lykofi only a poorly preserved assemblage with *Pinus palaeostrobus, Comptonia* and Lauraceae is available. At Fylakton *Eotrigonobalanus* dominates over rarely representd *Myrica longifolia*, cf., *Rhamnus* sp. and clamoid and sabaloid palms. Also eight boreholes sections from the lignite and clastic sediments are yielded in order to correlate the leaf Floras with the pollen and spores assemblages.

The Oligocene flora of Evros includes in general a mixture of the Palaeotropical/extinct and modern Arcto-Tertiary (i.e. Turgai) elements. The former are characteristic of Late (-Middle) Eocene floras of Europe and are mainly represented by *Eotrigonobalanus, Platanus neptuni, Lauraceae, Myrica longifolia, Comptonia difformis* f. *dryandroides, Ziziphus ziziphoides* and palms. The later group of broadleaved deciduous rees includes those elements, which immigrated into East Europe mainly form Central Asia via the Turgai Strait. In the Oligocene Ashutas flora of Kazakhstan the following species are analogues to the Evros assemblages: *Fagus antipofii, Nyssa* (alias *Quercus) alexeevii* and *Alnus schmalhausenii*. The Central European vicariant and partly closely allied species are *Fagus saxonica, Nyssa altenburgensis, Alnus gaudinii* and *Acer tricuspidatum* f. *crenatifolium*.

Less thermophilic plants of Evros survived to the Miocene of Evia: *Fagus, Alnus gaudinii, Comptonia, Myrica, Lauraceae, Acer tricuspidatum* f. *crenatifolium, Cedrela attica, Ziziphus ziziphoides*. The extinct Eotrigonobalanus was replaced at the Oligocene/Miocene boundary by evergreen sclerophyllous oaks.
Keywords: Palaeobotany, Palynology, Oligocene, Northeastern Greece.

Palynological studies in the southern part of the Carpathian Foredeep In the Czech Republic

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The sediments of the Moravian part of the Carpathian Foredeep are of Eggenburgian to Lower Badenian ages and of marine or brackish origin. Pollen and spores confirm a warm - subtropical climate in the whole studied interval (Sapotaceae, Palmae, Engelhardia, Lygodium, Symplocos, Reevesia, thermophile oaks...).

Practically all the Lower Miocene palynospectra are strongly facially influenced. This fact is reflected in the proportional changes between the paleotropic and arctotertiary members and it is very difficult to specify any explicit climate changes. A higher percentage of the arctotertiary elements occurred locally for example in the sediments of the Eggenburgian (Oleaceae, Chenopodiaceae, Ericaceae, Taxodiaceae) and Karpatian (Alnus, Tiliaceae, Polypodiaceae, Lythraceae, Sparganium) ages.

Oscillations in salinity and occasional higher evaporation in the marginal basins were ascertained in the Eggenburgian - Ottnangian. The vegetation of the salt marshes (Chenopodiaceae, *Tamarix*) and insolation places (Caryophyllaceae, Ericaceae) changed very quickly with the various growth stages of the swamp (Taxodiaceae, Myricaceae). Even the freshwater flora appeared (*Sparganium, Potamogeton, Nelumbo*, Cyperaceae). The genus *Nelumbo* has not occured in the younger sediments (DOLÁKOVÁ et al. 1999).

The marsh facies were common in the Karpatian palynospectra. The frequent alteration in palynomorphs caused by the crystallization of pyrite in the anoxic conditions was observed. Pollen in conglomerates testify the low dynamics of water and a short transport. The marked azonal associations (such the marsh palm forest with Sparganiaceae, facies with frequent *Intratriporopollenites insculptus* Mai - *Craigia*, Pteridaceae, Lythraceae, Oenotheraceae, riparian forest with *Alnus*) were remarkable in the lower and marginal developments of the Karpatian age. The schlier facies was connected with an increasing of Pinaceae and marine microplankton amount. This fact is related to the real marine conditions and a greater distance to the shore (Doláková 2002).

The Badenian palynospectra were also rich in marine Dinoflagellata. The tapeta of foraminifers were found. In the Badenian palynospectra higher differentiation of the pollen of Quercoideae - thermophile likewise deciduous are observed. Pollen of Gothanipollis gothani Krutzsch and Tricolporopollenites indeterminatus (Romanovicz) Ziembinska- Tworzydlo wery determined at first. Pollen of Caryophylaceae occurred regularly.

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DOLÁKOVÁ N., HLADILOVÁ Š. & NEHYBA S., 1999. Development of Sedimentation, molluscs and palynospectra in the Lower Miocene of the south-western Part of the Carpathian Foredeep in Moravia (Czech Republic). **Acta Palaeobotanica**, Suppl. No. 2, W. Szafer Institute of Botany, Polish Academy of Sciences, Krakow, 269-278.

