Academy of Sciences of the Czech Republic

**Geological Institute**
**Annual Report 1995**

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*Editorial Note:* This Report is based on contributions from various authors. Scientific quality of the contributions is their responsibility. Compiled by J. Krhovský.

## 1. General Information

The Geological Institute AS CR is focused on research activities in the principal branches of geological sciences. The research topics most developed in the Institute are as follows:

- Petrology of igneous and metamorphic rocks.
- Lithostratigraphy of crystalline complexes.
- Structural geology and tectonics.
- Identification of Paleotectonic settings.
- Terrane identification.
- Taxonomy and phylogeny of fossil organisms.
- Paleobiogeographical aspects of Paleogeography of Variscan Europe.
- Paleoecology (incl. population dynamics, bioevents)
- Paleoclimatology as evidenced by fossil organisms and communities.
- Biostratigraphy and high-resolution stratigraphy.
- Basin analysis and sequence stratigraphy.
- Exogenous geochemistry.
- Karstology.
- Quaternary geology.
- Paleomagnetism.
- Magnetostratigraphy.
- Petromagnetism.

The research potential of the Institute is divided into 8 units:

**Specialized scientific departments:**
1. Endogenic geology
2. Paleontology
3. Exogenic geology and geochemistry
4. Paleomagnetism
5. Sedimentology and stratigraphy

**Service units:**
1. Laboratory of Physical methods
2. Laboratory of Chemical methods (canceled September 1996)
3. Information Centre (Library and Computer Network)

The scientific concept of the Geological Institute and the evaluation of its work's results are the responsibility of the Scientific Council that consists of both the internal and external members. Besides research, members of the Institute are involved in lecturing at universities and in the postgraduate education system. Special attention is also paid to popularization of the most interesting scientific results in public media.

## 2. Connections

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**3. Principal Administrative activities in 1996**

In the course of 1996, the new Institute Director was installed. Several research workers left the Institute for other Academy Institutes. In the same time roughly the same number of specialists joined the Institute from different institutions and several specisalists retired to pension (see Staff News).
One volume of the Geological Institute's journal Geolines were issued during 1996.

**4. Staff (as of December 31, 1996)**
Staff (as of December 31, 1996)

**Management**

| | |
|---|---|
| RNDr. Pavel Bosák, CSc. | Director of the Institute |
| Ing. Ottomar Gottstein, CSc. | Deputy Director |
| RNDr. Jan Krhovský, CSc. | Chairman of the Scientific Council |

**Head Office:**
František Bobek (*technical service*)
Josef Brožek (*photographer*)
Ing. Jana Čadková (*assistant to the Director* )

RNDr. Petr Čejchan (*computer specialist*)
Ing. Miroslav Fridrich, CSc. (*computer specialist*)
Karel Jeřábek (*garage attendant, driver*)
Jaroslav Kratochvíl (*technical service*)
Petr Vachalovský (*technical service*)

## Scientific departments

**Department of Endogenic Geology**
Scientific Staff:
RNDr. František Patočka, CSc. Head of the Department (*petrology, geochemistry*)
Ing. Jiří Fiala, CSc. (*structural geology, metamorphic petrology*)
RNDr. Miloš Lang, CSc. (*igneous petrology*)
prom. geol. Jiří Novák (*petrology*)
RNDr. Edvín Pivec, CSc. (*igneous petrology*)
Mgr. Martin Svojtka (*geochronology*)
doc. RNDr. Jaromír Ulrych, CSc. (*igneous petrology, geochemistry*)
RNDr. Zdeněk Vejnar, DrSc. (*petrology*)
RNDr. Jarmila Waldhausrová, CSc. (*petrology*)

Technical Staff:
Josef Forman (*technician*)
Ing. Jaroslava Pavková (*secretary of the Department, technician*)
Jana Rajlichová (*technician*)
Jaroslava Tejčková (*cleaning*)

**Department of Paleontology**
Scientific Staff:
prom. geol. Arnošt Galle, CSc. Head of the Department (*Devonian corals*)
RNDr. Jiří Bek (*Devonian and Carboniferous spores*)
RNDr. Petr Čejchan (*paleoecoogy*)
RNDr. Václav Houša, CSc. (*Jurassic and Cretaceous stratigraphy, calpionellids and ammonoids*)
RNDr. Magda Konzalová, CSc. (*Proterozoic, Early Paleozoic, Jurassic, Cretaceous and Tertiary palynology*)
RNDr. Miroslav Krůta, CSc. (*Early Paleozoic ostracodes*)
RNDr. Radek Mikuláš, CSc. (*ichnofossils*)
doc. RNDr. Luftulla H. Peza, DrSc. (*Mesozoic molluscs*)
doc. RNDr. Zbyněk Roček, DrSc. (*Origin and evolution of the Amphibia, Tertiary Anura and Sauria*)
RNDr. Miloš Siblík, CSc. (*Mesozoic brachiopods*)
RNDr. Marcela Svobodová, CSc. (*Cretaceous palynology*)
RNDr. Milada Vavrdová, CSc. (*Proterozoic, Paleozoic and Mesozoic palynology and plankton*)
Technical Staff:
Josef Brožek (*cleaning*)
Marcela Šmídová (*secretary of the Department, technician*)

**Department of Exogenic Geology and Geochemistry**
Scientific Staff:

RNDr. Václav Cílek, CSc. Head of the Department (*Quaternary Geology*)
Ing. Ottomar Gottstein, CSc. (*geochemistry of granitic and metamorphic rocks*)
Ing. Olga Kvídová, CSc. (*exogenic and environmental geochemistry*)
RNDr. Vojen Ložek, DrSc. (*Quaternary geology, malacozoology*)
Ing. Jaroslav Martínek (*geochemistry*)
Ing. Luděk Minařík, CSc. (*geochemistry*)
RNDr. Eliška Růžičková (*petrology, Quaternary geology*)
doc. Ing. Petr Skřivan, CSc. (*exogenic and environmental geochemistry*)
RNDr. Antonín Zeman, CSc. (*exogenic geology*)
RNDr. Anna Žigová, CSc. (*pedology, paleosoils*)

Technical Staff:
Jaroslava Bednářová (*editorial services*)
RNDr. Miloš Burian (*chemical analyst*)
Magdalena Čejková (*cleaning*)
Ing. Irena Dobešová (*maternal leave*)
Miroslav Karlík (*technician*)
Jana Krejčová (*technician*)
Jana Macháčková (*secretary of the Department, technician*)

**Department of Paleomagnetism**
Scientific Staff:
Ing. Petr Pruner, CSc. Head of the Department (*geophysics, paleomagnetism*)
Ing. Miroslav Krs, CSc. (*geophysics, paleomagnetism*)
prom.geol. Otakar Man, CSc. (*geophysics*)
Mgr. Jana Slepičková (*geophysics*)
RNDr. Daniela Venhodová (*petrophysics*)

Technical Staff:
Otto Čejchan (*mineralogical laboratory methods*)
Jana Drahotová (*technician*)
Věra Havlíková (*technician*)

**Department of Sedimentology and Stratigraphy**
Scientific Staff:
Ing. Václav Suchý, CSc. Head of the Department (*sedimentology and basins analysis*)
Mgr. Šárka Eckhardtová (*organic petrography and sedimentology*)
RNDr. Jindřich Hladil, CSc. (*Devonian stratigraphy and reefs*)
RNDr. Jan Krhovský, CSc. (*Upper Cretaceous and Cainozoic stratigraphy, calcareous nannofossils and foraminifers*)
Marie Lachmanová B.Sc.(*sedimentology*)
RNDr. Karel Melka, CSc. (*x-ray analyst*)
RNDr. Petr Štorch , CSc. (*Ordovician and Silurian stratigraphy, graptolites*)
RNDr. Jiří Žítt, CSc. (*Cretaceous and Tertiary sedimentology, echinoids and crinoids*)

Technical Staff:

Jana Macháčková (*secretary of the Department, technician*)

## Professional Departments:

**Physical Methods Service Laboratory**
Ing. Anna Langrová - Head of the Laboratory (*microprobe and scanning microscope analyst*)
Jiří Dobrovolný (*RTG specialist*)
Jaroslava Jabůrková (*preparing of thin sections*)
Ivana Konopáčová (*preparing of thin sections*)
Milena Kozumplíková (*microprobe and scanning microscope operator*)

**Scientific Information Section and Library**
RNDr. Helena Purkyňová Head of the Department (*librarian*)
PhDr. Liliana Peza (*librarian*)

**The Economic Department**
Ing. Ottomar Gottstein, CSc. Head of the Department
Antonín Čejka (*technical service*)
Michael Dytrt (*telephonist*)
Svatava Jandeková (*personnel section*)
Ludmila Jilichová (*telephonist*)
Jana Klímová (*accountant*)
Lenka Staňková (*accountant*)

*Scientific Council*

Prof. RNDr. Vladimír Bouška, DrSc. (Faculty of Sciences, CharlesUniversity)
RNDr. Václav Cílek, CSc. Vice-Chairman (Geological Institute ASCR)
Prof. RNDr. Petr Čepek, CSc. (Faculty of Sciences, Charles University)
RNDr. Jan Cháb, CSc. (Czech Geological Survey)
prom. geol. Arnošt Galle, CSc. (Geological Institute ASCR)
RNDr. Jan Krhovský, CSc. Chairman from May (Geological Institute ASCR)
RNDr. Miroslav Krůta, CSc. (Geological Institute ASCR)
Doc. RNDr. Zdeněk Kukal, DrSc. (Czech Geological Survey)
RNDr. František Patočka, CSc., Chairman till May (Geological Institute ASCR)
Ing. Petr Pruner, CSc. (Geological Institute ASCR)
Doc. RNDr. Jaromír Ulrych, CSc. (Geological Institute ASCR)

*Foreign consultants:*
Prof. Petr Černý (University of Manitoba, Winnipeg, Canada)
Prof. Jaroslav Dostál (Saint Mary's University, Halifax, Canada)
Prof. Peter E. Isaacson (College of Mines and Earth Resources, University of Idaho, U.S.A.)
Prof. Ronald Parsley (Tulane University, New Orleans, U.S.A.)

**5. Staff News**
*January* Jan. 1 RNDr. M. Šťastný, CSc. left for the Institute of the Rock Structures and Mechanics ASCR

| | | |
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| | | Mrs. J. Čápová and Ing. J. Benešová retired to pension. |
| *February* | Feb. 1 | Mrs. H. Grebíková left the Institute. |
| | | RNDr. H. Purkyňová joined the Institute after her maternal leave. |
| | | RNDr. K. Melka, CSc. attached to Institute. |
| *April* | April 1 | RNDr. R. Mikuláš, CSc. took up one year scientific schoolarschip of The Royal Society, London at The University of Liverpool. |
| | | Mrs. J. Krejčová (technician) joined the Institute. |
| | April 1 | Mr. P. Kohák (technician) leave the Institute. |
| | April 1 | Mr. G. Hašek (technician) joined the Institute. |
| | April 1 | Doc. RNDr. J. Ulrych, CSc. joined the Institute. |
| | April 1 | Mrs. J. Jabůrková (preparation of thin sections) took up maternal leave. |
| *May* | May 1 | Mrs. V. Frimlová (accountant) leave the Institute. |
| | May 22 | New Scientific Council was elected. |
| *June* | June 30 | RNDr. O. Nekvasilová retired to pension. |
| *August* | Aug. 1 | Ing. J. Martínek attached to the Dept. of Exogenic Geology and Geochemistry. |
| *September* | Sept. 1 | RNDr. P. Čejchan became attached to the Dept. of Paleontology. |
| | Sept. 1 | Mgr. J. Slepičková attached to the Dept. of Paleomagnetism. |
| | Sept. 15 | Ing. Chalupský, Mrs. M. Malá, and Mgr. J. Švec left for the Institute of the Rock Structures and Mechanics ASCR. |
| | Sept. 16 | Mrs. L. Staňková (accountant) joint the institute. |
| | Sept. 30 | RNDr. V. Houša, CSc. finished in the function of the Institute Director. |
| *October* | Oct. 1 | RNDr. P. Bosák, CSc. appointed as Director of the Institute |
| | Oct. 1 | Bc. M. Lachmanová joined the Dept. of Stratigraphy and Sedimentology. |
| | Oct. 31 | Ing. M. Hříbal left for the Institute of the Rock Structures and Mechanics ASCR |
| *December* | Dec. 31 | Mr. M. Dytrt (telephonists) leave the Institute. |

## 6. Undergraduate and Postgraduate Education

*Undergraduate and Postgraduate Courses at Universities Given by Members of the Geological Institute ASCR:*

Bosák P.: *Karstology and Paleokarstology.* Postgraduate course, Faculty of Sciences, Prague.
Cílek V.: *Landscape and Culture.* Summer session course, Simon Fraser University, Vancouver, Canada.
Cílek V.: *Landscape, ecology, culture and language.* Summer school course, Northwestern University, Evanston, Chicago.
Cílek V.: *Sandstone phenomenon.* Field course, Institute of the fundamentals of learning, Pedagogical Faculty, Charles University.
Cílek V.: *Gaia and ecology.* Undergraduate course, Institute of the fundamentals of

learning, Pedagogical Faculty, Charles University.
Hladil J.: *Origin of carbonate rocks*. Undergraduate and postgraduate special courses, Faculty of Sciences, Masaryk University, Brno.
Houša V.: *Taxonomy and nomenklatorics*. Undergraduate course, Faculty of Sciences, Charles University, Prague.
Houša V.: *Paleobiogeography.* Undergraduate course, Faculty of Sciences, Charles University, Prague.
Krhovský J.: *Mass extinctions*. Undergraduate course, Faculty of Sciences, Charles University, Prague.
Krhovský J. & Roček Z.: *Evolution of the Global Ecosystem.* Postgraduate course, Faculty of Sciences, Charles University, Prague.
Krs M., Pruner P.: *Paleomagnetism and paleogeography of the Variscan formations of the Bohemian Massif, comparison with other European Regions*. Undergraduate course, Faculty of Sciences, Charles University, Prague.
Pruner P.: *Paleomagnetism and paleogeography of Mongolia from the Carboniferous to the Cretaceous*. Undergraduate course, Faculty of Sciences, Charles University, Prague.
Ložek V.: *Development of the Nature during the Quaternary Era.* - Undergraduate course, Faculty of Sciences, Charles Univeristy, Prague.
Roček, Z. *Evolution of vertebrates*. Undergraduate course, Faculty of Sciences, Charles University, Prague.
Roček, Z. *System of fossil vertebrates*. Undergraduate course, Faculty of Sciences, Charles University, Prague.
Skřivan P.: *Environmental chemistry.* Undergraduate course, Faculty of Forestry, Czech Agricultural University, Prague.
Štorch P. : *Principles and methods of stratigraphy*. Undergraduate course. Faculty of Sciences, Charles University, Prague
Ulrych J.: *Methods of mineralogical investigation.* Undergraduate course, Faculty of Sciences, Charles University, Prague.
Ulrych J.: *Interpretations of mineralogical data.* Undergraduate course, Faculty of Sciences, Charles University, Prague.
Ulrych J. & Matějka D.: *Geochemistry of volcanites of the Bohemian Massif.* Undergraduate course, Faculty of Sciences, Charles University, Prague.
Zeman A.: *Geology and Pedology.* Undergraduate course, Pedagogic Faculty, West Bohemian University, Plzeň.
Žigová A.: *Geographic distribution of soils and protection of soil resources in the Czech Republic.* Undergraduate course, Faculty of Sciences, Charles University , Prague.

