EUG XI

Symposium BG05

Effects of Environmental Perturbations on Extinction and Evolutionary Innovations

Convenors

Paul Barrett
Eric Buffetaut

BG05
Extinction and Evolutionary Innovations

Wednesday AM Session

BG05 : WEam01 : G1
Possible Effects of Environmental Perturbations on Macroevolutionary Trends of Mid Jurassic to Early Cretaceous Radiolaria

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The rate of evolutinary turnover of nearly 400 radiolarian species/subspecies is analyzed in order to document the long term patterns of taxonomic turnover within the group during the Mid Jurassic to Early Cretaceous interval (approx. 60 Ma). The pattern and dynamic of evolutionary change is described using four indices: rate of species origination, rate of extinction, rate of diversification and rate of turnover. Plots of cumulative sampling effort suggest that the analysed taxonomic pool represents an adequate sample of total standing diversity for most examined subintervals.

With the exception of a prominent mid Bajocian peak in the rate of extinction, rates of species origination exceed extinction for most of the Middle Jurassic. Radiolarian evolutionary changes were overall in equilibrium throughout most of the Callovian and Oxfordian, as indicated by diversification rates (that is the difference between speciation and extinction rates) near zero. The Kimmeridgian-Tithonian records the lowest rate of diversification and it is followed by a dramatic increase in origination near the Jurassic-Cretaceous boundary.

A randomisation test was performed to assess the influence of uneven sampling on the observed pattern of taxonomic turnover and found that randomly obtained patterns are significantly different from the observed one (apart from the beginning and end of the dataset). Therefore, the observed pattern in species turnover rate is not the artefact of sampling and reflects a palaeobiologically significant and meaningful change.

The Bajocian and Tithonian/Berriasian events coincide with substantial climate-derived perturbations in water cycling, nutrient supply and oceanic productivity. They point to a negative relationship between radiolarian macroevolution and changes in the state of nutrient availability, although further work is needed to refine the temporal resolution of this relationship and to explore ecological aspects of its causal link with respect to radiolarian evolution. Our results stress the non-linear influence of abiotic (environmental) factors to radiolarian evolution.

BG05 : WEam02 : G1
Size Variability in Planktic Foraminiferal Assemblages: Ecological and Evolutionary Implications

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In the past 140 million years planktic foraminifers have undergone at least three periods of diversification, each of which is thought to have involved increases in test size. The test size of planktic foraminifers is strongly related to the biology of the organism since a) the shell volume is related to the cytoplasm-mass and b) the surface area corresponds to the supply of resources necessary for the metabolism of the organism. Therefore, test size may reflect environmental change in addition to evolutionary innovation. Surprisingly, until now no data exists concerning the size variability of entire planktic foraminiferal assemblages in the Holocene or the late Phanerozoic.

In order to determine the influence of the environment on size the variability of modern foraminifera, surface sediment samples have been analysed on a global scale using automated image analysis techniques. An average of 1700 planktic foraminiferal specimens has been measured from each of the 100 sediment samples, covering the major environmental gradients. The maximum diameter of all individuals larger than 150 µm in each assemblage has been measured.

The size range of all specimens examined in the Holocene assemblages increases three-fold from the poles to the tropics. The relationship between size (determined as the 95-percentile of the size range in the assemblage) and temperature, however, is not linear. Rather, it displays two minima, one at 2°C and a second at 18°C. These minima correspond to the polar and subtropical frontal systems that separate three domains of regional size maxima: polar, subpolar/temperate and subtropical/tropical. These distinct minima of the 95-percentile suggest that hydrographic fronts may be unfavourable environments for foraminifers to grow to large sizes. The general increase in mean test size outside these regions is likely a result of increasing metabolic demands of foraminifers with increasing temperature.

