



## Forenings- meddelelser

### Nordisk Geologisk Vintermøde 2000 i Trondhjem, Norge – Ansøg DGF om tilskud

Danske specialestuderende har nu mulighed for at få dækket deres rejseudgifter ved deltagelse i de nordiske geologiske vintermøder. Midlerne stammer fra overskuddet fra 23. Nordiske Geologiske Vintermøde i Århus i 1998.

Ansøgning om tilskud til rejser indsendes til DGF. Yderligere oplysninger og ansøgnings-skema findes på DGF's websted – 2dgf.dk.

Ansøgningerne bedømmes af to af Dansk Geologisk Forenings bestyrelsesmedlemmer, et fra København og et fra Århus.

#### Retningslinier:

- 1) Der gives tilskud til danske specialestuderendes deltagelse i Nordisk Geologisk Vintermøde under forudsætning af, at ansøgeren skal holde foredrag eller præsentere poster. Abstract skal indsendes sammen med ansøgningen.
- 2) Der gives principielt kun tilskud til én forfatter i forbindelse med et foredrag eller en poster.
- 3) Som kvittering for bevillingen skal der indsendes en kort rapport (max. en halv A-4 side) til Dansk Geologisk Forening umiddelbart efter hjemkomsten fra mødet.

## Kommende møder

### Dansk Mineralogisk Selskab

Møderne afholdes fredage på Geologisk Museum, Øster Voldgade 5–7, København.

### DGF FORUM

#### For Anvendt Geologi

Tirsdag d. 20. april 1999 kl. 17–21: **Møde om oliegeologi** arrangeret i samarbejde med Mærsk Olie og Gas samt SPE. Mødet afholdes hos Mærsk Olie og Gas, Esplanaden 50, 1263 København K. Begrænset antal deltagere. Tilmelding og eventuelle spørgsmål til:

Poul Henrik Due, Teknologisk Institut, Byggeri, Tlf. 4350 4118 eller e-post: forum@geologi.com.

#### Program:

Kl. 17.00: Social event

Kl. 18.00: Mærsk Olie og Gas: *Geology of the Tagi reservoir in Algeria.*

Kl. 18.20: Mærsk Olie og Gas: *Integrated geophysical and geological study of the reservoir potential of the chalk sequence in the Danish Central Graben.*

Kl. 18.40: Amerada Hess: *South Arne geological model.*

Kl. 19.00: Spisning.

Kl. 20.00: Phillips Petroleum: *Maturity modelling of the southern flank of the Rub al Khali Basin.*

Kl. 20.20: Statoil: *Siri field geological model.*

### Malmgeologisk Klub

Møderne afholdes på Geologisk Institut, Østervoldgade 10, København.



### Palæontologisk klub

Tirsdag d. 13. april 1999: P. Christiansen: *En vægtig succes: Elefanternes udvikling.*

Tirsdag d. ?. april 1999: T. Ekdale: *Om sporfossiler, K/T grænse m.v.*

Tirsdag d. 27. april 1999: P. Makovicky: *Dinosaurer og æg fra Gobi.*

Tirsdag d. 4. maj 1999: R. Bromley & B. Richter: *Computer-forfalskning af fossilillustrationer.*

Tirsdag d. 11. maj 1999: R. Dingle: *Palaeoclimates, pre- and early glacial in Antarctica.*

### Petrologisk klub

Foredragene finder sted onsdage kl. 12.15–13.00 i auditorium a, trappe A, 2. sal på Geologisk Institut, Øster Voldgade 10, København. Henvendelse om foredrag til Poul Martin Holm, e-post: paulmh@geo.geol.ku.dk, Lotte Melchior Larsen, e-post: lml@geus.dk eller Minik Rosing, e-post: minik@savik.geomus.ku.dk.

Onsdag d. 7. april 1999: Birgitte Printz Christensen (GI): *Vulkaniter fra Kap Verde Øerne.*

Onsdag d. 14. april 1999: Erik Krogstad (DLC): (emne endnu ikke fastlagt).

Onsdag d. 21. april 1999: Henrik Stendal (GI): *Guld i Sydgrønland – genese.*

Onsdag d. 28. april 1999: Henriette Hansen (DLC): *Genesis of high Tipicrites in East Greenland.*

Onsdag d. 5. maj 1999: Michael Storey (DLC): *3.9 Ga pillow lavas from Issua, West Greenland.*

Onsdag d. 12. maj 1999: Adam Garde (GEUS): *Ketiliderne.*

Onsdag d. 19. maj 1999: Lars Ole Boldreel (GI): *Færøerne i Tertiær.*

Onsdag d. 26. maj 1999: Jens Konnerup-Madsen (GI): *Fluids in South Norway.*

Onsdag d. 2. juni 1999: Bjørn Hageskov (GI): *Shearzone- & forkastningsproblemer langs Oslo riftens østrand.*

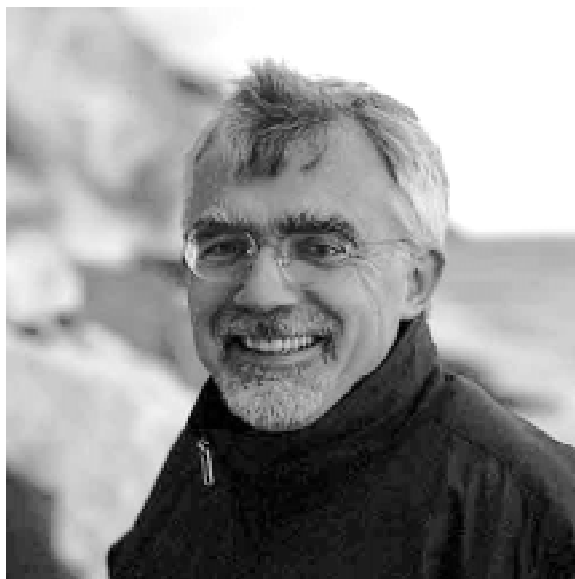
Onsdag d. 9. juni: Jesper Øksne Jørgensen (GI): *Oceanic carbonatites.*



### Sedimentologisk klub

Alle foredrag holdes onsdage kl. 15.00 i mødelokale 3, trappe B. 3. sal på Geologisk Institut, Øster Voldgade 10, København.

## DGF Afholdte møder



Torsdag d. 3. december 1998:

### Temamøde: **Uro i Danmarks og Grønlands Undergrund**

På mødet blev Danmarks Geologipris, der er på 25 000 kr tildelt Peter Japsen.

Peter Japsen er geofysiker og ansat som seniorforsker ved Danmarks og Grønlands Geologiske Undersøgelse (GEUS). Peter Japsen har siden 1980 arbejdet med forskellige aspekter af Nordsøens geologi, herunder teorier vedrørende landhævning og erosion i Danmark og Nordsøen. Hans forskning bidrager også til den fortsatte udnyttelse af Nordsøens olie- og gasforekomster.