<u>*Supervisors in Undergraduate Studies:*</u>

M. Dvořáková, Faculty of Forestry, Czech Agricultural University, Prague *(supervisor P. Skřivan)*
J. Hlaváč, Faculty of Sciences, Charles University, Prague *(supervisor V. Ložek)*
P.Jarošová, Faculty of Forestry, Czech Agricultural University, Prague *(supervisor P. Skřivan)*
J Laurin, Faculty of Sciences, Charles University, Prague (*scientific consultant R. Mikuláš*)

J. Samek, Faculty of Forestry, Czech Agricultural University, Prague *(supervisor P. Skřivan)*
L. Sedláčková, Department of zoology, Faculty of Sciences, Masaryk University, Brno (*supervisor Z. Roček)*
L. Slavík, Faculty of Sciences, Masaryk University, Brno *(supervisor J. Hladil)*
J. Slepičková, Faculty of Sciences, Charles University, Prague (*supervisor P. Pruner*)
P. Špaček, Faculty of Sciences, Masaryk University, Brno *(supervisor J. Hladil)*
N. Stanišová, Institute of Chemical Technology, Prague *(scientific consultant V. Suchý)*
R. Štorc, Faculty of Sciences, Charles University, Prague (*scientific consultant J. Žítt*)
J. Vejvalka, Faculty of Sciences, Charles University, Prague (*supervisor Z. Roček)*
P. Zajíc, Faculty of Forestry, Czech Agricultural University, Prague *(supervisor P. Skřivan)*
R. Zuzka, Faculty of Sciences, Charles University, Prague *(supervisor J. Fiala)*

*Supervisors in Postgraduate Studies:*

RNDr. J. Bek, Geological Institute ASCR, Prague *(supervisor M. Vavrdová)*
Mgr. Š. Eckhardtová, Geological Institute ASCR, Prague (*supervisor V. Suchý)*
RNDr. B. Hamršmíd, Moravské naftové doly a.s., Hodonín *(supervisor J. Krhovský)*
Mgr. L.Juřičková, Faculty of Sciences, Charles University, Prague *(supervisor V.Ložek)*
RNDr. J. Kvaček, National Museum, Prague *(scientific consultant M. Konzalová)*
Mgr. L. Motl, Schola Humanitas Litvínov - Faculty of Forestry, Czech Agricultural University, Prague *(supervisor P. Skřivan)*
Ing. J. Sedláčková, Institute of Chemical Technology, Prague *(scientific consultant V. Suchý)*
Mgr. J. Slepičková, Faculty of Sciences, Charles University, Prague (*co-supervisor P. Pruner).*
RNDr. M. Streitová, Faculty of Sciences, Masaryk University, Brno *(supervisor J. Hladil)*
RNDr. E. Střelcová, Czech Geological Survey, Branch Brno and Masaryk University, Brno *(scientific consultant V. Suchý)*
Mgr. R. Štorc, Faculty of Sciences, Charles University, Prague (*scientific consultant J. Žítt*)
Mgr. M. Vach, Institute of Applied Ecology, Faculty of Forestry, Czech Agricultural University, Prague *(supervisor P. Skřivan)*
RNDr. Miloš Vater, Zoological Institute of the Slovak Academy of Sciences, Bratislava (*supervisor Z. Roček)*

RNDr. F. Patočka was the member of the Board of Postgraduate Studies on Geology, Faculty of Sciences, Charles University, Prague.

**7. Department of Endogenic Geology**

Results of projects in 1996:

**Foreign Grants and Joint Projects**

Joint projects of Geologisch-Paläontologisches Institut der Johann-Wolfgang-Goethe-Universität Frankfurt a. Main and Geological Institute ASCR, supported by the Deutsche Forschungsgemeinschaft, Bonn.

(1) Bilanzierung und Modellierung eines angekippten Krustenprofils von der Anchizone bis zur Amphibolitfazies, W-Rand Teplá-Barrandium *(G. Zulauf and G. Kleinschmidt, Geologisch-Paläontologisches Institut Johann-Wolfgang-Goethe-Universität Frankfurt a. M., **J. Fiala** & **Z. Vejnar**)*
The Late Paleozoic evolution of the Teplá-Barrandian unit has been interpreted as a consequence of the Variscan gravitational and rheological plateau-collapse.
The transtension kinematics in Cadomian basement of the Teplá-Barrandian in Cambrian led to exhumation of deeper crustal levels and tilting of metamorphic isograd surfaces. An intensive Cambrian supracrustal plutonism (Teplá and Domažlice crystalline complexes) and volcanism (Barrandian syncline) occur contemporaneously with this transtension. The Mid-Cambrian marine sediments point to complete dissection of the original Cadomian relief. Starting probably from Silurian at the N-edge of Teplá-Barrandian an active continental margin evolved. After closing of an intervening ocean in Devonian the attenuated Saxothuringian continental crust was subducted under the Teplá-Barrandian one. Thereafter, in Carboniferous the substantially thickened continental crust was subjected to gravitation collapse and tectonic denudation of the roof pendant. The recent analogue of this configuration can be found in Himalayan orogen. The Teplá-Barrandian in this model represents probably a Late-Devonian to Early-Carboniferous Tibet-Plateau.

(2) Strukturelle und kinematische Entwicklung der Zentrallböhmischen Scherzone (CBS) zwischen Klatovy und Rittsteig *(G. Zulauf, G. Kleinschmidt and D. Scheuvens, Geologisch-Paläontologisches Institut Johann-Wolfgang-Goethe-Universität Frankfurt a. M., **J. Fiala** & **Z. Vejnar**)*
The Teplá-Barrandian/Moldanubian *s.s.* boundary is characterised by the intrusion of large felsic (Bor, Babylon, Nýrsko, Klatovy) and small mafic (Mutěnín, Drahotín) plutons, which were emplaced in a shear zone during ductile shearing. The NNW-SSE trend of the 35 km long Bor pluton is parallel to that of the West Bohemian shear zone (WBS). Near Neukirchen, the WBS bends sharply towards WSW-ENE orientation and is continuated as a Central Bohemian shear zone (CBS), which is intruded mainly by the Klatovy granitoid type of the Central Bohemian Pluton. An attempt has been done to date the fault-related plutons, in order to constrain the age of the tectonic activity along shear zones.
For all analysed granitoids of the WBS and CBS the discordant U-Pb zircon data result from combination of different amounts of inherited lead from various sources and (sub) recent lead loss. From these reasons almost relatively wide ranges can be only defined for the time of granitoid intrusions. For the Bor pluton is this range between 315 and 332 Ma, for the Babylon granite between 320 and 345 Ma. For the Klatovy granitoid range can be defined between 335 and 357 Ma, which is in good agreement with K/Ar cooling age of biotite at 339±10 Ma obtained on the same sample. Similar but slightly higher range of 342 and 361 Ma was obtained from zircons of the Nýrsko granitoid giving the biotite K/Ar cooling age of 342±8 Ma.

(3) Magmatische und metamorphe Entwicklung frühpaläozoischer Plutonite in einem kohärenten Krustenprofil am SW-Rand des Teplá-Barrandiums *(P. Blümel, Institut für*

*Mineralogie der Technische Hochschule Darmstadt, G. Zulauf, Geologisch-Paläontologisches Institut Johann-Wolfgang-Goethe-Universität Frankfurt a. M.,* ***J. Fiala, Z Vejnar*** *& J. Babůrek, Czech Geological Surwey, Prague)*

A range of plutons intruded in Early Paleozoic the Cadomian basement in the SW part of the Teplá-Barrandian. The intrusive complex was thickened, metamorphosed and tilted to the E in the course of Variscan orogeny. An opportunity is given to study a coherent 35 kms long crustal section reaching, regarding the intrusion level, from lower and middle crust (coronitic gabbro at Neukirchen) to upper crust (granodiorite of Stod). Gradients or discontinuities in relation to depths of intrusions and Variscan tectonometamorphic overprints will be studied with the aid of petrologic, geothermobarometric and structural investigations of plutonic rocks as well as of their contact aureoles along the mentioned tilted section.

International Geological Correlation Programs, UNESCO

IGCP Project No. 369: Comparative Evolution of Peri-Tethyan Rift Basins. Subproject 2a Magmatism and Rift Basins Evolution: Peri-Tethyan Region

(a) Age related contrasting alkaline volcanic series in North Bohemia ***(J. Ulrych & E. Pivec)***

The Upper Cretaceous - Tertiary volcanism of the north-eastern part of the Ohře (Eger) rift in the northern Bohemia displays characteristic features of two intraplate magmatic series. An older (79 - 50 Ma) unimodal ultramafic ultra-alkaline (olivine melilitite to olivine nephelinite) series represents the precursor of rifting occurs exclusively in external blocks of the Ohře rift. A younger (40 - 18 Ma) bimodal (basanite-phonolite) rock series of alkaline character predominates in the internal blocks of the rift. The later series is characteristic of the highly-volcanic active rifts. In the central part of the Ohře rift, in the České středohoří Mts., there prevails a mildly alkaline bimodal basanite-trachyte association. Enrichment of the ultramafic series in incompatible elements (Rb, REE, Y, U, Th, Zr, Hf, Nb, Ta, P) could be explained by low degree partial melting of a metasomatically enriched mantle source and/or steady zone refining process of magma generation. Further enrichment during the postmagmatic process within the high level crustal reservoir source is likely. The $^{87}Sr/^{86}Sr$ (0.70327 - 0.70366) and $^{143}Nd/^{144}Nd$ (0.51267 - 0.51287) ratios of the (ultra)mafic rocks of both magmatic series are similar and close to those of HIMU OIB. Highly evolved phonolites, which originated by the low-pressure crustal fractionation of the parental basanitic magma, were affected by some crustal contamination ($^{87}Sr/^{86}Sr$ = 0.70431 - 0.70534). The additional gains of a lithophile element in phonolites are most probable. The volcanic association of the Ohře rift is comparable with classic areas of bimodal alkaline volcanism, such as in Hegau, Rhön and the East African Rift.

(b) The Podhorní vrch volcano: volcanological and geochemical characteristics (***J. Ulrych & E. Pivec)***

Podhorní vrch volcano (15 - 12 Ma), situated near Mariánské Lázně spa in western Bohemia, belongs to the Miocene-Pliocene volcanism of the Bohemian Massif. The volcano occurs spatially associated with the tectonic zone striking NNW - SSE pertaining to the Neogene Domažlice - Cheb Graben. All its volcanic products reveal the olivine nephelinite composition. On the basis of geochemical criteria they could be considered as undifferentiated products of mantle origin (Mg-value = 71 - 74 Cr > 500, Ni > 250, Co > 50, Sc > 30 ppm; presence of lherzolite xenoliths). Strontium (

$^{87}Sr/^{86}$ Sr = 0.7035) and neodymium ($^{143}Nd/^{144}Nd$ = 0.51286) isotope composition bears for mantle origin as well. High contents of selected incompatible elements (U = 1.7 - 5.2, Th = 9.3 - 15.9 REE = 320 - 460 ppm, LaN/LaN = 29 - 54) are most characteristic. Coarse- to medium- and fine-grained segregations of ijolite to turjaite composition in the parental olivine nephelinite are presented by the nepheline + melilite/(leucite + sanidine) + diopside/fassaite - aegirine ± sodalite, titanian magnetite, fluor-hydroxyapatite mineral paragenesis. Origin of the segregations is associated with the late-magmatic stage concentrating alkalies (Na), trace incompatible elements (REE, U, Th, Nb, Ta, P) and volatile components (F, Cl, $H_2S$). The segregations are characterised by the low contents of Si, Al and K and higher concentrations of Ca in comparison with that from classical localities (Maiches and Löbauer Berge - Germany). This composition has been reflected in the crystallisation of melilite, instead of leucite and sanidine.

**Grant Agency of the Czech Republic**

No. 205/95/0149 - The influence of postmagmatic processes on the mineralogical and petrochemical composition of granitoids within Krušné hory - Smrčiny anticlinorium (*M. Štemprok, Faculty of Sciences, Charles University, Prague,* ***E. Pivec, J.K. Novák, M. Lang****)*

The study of granitic rocks was focused to granites of the young intrusive complex in the Karlovy Vary along the Ohře River. The section is formed by two-mica granites classified as alkali-feldspar granites. Some parts of these rocks show a high stage of postmagmatic autometamorphic processes and are close to Li-granites. They are composed of feldspars, quartz, dark and white micas, topaz, tourmaline, clay minerals in pseudomorphs ( mixture of kaolinit and dickite) after older feldspars beside fresh ones, and cassiterite and zircon as accessories. These porous rocks have a higher content of $LiO_2$ (about 0.10 wt. %). Dark micas in these zones strongly affected by postmagmatic proces correspond in the core to siderophyllite while the rim to zinnwaldite. From this may be suggested that Li-mica granites in the Krušné hory area are not products of extreme differentiation of biotite granites but the results of metasomatic processes or melting of earlier formed granites similarly as it is suppose in Cornubian batholith.

The considerable chemical data set concerning to granites of the Krušné hory Mts. Batholith was statistically treated to show evident differences in bulk phosphorus content between both the Eastern and Western plutons. Whereas the Eastern pluton is a classic example of the P-low subtype, the granites of the Western pluton are commonly enriched above the theoretical apatite solubility curves. Additional investigation is focused on phosphorus content in feldspars. Compositional granite characteristics of the Western pluton show affinities with post-collisional setting (e.g. Cornubian batholith), and those of the Eastern pluton with anorogenic setting ( similar to Transbaikalia and Nigeria). Authors suggest that difference has not been caused by different conditions of crystallization path, but by the amount of phosphorus in melt derived from the protolith. In the Krušné hory Mts., there the role of phosphorus does not appear to be as decisive for ore productivity as shot of fluorine and/or boron.

No.205/94/0687 - Isotopic study of accessory minerals from deformed granitoid rocks of the Moldanubian Zone in the Bohemian Massif *(J. Košler, Charles University, Prague, K. Vokurka, Czech Geological Survey, Prague &* ***M. Svojtka****)*

The largest orthogneiss body in the Moldanubian zone of the southern Bohemia near Stráž forms a NE-trending elongated lens (ca 15 $km^2$) tectonically intercalated with the surrounding biotite-cordierite paragneisses of the Monotonous Group, for which a late Proterozoic maximum deposition age has been established on the basis of U-Pb detrital zircon data (Kroener et al., l988). The Stráž orthogneiss has a zonal fabric with the most deformed outer parts and the central part containing relics corresponding to a metagranite, suggesting the rock had an igneous protolith. Intrusive origin of orthogneiss is also indicated by strong migmatitization in the surrounding paragneisses, the intensity of which increases near the paragneiss/orthogneiss boundary. The orthogneisses and the surrounding paragneisses share a common dominant NE to NNE trending foliation which is parallel to the orthogneiss margins. For U-Pb isotopic study of zircons orthogneiss sample was collected 0.3 km NW of Lásenice. Backscattered electron study has revealed fine oscillatory zoning in most of the studied grains. Zircons from the Stráž orthogneiss show a considerable scatter in their U-Pb isotopic compositions. Three zircon size fractions plot on different discordias and form a cluster of data points near 420 Ma in the concordia diagram. Two of the three size/morphological fractions plot above the concordia, indicating strong disturbance of their U-Pb systems, probably associated with U-loss or different initial Pb proportions. In addition, two positively discordant samples have the highest common lead contents and the grains have high content of apatite inclusions. Composition of short prisms (53-85 mm) plots well above the composition of the zircon size fractions, near 500 Ma. As the 53-85 mm size fraction is dominated by short prisms, the composition of air-abraded 53-85 mm short prisms effectively corresponds to that of air-abraded 53-85 mm size fraction. The two fractions define a discordia with an upper intercept at 552±11 Ma. The lower intercept (near 0 Ma) indicates a recent Pb-loss. Both the euhedral shape and fine oscillatory zoning are indicative of magmatic crystallization of studied zircon grains and, accordingly, the 552 Ma upper intercept age is interpreted as representing an early Cambrian magmatic crystallization of the Stráž orthogneiss protolith.

**Grant Agency of the Academy of Sciences CR**

A 3111601 Geochemical development of volcanic complex from the central part of the České středohoří Mts. ***(J. Ulrych, M. Lang, F. Patočka & J.K. Novák)***
Forty rock samples was used for the study of petrology and geochemistry of the volcanic complexes of the České středohoří Mts. Samples have been studied for bulk and trace element chemistry and prepared for the $^{87}Sr/^{86}Sr$ and $^{143}Nd/^{149}Sm$ isotope study.

A 313410 - Petrology and geochemistry of the Tertiary volcanites from the Mariánské Lázně spa region (***E. Pivec, M. Lang)***.
The petrology and geochemistry of olivine nephelinite (15 - 12 Ma) from the Podhorní vrch area were studied inclusive of lherzolite inclusions and „doleritic“ exsolutions close to ijolite with mineral association clinopyroxene-melilite/leucite, sanidine ± sodalite, olivine, magnetite, and apatite. Conclusions were published (see list of publications). The series trachybasalt - basaltic andesite - trachyandesite - trachyte - rhyolite (between 11.4 and 12.9 Ma) from this area represent the continuation of the olivine nephelinite above. The petrology and geochemistry especially of these trachytic rocks *s.l.* are similar to the rocks suite in Siebengebirge (Germany).

A3013610 - The development of the Early Paleozoic volcanic complexes of the West Sudetes: the Železný Brod as an example *(**F. Patočka**, M. Fajst, Charles University, Prague , **J. Ulrych, M. Vavrdová**)*

(a) Geochemistry and $^{40}$**Ar-**$^{39}$**Ar** dating of metamorphisms in the Variscan High Pressure Terranes of the Rýchory Mts. (W Sudetes, Bohemian Massif): paleotectonic significance (*H. Maluski, Université Montpellier 2, France and **F. Patočka**)*

The mafic metavolcanics (blueschists and greenschists) of the Rýchory Mts. crystalline complex (West Sudetes) experienced sea-floor hydrothermal alteration (spilitization?). The metabasite geochemistry (namely trace element and REE abundances) indicate that the protolith was comparable in composition with (1) tholeiitic to transitional ocean-floor basalts and (2) transitional and alkaline intra-oceanic island basalts.