Evolutionary diversification and/or global environmental change are both potential driving forces for size variation of planktic foraminifers in space and time. As a first step towards elucidating these processes, Cenozoic size variation of foraminiferal assemblages has been analysed globally at six drill holes. A pattern of iterative change in the size of planktic foraminifers is visible in the results of this analysis. Three major cycles exist, characterised by an overall reduction in test size at the K/T boundary, in the Mid-Eocene, and the Mid-Miocene, with a pronounced size increase occurring from Mid-Miocene to the present day.

This study has identified significant variation in the size of planktic foraminifers on both geographic and stratigraphic scales. Further research will focus on the relationship between iterative size variation of planktic foraminifers in the Cenozoic and paleoceanography as well as the evolution of the group as a whole.

BG05 : WEam03 : G1
Large-Sized Specimens of *A. infracretacea* and *R. terebrodentarius*: May Increasing Fertility Yield Morphometric Changes?

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Morphometric analysis of nannofossils may provide interesting insights to our understanding of their evolution. In this work morphometric analyses were performed through the Early Aptian OAE1a on two calcareous nannoliths (*Incertae Sedis group*): *Assipetra infracretacea* and *Rucinolithus terebrodentarius*. The investigations were mainly undergone on samples from the Cismon drillcore (Northeastern Italy) and DSDP Site 463 (Mid Pacific Mountains). In each smear slide, 100 specimens of *A. infracretacea* and *R. terebrodentarius* were measured by using the NIH-IMAGE software in order to document fluctuations in their dimensions. These nannoliths are very peculiar since they are represented by two different morphotypes (normal- and large-sized). The maximum diameter of the normal-sized *A. infracretacea* ranges from 3.88 µm to 6.41 µm, in the large morphotypes from 8.03 µm to 16.2µm, whereas the diameter of the two morphotypes of *R. terebrodentarius* ranges from 3.55 µm to 5.69 µm and from 7.55 µm to 14.64 µm, respectively. We documented a bimodal dimensions range for both species and no transitional forms were observed between the normal- and the large-sized morphotypes. Therefore, the different morphotypes can be considered as separate species of the same genus. The nannofossil assemblages from Hauterivian and Barremian black shales display high abundances of the normal sized morphotypes much likely indicating increase of surface water fertility. Large morphotypes were first observed at the onset of the Early Aptian maximum perturbation ('The Superplume Event'). The large morphotypes display a very short distribution range (Early Aptian-latest Aptian) and they increase in abundances and outnumber the normal-sized ones within the Selli Level (the sedimentary expression of the OAE1a). In particular, the highest abundances of the large-sized morphotypes were found within layers with the most abundant amounts of organic matter (TOC%). The Selli Level is interpreted as high productivity and warming event representing the starting point of the 'Mid-Cretaceous Greenhouse conditions'. The increase in dimensions of *A. infracretacea* and *R. terebrodentarius* may be a biological response to the high levels of carbon dioxid, enhanced nutrients from the continents and increase in paleotemperature.

BG05 : WEam04 : G1
Environmental Control of Microstructural Novelty in Molluscan Evolution?

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Bivalve molluscs display a variety of microstructural arrangements that confer a range of different mechanical properties. There appear to be certain links between different microstructural arrangements and particular life-habits exploited by the animals and styles of overall shell morphology, for example homogeneous shell structure is restricted to infaunal forms and all calcitic microstructures occur in the outer layers only of epifaunal taxa. Have some shell microstructures been important innovations during the spectacular adaptive radiations shown by the class? In this talk I shall examine the question as to whether at least some microstructural innovations had environmental cues. In particular, I will present new data on the effect of seawater temperature of microstructure and mineralogy.

BG05 : WEam05 : G1
The Triassic-Jurassic Boundary Event: Linking the Terrestrial and Marine Records

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Significant extinctions took place across the Triassic-Jurassic boundary in both terrestrial and marine environments, but the relative timing of these events, and relationships to other major environmental changes are poorly known. On the land, a major floral and faunal turnover is evident from lacustrine successions, whilst in the sea there is a good record of significant relative sea-level changes that accompany faunal changes. Here we present carbon-isotopic data from two key sections across the T-J boundary (Jameson Land, East Greenland, and St Audrie's Bay, England) and discuss the significance of the stratigraphic patterns in terms of global perturbations in the carbon cycle. Comparisons and contrasts are made with data from other mass extinctions.