Prisen uddeles én gang om året af Danmarks og Grønlands Geologiske Undersøgelse (GEUS) efter indstilling fra Dansk Geologisk Forenings bestyrelse.

James A. Chalmers (GEUS): *Den Kænozoiske hævnning i Grønland: Islandsk plume, glacial erosion fra istiden eller noget andet?*

There appear to have been at least two significant episodes of uplift around the North Atlantic during the Cenozoic, and in many places it is not easy to separate the two. Effects related to emplacement of the Iceland plume probably caused one episode, mostly in the Palaeogene. The second episode took place in the late Cenozoic, and comprised uplift of basin margins as well as accelerated subsidence of basin centres. Cenozoic uplift of Scandinavia and of the British Isles has been suggested since at least the beginning of the 20th century. However, it is only recently being recognised in the literature that a major Neogene tectonic event has affected nearly every continental margin in the area (including western and eastern Greenland) and far into the European craton. Pre-Cenozoic rocks are generally exposed onshore and the pre-Quaternary sediments offshore are generally of Neogene age. Between the two, inclined

Palaeogene and older beds are truncated by erosional unconformities along many coastlines. Accelerated late Cenozoic subsidence is well known in many offshore areas adjacent to the uplifted landmasses. A variety of methods that have been used to investigate uplift, erosion and redeposition: studies of maximum burial, fission tracks, geomorphology, sediment supply and of structural relations. These methods each investigate only one aspect of the phenomenon, and a thorough understanding of the processes of uplift and erosion can only be achieved if results from these methods are integrated.

The main mechanisms suggested in the literature for the large-scale, late Cenozoic events are: emplacement of magma in and at the base of the crust leading to isostatic uplift, flow of asthenospheric material into active diapirs, isostasy associated with glacial erosion, phase changes in the lithosphere due to pressure relief and regional compression of the lithosphere. A general model must be constrained by observations from all affected areas and must be based on several methods rather than just one. It must also take into account that the fact that the effects reach well into the craton.

L.O. Boldreel (GI) & M. S. Sparre (GEUS): *Vertical movement on the northern part of the Faroe-Rockall plateau during the Cenozoic as illustrated from reflection seismic data.*

L. Jensen (StatOil): *Kænozoisk hævnning af Skandinavien.*

Ole Graversen (Geologisk Institut, København): *Pliocene hævnning af Det danske Bassin.*

En strukturel analyse af den præ-kvartære flade i Danmark viser, at Palæogen og Neogen har gennemgået en række intraplade-deformationer. De tektoniske faser kan registreres som regionalt udviklede diskontinuitetsflader og ved den lithologiske ændring omkring grænserne (Graversen 1998, submitted). I Midtjylland styres bassinindsynkningen i Miocæn af en V-dykkende akse. Den senere deformation af de miocæne aflejringer følger derimod en NV-dykkende foldeakse, der viser, at det post-miocæne regionale stressfelt er ændret. Den nye retning er parallel med kurverne for den neogene hævnning (Jensen & Michelsen 1992, Japsen 1992, 1993), og vitrinitreflektansdata (Thomsen i Koch 1989) viser, at 200 m hævningslinjen går igennem Søby-Fasterholt området i Midtjylland (Fig. 1).

Ved overgangen til Pliocæn forskydes kystlinien (coastal onlap) mod sydvest (Michelsen 1994), og det foreslås, at denne relative havniveausænkning kan relateres til den initiale fase af den neogene hævnning. Denne model bekræftes af den fortsatte forskydning af kystlinien ud i bassinet op igennem Pliocæn (Michelsen 1996).

Esrum-Alnarp dalen er en graben, der gennemskærer Danien kalken i den Fennoskandiske Randzone. Graben er formodentlig etableret i Eem-Weichel (ældste aflejringer: tidlig Weichel, Schuldt 1981), og det viser, at hævnning og strækning af skorpen kan registreres frem til sen Pleistocæn. Erosionen efter anlæggelse af graben andrager omkring 100 m.

Den regressive og trinvis udvikling af marint onlap igennem Pliocæn og etableringen af Esrum-Alnarp Graben viser at den Plio-Pleistocæne hævnning af Det danske Bassin må antages at være foregået i en række adskilte faser. Geodætiske målinger af de vertikale ændringer af Danmarks søbøve overflade viser sammen med jordskælvsaktiviteten

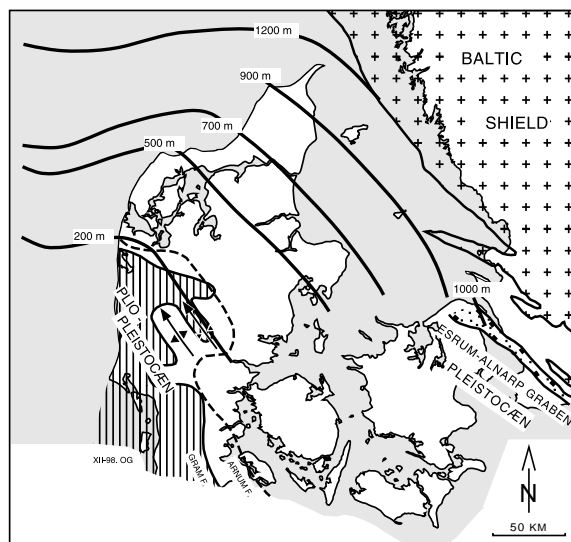


Fig. 1. Plio-Pleistocæn hævnng og deformation af Det danske Bassin. Hævnngslinier (500-1200 m) efter Jensen & Michelsen (1992) modificeret i.h.t. Japsen (1992).

langs den Fennoskandiske Randzone at hævnng/indsynkning af Det danske Bassin fortsat er aktiv.

Gravarsen, O. 1998: Intra-plade deformation af de palæogene og neogene formationer i Danmark. Asger Berthelsen Symposium, Geologisk Institut, Københavns Universitet, *Abstracts*, 25-26.  
 Gravarsen, O. submitted: Paleogene-Neogene intraplate deformation of the Danish Basin. *Bulletin Geological Society of Denmark*.  
 Japsen, P. 1992: Landhævningerne i Sen Kridt og Tertiær i det nordlige Danmark. *Dansk Geologisk Forening, Årsskrift for 1990-91*, 169-182.  
 Japsen, P. 1993: Influence of Lithology and Neogene Uplift on Seismic Velocities in Denmark: Implications for Depth Conversion of Maps. *American Association of Petroleum Geologists Bulletin*, 77, 194-211.  
 Jensen, L. N. & Michelsen, O. 1992: Tertiær hævnng og erosion i Skagerrak, Nordjylland og Kåtetgat. *Dansk Geologisk Forening, Årsskrift for 1990-91*, 159-168.  
 Koch, B.E. 1989: Geology of the Søby-Fasterholt area. Geological Survey of Denmark, Ser. A, 22, text 171pp, atlas 121 pp.  
 Michelsen, O. 1994: Stratigraphic correlation of the Danish onshore and offshore Tertiary successions based on sequence stratigraphy. *Bulletin Geological Society of Denmark*, 41, 145-161.  
 Michelsen, O. 1996: Late Cenozoic basin development of the eastern North Sea Basin. *Bulletin Geological Society of Denmark*, 43, 9-21.  
 Schuldt, J. 1981: Om Esmørdalens geologi. *Dansk Geologisk Forening, Årsskrift for 1980*, 77-81.

