

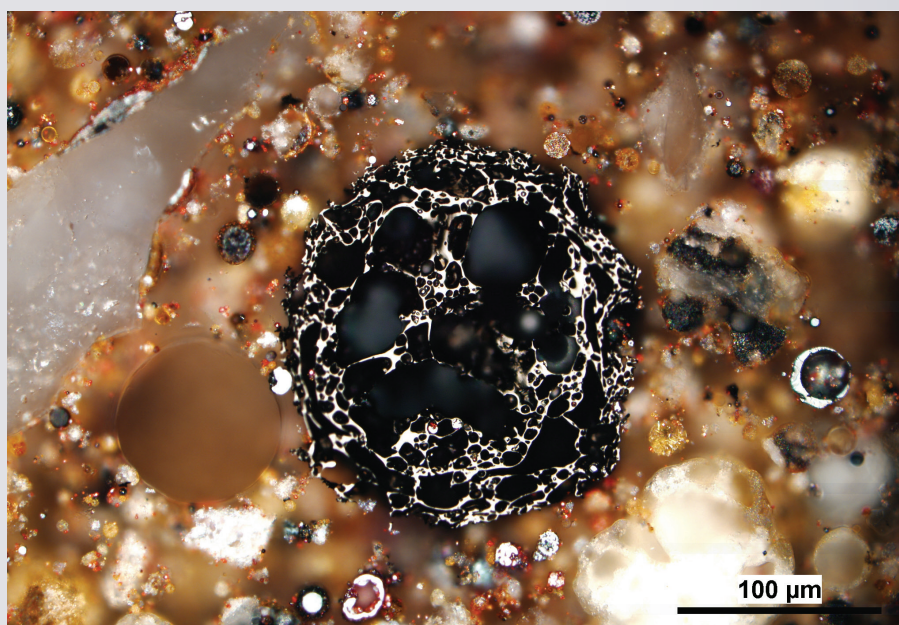


INSTITUTE OF ROCK STRUCTURE AND MECHANICS
The Czech Academy of Sciences

DEPARTMENT OF GEOCHEMISTRY

THEMATIC RESEARCH FOCUS

- COAL AND ORGANIC PETROLOGY
- MINERALOGY AND
PETROGRAPHY OF MAGMATIC
ROCKS
- ORGANIC AND INORGANIC
CHEMISTRY OF GEOMATERIALS
- SORPTION AND POROSIMETRIC
ANALYSES



Spherical, porous char particle from a burnt-out lignite waste heap

JOIN RESEARCH CENTER

The joint Laboratory of Sorption and Porosimetric Analyses was established by the Institute of Rock Structure and Mechanics together with the Faculty of Science, Charles University. Joint research is focused on the porous texture of rock materials and their changes due to environmental conditions and technological processes.

MAIN SCOPE OF RESEARCH

- Study of paleoenvironmental and palaeoclimatic conditions, and weathering processes of sedimentary basins
- Coalification and dispersed organic matter in relation to diagenesis and rock metamorphism
- Investigation on the carbon dioxide and methane sorption capacity of porous natural and artificial materials in dependence on their properties
- Development and study of new ordered micromesoporous carbon materials as adsorbents for CO₂
- Investigation of the sensing properties of chemiresistors
- Mineralogy and geochemistry of accessory minerals in granitic rocks
- Sn-W and U mineralization connected with granitic rocks
- Products of incomplete combustion, carbonaceous particles, hydrocarbons, and toxic elements in environment and sediments
- Detection of modification of rock fabric by conservation agents used for hydrophobisation and consolidation of stones
- Investigation of the properties of the corrosion layer on nuclear fuel cladding pipes

KEY RESEARCH EQUIPMENT

- NIKON stereoscopic microscope
- NIKON microscope with LUCIA image analysis system, Laboratory Imaging
- Olympus BX51 optical microscope with a Carl Zeiss MK3 Photomultiplier under both reflected light and fluorescence regimes
- Carl Zeiss Axio Imager M2m optical microscope with a spectrometer
- DuraScan - 20 microhardness tester (Struers)
- Trace gas chromatograph – DSQ II single quadrupole mass spectrometer (ThermoElectron)
- Trace 1310 gas chromatograph – ISQ single quadrupole mass spectrometer (ThermoElectron)