BG05 : WEam08 : G1
The Effects of Changing Atmospheric CO_2 on Plant Evolution

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The long-term impact of the emergence of major plant groups on atmospheric CO_2 has been thoroughly discussed (e.g. Berner, 1997). The reverse scenario, however, has been less well discussed: whether changes in atmospheric CO_2 influenced plant evolution.

Comparing published data on the relationship of vascular plant species number and turnover rates over geological time (Niklas, 1997) with estimates for global atmospheric CO_2 (Berner, 1991) the results tentatively suggest that emergence of the major plant groups occurred at times of increasing atmospheric CO_2. In addition, high rates of species turnover appear to correlate with the high levels of atmospheric CO_2, and low levels with notably more extinctions than originations.

This paper will therefore address the question as to whether there a causal relationship between high atmospheric CO_2 and the emergence and diversification of major plant groups?

Evidence for the relationship will first be presented, examining the broad trends in the geological record and also focussing on specific time intervals. Consideration will then be given to possible reasons as to why such a relationship might exist. In particular evidence for the physiological influence of elevated atmospheric CO_2 on present day forested ecosystems, most notably tropical rain forests

(Phillips & Gentry 1994, Philips and Sheil, 1997), will be examined, and its relevance to the patterns in the geological record discussed.

This paper will propose that a combination of direct and indirect effects of elevated atmospheric CO_2 on plant growth and survival have been major contributory factors to the emergence and evolution of major plant groups through geological time. Central to the line of argument is the fact that changes in atmospheric CO_2 are global, not local. Thus, there are not the opportunities for plant migration (compared to migration during, for example, glacial-interglacial cycles), increasing evolutionary and selection pressures on plants during times of elevated atmospheric CO_2.

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BG05 : WEam09 : G1
Clayey Mineral Assemblages in Siliceous Rocks: Evidence of Anoxic Events in the Mesozoic of Southeastern Russia (Sikhote Alin Range, Dalnegorsk Village)

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In the Sikhote Alin Range, the most representative sequence among the Mesozoic deep-water siliceous deposits has been documented in the vicinity of Dalnegorsk village [Bragin,1991; Grigoriev et al., 1999; Bragin, 2000; and others]. These deposits are confined to within an accretionary pile; the sequence is monotonous and it is comprised of diverse siliceous rocks (Triassic-Late Jurassic) and flysch (Early Cretaceous). The siliceous rocks include siliceous mudstones, gray and light gray cherts, and red jaspers. All the lithologies contain abundant radiolarian remains that were used for dating. The radiolarian assemblages have been identified for each particular time interval, and they are detailed in [Bragin, 1991, 1993, 2000, etc.]. Geochemical signatures discriminating the silicites of diverse origins in the Middle Triassic-Early Jurassic siliceous sequence from Sikhote Alin were identified earlier [Volokhin, 1985, 1988]. This study integrates the data on the radiolarian assemblages, clayey mineral assemblages, and geochemical peculiarities of the siliceous rocks of various ages and correlates these data to volcanic manifestations.

The siliceous sequence exposed at Dalnegorsk village (Rudnaya River) shows authigenic clayey mineral assemblages that allow anoxic biotic events to be correlated to volcanic activity. The clayey minerals occur in voids between quartz aggregates or in veinlets pervading the rock. Four principal assemblages of authigenic clayey minerals are distinguished in the sequence: (1) a sericite assemblage (Indian-upper Olenekian, Triassic); (2) a chlorite-sericite assemblage with micas decreasing and chlorite increasing gradually toward the Norian stage (lower Anisian-Norian); (3) a nearly total lack of clayey minerals in the siliceous rocks (Rhaetian to Lower-Middle Jurassic); (4) a mica-chlorite-smectite assemblage (Upper Jurassic-Lower Cretaceous). These assemblages differ in terms of chlorite compositions.