Pollen and dinoflagellates in the upper Tortonian section of the continuous "Huelva" dill core. Paleoenvironmental interpretation

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The "Huelva" core sample was extracted near the bull ring in the city of Huelva (Guadalquivir basin). It is a continuous core of 10cm diameter section and 197.5m deep. The sediments record the last 4m of the "Calcarenita de Niebla" formation from the upper Tortoniense and the whole "Arcillas de Gibraleón" formation which includes the Tortonian – Messinian boundary and a large part of the Mesiniense (Civis *et al.*, 1994). The age has been determined by five planktic foraminiferal bioevents which have been correlated with other Atlantic and Mediterranean areas.

In this paper the palynological content of the samples corresponding to the upper Tortonan section of the "Arcillas de Gibraleón" formation (between 169.5m and 164m) is studied. In these samples two of the planktic foraminíferal bioevents identified are found: the first, Event 2 of Sierro *et al.* (1993), is found at a depth of 168.9m and the second, Event 3 of Sierro *et al.* (1993) at a depth of 164m.

The samples are in general abundant. Among the continental forms *Pinus* predominates, but there are also good percentages of spores (27.5%) and wingless pollen (21.8%). As far as the dionflagellate cysts are concerned, they reflect a neritic environment with predominance of the *Spiniferites/Achomosphaera* group although it progressively decreases. Alongside this ,there is a greater representation of outer platform and cosmopolitan forms than of the coastal. With respect to the temperature, thermophile/cold intolerant elements stand out.

From the sample 168.9 there is a large increase in the abundance and diversity among the marine forms; the pollen increases quantitativley thanks to the increase in *Pinus*, but the diversity decreases a lot due to

the disappearance of many Angiosperms and the sharp drop of spores. The dionflagellates reach their maximum abundance and diversity although the *Spiniferites/Achomosphaera* group continue decreasing.

The last samples studied in this section of the core are quite different as far as the the palynomorphs being rich but not very diverse. The set of dionflagellates is dominated by *O. janduchenei*, that show higher percentages than the *Spiniferites/Achomosphaera* group. These are followed in importance by oceanic species; the rest of the species are practically reduced to a presence. Among the pollen the Angiosperms practically disappear, *Pinus* being the only one found along with a small portion of spores.

CIVIS, J., ALONSO GAVILÁN, G., GONZÁLEZ DELGADO, J.A. & BRAGA, J.C. 1.994. Sédimentation carbonatée transgressive sur la bordure occidentale du couloir nord-betique pendant le Tortonien supérieur (Fm. Calcarenita de Niebla, SW de l'Espagne). **Géol. Méditerran**. 21(1-2): 9-18.

SIERRO, F.J., FLORES, J.A., CIVIS, J., GONZÁLEZ DELGADO, J.A. & FRANCÉS, G. 1.993. Late Miocene globorotaliid event-stratigraphy in the NE Atlantic and Mediterranean. **Mar. Micropaleontology**. 21: 143-168.

The first litho-palynostratigraphic scheme for Paleogene-Neogene deposits of anadyr shelf, Russia

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In 2002 year the first deep well within Russian sector of Bering sea shelf was drilled by OAO "SIBNEFT". It was placed in 180 kilometers from the Anadyr coast forward to the east and has amounted 2785 meters of the depth. The complex researches of the lithology of the opened deposits and the distribution of different palynomorph groups (spores, pollen, microalgae such as dinoflagellate chlorophytae and other organic residues) on the section Tsentralnaya hole 1 have permitted to create the first enough detailed scheme of subdivusion for Paleogene-Neogene deposits of Anadyr shelf. For the first time this scheme is presented lower.

Vegetation changes of the Baikal region based on palynological study of Lake Baikal sediments in Russia

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The Baikal Drilling Project (BDP) succeeded in drilling cores of 200m (BDP96-1) (uppermost 6m missing) and 600m (BDP98-2) (uppermost 2m missing) length from the bottom (at 335m and 382m water depth) of the Academician Ridge in Lake Baikal. Our pollen analyses of the BDP96-1 and BDP98-2 core samples from Lake Baikal revealed detailed change of the floral characteristics from late Miocene to near present. It is therefore suggested by this study that recent floral composition in the Baikal region came out of the extinction of many broad-leaved trees as a result of environmental changes and that the changes occurred quickly at two times: around 8.6 Ma and around 1Ma.

At the first, the result of pollen analysis of 480-600m samples of BDP98-2 supported the composition found at northern Baikal, demonstrating that the pollen proportion of broad-leaved trees from the samples was

high, and many taxa existed. However, an abrupt change was found around 8.6Ma. The pollen content of vegetation before 8.6Ma was characterized by abundant broad-leaved tree genera, but after 8.6Ma, only *Betula* and *Alnus* pollen were abundant among broad-leaved tree genera. SFI (Steppe/Forest Index)(Travers,1988) also shows drastic increase at 8.6Ma, reflecting the intensification of dry conditions.