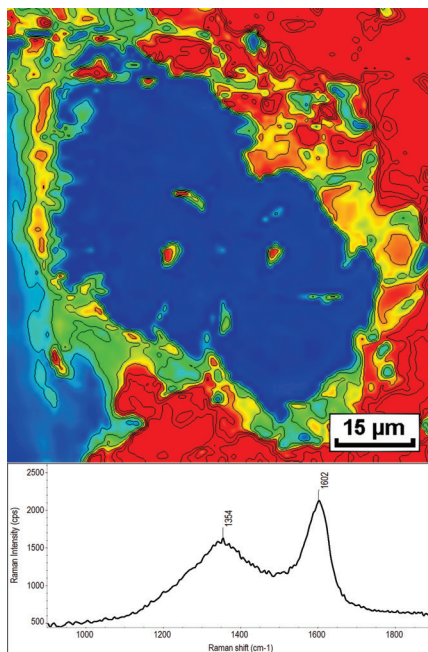


Hidden IGA-100 Intelligent Gravimetric Analyser, Hidden Isochema



PASCAL 140 + PASCAL 440 EVO mercury porosimeters, Thermo Scientific

- CDS 5000 Pyroprobe Unit
- ASE extractor (Dionex)
- PASCAL 140+240 Porotec porosimeters (Thermo Scientific)
- PASCAL 140 + PASCAL 440 EVO porosimeters (Thermo Scientific)
- IGA-100 and IGA 002 – Intelligent Gravimetric Analyser (Hidden Isochema)
- SURFER volumetric sorption analyzer (Thermo Scientific)
- High-pressure sorption apparatus up to 15 MPa (equipment designed and produced in-house)
- Pycnomatic ATC helium pycnometer (Thermo Scientific)



Study of organic matter and brannerite in samples from the Zadní Chodov uranium deposit of the Bohemian Massif. Distribution correlation map of graphitic material around brannerite/uraninite grains and its Raman spectrum.

ACHIEVEMENTS

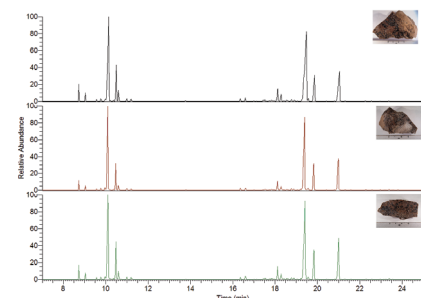
● PETROLOGY, GEOCHEMISTRY AND THERMAL MATURITY, AND PALEOENVIRONMENTAL HISTORY OF MIRES AND SEDIMENTS

Havelcová M., Machovič V., René M., Sýkorová I., Lapčák L., Špaldoňová A., 2020. *Geochemistry of shear zone-hosted uranium mineralisation at the Zadní Chodov uranium deposit (Bohemian Massif)*. ORE GEOLOGY REVIEWS 120, 103428.



Lamellar graphite in rocks from the Zadní Chodov deposit

Havelcová M., Machovič V., Sýkorová I., Lapčák L., Špaldoňová A., Mach K., Dvořák Z., 2018. *Duxite – Fossil resin of Miocene age*. ORGANIC GEOCHEMISTRY 124, 190–204.



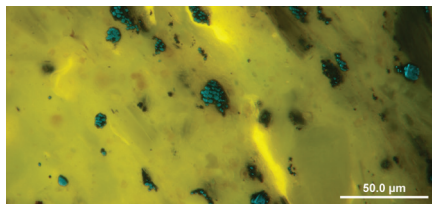
Total ion chromatograms of extracts of three duxites (fossil resins from the northwest part of the Czech Republic), showing their similarities

Havelcová M., Machovič V., Špaldoňová A., Lapčák L., Hendrych J., Adam M., 2019. *Characterization of Eocene fossil resin from Moravia, Czech Republic: Insights into macromolecular structure*. SPECTROCHIMICA ACTA PART A: MOLECULAR AND BIOMOLECULAR SPECTROSCOPY 215, 176–186.



Fossil resin piece at the exposure of the clay sandstone

Kříbek B., Kněsl I., Rojík P., Sýkorová I., Martínek K., 2017. *Geochemical history of a Lower Miocene lake, the Cypris Formation, Sokolov Basin, Czech Republic*. JOURNAL OF PALEOLIMNOLOGY 58 (2), 169–190.



Yellow alginite and dark pyrite framboids in Tertiary Cypris sediment, Sokol Basin

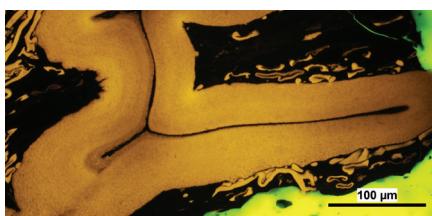
Kus J., Araujo C.V., Borrego A.G., et al., 2017. *Identification of alginite and bituminite in rocks other than coal. 2006, 2009, and 2011 round robin exercises of the ICCP Identification of Dispersed Organic Matter Working Group*. INTERNATIONAL JOURNAL OF COAL GEOLOGY 178, 26–38.