**Ole Valdemar Vejrbæk (GEUS): *Extent and thickness of the Lower Palaeozoic in the Baltic.***

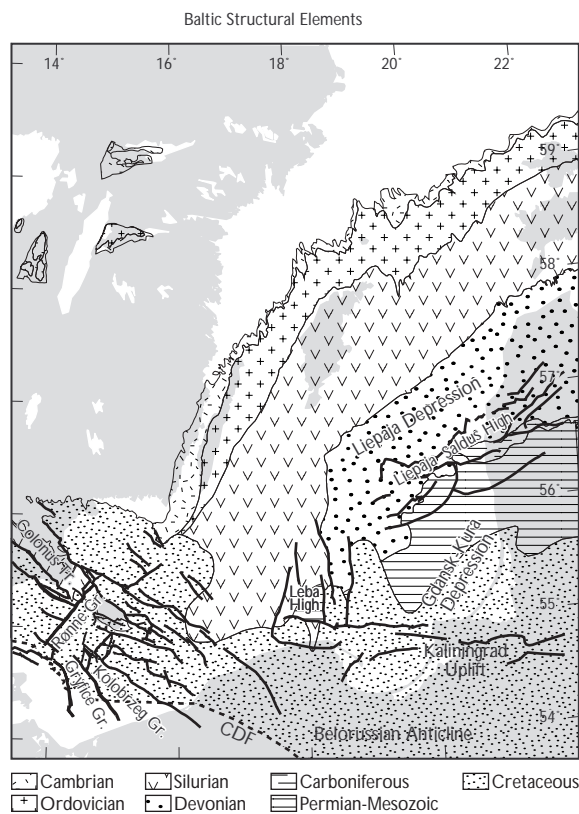
Regional mapping of the Lower Palaeozoic in the Baltic Sea in co-operation between Sweden, Latvia, Lithuania, Poland and Denmark has resulted in regional maps in the scale 1:1.000.000. Four isopach maps covering 1): Vendian and Lower Cambrian, 2): Middle and Upper Cambrian and the Tremadoc, 3): The Ordovician, and 4): The Silurian illuminate important phases in the structural development of the Baltic Sea area.

The Cambrian period is characterised by slow post-rift subsidence following a mild Vendian rifting along a NNE-SSW axis centrally in the Baltic and known as the Central Baltic rift. This is reflected by an axial depocenter with the thickest portion to the South. Vendian sediments are thus only significant in the axial part from Estonia to Poland. In the East a change from muddy and sandy deposition to no deposition took place during the Middle and Late Cambrian whereas more or less continuous deposition of organic rich shales took place to the west.

The onset of the Caledonian Orogeny is heralded with the changed thickness patterns in the Ordovician. The southern

Platform edge was uplifted resulting in thickness minima and the depocenter shifted to the eastern Jelgava Depression. A similar, but less developed North-Estonian depression was separated from the Jelgava Depression by the South-Estonian uplift. The main phase of the Caledonian Orogeny was reflected by the rapid deposition of the Silurian deposited in a foreland basin setting. Rates of deposition changed from 1 to 10 m/Ma as reported for the Alum Shale to in excess of 500 m/Ma in the Ludlow. This phase is thought to be coeval with the main phase of the Caledonian Orogeny.

The Silurian is erosionally truncated by overlying Devonian deposits in the central eastern portion of the Baltic area. The Liepaja-Saldus High with the associated Liepaja and Gdansk-Kura Depressions were formed in the latest Silurian earliest Devonian probably corresponding to a final phase in the Caledonian Orogeny, and are thus post depositional features. Outside the Devonian occurrences, the erosional truncation of the Lower Palaeozoic succession is even bigger, and the extent of the entire Baltic Synclinorium is defined by erosion. To the North, the limit is found in the Pre-Quaternary whereas the erosional limit to the south towards the Belorussian Anticline (the Beloruss-Mazury High) is deeply buried beneath Permian and Mesozoic sediment (the so-called Alpine Complex) in excess of 1 km. Additional structural elements affecting the Lower Palaeozoic succession are the Leba High initiated in the Late Carboniferous – Early Permian coeval with the major structural element in the Bornholm area. In the Bornholm area, and to a minor extend in the Leba High area further modification of the Lower Palaeozoic structural setting took place during the Laramide inversion phase.



## DGF Generalforsamling

Generalforsamlingen afholdtes på Geologisk Museum, mandag den 22. februar kl. 17.

Efter formanden Svend Stouges velkomst var dagsordenen følgende:

### 1. Valg af dirigent.

Formanden foreslog Peter Konradi. Peter Konradi blev enstemmigt valgt og konstaterede, at generalforsamlingen var lovligt indkaldt i Geologisk Tidsskrift og gav derefter ordet til Svend Stouge.

### 2. Formandens beretning.

1998 har været et godt år for foreningen. Nordisk Geologisk Vintermøde i januar var vellykket og gav overskud. Dette overskud er overført til DGF og skal bruges til rejsestøtte til studerende, som ønsker at deltage i kommende nordiske geologiske vintermøder. Generalforsamlingen blev i år afholdt i Århus i forbindelse med vintermødet. Efter generalforsamlingen holdt Karen Luise Knudsen (modtager af Danmarks Geologipris 1997) foredrag. I februar måned besøgte AAPG's distinguished lecture Dr. Roure fra Frankrig København og holdt foredrag. I maj måned arrangerede DGF en foredragsserie om Neogene Tectonics of the North Atlantic area. Den 2. oktober afholdte foreningen i samarbejde med Geologisk Institut et seminar i anledning af, at A. Berthelsen fyldte 70 år. I december måned afholdte foreningen det årlige temamøde i forbindelse med overrækkelsen af Danmarks Geologipris for 1998 til Peter Japsen fra GEUS. Prisen blev overrakt af fungerende direktør ved GEUS, Martin Ghisler.

### 3. Fremlæggelse af regnskab.

Torsten Hoelstad fremlagde et regnskab, der viste at foreningens økonomi er sund. Der er også i 1998 kommet flere medlemmer i foreningen. Regnskabet blev godkendt af forsamlingen. Begge revisorer har gennemgået regnskabet og godkendt det uden anmærkninger.