In the Early Triassic, the radiolarians experienced a period of “depression”, yet the data for that time are scanty. The Middle and, especially, Late Triassic displays specialized foraminiferal forms whose development continued into the Norian age. The middle/late Norian boundary shows major changes in the radiolarian assemblages. The same boundary displays significant changes in the composition of quartz modifications that fill in the rock matrix and constitute the radiolarian skeletons.

The predominance of chlorite in the sequence is likely due to the supply of disintegration products from synchronous volcanites into the silica deposition basin. The lack of clayey minerals within the Rhaetian-Lower Jurassic interval might suggest cessation of the syndepositional volcanism and purely biogenic silica accumulation. The presence of smectites implies prevalence of an external source of sediment supply and only slight rock alteration through lithogenesis.

Therefore, not only do clayey mineral assemblages in siliceous deposits elucidate the degree of postdepositional alteration, but they provide clues to the contribution of terrigenous supply to silica deposition in a basin.

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BG05 : WEam10 : G1
The Impact of Continental Fragmentation on Organismal Distribution: A Case-Study from the Early Cretaceous

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Interest in Mesozoic biogeography has greatly increased during the past decade, reflecting both the discovery of new specimens and the application of new techniques. Traditionally, it has been predicted that the fragmentation of Pangaea should have had a profound effect on the distributions of terrestrial organisms, although no study has provided any rigorous statistical support for this view. Recently, several studies of dinosaurian taxa (Sereno, 1999a,b) have failed to find clear vicariance signals that can be correlated with the sequence of continental fragmentation. It has been argued, therefore, that continent-level vicariance was a rare and relatively unimportant phenomenon, and that Mesozoic terrestrial biogeography was dominated by dispersal and regional extinction.

The current study applies a cladistic biogeographic method, ‘tree reconciliation’ (Page, 1994), to cladograms of dinosaurs, crocodiles, platynotan lizards, osteoglossomorph fish and amphiphyte plants. These data were analysed using the computer programme ‘TreeMap’ (Page, 1994). Previous theoretical considerations (Grande, 1985; Hunn and Upchurch, in press) suggest that cladistic biogeographic methods may fail because long time periods contain several superimposed and conflicting distribtuonal patterns. To alleviate this problem, the taxon cladograms were ‘pruned’ so that they contained only taxa from a designated portion of stratigrpahci range (here termed a ‘time-slice’). Thus, analyses were run for time-slices of various lengths, such as ‘Mesozoic’, ‘Jurassic’ and ‘Late Jurassic’. The statistical support for each of the optimal area cladograms found by TreeMap was then evaluated using a randomisation test (Page, 1991).

The results of this study reveal a statistically significant optimal area cladogram for the Early Cretaceous time-slice. The topology of this area cladogram suggests that Europe and Asia came into contact during the Early Cretaceous after a period of separation. Gondwana seems to have possessed an endemic fauna during the Late Jurassic, but this is not the case for Laurasia as a whole. Comparison of area cladogram topology with palaeocoastline reconstructions reveals considerable agreement in terms of both fragmentation/convergence sequence and timing. These results provide the first statistical support for a vicariance signal in Mesozoic taxa and indicate that continent-level vicariance was a major determinant of biogeographic patterns, at least during the Early Cretaceous.

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BG05 : WEam11 : G1
Natural Selection at the K/T Boundary