Two main metamorphic events affected the metabasites. In an earlier HP-LT metamorphic event the rocks experienced blueschist facies metamorphism. The HP-LT metamorphism was followed by a greenschist facies overprint. The results of the $^{40}$Ar-$^{39}$Ar geochronology on phengites from the Rýchory Mts. mafic blueschists date the end of the earlier metamorphism to 360 Ma. Around 340 Ma greenschist metamorphic event followed.

The elongated bodies of mafic metavolcanics are situated within the prominent NNE-SSW trending Leszczyniec shear zone following the Rýchory Mts. and Rudawy Janowickie Mts. Both the geochemical affinities and the blueschist facies metamorphism of the metabasites suggest that this shear zone evolved from the Variscan suture dividing western and central terranes of the West Sudetes. According to the radiometric age of the HP-LT metamorphism termination, the terranes accreted in Famennian.

A considerable time-span between the origin of metabasite protolith and the blueschist metamorphism may indicate a long-lasting consummation of large oceanic plate between Gondwana and Laurussia, possibly accompanied by terrane accretion, prior to the Variscan orogeny.

(b) The possible affinites of metasedimentary sequences of the central West Sudetes based on microfossil record *(**M. Vavrdová**)*

Metalydites from the Radčice Group (Ještěd Mountains) yielded poorly preserved, but abundant and varied fossil organic remains (chitinozoans, graptolite sicules, melanosclerites, nematoclasts and acritarchs). Despite the poor preservation of recovered microfossils, influenced by a metamorphic alteration, preliminary biostratigraphic assessment points to the Silurian age of sample JG-1 (Kryštofovo údolí valley). Filamentous nematoclasts were provisionally assigned to pterobranchids. Affinities sedimentary sequences of northern margin of Bohemian Massif to Baltic Province are apparent.

**Grants of the Charles University, Prague**

RUK No. 3239 Utilisation of crystal chemistry of apatite to interpretation of genesis of volcanic rocks *(D. Matějka, Charles University, Prague & **J. Ulrych,** P. Pazdernik, Charles University, Prague)*

Twenty rock samples was collected for study of the characteristic apatite crystal chemistry and proprier separation techniques were tested. Under the guidance of the supervisor (*J. Ulrych*) the paper „Distribution and bonding of phosphorus in Tertiary volcanic rocks of the Bohemian Massif“ by postgradual student Dipl. Geol. P.

Pazdernik, Erlagen, is under preparation.

**8. Department of Paleontology**

Results of projects in 1996:

**Foreign Grants and Joint Projects**

Joint project of URA-CNRs 1761, Université Paris 6, France and Geological Institute ASCR. - Les amphibiens du Tertiaire européen. Evolution, paléobiogéographie, paléoécologie. *(J.-C. Rage, Université Paris 6, Paris, France &* ***Z. Roček****)*
A complete review of the Mesozoic and Tertiary anuran taxa of Europe was compiled, with comments on their taxonomic assignment and geographic distribution. The review was submited as chapters „Relationships of Mesozoic anurans“ and „Tertiary Anura of Europe“ to be published in Heatwole, H. and R. Carroll (eds.): Amphibian Biology, Vol. 4 - Paleontology. Surrey Beatty & Sons.

International Geological Correlation Program, UNESCO
IGCP Project No. 335: Biotic Recoveries from Mass Extinctions. *(project leader D. Erwin, Smithsonian Institution)*
Sub-project - Restoring gradients from fossil communities: a graph theory approach ***(P. Čejchan)***
Ecosystem is an unusually complex entity with a great number of usually nonlinear interactions, evolving slowly in time. Time is one of the crucial point when doing ecosystem analysis. However, lot of the complexity becomes lost when the ecosystem becomes reflexed in the fossil record (our data).
The potential advantage of paleobiology when attempting to understand the ecosystem's dynamics is in its intrinsic large-time-span point of view. From this (large scale) point of view the recent ecology studies (roughly) fixed-time-cut of the problem, biased with a short-term "noise", while missing the secular trend. On the other hand, the above mentioned poor quality of mirroring of the results of extremely complex interrelations should be considered its serious handicap. A lot of tedious work has been done using traditional methods, but many questions are still open, as the underlying problem is intractable in a traditional manner.
With the coming of supercomputing, many formerly intractable problems can be challenged now using interdisciplinary approach to paleobiological problems (biology - geology - mathematics). New methods were developed, or improved, and applied to paleoecosystem reconstruction.
An attempt to understand the enormous complexity of ecosystem interrelationships in a large time-scale can be of some predictive value under the circumstances of the today's approaching global environmental crisis.

Sub-project - Organisation of the Final IGCP-335 Conference, Recoveries '97 Prague ***(P. Čejchan & J. Hladil)***
The IGCP Project 335 aims to be a platform for the study of survival and recovery of the biosphere, and restructuring of global environments, following mass extinctions. The final meeting of the UNESCO IGCP Project 335 "Biotic Recoveries from Mass Exctinctions" will be held on September 12-14, 1997 at Prague, Czech Republic. The conference is held under the auspices of the Geological Institute, Academy of

Sciences, and is organised by Petr Čejchan & Jindřich Hladil. It will take place at the new IKEM Conference Building, Vídeňská 800, Prague 4. The conference is devoted to ecosystem restructuring after major ecosystem collapses during the history of the Earth (including the recent). Numerous extinction events were followed by recoveries and origination of new ecosystems. This significant transformation could be realised in numerous ways. The meeting should bring together paleobiologists, paleontologists, biologists, ecologists, systems theorists, and other persons that are interested in the topic.
The project outlines are:
(1) to study patterns of extinction/survivorship of organisms during the mass extinction events;
(2) to analyse the evolutionary and ecological strategies that allowed clades and communities to survive and initiate subsequent biotic recoveries;
(3) to study the structure of the deep-crisis ecosystem;
(4) to elucidate the recovery initiation mechanisms;
(5) to find the time, space and functional patterns of the recovery;
(6) to refine the data and tools for this discipline;
(7) to develop general models by means of comparison of individual global crises in Earth's history;
(8) to apply these (predictive) models to better understanding the modern environmental and biodiversity crises.

**Grant Agency of the Czech Republic**

No. 205/94/1321 - Carboniferous spores of plant groups Lycophyte, Sphenophyte and Pterophyte. (***J. Bek***)
About 2000 samples were collected and evaluated from various fertile parts of Carboniferous plants from the collection of the National Museum in Prague during last three years. Research was concentrated on the spores from fructifications of three main plant groups - *Lycopsida, Sphenopida* and *Pteropsida*.
Cones of the genus *Lepidostrobus* (Brogniart) Brack-Hanes & Thomas produced only miospores of the genus *Lycospora* (Ibrahim) Schopf, Wilson & Bentall. One cone produced only one lycospore species (with one exception - *Lepidostrobus cernuus*) in all its parts (basal, middle and apical) and it seems that these cones rippened at the same time. Miospores belonging to the nine dispersed lycospores species were isolated from eight cone types of the genus *Lepidostrobus*.

| Parent plant | Miospores |
|---|---|
| *Lepidostrobus crassus* Němejc | *Lycospora parva* Kosanke |
| *Lepidostrobus haslingdenensis* Thomas & Dytko | *Lycospora noctuina* Butterworth & Williams |
| *Lepidostrobus lycopoditis* O. Feistmantel | *Lycospora rotunda* Bharadwaj |
| *Lepidostrobus stephanicus* Němejc | *Lycospora punctata* Kosanke |
| *Lepidostrobus cernuus* (Sternberg) Němejc | *Lycospora* cf. *brevis* Bharadwaj<br>*Lycospora* cf. *pseudoannulata* Kosanke |
| *Lepidostrobus cf. sternbergii* Corda | *Lycospora* cf. *pusilla* (Ibrahim) Schopf, Wilson & Bentall |
| *Lepidostrobus* sp. A | *Lycospora subjuga* Bharadwaj |

| | |
|---|---|
| *Lepidostrobus* sp. B | *Lycospora microgranulata* Bharadwaj |

Some of studied cones (only a few ones) were heterosporous, it means they produced male (miospores) as well as female (megaspores) reproductive organs. All of these cones are referred to the genus *Flemingites* (Carruthers) Brack-Hanes & Thomas. Fertile part of the genus *Sporangiostrobus* Bode (family uncertain but of lycopod affinity) contained spores belonging to thirteen dispersed species (till this time) of two genera - *Densosporites* (Berry) Butterworth, Jansonius, Smith & Staplin and *Cristatisporites* (Potonie & Kremp) Staplin & Jansonius. Most of these fertile branches contains only miospores, some of them (only a few ones) were bisporangiate with megaspores of *Superbisporites* type. These fertile branches probably rippened gradually from the basal to the apical parts and produced miospores with relatively large morphological variability.

| Parent plant | Miospores |
|---|---|
| *Sporangiostrobus feistmantelii* (Feistmantel) Němejc | *Densosporites* cf. *spinifer* Hoffmeister, Staplin & Malloy<br>*Densosporites spinifer* Hoffmeister, Staplin & Malloy<br>*Densosporites granulosus* Kosanke<br>*Densosporites lobatus* Kosanke<br>*Densosporites sphaerotriangularis* Kosanke<br>*Densosporites glandulosus* Kosanke<br>*Densosporites pseudoannulatus* Butterworth & Williams<br>*Densosporites anulatus* (Loose) Smith & Butterworth<br>*Densosporites gracilis* Smith & Butterworth<br>*Cristatisporites* cf. *saarensis* Bharadwaj<br>*Cristatisporites saarensis* Bharadwaj<br>*Cristatisporites solaris* (Balme) Potonié & Kremp<br>*Cristatisporites indignabundus* (Loose) Potonié & Kremp |

Cones of genera *Macrostachya* Schimper*, Calamostachys* Schimper and *Paleostachya* Weiss contained miospores and megaspores belonging to various dispersed species of the genus *Calamospora* Schopf, Wilson & Bentall. The most common are spores belonging to dispersed species *Calamospora breviradiata* Kosanke, *C. hartungiana* Schopf, Wilson & Bentall, *C. laevigata* (Ibrahim) Schopf, Wilson & Bentall, *C. liquida* Kosanke, *C. microrugosa* (Ibrahim) Schopf, Wilson & Bentall, *C. mutabilis* (Loose) Schopf, Wilson & Bentall, *C. pallida* (Loose) Schopf, Wilson & Bentall, *C. parva* Guennel, *C. pedata* Kosanke and *C. straminea* Wilson & Kosanke. It is very difficult to distinguish single sphenopsid cones based on their spore content because all calamospores species are very similar and their classification is based on less important morphological features influenced by fossilisation and by stage of their preservation.

A few fertile fronds of some pteropsid plants contained miospores belonging to various species of dispersed genera *Laevigatosporites* (Ibrahim) Schopf, Wilson & Bentall *, Latosporites* Potonié & Kremp, *Leiotriletes* (Naumova) Potonié & Kremp*, Punctatosporites* Ibrahim*, Cyclogranisporites* Potonié & Kremp and *Raistrickia*

Schopf, Wilson & Bentall.

No: 205/96/0066 Morphologic reaction of the model species during the extinction-recovery of the ecosystem (*Caliapora battersbyi*). *( **P. Čejchan** & **J. Hladil**)*
Thirty one populations of *C. battersbyi* have been selected for the analyses. They cover the entire stratigraphical interval of the Givetian with exception for the earliest and latest intervals of the Givetian stage, i.e. 200-300 ka, where the colonies are scattered. The population were documented and sampled from outcrops and drilled core of boreholes from the Moravian Karst facies over the entire Moravia. Seven populations have been separated from the core of the Ochoz V-1 borehole, Moravian Karst. Basing on the recent state-of-art in *C. battersbyi*, a matrix of nine bipolar, centred morphological progressions (morphing-series) has been prepared. Matrix with 180 discrete fields (classes for complex morphological features) was utilised for quantification of the data from slabs and thin-sections. Complement of the data basis took more than 160 000 measurements and associations. Recording of the physical and paleobiological concomitants represented another branch of the documentation. Our starting point to interpretative stage of the project is the base of data which involves a very large, unique information stored in Boolean matrices and by means of count of score per one class. The overall attributes of the population and the concomitants are: (i) mean morphological ranges calculated from 9 morphological progressions; (ii) medium age of the colonies [years], (iii) intensity of visible biological attacks [a scale 0-9]; mean density of colonies [$N/m^2$]; Shannon-Wienner index of diversity for assemblages of accompanied corallomorphs; (iv) number of concurrently occupied niches in multi-level coral sea floor; (v) exposition to mechanic factors in agitated water, storms, impingement of transported clasts [a scale 0-9]. The first inquiry about relations found that the morphological variability of *C. battersbyi* was since the early radiation slowly, but continuously decreased. This statement is valid both for the raw as well as corrected data. In individual peaks and depressions, the variability is well-correlated with the age of the colonies. However, there are two exceptions, in the first 0.7 and last 0.3 Ma of the existence of *C. battersbyi*. Good but locally imperfect correlation was documented also for exposition to mechanic factors. With respect to the diversity of the attendant corallomorphs, the variability is fairly independent. The relation to biological attack shows evident negative correlation in 2/3 of the species history, whereas the last 1/3 of this history possess slightly positive correlation (!). Slightly positive correlation exists in regard of the density of the population. Investigation of morphological patterns within the matrices indicate that especially some levels of recovery from the depressions show special features "<", that means: incrustation and branched deviation in corallum shape + thin and upwards shifted couples of squamulae + some irregularities in positioning + larger spacing of tabulae. This complex resembles an archetype. Further, advanced analysis of data is in progress.

No. 205/93/0001 - Neoteny and paedomorphosis as evolutionary factors in Tertiary Amphibia. Evidence from paleontological and developmental data ***(Z. Roček)***
The Tertiary Amphibia of Europe include some forms which are related to contemporary species but in which adults are much more ossified. When various developmental stages of a single taxon are documented in the fossil record, the cranial structures of adults of contemporary species correspond to earlier developmental stages of Tertiary forms; the postcranial skeleton is not affected. The phenomenon is exemplified by a common European

Tertiary anuran *Latonia* (Discoglossidae); the cranial elements of subadults of *Latonia* correspond to those in adults of contemporary *Discoglossus*. Similar relations may be found between Tertiary salamandrid *Chelotriton* and contemporary *Tylototriton* and *Echinotriton*, and even between two Tertiary forms, *Chelotriton* and the late Oligocene *Brachycormus*. Comparison revealed that the final pair differ not only in degree of their ossification but also in that *Brachycormus* retained ossified branchial apparatus, suggesting a shift towards neoteny. Since disappearance of heavily ossified forms and their substitution by forms ossified to a lesser degree correspond to periods of climatic deterioration in the late Oligocene and Pleistocene, it is apparent that abbreviation of somatic development played a significant role in surviving these unfavourable periods.
[Accepted abstract for the Fifth International Congress of Vertebrate Morphology to be held 12 - 17 July 1997 in Bristol, U.K.; the abstract will be published in Journal of Morphology (New York)]

No. 205/94/0759 - The Bohemian Ordovician as a stratigraphic standard for the Mediterranean Region (*J. Kraft, Regional Museum of Rokycany, **R. Mikuláš, M. Vavrdová, M. Krůta, P. Štorch** and others*)
Morphologically distinctive species of acritarchs such as *Coryphidium bohemicum* and *Arbusculidium filamentosum* were utilised for the definition of distribution pattern of unicellular marine phytoplankton in the Early and Late Ordovician time interval. Provincialism of Early Ordovician acritarchs was demonstrated on newly defined Coryphidium bohemicum Bioprovince within the peri-Gondwanan sedimentary sequences.

No.205/96/0156 - Brachiopod fauna of the Lowermost Liassic in Northern Calcareous Alps *(**M. Siblík**)*
Detailed samplings at some Hettangian localities of the Northern Calcareous Alps yielded numerous and varied brachiopod fauna. This fact is contrary to the generally accepted statement about the relative impoverishment of the lowermost Liassic brachiopod faunas in the Alpine chain. The localities as Breitenberg with prevailing terebratulid forms in the marly sediments, Saubachgraben (Osternhorn Group), Hochleitengraben near Gaissau and Adnet quarries should be mentioned in this connection. Subsequent collection in the Adnet area completed our knowledge of Middle - Upper Hettangian brachiopod assemblage containing 25 species. Rhynchonellids prevail there in number, while spiriferinid species (Liospiriferina) are poorly represented. Recrystallization of the interiors of the most shells made the study of the internal characters and thus the revision of the generic affiliations of some species impossible, however. Results of the study of the Adnet brachiopod fauna will be published in the Jb. geol. Bundesanst. Wien (l997).