### 4. Fremlæggelse af budget 1998.

Torsten Hoelstad fremlagde et budget der var i overensstemmelse med det netop gennemgåede regnskab. Budgettet blev enstemmigt vedtaget. Torsten Hoelstad foreslog, at kontingentet i 1999 hæves til 440 kr for ordinære medlemmer og til 220 kr for studerende. Der var enighed om at støtte kasserens forslag.

### 5. Evt. indkomne forslag.

Der var ikke indgået nogle forslag til bestyrelsen inden generalforsamlingen.

### 6. Valg af formand.

Svend Stouge blev genvalgt som formand.

### 7. Valg af øvrige bestyrelse.

Følgende blev valgt ind i bestyrelsen: Ida L. Fabricius, Lars Clemmensen, Torsten Hoelstad, Walter Kegel Christensen, Poul Henrik Due og Ole Rønø Clausen.

### 8. Valg af revisorer.

Knud Binzer og Peter Konradi blev genvalgt som revisorer.

### 9. Eventuelt.

Ingen fremførte bemærkninger under dette punkt.

Efter generalforsamlingen var der foredrag ved årets modtager af Danmarks geologipris for 1998, Peter Japsen.

Torsdag 4. februar, 1999: Peter W. Homewood (Elf Exploration Production, Pau, Frankrig): *Stratigraphy – Making Science of an art.*

I samarbejde med American Association of Petroleum Geologists (AAPG) præsenterede DGF årets AAPG Distinguished Lecture:

Stratigraphy, the study of sedimentary strata, is a major source of both hard and soft knowledge in the exploration for and production of hydrocarbons. Over two centuries, the push and pull between science and technology has provided the backdrop to developments in specialist sub-disciplines linking industry and academia. Today the movement is towards integration of the varied approaches and data types that have been perfected.

The recent development of 3-D referencing and imaging technologies leads to the novel requirement for a much greater degree of continuity and precision in stratigraphic knowledge. For example both standard facies models and classical biozonations lack requisite detail at the scale involved. They are no longer sufficient to constrain geological models for hydrocarbon prospect evaluation. They are even less satisfactory when developing reservoir models and when positioning production wells and their complex trajectories. Standard remedies enhance their performance by the use of quantitative data.

Theoretical advances are pulling the subjective practice of stratigraphy into the realm of hard science and technology. An example lies in the inversion of stratigraphic data, which may provide insight on the possible ranges in value of parameters such as subsidence, sea level variation and sediment supply. High resolution stratigraphic models, supplying more appropriate soft knowledge than facies models are another example.

Tools such as 3-D imaging and inversion require a new look at the stratigraphic record, at what may be registered within it, and how to exploit that information. The evaluation of multiple hypotheses, the measure of uncertainty and the notion of error are gaining ground in the realm of stratigraphy. Rather than turning this art into a sterile science, these developments broaden the scope of stratigraphy to constrain geological interpretations within the boundaries that exist in the real world.

## DGF FORUM

### For Anvendt Geologi

Onsdag d. 17. marts 1999, Geologisk Museum, København: **Den usynlige geolog – en debataften om geologerne i Danmark.**

Jens Morten Hansen (Forskningsstyrelsen), Gunnar Larsen (Fyns Amt): *Geologerne nu og i fremtiden.*

Martin Ghisler (GEUS), Bjørn Buchardt (Geologisk Institut, København): *De kommende geocentre.*

Bjarne Skovbro (Mærsk Olie og Gas), Jens Gregersen (Hedeselskabet), Gyrite Brandt (Københavns Vandforsyning): *Erhvervslivet og geologerne.*

Efterfølgende diskussion: *Samarbejde på tværs i den geologiske verden.*

Onsdag d. 24. marts 1999, Fysisk Institut, Århus Universitet: **Den usynlige geolog – en debataften om geologerne i Danmark.**



Steen Andersen (Skov- og Naturstyrelsen), Gunnar Larsen (Fyns Amt): *Geologerne nu og i fremtiden*  
 Olaf Michelsen (Århus Universitet), Poul Henrik Due (Forum for Anvendt Geologi)(stand-in for Martin Ghisler):  
*De kommende geocentre*  
 Bjarne Skovbro (Mærsk olie og Gas): *Erhvervslivet og geologerne*  
 Efterfølgende diskussion: *Samarbejde på tværs i den geologiske verden.*



## Palæontologisk klub

Tirsdag d. 29. september 1998: Professor Tong Jinnan (Wuhan): *The Permian and Triassic Transition in South China*. The mass extinction at the Paleozoic and Mesozoic transition is the biggest one during the Phanerozoic. While a big regression took place in many places of the world at the end of the Paleozoic, a remarkable transgression happened in South China during Changhsingian, the last stage of the Paleozoic. Thus a number of continuous marine Permian and Triassic sedimentary sequences exist in the various palaeogeographic sedimentary facies of South China, which probably recorded the whole process of this great transition.

The Meishan Section in Changxing, Zhejiang Province is not only the type section of the uppermost stage of the Permian but also a candidate of the GSGP (Global Stratotype Section and Point) of the PTB (Permian Triassic Boundary). Multidisciplines have been applied to the study of this section in order to establish an appropriate GSGP of PTB and reveal the critical events during the Permian and Triassic Transition.

Mandag d. 5. oktober 1998: David A.T. Harper (Geological Museum): *Sun, sand and brachiopods - a Tertiary-Pleistocene Caribbean cocktail*. Over 50 brachiopods taxa occur throughout the upper Cretaceous – Pleistocene successions of the Caribbean region. Although over 60 living species have been described from the Caribbean Sea, many are based on few specimens and some genera such as *Argyrotheca* and *Tichosina* that account for 13 and 21 species, respectively: some are almost certainly synonyms. Most fossil brachiopods were part of the sessile, suspension-feeding benthos mainly controlled by substrate in deep-water, darker environments on the deep shelves and slopes of the Caribbean basin. Fluctuations in diversity are apparent through the late Cretaceous and Cenozoic coincident with changes in facies patterns.

Diversity spikes during the Eocene and Miocene are coincident with varied deep-water lithofacies in contrast to the more monotonous Oligocene successions in some parts of the Caribbean with very sparse brachiopod faunas. Lateral differentiation was most apparent during the Miocene; chalk facies on Jamaica contain rare *Terabratulina* and *Tichosina* in contrast to diverse and abundant terebratulide assemblages associated with arc rocks on Carriacou and palaeocommunities with micromorphic *Argyrotheca* and *Terebratulina* from *Globigerina* sands in the Barbados accretionary prism. The Early Pleistocene faunas are of low diversity with the *Argyrotheca*, *Terebratulina* and *Tichosina*

association having a widespread distribution in deep-water carbonate facies around the basin.

Tirsdag d. 20. oktober 1998: Prof. Robert R. Reisz (Univ. of Toronto): *Paleozoic vertebrates and continents – patterns of Amniote Diversification during the late Paleozoic*. Amniotes are widely perceived as a paradigm of evolutionary success, as documented by 315 million years of extraordinary taxonomic and ecological diversification. Amniotes include extant reptiles, birds and mammals, but many additional groups of extinct amniotes, including dinosaurs, aquatic reptiles, flying reptiles are also spectacular components of this large clade. In order to gain an understanding of the evolutionary history of this group, it is important to study the patterns of diversification of amniotes, especially the earliest stages of this evolutionary radiation.