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It is frequently assumed that global catastrophes, such as those produced by very large meteorite impacts, cannot be selective in their effects, and that survival at such times is the result of chance rather than of any intrinsic qualities of the surviving organisms. At such times, extinction would be the result of “bad luck” rather than “bad genes”, to use Raup’s expression. The fossil record at the K/T boundary extinction, which is the best investigated of all mass extinctions, does not support such a contention. It has long been recognised that extinctions at the K/T boundary were not random: it is clear that some groups of organisms (especially those which died out !) were much more affected than others. Freshwater vertebrates, for instance, were much less affected than purely terrestrial ones, and small vertebrates were less affected than large ones. More generally, it seems that belonging to certain food chains rather than others played a crucial part in the selection process during the K/T boundary catastrophe. Can this kind of selection be considered as a special case of Darwinian natural selection ? It is obviously natural in that its causes are natural, although to some extent exceptional. However, it seems to involve selection at the interspecific more than at the intraspecific level. In the case of species which became completely extinct, the catastrophe caused no intraspecific selection at all. This does not mean that no intraspecific selection occurred at the K/T boundary, but it is not easily recognisable, all the more so that the extinction process was apparently very rapid, and hence the fossil record of evolutionary change during the period of very heavy environmental stress is not good (especially for large organisms). At the interspecific level, selection, in the form of differential species extinction, is much more apparent. However, the exact reasons why some species survived while others became extinct is still incompletely understood, although the collapse of food chains ultimately based on photosynthesis is a likely general explanation for many extinctions. Not to belong to such food chains apparently conferred a strong selective advantage to the members of some species. What is not easily quantified is the possible temporary decline in species which ultimately survived. Even though the K/T extinctions were highly selective, chance may also have played a part. However, there is no reason to believe that it was the sole factor involved, or that natural selection was ‘suspended’ during the catastrophe of the K/T boundary.

BG05 : WEam12 : G1
The K-T Mass Extinction, A Multi-Causal Scenario

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Paleontologic, climatic and ecologic data reviewed here thus provide strong evidence for a progressive, rather than sudden, mass extinction pattern that began during the last 500 k.y. of the Cretaceous and culminated at the K-T boundary. No single kill mechanism can be identified for this extinction pattern. Evidence for a likely multi-event killing mechanism includes a series of rapid and extreme climate fluctuations associated with sea-level changes, a period of major volcanic activity prior and across the K-T boundary and an asteroid or comet impact . Thus, the mass extinction resulted from an addition of unfavourable conditions which includes long term perturbations (e.g. Deccan traps volcanism, cooling, sea-level fluctuations) and short term event as asteroid impact, the latter giving the final stroke to an already stressed biosphere. Climate changes closely parallel this mass extinction pattern. The long-term 7-8°C cooling trend of the Maastrichtian culminated 500 k.y. before the K-T boundary and was followed by rapid warming in surface and deep-water temperatures by 3-4°C between 200-400 k.y., and rapid cooling of 3°C during the last 100 k.y. before the K-T boundary. Biotic stresses created by these rapid climatic changes appear to be responsible for the reductions in species populations and extinctions in both marine and terrestrial environments prior to the K-T boundary

BG05
Extinction and Evolutionary Innovations

BG05 : WEam13 : G1
Mineral Sources and Innovations of Biological Evolution

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Environmental perturbations did not only determine the major pathways of biological evolution: their most important innovation was the origin of life itself, abiogenesis. The idea of a bio-starting role of minerals underlies many modern concepts of abiogenesis.

Comparative analysis of bio-organisms and mineral individuals provides a bulk of evidence for biomineral homologies at the morphological, functional, ontogenetic, phylogenetic, and paragenetic levels and mineral predetermination of many features and functions traditionally viewed as purely biological. Insights into biological and mineral systems and analysis of functions of biominerals in living organisms cast doubts on existence of mineral roots of the living world. Pre-biological informational structures, gene predecessors and proto-organisms should be looked for among non-biogenic ordered hydrocarbon molecular systems. Highly structured solid hydrocarbons (bitumens) and highly carbonaceous substances provide best homologies with simplest biological organisms. The physico-chemical conditions of ordered hydrocarbon condensation are similar to the theoretical origin-of-life conditions. It has been shown that protein amino acids are produced during crystallization and thermal ordering of hydrocarbons as well as by means of radioactive synthesis, which suggests mineral-based genesis of primitive biofunctioning structures and hydrocarbon mineral individuals with structures and functions of proto-organisms. The most perfect model of a pre-biological organism is provided by fibrous kerite crystals formed in pegmatite voids (Yushkin, 1996). Their shape, structure and composition are very close to those of living organisms (Yushkin, 1996, 1998, 1999). The living world is not a product of the mineral world transformation. Both of them have a common source: non-condensed ionic-molecular systems, in which they originated and developed by different crystallization mechanisms in harmonic interaction with each other. Life originated and evolved as a unified whole, an integrated consequence of crystallization processes in complex hydrocarbon systems, rather than as a result of coincidence of random events and a combination of genetically different components. Evolution of minerals and living organisms is governed by common ontogenetic laws. The proposed model of the crystalline hydrocarbon proto-organism based on investigations of fibrous kerite crystals eliminates the major discrepancies and blocks on the way to creating a unified concept of abiogenesis (structural organization, assembly of macromolecules, inheritance mechanisms, chiral selection, etc.). It is realistic and brings solution of the problem of the origin of life to the level of experimental modelling.