No. 205/94/1744 - Global and regional factors, causing the relative sea-level changes and their influence on basin sediments and paleoenvironment (*D. Uličný, Charles University, Prague, S. Čech, Czech Geological Survey, Prague, J. Kvaček, **M. Svobodová** & L. Špičáková)*
The aim of the research of the last year of the project is the determination of the relative ages of the isolated fossiliferous localities in the Bohemian Cretaceous Basin and recognition of the original paleoenvironment.
Depositional conditions, fluvial sedimentation and the first records of the marine ingression were studied at three localities: Horoušany, Slaný and Brník.

Sedimentological, palynological and macrofloristic investigations of the basal claystones pointed out the environmental differences between flora, new paleoclimatological results of the fluvial sedimentation and age of single localities. The fluvial style of the Horoušany is small shoal of a meandering river.The paleoenvironment at the time of deposition was characterised by humid swampy vegetation contrary to the locality Slaný, where the palynospectra were composed predominantly of xerophytic vegetation . The oldest deposits (lower part of the Middle Cenomanian), from the palynological point of view, seems to be the deposits of the Slaný and Brník localities. Many very small representatives of angiosperm group, such as *Tricolpites minutus, Tricolpites parvulus* etc. has been recorded in the fluvial and brackish sequences. No triporate angiosperm pollen of the Normapolles Group has been found.

**Grant Agency of the Academy of Sciences CR**

Project A 313409 - Paleobiogeography of the Central European Variscides: Statistical evaluation of the assemblage similarities *(**A. Galle, P.Čejchan** & **J. Hladil**)*
The Lochkovian assemblages have not been compared because of inadequate data. Comparison of the faunas of Pragian of Iberia, Barrandian, and Thuringia revealed that Iberian faunas differ from those of Barrandian, while Barrandian faunas are similar to those of Thuringia. It seems to confirm the peri-Gondwanan origin of the Saxo-Thuringian terrane as well as the sedimentation of the both terranes mentioned near of each other. Differences of the peri-Gondwanan Iberian and Barrandian faunas was caused by bathymetric differences and/or by Proto-Tethyan origin of Iberian terranes.
In the Emsian, localities of Barrandian, Iberian Peninsula, and Moravia were studied. Iberian assemblages form relatively homogeneous cluster separated from Barrandian assemblages. Position of the Dalejan assemblage is notably similar to the Iberian assemblages as well as the Moravian assemblage; it is, in our opinion, caused by bathymetry. It seems to be confirmed by known Emsian eustatic sea-level rise.
Eifelian localities of Barrandian, Moravia, Rhenish Slate Mountains (RSG), Ardennes, Carnic Alps, Iberian Peninsula, and Turkey were studied. Diminishing of the differences between peri-Gondwanan and Laurussian assemblages is characteristic of Eifelian. Paleogeographically close localities still cluster together (Iberian localities), Moravian and RSG localities are close to each other, but, on the other hand, Laurussian Horní Benešov, Ardennes, and Rohr in RSG are close to peri-Gondwanan Carnic Alps and Turkey. Interesting is the separate position of the Acanthopyge Limestone assemblage and its distance from the Choteč Limestone assemblage: we explain the difference of the Acanthopyge and Choteč assemblages by bathymetry, while separate position of the Acanthopyge Lst. assemblage is less clear. Therefore we placed the assemblage discussed into Givetian, as the fauna shows clear Givetian relations although its age based on conodont parastratigraphy is Eifelian. In the Givetian, the Acanthopyge Lst. assemblage does not show any peculiar position. It seems to confirm the migration of faunas from the east.
Givetian assemblages of Laurussian RSG and Ardennes, north of France, Moravia, Harz, and Holy Cross Mts., and peri-Gonwanan Barrandian, Iberian Peninsula, Carnic Alps, and Turkey have been studied. Although the Laurussian localities predominate, the tree is homogeneous and the differences between peri-Gondwanan and Laurussian assemblages disappeared. It corresponds with the tectonic shortening of the

sedimentary basins and profuse communication among respective assemblages. It is also confirmed by known sea-level rise in Givetian.
Among Frasnian localities, the Laurussian ones predominate: RSG, Ardennes, north of France, Harz, Moravia, and several Polish localities. Originally peri-Gondwanan are the localities of the Iberian Peninsula, fauna of Nepal is exotic. The tree is homogeneous due to the cosmopolitan nature of the assemblages, and the differences between peri-Gondwanan and Laurussian assemblages can not be traced. Clustering of Polish localities is conspicuous and can be an artefact. Their separation from the Moravian assemblages seems to confirm certain degree of separation of Moravia and Poland. Moravian assemblages fit well into the group of RSG, Ardennes, and Harz, as well as the Nepal assemblage. Iberian localities are distant from each other due to cosmopolitan nature of Frasnian assemblages and their respective small differences. Famennian localities have not been evaluated because of scarcity of data.

No.A 3013606 - Carnian spiriferid brachiopods of the Slovak Karst and Northern Calcareous Alps. *(**M. Siblík**)*
Carnian spiriferid brachiopods coming from the Slovak Karst are the only greater group of the Upper Triassic brachiopods of the area that have not been studied in detail yet, despite of their common occurrence. The great external variability is characteristic *of Laballa suessi* (Zugmayer) that is known well from the Koessen Beds. Its occurrence in the Carnian of the Slovak Karst is thus surprising but this was already mentioned by Pearson, l977. The present study confirmed the external identity of the Slovak material with Zugmayer's species, in the same time the study of the internal characters of the Carpathian specimens proved the affiliation with *Laballa*. Very similar *"Cyrtina"(Laballa) ambigua* based on 2 specimens from Silická Brezová was described by Balogh, l940. Considering the extremely large external variability of *L. suessi*, the existence of "ambigua" as a good species seems unclear at present. Possible synonymy should require the comparison with Balogh s type specimens deposited in Budapest. *"Spiriferina" halobiarum* Bittner commonly occurring esp. in the Ostré vršky hill on the Plešivec Plateau is usually affiliated to *Mentzelioides* Dagys. The proof of this attribution should be proved in the Carpathian material as this species occurs only rarely in the Alps.

**9. Department of Exogenic Geology and Geochemistry**

Results of projects in 1996:

**Foreign Grants and Joint Projects**

International Geological Correlation Program, UNESCO
IGCP Project No. 384: Impact and extraterrestrial spherules and stratigraphic boundaries *(V. Bouška - Faculty of Sciences, Charles University, Prague, R. Sláma - National Museum, Prague, **V. Cílek** & **J. Krhovský**)*
During the first year of research nearly complete bibliography of Czech and Russian studies from the area of former Czechoslovakia was summarised for Debrecen meeting. The field research was concentrated towards searching for cosmic or terrestrial spherules in Devonian limestones of Bohemian and especially Moravian Karsts where Famenian-Frasnian boundary was studied. The latter has been considered by some authors to be impact-controlled. The insoluble relicts of the

samples well biostratigraphically dated by conodonts were used for the study but no cosmic material has been found.

Pole-Equator-Pole III, PAGES, UNESCO *(F. Gasse leader of the group, University of Paris, France, **V. Cílek** co-ordinator in the Geological Institute ASCR)*
The general aim of the PEP III profile is to cover the last glacial cycle (with special emphasis on the last 2 000 years) in paleoclimate profile Greenland-Scandinavia-Central Europe-Mediterranean-Africa-Antarctica. The Czech part of the project concentrates on climate synthesis. This is achieved by summarising of all relevant published data for the area of Czech Republic and nearby regions and by filling the temporal and special gaps. Since the general funding of PEP III project is low the research is conducted by means of local grant support (e.g. see project „Dry climatic phases in the Middle Holocene“ in this volume).

Joint project of the U.S. Peace Corps, Management of the Landscape Protected Area of the Slovak Karst, and Geological Institute ASCR: The Nature protection and Management of Silica Intermittent Lake
*( Main coordinator - B. Kaliser, U.S. Peace Corps in Slovak Karst Environmental Office, **V. Cílek** - expertise)*
The project was aimed for the understanding of lake level changes (the lake became completely dry in 1995) in Silica, Slovakian Karst Biosphere Reserve. The 27 open pits revealed a variety of Holocene sediments which together with detailed karstic research of the nearby karst terrain lead to new data on karst hydrology and lake level dynamics. New detailed plan of the lake management was invented and the main results published.

**Grant agency of the Czech Republic**

No. 205/95/1392 - Dry climatic phases in the Middle Holocene - correlation of isotopic and biostratigraphic methods *(J. Hladíková, Czech Geological Survey, Prague, **V. Cílek** & **V. Ložek**)*
Dry climatic oscillations in the Epiatlantic and Subboreal represent the most important Holocene climate change. These changes are well recorded in accumulations of calcareous tufa deposited by karst resurgences. A calcareous tufa mound, about 40 000 $m^3$ in volume, was deposited in Sv. Jan pod Skalou in the Bohemian Karst. The spring is characterised by discharge close to 20 l/s and virtually constant temperature of 11.3-11.6 °C which indicates large and deep groundwater reservoir. The middle part of the tufa complex is developed as 13 m thick strata covering the Middle Holocene approximately from 8 000 - 2 500 years B.P. The tufa body was studied by several independent methods. The dating was performed on the basis of malacostratigraphy, archaeology, AMS radiocarbon dating of charcoals, radiocarbon and U-Th series dating of carbonate.The paleoclimatological and paleoenvironmental analyses were conducted by biostratigraphical and stable isotopes methods. For the first time, the oxygen isotopes paleoclimatic curve was constructed for the larger part of Bohemian Holocene displaying not only a series of temperature oscillations but important similarities with Greenland Camp Century ice record (Fig. 1).

No. 205/95/0841 - Structural and textural characteristics of the main genetic types of clastic Quaternary sediments in the Czech Republic *(**E. Růžičková, A. Zeman** & M.*

*Růžička, Czech Geological Survey, Prague)*
Complex research of glacial deposits was completed both in the field and by cameral methods. Seldom found flow till was documented together with typical lodgement till in one of the southernmost localities of glacial sediments at Blahutovice. Thin section studies (applied for the first time in Quaternary sediments in the Czech Republic) showed massive structures of lodgement till with more or less preferred orientation of elongated sand clasts. Parallel bedding expressed by intercalation of finer and coarser grained layers is characteristic for subglacial melt out tills.
Coluvial sediments were studied in a large extend. They perform many different structural and textural features depending on processes of their origin (gravitation, solifluction, run-off etc.). Their grain-size distribution depends mostly on the source material (character of weathered products), the structural features resulted from the environmental conditions and processes of transport and sedimentation. Different types of sediments were documented in the field, some details were studied using thin section of samples.
In the succession between typical eolian sediments (loess) and coluvial deposits many transitional facies are recognised starting with debris containing admixture of eolian silt to loess with scattered clasts cumulated sometimes into more or loess continuous layers. Structures of some layers within loess complexes indicate run-off processes during their deposition.
Fluvial sediments represent very important genetic group. Gravels and sands of river-bed facies were studied in numerous sections in terraces of the Labe River and its tributaries. Some our finds indicate much more complicated construction of terrace bodies than was believed (periglacial phenomena, interlayers of laminated overbank muds - both proving interruption in sediments).

No. 205/96/0011 - Geochemical, biological, and anthropogenic mobilisation factors of selected minor and trace elements in the course of the rock weathering. *(**P. Skřivan**, D. Fottová, Czech Geological Survey, Prague, **M. Burian, O. Kvídová, L. Minařík** & **J.K. Novák**)*
(a) Main forms of the studied elements (As, Be, Cd, Cu, Mn, Pb and Zn) in both types of granite of the Říčany massif (bedrock of the "Lesní potok" experimental catchment area) were determined through leaching experiments. Analyses of their separated rock forming minerals have shown that Cr, Mn, Fe, Co and Ni, as well as Zn and Cd, are in more than 80% accumulated in the biotite, while oligoclase is the main Be- bearing mineral and Pb is accumulated in K-feldspar.
To evaluate the significance of the principal mobilisation factors (abiotic, biotic and anthropogenic) of studied elements in the course of rock weathering, data concerning the chemical composition of the bulk atmospheric precipitation, beech/hornbeam- and spruce throughfall, and surface discharge were collected in the Lesní potok catchment. Cumulative samples of throughfall were collected into a sets of polyethylene "VOSS" collectors on a monthly basis. It was found that these simple devices posess several significant disadvantages. They do not prevent falling leaves and other solid parts of the vegetation into their collecting funnels. The solids are then leached with the subsequent precipitation events which increases the concentration of the leachable elements and causes positive errors of the determination. The hydrophobic (polyethylene) surface of the funnel attaches a considerable portion of the solid atmospheric aerosol which has to be considered as an integral part of the cumulative samples of throughfall. The attached particles are washed-out at the end of the

individual sampling period which thus causes a negative error of the determination. For these reasons a new type of Glass Cone Throughfall Collector (GCTC) was developed and tested. The "GCTC" collector was found to eliminate al the previous malfunctions of the "VOSS" collector.

To compare the mobility of the studied elements, and the impact of the tree vegetation on their mobility in regions with different kind of bedrock, experimental landscape with contrasting underlying rock (carbonates of the Bohemian Karst) has been selected and equipped with appropriate devices for the bulk precipitation and throughfall monitoring. The differences in the chemistry of throughfall together with the course of the element distribution in the corresponding soil profiles will be correlated and discussed in 1997.

(b) Distribution and mobility some of metals during biotite alteration occurring in the Říčany granite**.** ***(J.K. Novák, L. Minařík & M. Burian)***

The biotite concentrate used in an acid leaching experiments and subsequent studies belongs to the Říčany monzogranite (locality of Srbín and Žernovka). Acid leaching conducted at room temperature and pressure conditions is discussed. The leachates obtained after 14 day reaction with 0.01 M $HNO_3$ was analysed using atomic absorption spectroscopy. Mobility of metals was calculated as follows: Cd >Cu >As >Co=Ni >Zn >Mn >Cr. The increased content of the toxic cadmium in a leachates is interesting. This information may be useful in evaluation of the effect of acid rains on weathering process in a metamorphic and plutonic areas.

(c) Mobility of some metals during leaching of the rocks. ***(L. Minařík, M.Burian & J.K. Novák)***

The concept of relative rock dissolution with 0.01 M $HNO_3$ was tested on both the silicic and the mafic rocks. The studied rocks come from the Central Bohemian Pluton (Říčany monzogranite, Jevany syenogranite, Pecerady gabbro). Only melanocratic diorite was collected in the deep borehole of B-1 (Bechlín). Although the Říčany monzogranite contains relatively increased amount of toxic beryllium, fortunately**,** the Be concentration in leachates is very low. Silicic plutonites commonly show higher mobility of Cu, Cd, Ni, Co, and Zn than that of Pb, Cr, Be, As, and Fe. General dissolution sequence for mafic rocks studied is as follows:

melanocratic diorite: Cd >Cu >Ni >Zn >Mn >Pb >Co >Be=As >Cr

gabbro: Cu >Cd >Pb >Ni >Co >Zn >Mn >Be >Cr >Fe =As.

From the toxic elements, only cadmium may be released into the environment in a relatively higher amount in the mafic rocks more than that in silicic plutonites.

(d) Leaching of some heavy metals in silicic rocks. (***L. Minařík, M. Burian & J.K. Novák***)

The basic idea is to make the comparison between trace element content in the silicic parent rocks and that in leachates. The dissolution experiments were conducted with both the Říčany monzogranite and the Jevany syenogranite and moreover, with the Truba sandstone collected in vicinity of Kostelec n.L. Results of the 14-day leaching, using 0.01 M nitric acid at low temperature suggest following sequence:

;porphyritic monzogranite: Cu, Cd, Ni, Co, Mn, Zn, Be, As, Fe, Pb, Cr

syenogranite: Cu, Cd, Ni, Co, Mn, Zn, Pb, Cr, Be=As, Fe

sandstone: Ni, Mn, Cd, Cu, Pb, Zn, Cr, Co, Be, Fe, As.

No. 526/96/1041 - The effect of soil cover erodibility on surface water contamination. *(M. Janeček, Research Institute for Soil and Water Conservation, Prague,* ***P. Skřivan, O. Gottstein & M. Burian****)*

The chemical aspects of the research subject (course of the interaction of suspended matter with surface water) were studied in the model system involving the artificial rainwater and the runoff of heavily contaminated (with extremely high concentration of Pb, Sb, Zn, and Cd) soil, obtained during the experiments carried on in the Mini Rainfall Simulator Eijkelkamp.
Composition of the artificial rainwater (AR) was evaluated to correspond to the mean concentration of selected principal components (Na, K, Ca, Mg, Fe, $HN^{4+}$, $SO_4^{2-}$, $NO^{3-}$ a $Cl^-$) obtained throughout the bulk precipitation sampling in the Černokostelecko region since 1993. The pH of the AR containing the suspended soil particles was then appropriately modified with the mixture of $H_2SO_4$ and $HNO_3$ (6:5) acids. The liquid and solid phases were separated after selected equilibration time through centrifugation and membrane filtration and resulting pH was determined. The studied time span of the equilibration of individual samples was chosen within 10 min. and 15 days. The liquid samples were stabilised with diluted $HNO_3$ and they have been subjected to AAS analysis for the content of selected trace elements (As, Cd, Cu, Fe, Mn, Pb, Zn, complete results are so far not available).