Recent advances in our understanding of the origins and early history of amniotes have led to the reconstruction of well supported hypotheses of evolutionary relationships. It has therefore become possible to reconstruct for the first time the general patterns of amniote diversification, especially if we use the comparative method. Whereas the evolutionary history of many invertebrate and lower vertebrate groups is associated with aquatic environments, the early history of amniotes appears to have been restricted almost entirely to terrestrial habitats. The fossil record of the Paleozoic provides clear evidence that the synapsid part of the basal amniote dichotomy diversified much more rapidly than the sauropsid branch, and maintained a dominant role on land until the end of that era.

Tirsdag d. 27. oktober 1998: Conall Mac Niocail (Univ. of Oxford): *From Rodinia to Pangea - new views on old continents*. The existence of a Neoproterozoic supercontinent “Rodinia” was originally proposed on the basis of matching truncated “Grenville-aged” orogenic belts. Some support for this assembly has come from palaeomagnetic data from Australia which broadly support a fit between elements of eastern Gondwana and Laurentia in a so-called “SWEAT-fit”. However other elements of the fit have yet to be tested and the widespread acceptance of the “Rodinian Supercontinent is somewhat out of proportion to the actual evidence for its existence. I will show that 1110-800 Ma palaeomagnetic data for Laurentia, Baltica, Kalahari and Congo-Sao Francisco cratons broadly support a “looser” Rodinia configuration, but break up the continuity of the “Grenville-aged” mobile belts which comprise the primary evidence for the existence of “Rodinia”. Thus, while there may well have been a large continental assembly in the Neoproterozoic the evidence is nowhere near as conclusive as the widespread acceptance of the hypothesis would imply.

Initial break-up of “Rodinia” is estimated to have occurred between 750-725 Ma, marked by the divergence of the APW paths for eastern Gondwana and Laurentia and the southward drift of Laurentia from equatorial to higher southerly latitudes. A paucity of reliable palaeomagnetic results from the Gondwana elements precludes analysis of the drift history of the elements of Gondwana from 700-600 Ma but the available palaeopoles do not form a coherent group until about 550Ma, in line with geological and geochronologic arguments for the timing of collision between the east Gondwana blocks, the south American cratonic nuclei and Africa. In contrast, palaeopoles from

Baltica and Laurentia form a coherent swath, in a “Rodinia” fit, until about 600 Ma, when the respective apparent polar wander paths diverge, marking rifting and the initiation of the Iapetus Ocean at around 580 Ma. Similarly, separation between Laurentia, Amazonia and Siberia seems to have occurred around 550 Ma, with Laurentia moving towards equatorial palaeolatitudes by the early Cambrian. Thus the existence of another supercontinent, Pannotia, in latest Precambrian time is questionable or is, at best, ephemeral. The Iapetus Ocean reached its maximum extent (c. 6000 km) in the late Cambrian, and earliest Ordovician and by early to middle Ordovician time several arcs had developed within the Iapetus Ocean, including areas at both the Laurentia (c. 10–20 degrees south) and Avalonian (c. 50–60 degrees south) margins, and a possible intra-oceanic arc (c. 30 degrees south). There is a striking correspondence between these palaeomagnetically-positioned areas and statistically determined brachiopod distribution. The palaeogeography of these areas provide important constraints on the Taconic Orogeny and argue against a Laurentia-Gondwana collision in the middle Ordovician.

Philip J. Currie (Tyrell Museum): *Feathered Dinosaurs from China*. In recent years some of the most significant specimens for understanding the transition from dinosaurs to birds have been recovered from the Yixian Formation of Liaoning in northeastern China. These includes as many as 1,000 specimens of the primitive bird *Caudipteryx*, three skeletons of the compsognathid *Sinosauropteryx*, two skeletons of *Protoarchaeopteryx* (an animal that represents a morphological intermediate between the other two) and three skeletons of the newly described *Caudipteryx*. The skeleton of *Protoarchaeopteryx robusta* provides insight into a morphological stage more primitive than *Archaeopteryx*. This remarkable animal seems to have been a cursorial runner that possessed long feathers at the extremity of its long tail, and possibly on its arm. *Caudipteryx* represents another cursorial animal, with well-developed remiges and restrictes. In contrast with *Archaeopteryx* and other volant birds, the feathers are symmetrical in both of these species. Their bodies were insulated by plumulaceous feathers that resemble the integumentary structures of the non-avian theropod *Sinosauropteryx*. The two distinct types of feathers associated with these animals suggest that feathers evolved from a simple branching structure that became progressively more complex. Cursorial adaptations, relatively large size and symmetrical contour feathers favour the theory that flight evolved from the ground up. The recovery of two new types of feathered animals more primitive than *Archaeopteryx* suggests that feathers were widely distributed amongst non-avian theropods (see Nature 25/6–1998 and National Geographic July 1998).

Niels Bonde: *Airsacs in Archaeopteryx of Berlin*. It has always been a mystery that the oldest birds, *Archaeopteryx*, of the late Jurassic apparently had no airsacs as pneumatic foramina in the skeleton had never been observed, although they had been searched for.

While measuring the vertebrae of the perhaps most famous fossil in the World, the Berlin specimen of *Archaeopteryx lithographica*, Peter Makovicky (my former student of theropod dinosaur vertebral column – now in New York

and I to our surprise discovered, that despite claims after 120 years of research, this fossil does indeed clearly show pneumatic foramina in some of the anterior vertebra of the neck. Thus this confirms, that pneumatizations in birds (more advanced than *Archaeopteryx*) are in fact homologous with those in advanced theropods, and those pneumatic foramina are not independently evolved in the two groups. On contrary this confirms among many other features the close relationship between the two groups. It seems that the smallest specimen of *Archaeopteryx* has similar foramina in the anterior dorsals and perhaps in a rib – a further confirmation of the homology as this may in fact be a separate species (see Nature 24/9–1998).

Tirsdag d. 3. november 1998: Prof. Mike Benton (Bristol): *Biodiversity in the Past, Present and Future*. Palaeontologists are uniquely lucky that they have several independent data sets with which they can study the history of life: the order of fossils in the rocks, morphological cladistic data, and the molecular phylogenetic signals form many independently evolving molecules. It is possible to compare the results from these different techniques, and they show remarkable degrees of congruence for all groups so far tested, and for fossils deposited in a range of habitats. This confirms that the fossil record is adequate to tell the history of life, as Darwin hoped, and that the various modern phylogenetic reconstruction techniques work.