The second, the flora in early Pleistocene characterized by a large proportion of conifer pollen and a small quantity of broad-leaved tree pollen, though *Betula*, *Salix* and *Alnus* were present at a considerably higher rate than were found in the northern Baikal palynological study (Kulchitskii et al., 1993). Floral change in that geographic location ranged from savanna to desert that included some forest/steppe through Pliocene (Kawamuro et al., 2000). There were many plant genera and some families that declined in proportion and became extinct rapidly in the regions surrounding Baikal. Some typical genera growing commonly under suitable conditions for such plants in Siberia were partially extinct in late Pliocene and extinct during early Pleistocene. Regarding conifers, *Tsuga* suffered a steep decline at 2.5Ma, and after some restoration in numbers from 2.0Ma to1.4Ma, ceased to exist in the Baikal region at 1.3Ma. Taxodiaceae was evident in samples from 5.0Ma and ceased to exist at 1.2Ma in the region. *Cedrus* pollen continued during 4.2Ma and 1.5Ma, but declined after 1.5Ma. *Podocarpus* pollen that was similar in occurrence to *Cedrus*, became extinct earlier at 2.2Ma. These genera and families have disappeared in the Baikal area in recent times.

Within the broad-leaved trees, deciduous and evergreen were evident in the group consisting of *Quercus*, *Castanea* and/or *Castanopsis*, *Ulmus* and/or *Zelkova*, *Celtis* and *Corylus* and/or *Carpinus*, both under warm and cool temperate climate conditions, but declined from 2.5Ma to 1.5Ma. *Celtis* declined at 1.6Ma, but other genera and families were extinct between 1.2Ma and 1.0Ma. *Tilia* was evident until 2.5Ma, but declined from that period and was extinct just before 1.5Ma. *Acer* oscillated in that period, but disappeared near 1.5Ma in the Baikal area. After the beginning of Pleistocene, arctic flora characteristically was present, especially tundra vegetation in the glacial ages.

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A Neogene dinoflagellate cyst biozonation for the Norwegian-Greenland Sea

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A new dinoflagellate cyst zonation for the Neogene of the Norwegian-Greenland Sea is proposed. The zonation build on biostratigraphic information from ODP sites in the Norwegian-Greenland Sea and from stratigraphic and deep wells on the Norwegian Shelf off mid Norway and on the western Barents Shelf margin. The new dinoflagellate cyst biozonation is based on last occurrences of selected dinoflagellate cyst species. The zonation tied to a chronostratigraphic framework by using correlation to the magnetostratigraphy and oxygen isotope stratigraphy, as well as other biostratigrahic datums, of ODP Legs 104, 151 and 162. The Neogene chronostratigraphic interval is divided into 3 zones covering the Pleistocene and Pliocene, and into 11 zones covering the Miocene. The zonation is considered applicable throughout the North-Atlantic Gateway. The application of dinoflagellate cysts for biostratigraphic purpose in the Upper Pliocene and younger sequences may, however, often be hampered by low productivity and extensive reworking in the glacially influenced units. In addition there are obvious provincial differences between the Atlantic water influenced assemblages along the Norwegian Coast and the Greenland current influenced assemblages through the Pleistocene, Pliocene and possibly also the Late Miocene.

Mid-latitude Eocene-Oligocene dinoflagellate cyst assembalges from Kyushu, Japan; A link between Tethyan and northwestern pacific realms

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Paleogene dinoflagellate cysts in the NW Pacific have been studied in the high-middle to high latitudes (e.g., Bering Sea and northern North Pacific by Bujak, 1984; northern Japan by Kurita and Matsuoka, 1994, and others) and in the high-low latitudes (East China Sea by Yu, 1984, and others). For implementing the missing between those regions, recent data accumulation was made in the Paleogene in southwest Japan. The Kyushu region in southwestern part of the Japanese Islands, located just north of the East China Sea, has good exposures of Eocene- Oligocene sediments of nonmarine and shallow-marine origin. Several data from calcareous nannofossils provided age controls. These make a good background for the dinoflagellate study in a region between the Tethyan realm (East China Sea) and the possible "northwestern Pacific realm".

The Eocene assemblages from northwestern Kyushu include following species; Areosphaeridium diktyoplokum, Cordosphaeridium inodes, Cordosphaeridium sp. cf. C. exilimurum, Dracodinium similis/solida, Dracodinium varielongituda, Glaphyrocysta exubarens, Glaphyrocysta sp. cf. G. intricata, Phthanoperidinium comatum, P. echinatum, Selenopemphix nephroides, Wetzeliella articulata. In addition to this information from the Eocene, recent occurrences from the Oligocene sediments in the same region suggest significant changes in species composition across the Eocene-Oligocene boundary, although their details are still under consideration.