No. 404/94/0604 - Settlement and development of the Holocene flood plain of the Labe River between Nymburk and Mělník *(D. Dreslerová, Archaeological Institute ASCR &* ***A. Zeman****)*
The study of the Holocene Labe River flood plain dynamics was finished in 1996. In the middle course of the Labe River flood plain the occurrence of three levels was confirmed, two flood plain terraces (higher and lower) and the present flood plain. These three levels provide evidence for existence of three periods when the river reached graded profile which means, that the river neither erodes nor accumulates.
*Higher flood plain terrace* represents a remnant of early Holocene flood plain of the Labe River, its surface lies 4 m above the present river level. The age of these sediments was dated by means of the radiocarbon and varies from 9 490 to 10 370 years B.P. Remnants of abandoned meanders on its surface are very typical. On the locality Kozly, the filling of these meanders was dated 8 800 years B.P.
*Lower flood plain terrace* represents a part of the Labe River flood plain. This terrace is composed by two layers. Accumulation of the lower layer started 7 700 - 8 500 years B.P, surface of this accumulation was colonised in Neolothic. During Neolithic was this surface suddenly buried by gravel and sand deposition. This materials formed the top of lower flood plain terrace and from Eneoliothic was colonised.
*Recent flood plain* is in comparison with former parts of the Labe River flood-plain the narrowest one. This very frequently flooded area is covered with fluvial looms. Numerous oxbow lakes occur on their surface and their water communicates with the water of the Labe River bed.

**Grant Agency of the Academy of Sciences of CR**

A3 013 603 - Biogeochemical cycles of trace elements, their sources and redistribution in a catchment with granitic bedrock: a model study ***(P. Skřivan****, J. Bendl, Analytika s. s r.o.,* ***M. Burian, O. Gottstein, O. Kvídová & L. Minařík****)*
The aim of this study is to determine the content and speciation of several less common trace elements in the abiotic and biotic compartments of a model landscape (catchment-area) and to evaluate their main biogeochemical fluxes. The study takes the advantage of employing the unique analytical procedure (ICP-MS), which enables

to determine a broad spectrum of elements (both essential, indifferent, and environmentally hazardous, such as Cs, In, Mo, Rb, REE, Sb, Se, Tl, U, V, W, Zr, etc.), sometimes in extremely low concentrations.
The content and flux of the elements has been studied in the basement rock (Říčany massif), soils, bulk atmospheric precipitation, beech/hornbeam and spruce throughfall and surface water of the experimental catchment-area "Lesní potok". The impact of acid atmospheric precipitation and of the metabolic activity of forest trees on the elements mobilisation has been studied through their distribution (and temporal changes in the distribution) in soil profiles and through the mass balance of their fluxes in the experimental catchment-area.

**Grants of the Ministry of Environment**

Quaternary geology and malacozoology of Podyjí National Park (***V. Ložek & V. Cílek***)
Small monograph (80 pp.) summarised the fossil and the modern malacozoology research of this important and only recently opened area around the Dyje Valley (frontier zone between the Czech Republic and Austria). The most important results were described in the former annotations. The 1996 activities concentrated on the preparation of the monograph.

Molluscs of the Protected Landscape Area Labské pískovceu *(**V. Ložek**)*
The plan of unifying Czech and German „Elbe Sandstones“ frontier area into one large National Park lead to detailed malacozoological research of about the same scope and purpose as the NP Podyjí research (see monograph „Molluscs of NP Podyjí“). About 70 sites have been so far searched and analysed and the total number of localities should exceed 100 so precise environmental evaluation is emerging.

Standard massif activity and the weathering of Pravčice Sandstone Arch
*( J. Zvelebil, Institute of the Rock Structure and Mechanics, ASCR, Prague & **V. Cílek**)*
The several years program is aimed for the understanding of the standard massif activity: the movement of the Arch as measured on six places by J. Zvelebil, and rock crust formation and salt destruction studied by V. Cílek. Two antagonistic processes seem to play the most important role in sandstone relief formation: (a) - surface hardening and the origin of rock crusts. Endocrusts or interior crusts originate along the sandstone surface by cementation of silica or less commonly of ferruginous crusts and some salts. It may be a fossil or quite modern phenomenon. Exocrusts or exterior crusts originate on the surface of sandstone mostly as ferric infiltrations on the walls of tectonic fissures and they are mostly of Tertiary age. The isolated rock pillars and towers owe their shape mostly to the protective secondary hardening. The minute globulae of opal were frequently found in castellated rocks of Česká Lípa, Kokořín and Labské pískovce regions. (b) The antagonistic mechanism to surface hardening is represented by salt weathering. The acid rains attack cement of the quartzose sandstones to produce gypsum, K-Al sulphates and variety of other salts such as ammonium nitrate of possible microbial origin and anthropogene salts - chlorides, phosphates and others ones. Most of salts are destructive. They behave in three basic destructive modes:
I-salt efflorescens and subflorescences attack the several mm thick layer of stone and they cause peeling off small scales or individual grains
II-salt blisters attack and often totally decompose 3-5 mm thick outer layer.

III-salt subflorescences developed under rock crust may cause peeling off pieces of rock several kilograms heavy.
The opal and salts are components of the same solutions percolating in rock massif. Their precipitation at the ends of capillary water pathways may cause both - the hardening and the destruction as well. However the most frequent case is rock hardening and rock crust evolution. The evolving crust is subsequently perforated and complex microrelief with numerous small cavities often develops behind the crust

**Industrial grants**
Cement Bohemia **Prague** a.s.- Beroun . - Geological salvage research in the area of the Čertovy schody Quarry *( **A. Zeman** & **V. Suchý**)*
Present mining activities for limestone in the Čertovy schody Quarry (Koněprusy area, Beroun District) in the western part of the Bohemian Karst have revealed a number of steep, almost vertical depressions that penetrate several dozen metres into carbonate sequences. These features resembling solution pipes appear to follow presumably older, south-north-oriented thick mineral veins filled with hydrothermal coarse-grained calcite (see the respective chapter on the GLU No. 5807 Internal research project reviewed by V. Suchý). Most of the depressions are of circular cross section and about 10 metres or more in diameter. Sedimentary fill of the cavities is locally well stratified and includes Tertiary clastics and Cenomanian marine sediments (glauconitic sandstones and Turonian marlstones occurring at approx. 450 metres a.s.l.). Further down the hollows, thick brown and reddish clay and sandy sediments of uncertain age occur that reach several dozen metres in thickness. Our findings have double-folded geological importance: (1) The Upper Cretaceous deposits have been found in the central part of the Bohemian Karst, following earlier reports by Kukla, Zelenka and other investigators, which, in turn, increases our knowledge about the paleogeography of the Upper Cretaceous period in the area studied. (2) There is a thick sequence of sediments of unknown age present beneath the Upper Cretaceous sedimentary cover that may be of Lower Cretaceous or older in age. If so, this sequence may clearly serve as a powerful potential source of geological information with respect to the pre-Cretaceous history of the Bohemian Massif which, so far, has largely been obscured due to the lack of sedimentary record of that age. Our present activities concentrate on exact dating of these sediments and the relationship of solution depressions to the adjacent hydrothermal veins.

## 10. Department of Paleomagnetism

Results of projects in 1996:

### Foreign Grants and Joint Projects

National Museum of Natural History, Leiden (sponsored by The Netherlands Oil Company) - MAGNETOARGOS - Magnetostratigraphic Investigations of Early Cretaceous Limestone Beds, The Río Argos Area, Provincia Murcia, SE Spain. (***M. Krs, V. Houša, P. Pruner, D. Venhodová, O. Man,*** *J. M. Parés*, *Barcelona, Spain & Ph. J. Hoedemaeker*, *Leiden, The Netherlands).*
Magnetostratigraphic results derived for the Jurassic/Cretaceous boundary strata at Brodno near Žilina (Western Carpathians, Slovakia) were the basis for extending similar high-resolution studies to next localities in the Tethyan realm. Two localities

were selected for investigations, in the Río Argos area (Subbetics, SE Spain) and in the Bosso Valley (Umbria, central Italy). Altogether 361 oriented hand samples were collected from the Early Cretaceous limestone beds in the Río Argos area during 1995. All these samples were systematically investigated by means of paleomagnetic and magnetomineralogical methods. Two Reports were elaborated. It has been clearly proved that the carrier of remanent magnetisation in the limestone samples is magnetite with an unblocking temperature less that 540 - 560°C showing three components of remanence. Similar properties are shown by numerous Mesozoic limestone samples from other localities in the Tethyan realm, which are generally suitable for derivation of magnetostratigraphic scales. However, detailed magnetomineralogical and multi-component analysis studies resulted into originally unexpected finding that the limestone beds from the Río Argos were either totally demagnetised during the Neogene (with post-tectonic remanence) or partially demagnetised during the folding process (with syn-tectonic remanence). The results obtained are useful for methodology of next magnetostratigraphic investigations of limestone beds in other localities in the Tethyan realm. Consequently, a publication with methodological findings is under preparation. However, the authors were able to find a substitute locality suitable for high-resolution magnetostratigraphy across the Jurassic/Cretaceous boundary strata at Carcabuey (S. Spain). Pilot samples from Carcabuey show extremely suitable properties for derivation of paleomagnetic directions (precise Zijderveld diagrams, accurate separation of secondary and primary components of remanence, good paleontological records based on ammonites and calpionellids). In addition to the above studies, laboratory investigations of samples from the Bosso Valley were partly investigated already in 1996. The Project MAGNETOARGOS was sponsored by The Netherlands Oil Company (due to courtesy of Dr. Ph. J. Hoedemaeker).

Joint project of Geological Survey of the Slovak Republic, Bratislava and Geological Institute of the ASCR. - Deep structure and geodynamic model of the Western Carpathians, paleomagnetic investigations 1996. ***(P. Pruner, M. Krs, O. Man, J. Slepičková & D. Venhodová)***
Basic paleomagnetic data were derived on pilot samples collected from the Tatricum, Manín and Križna units covering the Triassic, Jurassic and Cretaceous periods. Dr. M. Rakús from the Geological Survey of the Slovak Republic, Bratislava took part in the field collection of hand samples, from which laboratory specimens were prepared for detailed paleomagnetic and petromagnetic studies. Respective remanence components were separated by means of the multi-component analysis after application of progressive thermal demagnetization procedures. Phase changes of magnetically active minerals were also investigated during laboratory thermal treatments. Preliminary data indicated localities suitable for next detailed paleomagnetic investigations. Especially the localities of rocks with normal and reverse paleomagnetic directions are the primary targets for next investigations.

## 11. Department of Sedimentology and Stratigraphy

Results of projects in 1996:

### Foreign Grants and Joint Projects

Deutsche Forschungsgemeinschaft, Bonn. - Die Koněprusy Riff-Kalke (Unterdevon, C.R.) unter besonderer Beruck-sichtigung der Bryozoen und Algen.
*(G. Flajs, Rhein-Wesfälisches Technische Hochschule &* ***J. Hladil****)*
Implementing the timing and displacement of the sedimentary facies displays that the carbonate facies of the lower tract of the Koněprusy Limestone are "climbing" towards the north-west. They are composed mostly of crinoid and bryozoan debris. The amount of the bryozoan debris is much more significant than formerly assumed because it hardly drop below the limits of 20 v. % and usually fluctuate in the interval of 30-45 v. % of the rock. The true reef stage of the Pragian complex has been reduced only to middle/late Pragian levels when the accumulation reached the contact with the sea-level, as documented in terraces and pebbles in eastern part of the Čertovy schody Quarry West, or in the northern part of the Quarry East, respectively. The estimates of the volume of these reef and reef-adjoined facies are about 5 v. % of the whole Koněprusy Lmst. This true reef stage, with exception for some special types of reefs and bioherms they are scattered laterally and lower in the section, is preferentially situated within the massif of the Zlatý kůň Hill. Based on the section data, this reef is not directly rooted in the sequence boundary between the Lochkov Lmst. (Kotýs Facies) but its frame is evidently settled on the coarse crinoidal-bryozoan debris among formerly craggy-shaped; its development is aggradative, with retrogression in the latest stage. The composition of the redeposited rounded pebbles enables an assumption about emerged atoll-lagoon deposits although the shape in detail is unknown.

Deutsche Forschungsgemeinschaft, Bonn. - Die Stromatoporoidenfauna der Koněprusy Riff-Kalke (Unterdevon, C.R.). *(A. May, Universität Münster, BRD &* ***J. Hladil****)*
The stromatoporoids belong to extinct groups of demosponges which were effective but blooming communities of the Devonian reefs. Spreading of this fauna was based on dispersal of the larval stages which had to be largely transported in the former oceans. Although the data on the Pragian stromatoporoids are scattered in global scale, a new activity seems to fill the gaps in this knowledge (for example the progress in North America, Australia, France and China). Evaluation of abundant fauna of the Koněprusy Limestone is important for understanding the North Gondwana margin migration routes and paleogeography of the basins. New sampling of stromatoporoids provided large collections from the reef. However, many structures formerly assigned to stromatoporoids are stromatolites, algae, cements and replicative overgrowths of tabulates and bryozoans. Significantly lower density of stromatoporoid colonies have been found in the Quarry East, even lesser amount in the underlying beds (very rare, redeposited fragments). Collections cover the entire quarried area and the specimens have been fixed to the 3-D co-ordinates.

Joint research of the Mineralogical and Petrographical Institut, University of Basel, Switzerland and the Geological Institute of the ASCR. - Vitrinite reflectance and shear-induced graphitization in orogenic belts - (*M. Frey, University of Basel &* ***V. Suchý***)
Vitrinite reflectance (VR) is an important indicator of incipient metamorphism and it has been generally assumed that temperature and, to a lesser degree, time are the two main variables. The potential role of stress on VR remains, however, much less clear and was addressed in the present study.

In the Kadersteg area, N of Lake Oeschinen (central Switzerland), four different Helvetic tectonic nappe units are outcropping, comprising mainly limestones, marls and greywackes of Mesozoic and Lower Tertiary age. VR ($R_r$, $R_{max}$, $R_{min}$) and illite crystallinity (IC) were determined from a very steep section at elevations between 1 700 and 2 900 m a.s.l. In general, $R_r$, $R_{max}$ and IC increase from tectonically higher to lower units, i.e. from upper diagenetic (2-3 to 4-5% Rr) to upper anchizonal conditions (3-4 to 5-6% $R_{max}$).
Many samples contain, in addition to coaly fragments, abundant semigraphitized and graphitized particles that appear to be of authigenic origin. "Transitional matter" shows $R_{max}$ values ranging from 7 to about 11% and $R_{min}$ of 1.3-3.4% ; "optical graphite" shows $R_{max}$ of about 15-16% and $R_{min}$ of 1.6-1.8%. There is good textural evidence that tectonic deformation has played a major role in the development of these strongly coalified particles. The first tiny needle-like crystals of graphitic material occur within narrow shear zones transecting the rock matrix. The beginning of graphite formation parallels the onset of plastic deformation and dynamic recrystallization of quartz. Strongly elevated vitrinite reflectance ($R_{max}$) and bireflectance values are found near thrust planes, where microscopic observation on quartz grain morphology indicates an increase in strain intensity. It is suggested that frictional heating associated with thin shear zones was responsible for the formation of authigenic graphite in the Kandersteg samples.
Our results indicate that an intimate association of different types of apparently authigenic organic matters with contrasting reflectivities is probably a common feature of many intensively deformed subgreenschist and greenschist-facies sediments. Vitrinite grains in one single rock sample may exhibit very contrasting reflectivity values and thermal experience due to local influence of frictional heat. This implies that vitrinite-based paleogeothermometry in strongly deformed sediments of high thermal maturity requires careful separation of coexisting types of vitrinitic particles.

Peri-Tethys Programm. - Cenozoic paleogeographic map series of the northern Peritethys area *(co-ordinator: J. Meulenkamp, University of Utrecht, the Netherlands, national co-ordinators: K. Holzová, Charles University, Prague,* ***J. Krhovský*** *&* ***M. Konzalová****)*
Drafts of seven paleogeographic maps of Peri-Tethys area were prepared for Ypresian, Lutetian, Late Rupelian, Early Burdigalian, Langhian, Tortonian and Pliocene on the meeting in Bratislava.