Tirsdag d. 17. november 1998: Mette E. Rasmussen: *Hadrosaurer/andenæbsøgler – Funktionel anatomi og fylogeni*. Hadrosaurerne forben har, siden det første hele skelet af en dinosaur (*Hadrosaurus foulkii*) blev beskrevet i 1858, været med til at danne forestillinger om hvordan disse dyr levede. Alligevel er selv de nyeste rekonstruktioner og opstillede skeletter af hadrosaur morfologisk ukorrekte. Håndled, albue og skulder er ofte ude af led, specielt i de rekonstruktioner hvor forbenet er involveret i lokomotion. En rekonstruktion af hadrosaurerne, såvel som de nært beslægtede iguanodonters forben viser, at håndfladen var overvejende medialt orienteret, når forbenet var strakt mod jorden, og ikke posteriort, som det ofte ses afbilledet. Men Hadrosaurerne var i stand til at bruge forbenene til lokomotion og på trods af den umiddelbart spinkle morfologi (specielt sammenlignet med iguanodontiderne) er der en række specialiseringer i hånden hertil. Rekonstruktionen af forbenet, sammenholdt med sporserier der indeholder håndaftryk, viser, at hadrosaurerne overkrop svingede lidt fra side til side, når de gik.

En cladistisk analyse baseret på 92 karakterer fra forbenet af 18 hadrosaur, 8 andre ornithopoder samt *Heterodontosaurus* resulterede i eet træ, der viste sig at være fuldt sammenligneligt med andre publicerede fylogener over ornithopoderne, baseret på kranier og evt. andet postkranialt materiale. På stamtræet kan man følge forbenets funktionelle udvikling gennem ornithopodernes historie fra små, tidlige bipede former, over de lidt større ornithopoder med kraftige gang-adaptede hænder til de store hadrosaurer og iguanodontider med funktionelt opdelt hænder med kun de tre midterste fingre specialiseret i lokomotion.

Tirsdag d. 8. december 1998: Svend Kragballe: *Bentiske foraminiferer fra skrivekridtet i Danmark*. Betydningen af Øvre Kretassiske og Paleocæne bentiske

foraminiferer som indikatorer for palæomiljø er forbedret over de sidste 20 år ved publikation af resultaterne fra Deep Sea Drilling Project. Det er nu anerkendt, at miljø-inducerede fauna-ændringer reflekterer palæo-oceanografiske, paleogeografiske og palæoklimatiske ændringer. Tolkning af aflejningsdybde for marine palæomiljøer ud fra bentiske foraminiferer har traditionelt været baseret på dybdefordeling af recente, bentiske foraminiferer.

Det meste af Nordeuropa var i Øvre Kridt til Danien oversvømmet. Transgressionen opnåede sit maksimum i Sen Campanien – Tidlig Maastrichtien. Den efterfølgende regression (Sen Maastrichtien – Tidlig Danien) resulterede i en reduktion af karbonat-sedimentation i det nordeuropæiske område. Tidligere undersøgelser fra det danske område har postuleret at ændringer i sammensætningen af den bentiske foraminifer-fauna op mod Kridt-tertiær grænsen var et resultat af ændringer i vanddybde. Forudsætningen er, at der i Øvre Kridt har eksisteret en klar dybdezonering af den bentiske foraminifer-fauna.

En taxonomisk og palæoøkologisk analyse af bentiske foraminiferer er blevet foretaget fra henholdsvis Nazilów i Polen og Stevns Klint og Nye Kløv i Danmark. Formålet var at undersøge om faunaen ændrede sig med skiftende palæo-oceanografiske forhold umiddelbart før Kridt-tertiær grænsen som tidligere postuleret. Resultaterne af denne undersøgelse indikerer, at ændringer i sammensætningen af den bentiske foraminifer-fauna fra det danske og polske område er et resultat af et mere kompliceret økosystem, som er vanskeligt at passe ind i en oversimplificeret dybde-model.

Tirsdag d. 15. december 1998, Palaeontologisk Klubs julemøde: Susan Turner (Queensland Museum, Brisbane, p.t. Hannover): *Heat, dust and flies - collecting fossil fish bits and other vertebrates an Australia.*

In the last ten to fifteen years there has been a significant increase in the Palaeozoic vertebrate database, both macro- and microvertebrate, in East Gondwana (= Australia + Antarctica, Young 1981, Alcheringa). This has come about through the co-operation and energy of a small group of active fish and early tetrapod workers in conjunction particularly with conodont workers. Systematic exploration and bed-by-bed collecting of as many sites as possible has been fostered in recent years and bulk acid preparation employed for example by the team of Professors John Talent and Ruth Mawson of Macquarie University has increased our knowledge of marine and non-marine taxa. This work has been further enhanced in recent years by the highly successful Unesco-IUGS International Geological Correlation Programme project 328. This IGCP project on Palaeozoic microvertebrates and their geological uses was initiated and co-led by Drs Gavin Young (Canberra) and the speaker, latterly with Dr. Alain Blicq (France) and ran from 1991 to 1996 with results still being published.

Here is a guided tour of some of the key hunting grounds for Palaeozoic fish in Australia including a selection of the vertebrate sites on which the speaker had worked in Australia, including field work carried out under the IGCP banner. This field work is carried out in the driest continent on earth. Devonian sites included Mt Winter in the Cleland Hills in central Australia near the Northern territory-Western Australian border where in 1991 Turner and Young discovered a rich bone bed at Orange Peel Knoll and other sites containing turiniid thelodont scales (agnathan fishes), acanthodian scales, placoderm and „baby“ lungfish re-

mains; the classic placoderm and lungfish sites of the Lower Devonian of Taemas-Wee Jasper; the early Middle Devonian Hatchery Creek Conglomerate of the Burrinjuck Dam region where Young found a thelodont and placoderm assemblage; numerous localities in the Lower Devonian of central western NSW where Turner and her Ph.D. student C. Burrow are investigating microvertebrate faunas; the long continuous Silurian to early Carboniferous sections of the Broken River district of north Queensland where Turner has been working on macro- and microvertebrates including a new lungfish; and sites in northern Queensland, such as the Fanning River district with hyllolepid placoderm remains and biostratigraphically important phoebodont and other shark remains.

Photos were shown from the recent CAVEPS trip to the unique Late Devonian Gogo Formation in Western Australia where John Long W. Australian Museum, Perth and others have described more than 40 taxa of placoderms, palaeoniscoids, and lungfish.