Mansour A., Geršlová E., Sýkorová I., Vöröš D., 2020. *Hydrocarbon potential and depositional paleoenvironment of a Middle Jurassic succession in the Falak-21 well, Shushan Basin, Egypt: Integrated palynological, geochemical and organic petrographic approach*. INTERNATIONAL JOURNAL OF COAL GEOLOGY 219, 103374.

Mizera J., 2019. ¹⁰Be in Australasian microtektites compared to tektites: Size and geographic controls. GEOLOGY 47, e459.

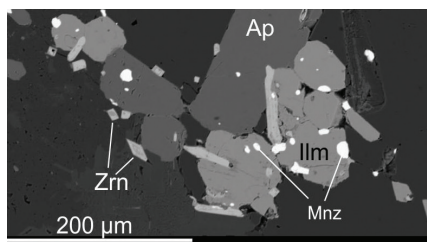
Opletal V., Geršlová E., Nehyba S., Sýkorová I., Rez J., 2019. *Geology and thermal maturity of Namurian deposits in the Němčičky Sub-Basin as the South-eastern continuation of the Upper Silesian Coal Basin (Czech Republic)*. INTERNATIONAL JOURNAL OF COAL GEOLOGY 216, 103323.

Opluštil S., Sýkorová I., 2018. *Early Pennsylvanian ombrotrophic mire of the Prokop Coal (Upper Silesian Basin); what does it say about climate*. INTERNATIONAL JOURNAL OF COAL GEOLOGY 198, 116–143.



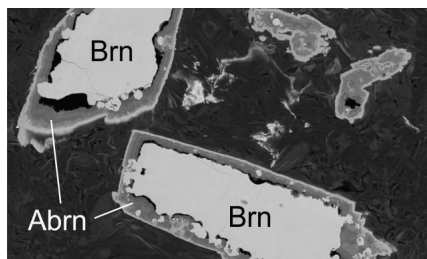
Sporinite in bituminous coal from the Prokop Coal Mine, Upper Silesian Basin (fluorescent mode)

René M., 2017. *REE and Y mineralogy of the Moldanubian batholith (Central European Variscides)*. In: HORIZONS IN EARTH SCIENCE RESEARCH 17. Nova Science Publishers, Inc., New York, USA, 74–114.



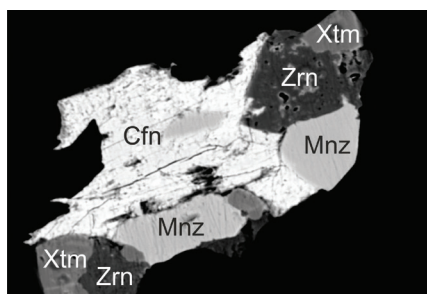
SEM BSE image of typical accessory mineral assemblage in two-mica granites of the Moldanubian batholith (Ap – apatite, Ilm – ilmenite, Mnz – monazite, Zrn – zircon)

René M., 2017. *Alteration of granitoids and crystalline rocks and uranium mineralisation in the Bor pluton area, Bohemian Massif, Czech Republic*. ORE GEOLOGY REVIEW 81, 188–200.



SEM BSE image of brannerite (Brn) and altered brannerite (Abrn) from the Zadní Chodov uranium deposit

René M., 2018. *Petrology, geochemistry and mineralogy of greisens associated with tin-tungsten mineralisation: Hub stock deposit at Krásno-Horní Slavkov ore district, Czech Republic*. In: CONTRIBUTIONS TO MINERALIZATION. Intech, Rijeka, Croatia, 1–22.



SEM BSE image of accessory mineral assemblage from greisenised granite, Horní Slavkov Sn-W-Li deposit (Cfn – coffinite, Mnz – monazite, Xtm – xenotime, Zrn – zircon)

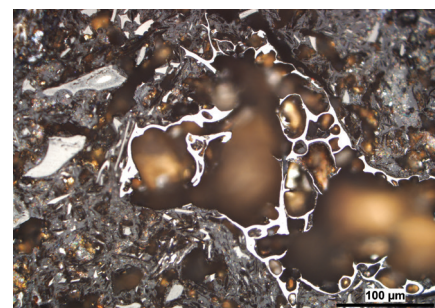
René M., Dolníček Z., 2017. *Uraninite, coffinite and brannerite from shear-zone hosted uranium deposits of the Bohemian Massif (Central European Variscan belt)*. MINERALS 7, 1–17.