These facts and ideas constitute the basement for the theory of hydrocarbon crystallization of life (Yushkin, 1999) as mineral organismobiosis (structural and molecular evolution of crystal-like ordered molecular hydrocarbon systems, protoorganisms), a theory relying on empirical data and unifying abiogenic hypotheses of holobiosis (priority of cell-like structures with incipient metabolism) and genobiosis (priority of structures with gene properties). It appears appropriate to distinguish a pre-biological stage in the history of the biosphere, at which took shape and developed non-biogenic hydrocarbon systems with incipient structures and functions of biological organisms.

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BG05 : WEam14 : G1
Earthworm-Clay Mineral Interactions and Potential Chemical Transfers into Runoffs

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Earthworm digestion of two samples consisting in quartz-mixed smectitic clays (saponite and hectorite) and of a sample of ferruginous smectite without quartz blending, both having been mixed with the same type of peat organic matter for digestion, induced small changes in the basal XRD spacings of the clay components, increases between 0.4 and 0.7 angstroems for the ferruginous smectite and the saponite, and an increase by 0.6 angstroems for the hectorite. Cationic solute contents in water leachates from mineral-organic mixtures increased by earthworm digestion, ranging from 1.2 mg/g of the mass for the saponite-organic system, to 1.1 mg/g of the mass for the ferruginous smectite-organic system, to 0.5 mg/g of the mass for the hectorite-organic system. The increase for the saponite-bearing system was largely due to increases in the Na, K and Mg contents, whereas that of the hectorite-bearing system was due to increases in the Na, K, Ca and Mg contents. For the ferruginous smectite, it was due to Fe, Mn, Al and Si increases. The earthworm activity induced reductions in the total dissolved REE contents by an amount of about 7 ng/g of the saponite-organic system, and by an amount of about 10 ng/g of the hectorite-bearing system. By contrast, water leachate from a gram of the ferruginous smectite-bearing system digested by the earthworms contained about 130 ng more total REE than the corresponding system without earthworms. The water leachates from earthworm-worked samples became relatively enriched in light REE involving saponite and ferruginous smectite, but no relative changes occurred between the light and the heavy REE fractions for the water leachates involving hectorite. The earthworm digestion caused significant differences in the K/Rb ratios of the water leachates. Another earthworm induced difference between two corresponding water leachates was in the Sr isotopic composition. The leachate from earthworm digested hectorite yielded an $^{87}Sr/^{86}Sr$ ratio of 0.70893 in contrast to that without earthworms having a value of 0.70921. The leachate from ferruginous smectite with earthworms had an $^{87}Sr/^{86}Sr$ ratio of 0.70974, but that without earthworms had a value of 0.70913. The collective information suggests that dissolutions of the clay minerals were an important process in the specific cases of mineral-organic interactions studied here. A common effect of these interactions is to increase the solute elemental contents in natural waters by significant amounts and to change the Sr isotopic compositions. Various mineral and organic interactions should play a key role in improved understanding of many environmental changes.