Early Carboniferous sites of importance in the search for tetrapods are those at Mansfield in Victoria and the Narrien Range in central Queensland's Drummond basin where Turner and Anne Warren, Melbourne and others have searched for many years in vain: lots of nice fish but no sign of tetrapods. Not until 1995 when a local rancher found bones on his property and sent them to the Queensland Museum. Subsequent Field investigation and comparison with known remains in Scotland, Northumberland and the eastern USA convinced Turner and her husband Tony Thulborn that the first tetrapods from the Southern hemisphere had been found in the mid Visean Ducabrook Formation. Since then with the expertise of Anne Warren who joined the team, field work and research funded by the Australian Research Council has resulted in the elucidation of this, one of the earliest tetrapod faunas comprising possible protoanthracosaurs as well as large rhizodonts (crossopterygian fishes), ctenodont lungfish, xenacanth and other sharks, gyracanthid acanthodians and numerous palaeoniscoid fishes. In addition some of the Mesozoic sites where Dr. Tony Thulborn, Queensland Univ., Brisbane has worked. These included the early Triassic site called The Crater in the Arcadia Formation, which has yielded one of the best and most interesting Triassic faunas in Australia comprising dominant amphibians described by Anne Warren and reptiles including thecodont and lizard-like forms and the first ever dicynodont bones to be found in Australia. The speaker herself found the fish *Saurichthys* here and an unusually preserved pleuromeid plant.

Thulborn has made a special study of some of the new dinosaur footprint sites and a review was given of the work at the Lark Quarry site at Winton western Queensland where the only recorded dinosaur stampede took place (the inspiration no doubt for part of Jurassic park). This site is now protected as a State Park although problems with the sun, wind, kangaroos and collectors have posed continuing headaches for conservationists. Thulborn's new work in the Lower Cretaceous Broome sandstone of NW Australia were highlighted. Dinosaur footprint were found at Gantheume Point in Broome and first published in the 1950s, but in recent years the late Paul Foulkes had done much to discover and interpret numerous dinosaur footprints sites up and down the Broome coastline. He has worked closely with Tony in recent years until his untimely death from cancer last year. But fortunately a recent grant means that the work can continue to understand the



palaeobiology of dinosaurs especially sauropods in the forests of that region around 100 million years ago. These too are protected sites and recent plundering has been brought to court.

The final discussion concerned the former political regime in Queensland that allowed the teaching of so-called „Creation science“ in natural science classes in many Queensland schools, and the on-going battle by one academic in Australia, Professor Ian Plimer of Melbourne University to bring to justice his case against fraudulent claims of creationists and others. Turner urged natural science colleagues to send money to a foundation made to support Plimer's trials which have literally ruined him (info with N Bonde).

Tirsdag d. 9. februar 1999: Fedor Steeman: *A redescription of a Placoderm fish from Spitsbergen: How maxima became gigantea, but remained the same size.*

In this talk a description of a Master project will be given, which was fulfilled at the Natural History Museum in Paris with a species of placoderm fish as study-object. Placoderms are archaic fishes with a body covered with bony plates which lived during the Devonian period, from about 400 to 360 million years ago. In most placoderms the bony plates form a kind of armour surrounding the shoulder region and possess a separate armour around the head region. These two armours are often jointed at two points in the neck area.

One of the major orders of placoderm fish is the Arthrodira, which are characterised by a specialised neck joint. The arthrodirans were, on their turn, traditionally divided in forms with short trunk-armours, called Brachythoraci, and forms with long trunk-armours, called Dolichothoraci. Nowadays, the latter group has been dropped, because it was realised that this was a paraphyletic assemblage. The Brachythoraci are, however, still retained by most authors as the crown-group of the arthrodirans. After the work of Goujet in 1984, the Phlyctaenii were established as the sister-group to the Brachythoraci and the Actinolepididae as the sister group to all the other Arthrodirans. Actinolepididae are characterised by a neck joint of the primitive sliding type.

The relationships within the Phlyctaenii are, however, still somewhat uncertain. This is because several species and genera are in a serious need of revision since their first descriptions several decennia ago. This is the case for a genus from Spitsbergen which was described in 1929 by Anatol Heintz. On the basis of the typical reticulate ornamentation on the armour plates, Heintz assigned several fragmentary fossils of the placoderms to the new genus *Arctaspis*. He then described five species, but unfortunately his descriptions are not very informative let alone consistent. The description of a large species belonging to this genus, of which material was present at the Natural History Museum of Paris, is therefore very desirable.

One interesting aspect is that Heintz described the species in question twice the same year, assigned it to different genera. Naming a fossilised trunk *Arctaspis maxima* and, slightly earlier, a steinkern (a preserved core of sediment that filled the trunk) *Monaspis gigantea*. This offers an intricate case for the priority rules of zoological nomenclature, because one has to choose arbitrarily which genus-name to preserve. In redescribing the species the composite name *Arctaspis gigantea* is preferred. An overview of the methods used in studying this placoderm species is given as well as a brief description of the morphology of *Arctaspis gigantea*.

When the morphology of this species was finally clarified, a reassessment of the phylogenetic relationships of the phlyctaeniids using cladistics could be attempted. It was discovered that the most parsimonious cladogram coming from the analysis was only aberrant in one point from the one originally proposed by Goujet when reviewing the family in 1984. Two families, the Arctaspididae (to which *Arctaspis* belongs) and the Arctolepididae group together on the basis of the three characters. The name „Arctaspididae“ is proposed for this superfamily (Steeman & Goujet, *in press*: Redescription of a large species of *Arctaspis* and subsequent review of the infraorder Phlyctaenii. *Journal of Palaeontology*). Further study of phlyctaeniid genera like *phlyctaenius* is recommended to ascertain these results.

Tirsdag d. 16. februar 1999: Hanna Hellrung (Stuttgart): *Plagiosaurus – aberrant amphibians from the Triassic of Germany.*

The middle-Triassic (Ladinian) fossil locality Kupferzell in South-Germany is rich in remains of amphibians. Most of the material are remains of the plagiosaur *Gerrothorax* sp. Some remains are from *Plagiosuchus pustuliferus*. Due to the excellent conservation our knowledge is completed over the anatomy of these species, which differ in the anatomy of the skull and the shoulder girdle, but are very similar in the pustular sculpture of their dermal bones. The plagiosaurs were an aberrant group of Triassic labyrinthodonts with cylindrical vertebrae, a largely broadened skull roof, giant orbitae and without tabular horns.

They were aquatic bottom dwellers. Some species possessed a dorsal and ventral trunk armour. Slides of the excavation, of fossils and life pictures give an impression of this fossil locality. They are completed by further remains of middle and upper Triassic plagiosaurs.

Mandag d. 1.marts 1999: Octavio Mateus (Portugal): *Upper Jurassic Dinosaurs from Lourinha and Portuguese Dinosaurs – with review of collecting in Laos.*

The Lourinha area is situated about 70 km NW from Lisbon on the west coast of Portugal. The geological layers are mostly from Kimmeridgian and Tithonian (Upper Jurassic) ages, with brackish and marine environments.

Dinosaurs were first discovered in the Lourinha area in 1897. Since then the area has been described as being the richest in Portugal in dinosaur remains. In the Upper Jurassic of Portugal the known dinosaurs are:

Theropoda: *Lourinhanosaurus antunesi*, ?*Megalosaurus pombali* and ?*M. insignis (nomina dubia)* and an indeterminate Ceratosauria.