Peri-Tethys Program. - Origin and distribution of the Oligocene „Menilite facies" in basins along the East European margin. *(Co-ordinator: M. Kováč, Faculty of Sciences, University of J.A. Komenius, Bratislava, Slovak Republic, national co-ordinator:* ***J. Krhovský****)*
Environmental modelling of the origin and distribution of siliceous laminites in the Lower Oligocene sequences along the continental margin through integrated paleontological, sedimentological, geochemical and paleomagnetic studies. Model of siliceous laminites origin is based on several findings: (1) biogenic origin of silica (diatoms, silicoflagellates, ebridians, cysts of archaeomonads, spicules of siliceous sponges); (2) blooms of siliceous phytoplankton reflect increase in productivity probably due to seasonal upwellings of the deep waters accumulated in the partly isolated marginal basins of early stages of the Paratethys; (3) good preservation of

silica point to low dissolution rate in deposits rich in organic matter accumulated in semi-locked basins. Slightly acid chemistry pertinent to silica preservation may be, on the other hand, cause of absence of calcareous microfossils in Menilite facies. The second cause may be primary, a competition with opportunistic siliceous phytoplankton. Accumulations of diatoms are concentrated to intervals of eustatic highstand and may represent drier phase of the long eccentricity orbital cycle.

Faculty Research Grant Programs, Earth Sciences, State University of New York, Oneonta. -

Sequence stratigraphy of Upper Silurian through Middle Devonian strata in the international stratotype areas of Bohemia, Czech Republic: Phase 1 - Pragian and Lower Emsian.

*(J.R. Ebert, State University of New York, Oneonta,* ***J. Hladil*** *&* ***P. Čejchan****)*

During this project, several Barrandian sections have been documented in detail. The works on the correlation between the features of the Appalachian Foredeep and Barrandian perform out the first improvements in stratigraphy. First results about the Pragian-Emsian transition have either partly published, partly in press. Individuality of the Pragian/Emsian sedimentary records in the Barrandian, in dimension of a few of kilometres, is bigger than could be explained in terms of facies variability within the deeper carbonate shelf and slope environment. This individuality was indicated in the Chlupac's stratigraphic and Chlupáč's-Kukal's event-stratigraphic concepts but present-day documentations increase these differences. Following the original fault concepts of Krejčí, Kodym and Svoboda we assume that the central-Barrandian brachysynform consists of several tectonic slices which are shaped similarly to thin-skin structure. The Pragian-Emsian displays three different patterns: (1) Missing sedimentation during the entire interval of latest Pragian to Early Emsian has been documented in the Koněprusy segment. This gap, which originated due to the emergence of the Pragian Koněprusy reef, corresponds to visible upper sequence boundary. The overlying, transgressive tract of the red, late Emsian limestones appeared very late in Sandberg's-Ib cycle having impact by many neptunian fills on the underlying complex. Therefore, the Koněprusy Pragian/Emsian history can be studied only in the fills. (2) A thick, rhythmic series of packstones deposited in conditions of lower ramp to slope have been formally classified to the Dvorce and Prokop facies. This sedimentation continued in the earliest Emsian, before the manifestation of an abrupt change in the basin configuration, which was reflected by a series of channelized debris flows which truncated the underlying beds. The early Emsian Zlíchov Formation represents an upwards thinning and fining calciturbidite sequence. (3) A thin, rhythmic series of packstones-wackestones resemble the Ammonitico rosso. Relatively starving slope was covered by lime-mudstone turbidites which largely involve the reworked hemipelagites deposited on the slope during the quiet intervals. Sedimentary record of this type is condensed, with symmetrical cycles. The base of the Zlíchov Formation consists of fine-grained calciturbidite banks. In these conditions, i.e. within the pattern (3), the best manifestation of the earliest Emsian *event* is available. A distinct series of eight dark-shale beds appears 2 m above the first occurrence of *Po. dehiscens* but 6m below the base of the Zlíchovian Fm. The best sections are the Stydlé Vody and Mramorka quarries. The (3)-type sedimentary record is typical for the segments in the northern, and partially in eastern part of the central-Barrandian brachysynform. The *event* interval, 1.1-1.3 m thick, consists of 8 dark shale beds occurring within the Ammonitico-rosso limestones. The event may be

connected with the Subzlichovian events in the Barrandian, with the boundary of the Ia/b cycles of Johnson and Sandberg in North America, with the changes at the Madmon and Zinzilbam Formation boundary in the Middle Asia, or higher with Walliser's 1984 Lower Emsian event.

**International Geological Correlation Programs**, **UNESCO**

IGCP Project No. 326: Oligocene-Miocene transition in the Northern hemisphere *(co-ordinator M.A. Akhmet'iev, Russian Academy of Sciences, Moscow, Russia, national co-ordinator **J.Krhovský**)*

Material for the biostratigraphic and eventostratigraphic correlations were collected in Oligocene to Lower Miocene sequences in the Romanian Eastern Carpathians and Transylvania, Lower and Upper Austria. Facies changes around the basal Šitbořice and basal Ždánice-Hustopeče events were recognised as sequence boundaries corresponding to the 3rd order eustatic sea-level falls. Responses to the circulation changes driven by paleogeographic evolution, sea-level fluctuations and climatic oscillations are traceble in all studied areas of the Paratethys.

IGCP Project No. 335: Biotic Recoveries from Mass Extinctions. *(project leader D. Erwin, Czech representative **J. Hladil**)*

- An attempt to define the ecological concept of refugia using basic system deliberation. ***(J. Hladil & P. Čejchan)***

Traditional data/interpretation studies have been carried out on the base of Bohemian and Moravian material. Besides this continued studies, some new tools and approaches have been developed. The prominent topics were: the post-crisis syndrome, complex view to environmental-paleobiological causality and/or factor cohesion and feedback, and role of refugia and refugees during the extinction-recovery processes. Especially, the problem of refugia seems to be topical as continuously attracts many discussions. Refugia conditions are fairly different from those they dominate diversified ecosystems before the first crisis. Former concept that conditions in refugia are simply worse is doubtful. Precisely defined, need not be worse or better but simply different. The ultimate conditions encompass the absolute limits of organic adaptive capability. The refugia conditions cannot be equal to conditions of thrifty systems or ultimate conditions but they must have some pros, at least in survival probability (nutrition and reproduction). Usually, the total sum of utilizable biologic nutrients in the refugium is the same or bigger than this that was accessible in structures thrifty systems. Possible refugium-taking strategies are: (i) shift to environment just below the ultimate limits, (ii) taking the so-called super-tramp strategy, (iii) minimising the metabolism and preferring omnivorous sustenance, (iv) utilising instable zones within the zone of medium-high environmental stress. This survival is realised, for example by: (i) appearance of new, in-crisis activated strategies; (ii) neighbouring with refugium allowing the passive diffusion. Some characteristics aid in overcoming the crisis. They are, for example: (i) less nutrient requirements and/or less selectivity of nutrient sources; (ii) short reproduction, so-called r strategy. Briefly we can say that some organisms are successive in crisis environments; this success depends on the capacity to migrate, survive and then emigrate to other regions. Are the refugia physically outlined or not? When they lack any physical boundaries they are part of internal exchange within the system. Such phenomena are to be conceptualised separately and they need another label. The concept of refugia can be effective only when a real system of natural refugia can be

demonstrated. From the stand-point of refuge quality, two types of refugia can be distinguished: large and stable reservoirs, e.g. the deep ocean (stable refugia) and zonal and quickly changing boundaries of systems (stationary refugia).
- Cascade of causally linked effects of rapid glaciation-deglaciation events: A possible cause of non-selectivity of mass extinctions ***(J. Krhovský & P. Čejchan)***
Absence of selectivity during mass extinctions in marine realm is regarded as an artificial feature appearing when a mass extinction is examined as a singular event without any inner structure. Cascade of causally linked effects of rapid glaciation-deglaciation event, as a model of mass extinction killing mechanism, may explain both the stepwise pattern of mass extinctions and the broad ecological spectrum of their victims. The coupling of glaciation and rapid deglaciation can lead to a decline of thermophilous organisms during the glaciation period and disappearance of many stenohaline pelagic and benthic aerobic organisms during environmental perturbances at the time of rapid deglaciation. They further broaden the ecological spectrum of the organisms wiped out. Mechanisms of rapid glaciation and deglaciation are discussed in detail. Abrupt onset and termination of volcanic production of sulphate aerosols are considered as one of the possible ultimate causations of the cascade of environmental changes.

IGCP Project No. 325: Correlation of paleogeography with phosphorites and associated authigenic minerals (*project leader J. Lucas, University of L. Pasteur, Strasbourgh, France)*
- Phosphate occurrences in the rocky-coast facies (Cenomanian-Turonian boundary interval, Bohemian Cretaceous Basin) ***(J. Žítt)***
Phosphatic crusts, microstromatolites, invertebrate coprolites, and ichthyolites occur in the Kaňk Member of the Peruc-Korycany Formation and in the Bílá Hora Formation of the Bohemian Cretaceous Basin. The study of phosphate microstructures, geological position, paleontological content and distribution enabled partial paleoenvironmental reconstructions of the studied time-interval. As for the crust formation, the sites of their formation were supplied by suspended mud particles able to be deposited even on steep to subvertical bottom rocky substrates. Early-diagenetic phosphogenic environments of the bottom mudy depositional sites (i.e. below the water-sediment interface) suffered by frequent small-scale disturbances causing the recyclation of organic remains.

**Grant Agency of the Academy of Sciences CR**
A3013503 - High-resolution graptolite stratigraphy and correlation of the selected Lower Silurian sequences of the Peri-Gondwanan Europe (***P. Štorch***)
Based on large amount of biostratigraphical data from Bohemia, Spain, Portugal, Italy (Sardinia), and some data from Germany, France (Corsica) and Austria (Carnic Alps), a standard graptolite biozonal scheme of the Lower Silurian of peri-Gondwanan Europe is being elaborated. Especially Spanish sections and graptolite faunas from Central Iberian Zone, Western Iberian Cordillera, and Asturia-Leon Zone were studied during the second year of the project. Several biozones of the late Llandovery and early Wenlock (*lapworthi, insectus, centrifugus, murchisoni* ) have been recorded for the first time in the Iberian Peninsula. In general, the graptolite faunas of deeper shelf areas closely resemble graptolite faunas of Bohemia (Barrandian area). On the other hand, shallow shelf areas of the Iberian lower Silurian yield considerably different assemblages. Faunal differences which complicate elaboration and application of the

joint zonal scheme may be likely explained by different bathymetry of the individual areas. The true biogeographical differences appear to be unlikely within the peri-Gondwanan Europe.
The basal Silurian *ascends- acuminatus* Biozone of the peri-Gondwanan Europe was analysed and reviewed. I the world-wide scale the existence of the two principal paleobiogeographical provinces was suggested in this time interval.
The Lower Silurian graptolite faunas and biozonation of the Yangtze Platform were studied during the author´s visit in China. Detailed correlation with peri-Gondwanan Europe and review on biogeographical faunal differences are under preparation.

**Grant Agency of the Czech Republic**
No. 205/95/1516 - Biotic crises and post-crisis recoveries recorded by Bohemian Silurian graptolite faunas ***(P. Štorch)***
Graptolite records and stratigraphic-range charts utilised in the earlier analysis of the Silurian graptolite dynamics in Bohemia were completed by new data. Current research was primarily focussed on the Lower Silurian sequence which allows more detailed approach, and on global correlation of extinction and speciation rates and diversity curves. The Bohemian data were plotted in local Lower Silurian graptolite zonal chart, being composed by 27 biozones. Each of the biozones were further subdivided into the lower and upper parts respectively. Thus 54 reference stratigraphical intervals were recognised to locate fluctuations in graptolite diversity as precisely as possible. The Czech biozones were correlated with the generalised zonal chart employed by the Subcomission on Silurian Stratigraphy in order to get reasonably precise correlation with local zonal charts used in widely separated territories around the World.
Six graptolite mass extinctions have been recorded from the base of the Silurian System to the top of Wenlock Series. New mass extinction event was revealed at the top of the *acuminatus* Biozone. Although the extinctions are of different magnitude, in every case less than 50 % of taxa survived the top of the reference interval. The data have not been callibrated with respect to zonal duration. Six Lower Silurian graptolite mass extinctions, as well as another three in the Late Silurian, are prominent enough, and wide spread around the world, that they cannot be artifacts of the methodology. O nine crises at least six ones are well correlatable with the most significant drops in global sea-level. On the other hand, the mid-Aeronian, basal Telychian, upper Telychian and basal Homerian increases in graptolite diversity correspond with periods of relatively high stand of sea level .

No. 205/94/0579 - The Ordovician of the central Bohemia as a stratigraphical standard for the Mediterranean Region (*P. Kraft, West-Bohemian Museum, Rokycany,* ***R. Mikuláš*** *&* ***P. Štorch***)
The aim of the project is an international correlation of the central Bohemian Ordovician within the framework of the peri-Gondwanan Europe and an appreciation of this sequence to be an international stratigraphical standard for the Mediterranean region. Critical revisions of fossils and lithology of particular formations, stratigraphical evaluations of fauna and flora, and a paleogeographical study (i.e. inserting of the studied region to an overall picture of Europe in the Ordovician) are necessary.

**Industrial grants**

Cement Bohemia Prague a.s.- Beroun. - Geological salvage investigation of carbonates in the Devonian reef of the quarried area Čertovy schody, with emphasis to biofacies / Facies and stratigraphy of the Koněprusy Limestone.
*(project leader **J. Hladil**, members L. Slavík, Masaryk University, Brno, **P. Čejchan, V. Suchý** & **A. Galle**)*
Koněprusy skeletal accumulation represents an unique open-sea carbonate buildup of Pragian age. Both, the Lower Devonian sedimentary log and bio-correlation indicate the Devonian peri-Gondwanan affinity of this complex. Twenty two lithological-biological facies have been defined and subsequently placed in an idealised stratigraphical column. The position and relations among the facies have been gathered in a scenario, which is prepared for publications as a series of six blockdiagrams. Scenario of the development of the Koněprusy skeletal accumulation is based on the section-by-section analysis in the quarries, using simultaneously the correlation based on the first preliminary results of the conodont stratigraphy. The lower sequence boundary corresponds to global lowstand in the *pesavis* Zone (i.e. 396.3-398 Ma). Besides the larger gap at the visible sedimentation unconformity in the N-wall of the Quarry West (approx. 2.5 Ma), the Lochkovian-Pragian omission of the sedimentation was traced also on the slopes of the elevation. This omission within the *Pedavis pesavis* Z. is seriously indicated also by the "pilot" conodont samples on the SW of the quarried area (approx. 0.5 Ma). The upper sequence boundary was set at the end of the *kindlei* Zone and was developed in the pireneae Zone (i.e. 389.4-391.6 Ma). The entire sequence of the Koněprusy Limestone is well-corresponding with the Sandberg's eustatic cycle Ia, however, the sedimentary record in the central part of the Koněprusy elevation represents only the highest Ia-highstand peaks of the middle part of the *kindlei* Zone. The setting of the Koněprusy buildup met two conditions: first the negative eustatic shift of the entire Ia cycle and second the Late Lochkovian tectonic elevation of the open-shelf seafloor along a pennate, dextral-transpression fault.

Cement and Lime Company Mokrá a.s., Brno-Mokrá. - Determination of visible technological markers and biostratigraphy of the Late Devonian limestone formations in Mokrá *(**J. Hladil, P. Čejchan** & **A. Galle**)*
Several useful, technological case studies were produced owing to this industrial grant. Of course, some basic scientific topics emerged during the technological work. It can be exemplified by the study about 28 reconstructed colonisation surfaces and four overall ecological parameters: diversity, biomass production, coverage, and patchiness/uniformity of the sea floor. The study results in following conclusions: A. *Recovery with reconstruction of similar ecosystem.* [1] Coincident peaks of both benthic diversity and associated biomass production were documented during second-order crisis with easy recovery. After a serious crisis, the trends are divergent. Then the biomass displays continuous decrease. Nevertheless, the diversity reach maximum just before the final collapse of the system, i.e. the "pre-extinction peak of diversity". Bacterial-poriferan high-coverage but low productive communities replace the former corallomorphs-dominated ecosystem. [2] The uniformity and coverage displayed similar evolution. However, the trends to utilise all of the possible surface appeared with a slight delay. This usage probably restarted just after decay of the mosaic structure of the benthos. [3] The intensive crisis of terminating Frasnian evokes the depressions in all parameters, i.e. diversity, biomass, coverage and uniformity. Small shifts in valleys can be interpreted in terms the following hypothesis: [a] first signal of

recovery after the post-crisis depletion is a slight rise in diversity; [b] this first diversity increase was still related to isolated patches and mosaic structures, whereas the uniformity of the carpet rose rather later; [c] trends to higher coverage and increase in biomass productivity continued the recovery process. B. *Recovery with origination of completely different system*. [1] Fatal extinction of relict corallomorph assemblage was characterised by a "pre-extinction peak of diversity". Of course, even during this last peak of the diversity three trends are almost apodeictically configured: rapid decrease in biomass production + decay in structures in favor of rising uniformity + attempts to spread in thin mottled films over the all accessible surface. These configuration signalise a serious jeopardy of the ecosystem before the other evident signals of the collapse. [2] A couple of divergent trends, i.e. decrease in biomass production vs. increase in coverage, and decrease in taxonomical diversity vs. increase in uniformity of plane-geometry of cover are related to the fatal crisis. This end crisis of Mokrá bears on three visible phenomena: ecological dynamics with limited sources around, and especially, on the tectonically changed profile of the carbonate ramp + changed chemistry of the sea water in the Devonian Horákov Bay.