Wednesday PO Session

BG05 : WEpo01 : PO
Mid Pliocene Nannoplankton Assemblages of the North Atlantic: A High Resolution Investigation into Nannoplankton Population Evolution

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This study consists of a comparative investigation of nannoplankton populations within the Upper Neogene, focusing on the Lower-Upper Pliocene boundary, NN15/16, approximately 3.9 Ma. The Lower-Upper Pliocene boundary saw the extinctions of Reticulofenestra pseudoumbilicus and Sphenolithus spp. and their replacement by Pseudoemiliania and Gephyrocapsa as the floral dominants. This high resolution study (4 kyr sampling) will improve our understanding of the detailed spatial and temporal characteristics of the evolutionary events at this time. It contributes to our comprehension of evolutionary biodiversity and ecology by testing the hypothesis that abundance fluctuations and changes in population composition reflect not only the overall evolutionary trends, but also responses to changing oceanographic conditions and species` individual ecological tolerances. We address the specific questions of how and why do planktonic species evolve; are nannoplankton extinction events rapid and globally synchronous; what controls phytoplankton diversity; what are the ecological preferences of particular taxa; and what is the interrelationship between biotic processes and environmental change?

BG05 : WEpo02 : PO
The Structural Oxygen of Minerals in Evolutionary Processes

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The structural oxygen of minerals has a great significance in the Earth evolutionary process. It is shown, that gas phase oxygen is able to com-pete with moving oxygen ions of the lattice of oxide mineral system by trap of position with profitable energy. This phenomenon may be observed in the processes of reconstruction of the surface of mineral formation. The reconstruction process of the surface are typical for oxide mineral forma-tion and take place at photostimulating formation of defects on the sub surface field of the lattice. Oxide minerals were researched. There are many surface oxygen forms on mineral surface. It is shown, that surface ion-radicals O- play the main role in the surface processes. Photoactivating forms are able to create the additional active surface centers. It may be the reason of the in-crease of the shortage of electronic centers. The value of the electronic center shortage divides minerals info two types with different photoadsorbtion to donor or accepter gas. For example, rutile and cassiterite are minerals with the surface electronic center shortage, but zincite is the mineral with longlive electronic centers. The testing reactions, for example, geteromolecularic photoisotopic oxygen change on the finedispercial oxide mineral system participa-tion of hole centers by formation nonstrong at 300 K complex are used for study of surface oxygen forms. If minerals are catalysts of main natural process, for example, formation cardon bounds: C-C, C=C, (XC=XC)n, so it can solve such problem as oil formation and origin of Earth life.

BG05 : WEpo03 : PO
Impact of Devegetation on Soil Dynamic-Interactions between Organic and Mineral Components

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Soils represent the interface among the atmosphere, the biosphere, the hydrosphere and the lithosphere. Their chemical and physical properties are affected by the plants and the associated micro-organisms. Since plants and their associated microbiota affect directly mineral weathering, soils covered by vegetation will not have the same structure and composition than soils without vegetation. Rain waters having imigrated through the upper horizon (0-30 cm of depth) of a soil covered by grass were collected under field conditions after each rain and from the same soil but after removal of its plants. The soil was analyzed four months after the devegetation process. Macro- and micro-nutrients were determined in the solid phase and the leaching waters of soils. The dissolved organic carbon (DOC) and the pH seasonal variations were examined. Among the major elements, the Ca and Si contents are the highest in the leaching waters from soil without plants, with about 9.66 mg/l and 8.20 mg/l, respectively. In the leaching waters from the same soil but with plants, the most abundant elements are K with about 6 mg/l and Si with about 5 mg/l. The preliminary results showed that the major impact of the devegetation process on the soil chemistry occurred in the three first months (summer-autumn) following the devegetation. The nutrient concentrations did not change considerably during the winter period. The most mobile elements from soils after devegetation are Ca with a mobilisation of about 595 mg per m^3 of soil, and Si with a mobilisation of 345 mg per m3. Compared to the undisturbed soil, only Na and REE seem to be higher in the leaching waters of the soil without plants. Four months of experimentation had no impact on smectite and calcite which were added to the soil, whereas hematite did react.