These data from the Kyushu region indicate possible extension of the Tethyan elements from the East China Sea into southwest Japan during the Eocene, which is contrasting to the northern assemblages. The development of this biogeographical contrast in dinoflagellates between the low and high latitudes along the East Asian continental margin, and its probable relation to the Terminal Eocene cooling, will be better drawn by further comparison of the data from southwest Japan.

Evolution of paleomycoflora from Late Cretaceous to Neogene in northeastern India

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The fungal population recovered from the Late Cretaceous to Neogene sediments of Garo and Khasi Hills in Meghalaya and from the Neogene sediments of Mizoram comprises altogether 54 genera and 186 species. The data accumulated from 10 traverse sections of Meghalaya and Mizoram has been utilized to compile the stratigraphic chart indicating the distribution pattern of fossil fungal remains from Late Cretaceous to Pliocene. The stratigraphic distribution pattern of the paleomycoflora has been utilized in evaluating the pattern of evolution of fungi from Late Cretaceous onward.

Poor diversification of fungi in the Late Cretaceous palynoflora was possibly due to the want of suitable host especially the suitable angiosperms. Inaperturate monocellate (e.g.*Inapertisporites*), Inaperturate multicllate (e.g. *Multicellites*), Monoporate (e.g.*Monoporisporites*, *Multicellaesporites*), diporate (e.g. *Diporicellaesporites*, *Anatolinites*, *Colligerites*) and many other types especially of smooth walled types are representing the Late Cretaceous paleomycoflora. From Paleocene onward, however, the paleomycoflora gradually became diversified both in quantitative and qualitative aspects with the pick generic and species diversity during the Neogene. The fungal spore association comprised from simple inaperturate, psilate to multicellular and ornamented forms. Environmental fluctuation caused by sea level changes and tectonic activities in and around the basinal area possibly was responsible for the fluctuation of diversity of fungi from Paleocene to Pliocene. The fungi could have evolved rapidly simultaneously with the rapid evolution of woody vegetation from Paleocene to Miocene period in Meghalaya and Mizoram.

Palynological basis for palaeoenvironmental interpretation of Cenozoic successions in the Yarlung Zangbo Suture area, Xizang (Tibet)

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An interpretation of the palaeoenvironmental evolution of the Yarlung Zangbo Suture area, Xizang (Tibet) during the Cenozoic Era is presented based on a palynostratigraphic and palynofacies study of two sections of the Lhasa terrane located near the suture. Three episodes of rapid uplift are recognized to have taken place during the Paleocene–Early Eocene, Late Eocene and Early Miocene (or Oligocene/Miocene transition); of these, the second is somewhat tentative. Intervening periods are considered to have been relatively stable. The periods of uplift led to the deposition of three suites of molasse sediments in the research area, represented by the Quxia Formation, the conglomerates in the lowest part of the Qiuwu Formation, and the basal conglomerates of the Dazhuka Formation respectively. The first episode may have led the terrane to be intermittently exposed to the atmosphere, while the second ended the marine history of this area and initiated the development of widespread swampy environments that are preserved as coals in the Qiuwu Formation. The last uplift led to the formation of hilly topography, which is reflected by the varicolored, coarse conglomeratic sediments of the Dazhuka Formation. During the whole process, the environments represented in Xizang were comparable to those of the modern southern margin of China, i.e., ranging from tropical to near tropical and from a shallow sea to mountains with peaks up to 1000–1500 m high.

Broad-scale floristic change across the Cretaceous-'Tertiary' in Australia

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Large databases of spore and pollen records have been used to study changes in palynofloras of Australia and North America (Lidgard and Crane, 1988; Crane and Lidgard, 1990; Lupia et al., 1999; Nagalingum et al., 2002). An Australian Cretaceous palynoflora database was used to study changes in the Australian pollen and spore record of various plant groups (Nagalingum et al., 2002). We expanded the Australian Cretaceous palynoflora database by incorporating Paleocene and Eocene assemblages. Inclusion of these additional assemblages permitted examination of long-terms floristic trends in Australia from the Cretaceous through the 'Tertiary'.

The extended database comprised 1529 samples, each of which comprised ten or more species of pollen and spores. Trends in palynomorphs were calculated using moving averages. Palynomorphs were grouped under major plant categories: angiosperms, gymnosperms and free-sporing plants. Each major plant category was sub-divided to study the changes in each of its constituent groups, e.g. gymnosperms were separated into conifer families. Angiosperm groups that contribute significantly to the modern Australian flora were also examined; some of these include Nothofagus and Proteaceae. These angiosperms show small increases in diversity during the Late Cretaceous. However, in the Paleocene and Eocene they display significant rises in diversity and become the main contributors to palynofloras.

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