Suchý V., Zachariáš J., Tsai H., Yu T., Chuan-Chou S., Světlík I., Havelcová M., Borecká L., Machovič V., 2019. *Relict Pleistocene calcareous tufa of the Chlupáčova sluj Cave, the Bohemian Karst, Czech Republic: a petrographic and geochemical record*

of hydrologically-driven cave evolution. SEDIMENTARY GEOLOGY 385, 110–125.

● PRODUCTS OF INCOMPLETE COMBUSTION, MOBILITY AND TRANSFORMATION OF POLLUTANTS

Kříbek B., Sýkorová I., Veselovský F., Laufek F., Malec J., Kněsl I., Majer V., 2017. *Trace element geochemistry of self-burning and weathering of a mineralized coal waste dump: The Novator mine, Czech Republic*. INTERNATIONAL JOURNAL OF COAL GEOLOGY 173, 158–175.

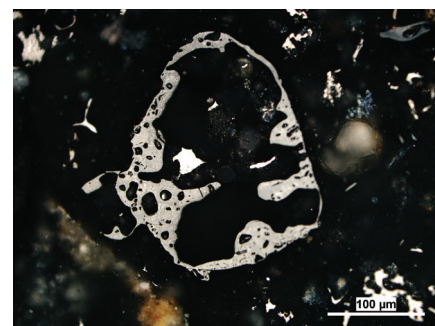


Expelled bitumen in a mineral matrix with coke spherule and detritus in burnt coal wastes, Intrasedimentary Basin

Misz-Kennan M., Kus J., Flores D., et al., 2020. *Development of a petrographic classification system for organic particles affected by self-heating in coal waste. (An ICCP Classification system, Self-heating Working Group – Commission III)*. INTERNATIONAL JOURNAL OF COAL GEOLOGY 220, 103411.

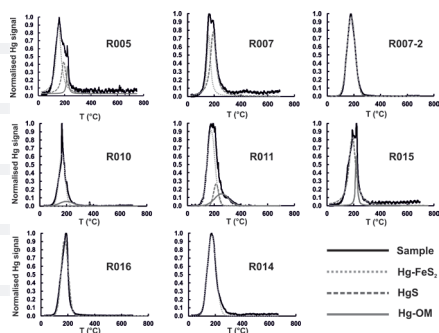
Perná I., Šupová M., Hanzlíček T., Špaldoňová A., 2019. *The synthesis and characterization of geopolymers based on metakaolin and high LOI straw ash*. CONSTRUCTION AND BUILDING MATERIALS 228, 116765.

Sýkorová I., Kříbek B., Havelcová M., Machovič V., Laufek F., Veselovský F., Špaldoňová A., Lapčák L., Kněsl I., Matysová P., Majer V., 2018. *Hydrocarbon condensates and argillites in the Eliška Mine burnt coal waste heap of the Žacléř coal district (Czech Republic): Products of high- and low-temperature stages of self-ignition*. INTERNATIONAL JOURNAL OF COAL GEOLOGY 190, 146–165.



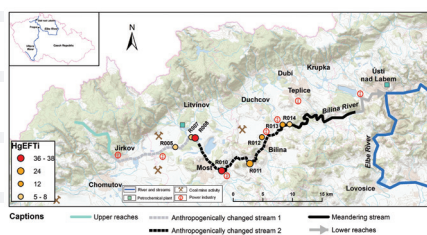
Spherical coke particles from burnt bituminous coal waste

Vöröš D., Díaz-Somoano M., Geršlová E., Sýkorová I., Suárez-Ruiz I., 2018. *Mercury contamination of stream sediments in the North Bohemian Coal District (Czech Republic): Mercury speciation and the role of organic matter*. CHEMOSPHERE 211, 664–673.



Thermo-desorption profiles obtained for analysis of several stream sediment samples, showing that mercury had volatilised at a temperature lower than 400°C

Vöröš D., Geršlová E., Díaz-Somoano M., Sýkorová I., Suárez-Ruiz I., Havelcová M., Kuta J., 2018. *Distribution and mobility potential of trace elements in the Main Seam of the Most Coal Basin*. INTERNATIONAL JOURNAL OF COAL GEOLOGY 196, 139–147.