## 12. Program of Advancements in the Scientific Research in the Key Directions of Science persued at the Academy of Sciences CR

**(12a)** K1-012-601 Key Directions in Science, Project No. 5: Geophysical processes and structure of the Earth (Bohemian Massif namely)
Subproject: Paleozoic evolution of the Bohemian Massif terranes integrated into the history of the European Variscides. (***F. Patočka, J. Fiala, A. Galle, J. Hladil, M. Konzalová, M. Krs, M. Krůta, O. Man, J.K. Novák, P. Pruner, J. Slepičková, M. Svojtka, P. Štorch, J. Ulrych, M. Vavrdová, D. Venhodová, Z. Vejnar & J. Waldhauserová)***

PRINCIPAL RESULTS:
The Bohemian Massif is an integral part of the suture zone of the European Variscan Belt. The zone, where formerly independent terranes were amalgamated theoughout the Early Paleozoic, was transformed into Variscan orogen during the Early Carboniferous by collision of Laurussia and Gondwana supercontinents. In the earliest Paleozoic some terranes of the Bohemian Massif (e.g. Barrandian and Saxothuringian Zone) belonged to Gondwana as the fossil communities and paleomagnetic data interpretations indicate. A large-scale extension and fragmentation of the Gondwana northern margin is documented by Cambro-Ordovician intrusives and bimodal volcanics of the Teplá-Barrandian Zone and West Sudetes. The Moravo-Silesian Zone was a peri-Laurussian terranes of the Bohemian Massif in the earliest Paleozoic, disappeared in the Devonian due to gradual convergence of both supercontinets. The terrane convergence resulted in subduction of the attenuated Saxothuringian lithosphere below the northern margin of the Teplá-Barrandian Zone. Individual terranes performed clockwise rotations (of 80° to 140°) prior and during the accretion processes. The waning of subduction and final disappearance of oceanic lithosphere (separating the individual terranes) towards the end of Devonian is indicated by 360 Ma old HP-LT metamorphism of the oceanic crust related basalts of possibly Ordovician age on the West Sudetes. The collision of Gondwana and Laurussia plates significantly narrowed the Moravo-Silesian Zone in the Carboniferous.

IMPORTANT INDIVIDUAL RESULTS:

(a) Variscan terranes: The facies disjunctions among the segments of basin fill in Moravian and Barrandian Devonian, with aspect to metamorphic terranes of Ještěd and Rýchory Mountains, Moravian Shear Zone, a.o. ***(J. Hladil)***

The study results in correlation of the results in facies and basin fills ***(J. Hladil**, J. Otava, Czech Geological Survey, Brno)*, terrane geology and deformation *(P. Orel, Czech Geological Survey, Brno, R. Melichar, Masaryk University, Brno)*, and paleomagnetism ***(M. Krs, P. Pruner)***. Conclusions are: (1) Facies: The facies disjunctions of the Moravian Devonian belts run the magnitude of n × 100 km. These tectonically individualised facies belts represent different parts of the Devonian extension basin of Rhenish-type. The trans-European continuity (and former sub-rectinilinear/ sub-latitudinal course) of the distinct Devonian belts corroborates a very strong narrowing and clockwise rotation of the Moravian Devonian belts. The entire concavity of these belts exceeds 90° and the differing clockwise rotations of the Devonian rocks in slices widely fluctuated (80-160°; comparison between the facies pattern after deformation and model facies arrangement for the Devonian). (2) Structures: The arrangement of segmented Variscan nappe structures suggest an extreme narrowing of the Moravian Zone. The W part of Moravia was pushed towards the north and the E part towards the south. The rheologically individualised zones rotated with dispersal about 80-140° clockwise finishing during the Late Carboniferous times. The 40 km-wide Moravian Shear Zone (along the Boskovice Furrow) is a very young Variscan feature. Strong rotation of the central and eastern Moravia was connected with rotation of the neighbouring Moravian, Moldanubian and Czech Cadomian terranes; the Czech Cadomian terrane with its Barrandian Palaeozoic cover was presumably cut from the former continuation of the Saxonia-Thuringia in the south-east being rotated clockwise and consequently pushed against the latter area. (3) Paleomagnetic data: The Devonian rocks of the Moravian Karst belt yielded the succession of the remanent magnetisation components which clearly indicate their clockwise rotation. The total rotation related to the present reference net ranges along the interval of 105-134° clockwise (the difference from the Devonian remanence, the C-component). With regard to the Devonian-stable-Europe reference net, the paleotectonic rotations within the Moravian Zone are of the order of 65-94° clockwise.

(b) Metasediments of variscan and prevariscan complexes of theBohemian Massif. *(M. Konzalová)*

A rest of small multicellular organisms have been revealed in the Kutná Hora crystalline complex. together with products of microbial communities and microfossils, partly mineralized, partly preserved as organic matter in various degree of alteration.

(c) Palaeomagnetic investigations aimed at global-tectonic interpretations and palaeogeography of Variscan and pre-Variscan formations in Europe. ***(M. Krs, P. Pruner, O. Man, J. Slepičková & D. Venhodová.)***

In 1996, the palaeomagnetic investigations were entirely concentrated on the Devonian rocks in the Barrandian area. Pilot hand samples (n = 45) of the Devonian limestone were collected from the localities of Koněprusy, Hostim, Quarry Prastav, U dubu sedmi bratří, Zlíchov and Branická skála. Detailed palaeomagnetic and petromagnetic data were derived for all the samples collected, respective remanence

components were separated by means of the multi-component analysis (using J.L. Kirschvink's method). The samples of the Devonian limestones from the localities of Hostim, U dubu sedmi bratří, Quarry Prastav and Branická skála showed suitable palaeomagnetic properties; consequently, next samples were collected from the above localities. Preliminary results indicate that the derived virtual-pole positions fall within the theoretical model illustrating palaeotectonic rotations for rocks older than the Carboniferous, values of palaeotectonic rotations differ from locality to locality. However, palaeogeographic reconstructions will require additional collections of oriented samples for detailed palaeomagnetic investigations.

(d) Palaeomagnetic investigations of formations close to the contact zone between the Bohemian Massif and the Western Carpathians. ***(P. Pruner, M. Krs, O. Man, J. Slepičková & D. Venhodová).***
Palaeomagnetic investigations were focused on Devonian and Carboniferous rocks from the Moravian Zone. Oriented pilot samples of rocks of different origin (limestones, greywackes, siltstones, shales) were collected from the localities of Jevíčko, Vitošov, Mohelnice, Jesenec, Újezd near Boskovice and Slavoňov. The main task of the work was to select sites with suitable palaeomagnetic properties so that sets of samples would be enlarged for next palaeogeographic reconstructions based on mean palaeomagnetic data. From the original set of samples of 49, only 24 were found suitable for palaeomagnetic investigations. Despite a small set of data, the newly derived values of palaeomagnetic declination and inclination for the localities of Mohelnice and Slavoňov are in agreement with previously derived Devonian directions, virtual pole positions for the localities of Jesenec and Vitošov are in agreement with those of the Early Carboniferous. Additional samples have to be collected with the aim to enlarge data sets needed for more precise derivation of R. Fisher's statistics values (semi-vertical angle of the confidence cone, precision parameter at the 95% probability level, e.g.).

**(12b)** K1 - 042-603 Key directions in Science, Project No. 6: Atmospheric and lithospheric processes with special reference to the territory of the Czech Republic. Sub-project: Dynamics of lithospheric processes. *(project leader **V. Suchý, J. Bek, P. Čejchan, A. Galle, Š. Eckhardtová, J. Fiala, V. Houša, J. Hladil, M. Konzalová, J. Krhovský, M. Krs, M. Krůta, M. Lachmanová, R. Mikuláš, J.K.Novák, O. Nekvasilová, L. Peza, Z. Roček, M. Svobodová Z. Vejnar** & **J. Žítt)***

IMPORTANT INDIVIDUAL RESULTS:
(a) Organic microfacies of Barrandian low Paleozoic. (***Š. Eckhardtová, V. Suchý**, I. Sýkorová, Institute of Rock Structures and Mechanics ASCR & P. Dobeš, Czech Geological Survey, Prague)*
In the Barrandian basin a thick sequence of graptolite-rich Silurian black shales was protruded by bed-parallel basaltic sills that caused an extensive contact alteration of enclosing sediments. The degree of shale alteration was examined by means of graptolite reflectance measurements. $R_0$ % values of graptolite cortex gradually increase from 0,7 % $R_0$ in adjacent unaltered shale up to 2,04 % $R_0$ characteristic of samples immediately close to the intrusive body. From Barker and Pawlelicz´s (1986) equation it follows that these reflectances correspond to the maximum temperatures of 74 °C and 280 °C, respectively. Basaltic sills themselves are crosscut by a number of small ptygmatic veinlets that are filled with calcite, quartz, chlorite, analcite and

prehnite. Solid brittle bitumen ($R_0$ = 1,067 %) and yellowish waxy substances are also present in some veins.
Fluid inclusion research on quartz crystals separated from the veinlets reveals the presence of abundant brightly blue- and yellow-fluorescing primary liquid inclusions which are likely composed of light oils. Homogenisation temperatures of the inclusions ($T_{hom}$) vary between 57 °C and 150 °C, with the most values between 80 and 100 °C.
We believe, that higher hydrocarbons entrapped in vein minerals represent petroleum-like products which were generated essentially "instantaneously" with respect to geological time when basaltic sills intruded into organic-rich sediments. This process may have been similar to the present-day generation of hydrothermal petroleum from immature organic matter as in has been observed in Guayamas Basin and elsewhere.

(b) The prograde metamorphic series of the Teplá Crystalline Complex and the Zone of Erbendorf-Vohenstrauß - a geochemical and Sr-Nd isotopic comparison. ***(J. Fiala,*** *F. Henjes-Kunst, Bundesanstalt f. Geologie u. Rohstoffe, Hannover, H. Müller-Sigmund, Institut f. Mineralogie, Petrologie u. Geochemie, Universität Freiburg &* ***Z. Vejnar)***
Recent geodynamic models for the crystalline basement in the W part of the Bohemian Massif mostly assume a tectonometamorphic equivalence between the Teplá Crystalline Complex (TCC) and the Zone of Erbendorf-Vohenstrauß (ZEV). Current studies investigate whether the correlation of TCC and ZEV also yields true for the geochemistry and Sr-Nd isotopic characteristics of their sedimentary protoliths. Major elements relations indicate that the sedimentary protoliths for TCC sequence consisted of immature (pelitic) greywackes. In appropriate projections all TCC samples lie within the variation range of ZEV paragneisses. Major and trace elements patterns of both units are best comparable with those of recent sediments from continental island arc (CIA) setting. In comparison with average upper continental crust (UCC) in general, highly incompatible elements are less enriched and highly compatible elements are less depleted in both units. Special minima in relation to UCC in the case of Ca, Sr, Nb and Cu and one maximum in the case of V were observed. This is also in accordance with the assumption of a CIA-type setting lacking geochemically evolved continental detritus.
REE spectra in general are similar to those of post-Archean shales with LREE enriched, smooth patterns and negative Eu anomalies. Several samples from the lower metamorphic part of the TCC, however display a distinct positive Ce anomaly with the other LREE less enriched. This feature is attributed to LREE leaching under oxidising conditions during sedimentation while $Ce^{4+}$ remains in the sediment. This samples give also higher Sm-Nd model ages ($T_{DM}$=1.8-2.0 Ga), while all others give lower model ages of 1.1-1.5 Ga. $Sr_i$ for all samples is fairly constant and compatible with the assumption of a dominance of detritus which is isotopically not very evolved. Geochemical and isotopic characteristics of the TCC very closely resemble those observed in the ZEV paragneisses. This evidence indicates that both units were coevally deposited and share either the same or at least a compositionally similar source region.

(c) Paleoenvironmental interpretations of early Oligocene palynomorphs of the Pouzdřany Formation. (***M. Konzalová)***

In the upper part of the Pouzdřany Formation and the lower part of the Uherčice Formation (South Moravia) the changes in the composition of organic-walled microfossil content were followed, namely within the biozone NP 22. The section is characterised by frequent laminated deposits. The short time intervals display different associations of vascular plant pollen derived from land and also different assemblages of phytoplankton. Only Pinaceae, inclusive *Picea*, *Tsuga,* and *Cedrus,* were found almost in all fossiliferous portion of sections. At several levels the existence of shore swamp communities of Taxodiaceae and Cupressaceae were recorded along with the communities of drier fagaceous forest with rich represented Juglandaceae (*Engelhardtia*). The admixture of so called Arctotertiary elements reaches up to 3 % only. Nevertheless, the whole composition of communities demonstrates the trend of gradual lowering of temperature. Also the record of key fossil *Boehlensipollis hohli* W.Kr. is worthy of mention for these communities. The taxa of phytoplankton show prevailingly the offshore condition, the littoral forms (*Tasmanites, Homotryblium, Crassosphaera*) occur rarely. Beside of littoral and offshore communities, the taxa with euryhaline *Wetzeliella* that tolerates the estuarine conditions and occurs often with *Pediastrum*, were identified. *Pediastrum* was recorded within the layers with freshwater diatoms and within the non calcareous clay at the base of the Uherčice Formation. Within one portion of Pouzdřany marl the higher frequency of angiosperm pollen, low frequency of organic-walled phytoplankton and rich association of calcareous plankton with species tolerate to lower salinity (*Braarudosphaera bigelowii, Dictyococcites ornatus*) was recorded. This can demonstrate the short-time outwash and the input of terrigenous material into the marine basin, the fact that was testify also in two other portion of sections. Also the rich fuzinit corroborate this periods of probable lower salinity.

(d) Ichnological record of paleogeographical and climatic changes in the Bohemian Massif. (***R. Mikuláš***)
(1) Recent and subrecent surfaces of Czech castellated sandstone rocks and hardened sandstone clasts in Quaternary sandy taluses provided cylindrical tunnels representing bees' nests. This phenomenon might contribute to knowledge of Quaternary climatic changes. (2) Some biogenic structures from the Peruc Member (nonmarine Upper Cretaceous, Bohemian Cretaceous Basin) have been reinterpreted. The grooves and ridges on fossil leaves have been recognized to represent traces of burrowing organisms, which originated in a soft sediment in a neighborhood of the plant remains lying on the lake floor or buried in the substrate. The leaves functioned in the sediment at the time of burrowing and/or during a compaction of the substrate as distinctive laminar bodies with specific physical characteristics and therefore they enabled the preservation of some aspects of ichnofabric otherwise invisible in the surrounding rock. Therefore the knowledge of ichnological content of the Peruc Member has been improved; moreover, this phenomenon
has no published analogies abroad.

(e) Petrological research of the diatreme in Teplice- Šanov spa. ***(J.K. Novák)***
As an independent volcanic body, the Miocene breccia pipe occurring in close neighbourhood of the Horský thermal spring (NE part of the Teplice-Šanov spa) was studied. Granulation breccia is splitted in fragments corresponding to both highly weathered olivine basalt (white in colour) and vitric alkali basalt. The white fragment showing green pseudomorphs after olivine contains a well-crystallised, mixed-layer

kaolinite/smectite as the dominant mineral, dark volcanic fragments are decomposed to beidellite smectite only. Rhyolite, rhyolitic ignimbrite, granite porphyry, metagranite, silicite, and marlstone are allochtogenous fragments. The laboratory investigations and the obtained data allowed to evidence of repeated eruption on the chimney body. The sedimentary sequences exposed in the surroundings of the locality are predominantly composed of the Upper Cretaceous marlstones and limestones, including silicified basal conglomerate.

(f) *Diptyxis* Oppenheim (Nerineacea, Gastropoda) from the Lower Cretaceous of Albania. On the distribution of *Diptyxis*. ***(L. Peza)***

A short overview about the genus *Diptyxis* Oppenheim and its palaeogeographic distribution was given. Three species inclusive two new ones were studied and described: *D. lutickei* (Blanckenhorn), *D. munellae* n. sp. and *D. mirditae* n. sp. These species originated from the Barremian-Aptian deposits of the northern part of the Mirdita zone, Munella Mountain and Lura Region (Northeast Albania). They were reported for the first time from the Balkan Peninsula.