Sauropoda: *Camarasaurus alenquerensis*, *Brachiosaurus atalaiensis* and a diplodocid not described.

Ornithischia: *Dacentrurus arnatus* (Stegosauria), *Draconopelta zbyziewskii* (nodosauridae), ?*Camptosaurus* and ?*Hypsilophon* (Ornithopods), *Trimucrodon cuneatus* and *Phyllodon henkelli* (Ornithopods).

A huge nest was found at the site near Lourinha. More than 100 well preserved dinosaur eggs and about 200 bone fragments ascribed to theropods were found among the eggs. (Eggs and embryonic bones were exhibited).

One other theropod named *Lourinhanosaurus antunesi Mateus* was recently described. It is the first allosauroid dinosaur from Iberian peninsula.

A short review was presented on Portuguese dinosaurs incl. extensive series of trackways. The results from a recent



fieldtrip to Laos with French colleagues was also presented.

Tirsdag d. 16. marts 1999: Reinhardt Møbjerg Kristensen (Zoologisk Museum, Københavns Universitet): *Den kambriske Eksplosion – fup eller fakta?*

Den kambriske meiofauna har længe været overset. Men ved hjælp af nye teknikker er det lykkedes at udtage flere forskellige metazoer, som er blevet sekundært fosfatiseret i kambriske kalkstensaflejringer. Det drejer sig om dyregrupper, så som Tardigrada (bjørnedyr), Kinorhyncha (mudderdrager) og Pentastomida. Fossilene er enestående godt bevaret og ved hjælp af scanning elektron mikroskopi (SEM) kan man se ultrastrukturelle karakterer, som er næsten lige så godt bevaret som på recent materiale. Der vil blive gennemgået en tidlig form (stem-group) for bjørnedyr fra Kambrium i Sibirien. Dyret har allerede mange avancerede træk, som kun kendes hos den ektoparasitiske heterotardigrad *Tetrakentron synaptae*, men "palæotardigraden" har også primitive karakterer så som søjler i epikutikulaen, der først og fremmest kendes hos de marine Arthrotardigrada. Fossilet er kun ¼ mm lang, men den er yderst kompliceret i sine kløer og sanseorganer.

Mikrofossiler af meiofaunadyr har været overset i diskussionen om den kambriske eksplosion. Man har først og fremmest fokuseret på den såkaldte Burgess Shale fauna, som udelukkende består af makrofaunadyr. De små dyr er ikke bevaret i denne form for "shale". Derimod er den lidt yngre "Orsten-fauna" meget rig på mikrofossiler, og disse velbevarede 3-D fossiler har helt revolutioneret vores opfattelse af f.eks. Crustacea's evolutionære udvikling. Der er indtil videre kun fundet yderst få meiofaunadyr i Prækambrium, men det skyldes udelukkende, at man ikke har kigget efter dem med de nye teknikker. Hypotesen om, at samtlige dyrerækker (phyla) af flercellede dyr skulle være opstået på ca. 10 millioner år i begyndelsen af Kambrium, kritiseres kraftigt. En alternativ forklaring på den kambriske eksplosion kunne være, at de flercellede dyr bare blev større i Kambrium, men at stamformerne var tilstede allerede i Prækambrium – bare som meiofaunadyr. Denne teori sammenholdes bl.a. med de nyeste DNA-undersøgelser, som f.eks. indikerer, at Nematoda skulle være udspaltet fra resten af Protostomia for 2 milliarder år siden.

Tirsdag 23. marts 1999: A. Boyd: *Floral changes in the Cretaceous of West Greenland.*

## Petrologisk klub:

Onsdag d. 10. februar 1999: Robert Frei (GI): *Os and Pb isotopes of rare OsIrRu minerals: A core-mantle boundary derivation?*

Onsdag d. 17. februar 1999: Henning Sørensen (GI): *Naujakasit, et meget sjældent mineral, der er bjergartsdannende i hyperagpatitiske lujavritter, Ilimaussaq-komplekset, Sydgrønland.*

Onsdag d. 24. februar 1999: Feiko Kalsbeek (GEUS): *S-type granites in the Caledonian fold belt of East Greenland.*

Onsdag d. 3. marts 1999: Synnøve Elvevold (GEUS): *Extracting P - T paths from zoned garnets.*

Onsdag d. 10. marts 1999: Paul Martin Holm (GI): *The depleted mantle component in the Cape Verde volcanics.*

Onsdag d. 17. marts 1999: Karen Hanghøj (DLC): *Kappenoduler.*

Onsdag d. 24. marts 1999: Malene Hein (GI): *Vulkaniter fra Kap Verdeøerne.*

## Dansk Geofysisk Forening

Torsdag d. 29. oktober 1998: Prof. Ray Bates: *Climate system stability.*

A fundamental problem in climate research is that of explaining how the Earth's climate remains stable on very long time scales. Positive feedback mechanisms such as the ice-albedo feedback and the lower tropospheric water vapour/infrared radiative feedback are known to exist which could, in principle, drive the climate system far from its observed mean state even in the absence of any external forcings. Extreme scenarios that have been envisaged are a completely icecovered earth on the one hand and a runaway greenhouse such as appears to have occurred on Venus on the other.

There is at present no generally accepted explanation for the stability of the Earth's climate. The most obvious candidate as a stabilising mechanism, the basic radiative Stefan-Boltzmann feedback, guarantees only that the emission temperature of the planet will adjust so that the time-averaged outgoing long wave radiation balances the absorbed solar radiation. It places little constraint on the surface temperature. The latter is determined by the strength of the greenhouse effect, which depends not only on the radiative properties of the atmosphere but, perhaps more important, on the dynamics of the atmosphere and oceans. A number of possible stabilising mechanisms have been proposed, based on various processes such as the radiative effects of clouds and upper tropospheric water vapour, the dynamical effects of the poleward heat flux by baroclinic eddies, and the feedback effect of the humidity factor in vaporation. All of the above mechanisms are controversial and their relative importance a matter of debate.

A new stabilising mechanism has recently been proposed by the speaker. It is based on an empirically discovered relationship between the poleward transport of angular momentum across 30° and the difference between the mean heights of the 500hPa surface in the tropics and the extratropics. This relationship is incorporated into a simple two-zone atmosphere-ocean model. Assuming that the atmosphere is in a state of dynamic balance on climatic timescales, the mean zonal surface winds, and hence the evaporation, are determined by the angular momentum transport. The model includes the solar radiation and the infrared radiation emitted from the surface. Using energy equations for the tropical and extratropical ocean basins, a mean climate state for the model is determined and the stability of small perturbations about the mean state is examined. It is found that the evaporative heat losses determined by the angular momentum transport act as a negative feedback on surface temperature perturbations. The feedback is of sufficient strength to overcome the water vapour feedback and hold the climate stable.

Torsdag d. 10. december: Henning Haack (DTU): *Meteoritter og liv på Mars.*