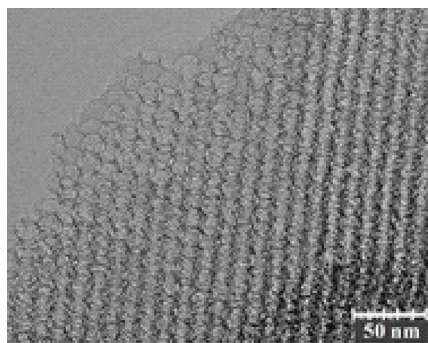
The degree of Hg contamination in stream sediment (Záluží-Ohnič stretch) samples, varying from moderate to very severe enrichment, that were taken from places in direct contact with the refinery and coal mining.

● TEXTURAL AND SORPTION PROPERTIES OF POROUS MATERIALS, CHEMICAL PROCESSES AT THE SURFACE OF SnO₂- AND CUOX-BASED CHEMIREISTORS

Hozák P., Vorokhta M., Khalakhan I., et al., 2019. *Insight into the gas sensing properties of CuOx nanowires by near ambient pressure XPS*. THE JOURNAL OF PHYSICAL CHEMISTRY 123, 29739–29749.

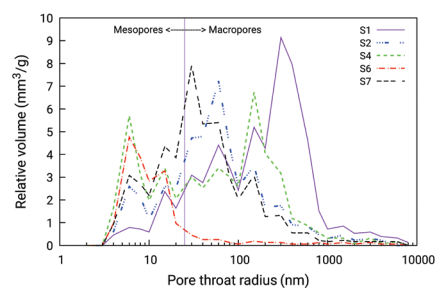
Nguyen H.G.T., Sims C.M., Toman B., et al., 2020. *A reference high-pressure CH₄ adsorption isotherm for zeolite Y: results of an interlaboratory study*. ADSORPTION 26, 1253–1266.

Pastvová J., Kaucký D., Morávková J., Rathouský J., Sklenák S., Vorokhta M., Brabec L., Pilař R., Jakubec I., Tabor E., Klein P., Sazama P., 2017. *The effect of enhanced accessibility of acid sites in micro-mesoporous mordenite zeolites on hydroisomerization of n-hexane*. ACS CATALYSIS 7, 5781–5795.



High-resolution TEM image of three-dimensionally ordered microporous carbon

Řimnáčová D., Weishauptová Z., Příbyl O., Sýkorová I., René M., 2020. *Effect of shale properties on CH₄ and CO₂ sorption capacity in Czech Silurian shales*. JOURNAL OF NATURAL GAS SCIENCE AND ENGINEERING 80, 103377.

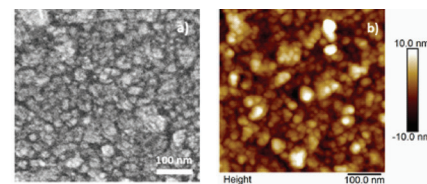


Mesopore and macropore size distribution of pores in Czech Silurian shales from high-pressure Hg intrusion data

Vorokhta M., Morávková J., Řimnáčová D., Pilař R., Zhigunov A., Švábová M., Sazama P., 2019. *CO₂ capture using three-dimensionally ordered microporous carbon*. JOURNAL OF CO₂ UTILIZATION 31, 124–134.

Vorokhta M., Khalakhan I., Vondráček M., et al., 2018. *Investigation of gas sensing mechanism of SnO₂ based chemiresistor using near ambient pressure XPS*. SURFACE SCIENCE 677, 284–290.

Weishauptová Z., Příbyl O., Sýkorová I., René M., 2017. *Effect of the properties of Silurian shales from the Barrandian Basin on their methane sorption potential*. FUEL 203, 68–81.



SEM (a) and AFM (b) images of a 30 nm thick SnO₂ layer prepared on the fused silica substrate

MAIN COLLABORATING PARTNERS

- Charles University (Praha, CZ)
- Brno University of Technology (Brno, CZ)
- Masaryk University (Brno, CZ)
- Technical University – VŠB (Ostrava, CZ)
- National Museum (Prague, CZ)
- Czech University of Life Sciences Prague (Praha, CZ)
- Nuclear Physics Institute of the CAS (Řež, CZ)
- Institute of Chemical Technology (Praha, CZ)
- J. Heyrovsky Institute of Physical Chemistry of the CAS (Praha, CZ)
- Institute of Macromolecular Chemistry of the CAS (Praha, CZ)
- Czech Geological Survey (Praha, CZ)
- North Bohemia Coal Mines (Severočeské doly a.s.) (Bílina, CZ)
- UJP Praha a.s. (Praha, CZ)
- Sokolovská uhelná a.s. (Sokolov, CZ)
- ČEZ Energetické produkty (a subsidiary of ČEZ, a.s.) (Hostivice, CZ)
- University of Salzburg (Salzburg, Austria)