BG05 : WEpo04 : PO
Dynamics of Health Impacts in Central Russia

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At present the impairment of public health is one of serious problems for Russia. Relationships in a regional system “human health - impact factors” have been examined by the example of the Oka river basin located in the central part of Russia, with an area of around 24,500 square km and population of 25,000,000. The study was concentrated, on the one hand, on the statistical and multifactor analysis of numerous data on social, economic, demographic, environmental, and medical service situation in provinces located within the basin and, on the other hand, on the investigation of human health parameters and indices characterizing the demographic processes in the 90s. Six groups of parameters across 13 territorial units have been analyzed for a period from 1985 to 1998.

The first group consisted of disability data, death rates, and prevalence and incidence sickness rates including infectious, endocrine, urogenital, circulatory diseases, diseases of respiratory and digestive systems, and others (17 main groups in all). The complex assessment of health level has been made as a weighted sum of sickness rate, disability and mortality indices for the period from 1985 to 1998.

The aggregate effects of economic, social, demographic, ecological, and medical service impacts to the level of human health in 1998 have been investigated by meance of factor analysis. Maps depicting the spatial distribution of factors values were made.

Based on the factor analysis a typology of health effects was developed, its criteria included the type of impact (or specific combinations of types) and their intensity. The comparison of results of the factor analysis with the complex assessment of health level in scores showed that in regions with minimal and low health levels economic and social activities are depressed. Some of these regions also experience a negative impact of ecologial and demographic factors.

The developed typology is a case of social risk assessment, it provides the opportunity to identify specific regions, which require immediate measures to regulate the social situation. The typology also makes possible to plan, in a differentiated way, the distribution of financial resources among social programs including the quality of medical services. This is important for the elaboration of regional policy in the field of improving human health and the quality of life.

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Sr and Pb Isotopes as a Tool for Tracking Human and Animal Historical and Ancient Migrations

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The identification of ‘foreigners’ in ancient burials is crucial to many archaeological theories of migration and colonization. Traditionally this is done by analyzing such things as skeletal traits, skull shape and burial goods, however, there is such a diversity of these factors within a population that they do not discriminate reliably between populations. The Sr and Pb content and isotope composition of human tooth enamel reflects the environment in which an individual developed. Teeth are composed of calcium phosphate, a carbonated hydroxyapatite mineral, often termed biological apatite, and renowned for its non-stoichiometry. There are two main tissues in a tooth: the hard, highly mineralised outer enamel and the softer, relatively organic-rich inner dentine. Once enamel is fully formed in the gums, the tissue-forming cells die, the blood supply is cut off and it looses the ability to regenerate. As a result, its composition is effectively fixed, locked into place in its tough crystal structure. Studies on archaeological teeth show that the enamel is resistant to alteration and it preserves Sr concentrations, within the range of life values (50-100 ppm), and $^{87}Sr/^{86}Sr$ values that reflect the diet of the person at the time when the tooth mineralized (in vitro for deciduous teeth and early childhood for permanent teeth). Dentine, however is clearly affected by burial and usually shows enriched Sr contents (200-600 ppm) and $^{87}Sr/^{86}Sr$ values close to, or within error of the burial environment. Lead behaves in a similar manner to strontium in terms of its ingestion and up-take in pre-metallurgical societies. With the advent of metal mining and smelting, however, new routes of lead ingestion were opened up and these reflected cultural habits and artifact use rather than the local geological sources. The resistant nature of enamel means that it withstands the effects of burial and diagenesis better than any other tissue type and preserves ‘life’ values of the isotopic composition. Used with archaeological data on lifestyle and diet, the data preserved in teeth provide valuable information about the different types of people in a burial site and their possible origin. For example, a tooth from a woman buried in a Neolithic site on the chalk gives a Sr isotope value of 0.710. The chalk has a value of c. 0.7075. The radiogenic nature of the Sr in this tooth demonstrates that this woman spent her childhood in an area with significantly more radiogenic soil that the chalk in which she was finally entombed. Pb data from the same tooth suggest an area near the Mendips is a likely site.