(g) *Adaptyxis* n. gen. (Nerineacea, Gastropoda) from the Mirdita Zone of Albania. ***(L. Peza)***

A new genus and two new species of nerineids (Gastropoda ) are described from the Lower Cretaceous deposits of the Mirdita zone, South Albania. *Adaptyxis* n. gen., and new species *Adaptyxis lavdaris* n. sp. and *Adaptyxis carinatus* n. sp. are studied and correlated with other nerineid genera and species. The fossil material originated from the Barremian-Aptian conglomerates and sandstones of the Buzemadhe Hill west from the town of Korca, south part of the Mirdita zone (Albania).

(h) Assemblages of amphibians in European Tertiary: Paleogeographic deduction. ***(Z. Roček)***.

- An overview of the anuran fossil record. *(B. Sanchiz, Museo nacional de ciencias naturales, Madrid, Spain &* ***Z. Roček****)*

A general overview of the known anuran fossil record is presented, with an emphasis on diversity and extinct groups. The fossil record is analysed for all anurans at the family level, and palaeontological minimal ages are inferred. Most of the record can be referred to extant families, but a few exceptions remain: the South American Jurassic *Vieraella* and *Notobatrachus*, the Asiatic Cretaceous *Gobiates* and the holarctic palaeobatrachids are especially discussed in this regard. However, the real evolutionary pattern appears to include few examples of lost, extinct diversifications within the order Anura, unless this merely derives from a sampling bias of the known fossil record. Diversity in the past has not proven to be higher than today, and it seems to have been growing very slowly through time. At least 10 Jurassic and Lower Cretaceous sites (dated >100 Ma) are known where multiple anuran remains have been recovered. In all these localities, one or a few anuran species are detected per site, but in no case have more than two very closely related genera been found. More diverse assemblages, including more than one family, are presently known only from the Upper Cretaceous and later. We consider the example of Europe, with a fairly rich fossil record, clearly documenting the role of addition, by means of transcontinental migration and minor speciation events, in the development of present anuran biodiversity. Finally, consideration is given to the relationships of the Palaeobatrachidae. This extinct family, known from the Upper Cretaceous to the Plio-

Pleistocene boundary (roughly 66 to 1.6 Ma) can be considered the sister-group and ecological equivalent to the living Pipidae.

(i) Microfossils of bituminous diatomites at the Kundratice lokality in the České středohoří Mts. ***(M. Konzalová)***
Two different assemblages of microfossils were revealed within the bituminous diatomites and tuffaceous diatomites at Kundratice locality (Jesuitengraben in Engelhardt) that differs in the composition of identifiable organic components and microfossils.
The lower level of diatomites, rich in bituminous matter is composed of algal organic detritus at different stages of decomposition and contain closely packed pollen exines of terrestrial and aquatic plants (e.g. *Nymphaeapollenites*). The low admixture of arctotertiary pollen is the characteristic feature of this community. In contrary to it, they are rich represented in the woodland recorded in pollen within the clayey sediments of the upper level. The change of environment along with change of plant communities is well demonstrated.

(j) Basin analysis and thermal history of the Barrandian terrane. (***V. Suchý***)
It was found that carbonate and shale sequences of the Barrandian Lower Paleozoic basin contain abundant bed-normal, north-south-trending calcite veins of syn- to post-tectonic nature. The veins are filled with massive calcite, dolomite, chalcedonic silica, minor sulphides and a variety of manganese minerals. Fluid inclusion measurements on calcite samples indicate precipitation of the veins from NaCl-$CaCl_2$-$MgCl_2$ brines of variable salinity, at 55-120 °C. Field observations show that the process of veining and vein calcite precipitation was associated with an extensive dissolution of enclosing carbonate sequences. In particular, unusual subvertical cavities of cylindrical shape link spatially to the calcite veins at some places. It has been suggested that these cavities that are often filled with (pre)Upper Cretaceous sediments may represent the “solution pipes” from which the carbonate was dissolved by circulating hydrothermal solutions. Structural analysis reveals that NS-trending calcite veins control the occurrence of many caves in Barrandian carbonate sequences. Hydrothermal origin of at least some caves in the area appears to be also supported by a common occurrence of so-called “Koněprusy rosettes”. These represent unusual, cauliflower-shaped speleothems composed of alternating layers of chalcedonic silica and carbonate that precipitated on the walls of some Barrandian caves. The “Koněprusy rosettes” may have originated from warm mineralised solutions in a way similar to the hydrothermal siliceous geyserites or “Carlsbad popcorn” to which they are strikingly similar.
These observations provide a growing pile of evidence that the sedimentary sequences of the Barrandian basin were extensively altered by warm fluids that were responsible for hydrothermal veining, dissolution of carbonate rocks and caves formation. A work is in progress to investigate the origin of the fluids, their evolution in time and space and the timing of individual hydrothermal events.

(k) Biostratigraphy of clayey accumulations in the Štramberk Limestone (Plaňava Formation). **(*M. Svobodová*)**
The Štramberk limestone bodies (Tithonian) near Štramberk contain lithologically different rocks of the Lower Cretaceous age. Claystones and marls of the different colours from brown, grey to dark grey contain more or less well preserved plant

microfossils, marine microplankton, chitinous linings of foraminifers and scolecodonts.
The most interesting palynomorph association was found in Š 91, where stratigraphically important dinoflagellates - *Batioladinium longicornutum, Muderongia staurota* and others were ascertained, which can confirm the Hauterivian age of the studied deposits. No angiosperm pollen were observed.

(l) The Devonian/Carboniferous limit in Northern Bolivia. ***(M. Vavrdová)***
60 samples from two boreholes situated in Northern Bolivia, Manuripi X-1 and Pando X-1 were processed with the aim of a stratigraphical and paleoecological assessment. Latest Silurian, Early Devonian, Frasnian and Famennian assemblages of acritarchs, miospores and chitinozoans were distinguished. Affinities to coeval palynological associations from South America, Northern Africa and Western America suggest plate-tectonic interaction between western Gondwana and eastern Laurentia during the Devonian.

(m) Taphonomy and paleoecology of selected groups of invertebrates (Crinoidea, Echinoidea, Brachiopoda, Bivalvia) in the upper Cretaceous sequences. Importance for the sedimentary environment and its changes. ***(J. Žítt, L. Peza & O. Nekvasilová)***
Comatulid crinoids were studied from the point of view of distribution of isolated skeletal elements in sections of the Kaňk Member and Bílá Hora Formation in the rocky-coast facies. Taphonomic features of Remesimetra and Semiometra in the Velim section indicate increased rate of burial regardless the lithology and Corg content in the rock (uppermost Kaňk Member and lowermost Bílá Hora Fm.) and absence of mechanical wear (relatively low-energy environment). Comatulid event was traced on the base of the Bílá Hora Fm. in the eastern part of the study area. Study of echinoid decorticated spines revealed that decortication is not taphonomic but rather diagenetic process of dissolution and disintegration of surficial stereom layer.
Taphonomy of the thecideid brachiopods from the shallow-water environments of the world is so far little known. Bohemian species (genera *Praelacazella*, *Eothecidellina, Thecidiopsis*) seem to be very susceptible to the mechanical wear. Not only brachial but also strong pedicle valves are very fragile and their occurrence , together with still articulated shells, signalises low agitated environments and rapid burial. The same is proved by overgrowing small bioclasts. In situ findings document that all types of solid substrates were suitable for these cementing species.
Study of rudist bivalves from the Předboj, Radim, Plaňany, and Velim localities shows only about 3 species to be represented, indicating the upper Cenomanian age of sections.

(n) Paleozoic metasediments of the Bohemian Massif, selected objects at the transition between the Variscan internal and external belts. ***(J. Hladil)***
*Ch. Pin* and *F. Patočka* discovered oolite embedded in metamorphosed marble of the Rýchory Mountains, in the low-grade metamorphosed Poniklá Group (Suchý Důl, Dolní Albeřice). The metamorphic history and structure of both carbonate rocks were investigated in detail *(J. Hladil, A. Galle, G. Dieken, W. Rottke)*. Originally, three hypotheses were tested: (1) fills in karstified relief, (2) fills in subsurface hydrothermal chambers, and (3) tectonic detachment and emplacement in a newly formed pile of slices. The final results of the study supported the version (3), as the

following facts have been documented: (A) Metamorphic history: As shown in Cl-luminescence, the replacement of ooids by dolomite happened in 3 major phases, withal, the last of them involves saddle dolomite. Superimposed changes on the carbonate of particles, former cement and low-metamorphic aggregates shows retrograde features, e.g. replacement by calcite, grain/size diminution (finally again in deep vadose circulation - Cl-bright fills, channels and rims along the corroded aggregates). Assumed burial could reach about 10 km. The marble has another history: According to relict structures, this carbonate rock was tentatively a dark grey corallomorph-bearing packstone. The rock has been strongly metamorphosed: the dolomite-calcite mosaic was equilibrated after the creep in higher p-T conditions. Later retro-grade events were reflected by depletion in dolomite, with granulation of the crystals. This carbonate was retracted up to collision ductile zone (about 20 km). (B) Structures and metasomatism: The lithons and bouddines of the oolite rock are on the faults. However, the marble metamorphic banding is circumfluent in respect of these bodies. Brittle deformation prevails in the internal parts of the oolite rock whereas the margins are schistose, with wrinkles and folds. The metamorphic banding in encompassing marbles corresponds to extremely elongated isoclinal folds. Contact between the oolite and marble is often masked by hydrothermal alteration, veins of quartz-calcite-sulfate composition. The massive quartz or carbonate metasomatosis gluttonizes more the oolite than the marble. This metasomatism found the tectonically embedded bouddines "in place", i.e. timing of this event is fit to syn- to post-kinematic stages. In addition, the alternated carbonate bodies are obliquely cut by a thrust with retrograde, wrinkled phyllonite. Age of this thrust represents the upper limit of the processes described above. Indications by fossils (?*Receptaculites* cf. *guilinensis* Yu.), facies (massive oolite depositions) and isotopes (Sr, *F. Patočka*) favorize the Famennian age, 365-355 Ma of the oolitic carbonate.

(o) Tithonian and Berriasian calpionellid associations. ***(V. Houša)***
The goal of the present project is to recognise general changes in calpionellid associations in the Jurassic/Cretaceous boundary strata, to study them in details with object to found main events in this changes, to establish their exact stratigraphic position toward the magnetostratigraphic zones and other scales of biostratigraphic zonation, especially the ammonite zonation, and to correlate them on different distant localities in the Tethyan region. Finally so calibrated magnetostratigraphic scale will be compared with magnetostratigraphic scale of the J/C boundary strata in the Boreal region with the goal to correlate them exactly and through them to correlate exactly the biostratigraphic scales in both regions.
In the last year was taken and studied pilot samples from the classic locality of J/C boundary strata in the BossoValley (Umbria, Italy) together with pilot samples for magnetostratigraphic investigations. The approximate position of the principal events in calpionellid associations and boundaries of magnetostratigraphic zones in this profile was established. Obviously biostratigraphic events appear independently on magnetostratigraphic events. Nevertheless in one case exists exact coincidence between one important event in calpionellid evolution (i.e. appearance of *Calpionella grandalpina*) and the base of reverse magnetozone M-19. This coincidence of both events was proved on all up to now studied localities, especially in Brodno (West Carpathians), Bossso (Italy) and Rio Argos (Murcía, Spain). In Rio Argos area was taken and studied pilot samples from the Tithonian part of the profile „Z" near

Caravaca and several proof samples (also for magnetostratigraphy) from Tithonian part of profile by the J/C boundary beds in Carcabuey (Granada, Spain).

(p) Cephalopod limestones of the Barrandian basin (Silurian), Czech Republic: Sedimentary environments and stratigraphic significance. (***V Suchý., J. Krhovský & Š. Eckhardtová)***
Sedimentological and taphonomical aspects of Silurian cephalopod limestones in the classical Barrandian area in Bohemia were studied. Cephalopod limestone levels are here developed in upper Wenlock (*T. testis* Biozone), in lowermost Ludlow (*C. colonus* Biozone), in middle Ludlow (*M. fritchi linearis* Biozone), in uppermost Ludlow (*M. fragmentalis* Biozone), in lowermost Přídolí (*M. parultimus* Biozone), and in uppermost Přídolí ( *M. transgrediens* Biozone).
Individual cephalopod horizons or "banks", in which cephalopod shells are dominant rock-forming constituent with some bivalves and brachiopods occasionally present, appear to have originated from a series of repeated gravity flows ranging from debris flows to turbidites. Field observations indicate that most of bioclastic material originally accumulated on former submarine highs which were drowned volcanic seamounts, with cephalopod primary accumulations on top. We think that some part of the shells may have floated for some time to allow postmortal accumulation by surface currents along shorelines or on the flat tops of submerged volcanoes. From these shallow-water locations cephalopod shells, along with other bioclasts, have been subsequently redeposited by gravity flows into deeper-water environments. Although decisive evidence is lacking, from the sedimentological context it appears likely that much of inferred gravity transport was in fact triggered during major storms that episodically influenced Barrandian shelf.
In proximal facies, bedding-parallel sheet cracks, neptunian dykes, slump folds and a variety of graded beds have been recognised in some sections and attest to mass movements down slope. On the slopes of submarine volcanic highs cephalopod sediments moved downhill to produce debris flow and turbiditic graded beds that were deposited in relatively deeper-water basinal setting on the foot of slope or below the seamounts.
Resedimented concentrations of cephalopod shells build up the uppermost parts of several transgressive-regressive, coarsening-upward sequences which typically prograde into basinal setting. At least two of these cephalopod limestone-terminated sequences (in uppermost Ludlow and in uppermost Přídolí) appear to be the result of eustatic fluctuations rather than local or regional epeirogeny. The distribution of cephalopod beds in Barrandian stratigraphic record generally reflects periods of sea level falls. It is suggested that eustatically controlled horizons of resedimented cephalopod shells can serve as a correlative tool to some other Lower Palaeozoic sedimentary basins.

**(12c)** K1-017-602 Key directions in Science, Project No. 22: The influence of climate and antropogenic factors on biosphere and geosphere. *(Co-ordinator V. Straškrabová, Hydrobiological Institute ASCR, České Budějovice)*
Sub-project: Climatical oscillations and environmental changes of the recent geological past. ***(V. Cílek & A. Žigová)***
The project concentrates on the study on climatical and environmental changes on three basic hierarchical levels:

(a) the first and the most important level concerns climate of the last 2 000 years. A. Růžičková and A. Zeman conducted with cooperation of the Archaeological Institute a detailed research of Labe floodplain and the history of human settlements in response to different hydrological regimes. V. Cílek bought important and large database od J. Svoboda containing appr. 10 000 climatical date (4 000 computer pages) excerpted from written sources and covering the climate since 950 A.D. The frequency analyses and other statistical methods as well as correlations with published data and natural records will be carried in the coming year.
(b) the second hierarchical level concerns Late Glacial and the Holocene. The most important environmental factor for the area of Czech Republic are considered to be the waves of continetal climate bringing not only harsh winters but 100-500 years lasting drought periods especiall in Subboreal of the Middle Holocene. The paleoclimate curve based on C, O stable isotopes for the 8 000-2 500 B.P. was for the first time obtained for the area of Czech Republic (tufa mound in Svatý Jan pod Skalou, Bohemian Karst, Prague region). Even older profile in nearby Švarcava covering Early Holocene would prolong OXY curve for the missing 2000 years. Limited data exist on time-span 0 - 1 000 years A.D.
(c) the third level is represented by last glacial cycle some 10-120 kyr ago studied on loess profiles of Central Bohemia and Southern Moravia as part of international projects (PEP III and others).

**13. Organization of conferences and scientific meetings**

P. Skřivan: Workshop SCOPE "Global Changes and Essential Elements Cycling in the Environment", 17-18 September,.1996, Geological Inst. ASCR, Praha.

**14. Publication activity of the Geological Institute**

This year the Geological Institute edited the third volume of Geolines, a new series of monographs and monothematic volumes of extended conference abstracts published by the Geological Institute of the Academy of Sciences of the Czech Republic. Articles in English on primary research in any field of geology (geochemistry, geophysics, petrology, stratigraphy, paleontology etc.) will be considered. Each number is thematically consistent, containing several papers on joint topic or, preferably, one large paper or monograph. More comprehensive systematic and regional descriptions of wider interest will be appreciated. Monothematic volumes of extended abstracts from specialised workshops and conferences will be considered as well.
Only original papers will be accepted which have not been published previously nor currently submitted for publication elsewhere.
The journal accepts papers within their respective sectors of science without national limitations or preferences. However, in case of extended abstracts, the conferences and workshops organised and/or co-organized by the Geological Institute will be preferred. The papers are subject to reviews. 25 offprints of each paper will be provided free of charge.

**1996**

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## 15. Publication activity of the members of the Geological Institute

### 1996

***15a) Refereed journal articles and monographs***
*** -** articles in journals with high citation impact factor

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