PROGRAM AND BOOK OF ABSTRACTS

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SGA Student Chapter Prague

Faculty of Science, Albertov 6
Charles University, Prague

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UAV Magnetometer Survey Improve Airborne Data

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Airborne magnetometer surveys are important part of the main sources of geological information in Australia. Large surveys were flown all across the mainland during last decades. Base line spacing varies between tens and hundreds of meters. In many cases spacing is not close enough to reveal important information about magnetic anomalies. Detailed surveys from surface or by helicopter are done if needed. We show that UAV magnetometer survey can reliably improve estimates of source magnetization direction in areas where airborne surveys were already done. We illustrate our findings with a case study from Jindabyne, Australia. We use conventional airborne data and data from our UAV survey and show advantages and limitations of UAV magnetometer survey in comparison with airborne and conventional ground magnetometer survey.

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Experimental investigation on kaolin under cyclic loading: inspection of drained cyclic preloading and undrained Miner's rule

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The results of an experimental investigation on Malaysian kaolin under monotonic and cyclic loading are presented. In the tests, a wide range of initial conditions were varied in order to investigate their influence in the mechanical behaviour of the kaolin. The response under monotonic loading was analysed by means of undrained monotonic triaxial tests with different initial mean effective pressures and overconsolidation ratios. The experimental plan under cyclic loading includes an odometer test with multiple unloading-reloading cycles and twenty undrained cyclic triaxial tests with either isotropic or anisotropic consolidation. In the latter tests, the influence of the initial stress ratio, deviator stress amplitude, drained cyclic preloading and sequence of packages of cycles with different deviator stress amplitudes has been investigated. The experimental results suggest that the variation of the aforementioned test conditions leads to remarkable changes in the accumulation rates of pore water pressure and strains. In addition, it was found that the so-called Miner's rule is not valid under undrained conditions.

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Influence of H_2O on deformation behavior and microstructure changes in Tana-quartzite

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Since quartz is among the most abundant minerals in continental crust and one of the first to show plasticity with increasing pressure and temperature, understanding its mechanical behavior is crucial for estimates on crustal strength and modeling of geodynamic processes. Since discovery of significantly lower mechanical strength of quartz as a consequence of H_2O presence in the crystal, remarkable amount of work has been done in order to improve the knowledge about processes and mechanisms responsible for the so called H_2O weakening effect. As the weakening effect depends on molecular H_2O, it is a disequilibrium weakening process that is difficult to incorporate into the existing flaw laws.

In order to evaluate mechanical behavior of quartz in the presence of H_2O, deformation experiments were performed in the solid-medium Griggs-type apparatus in coaxial setting under controlled laboratory conditions, using very pure natural quartzite from Tana quarry (northern Norway). The behavior of samples with added H_2O in range from 0 to 0.5 wt%, as well as of as-is samples, was studied in 1) three series of shortening experiments at 900 °C, 1 GPa and constant strain rate of 10^{-6} s^{-1} reaching 30% strain, 2) six strain rate stepping experiments covering 10^{-5}, 10^{-6} and 10^{-7} s^{-1}, 3) two temperature stepping experiments covering 750, 850 and 950 °C and 4) two hot pressing experiments maintaining the starting experimental conditions for 14 hours. FTIR spectroscopy was applied to evaluate H_2O for its speciation, quantity and distribution.

Microstructure examination was based on 1) optical microscope observation in cross-polarized light and with gypsum accessory plate, 2) CL imaging, 3) EMPA elemental mapping and 4) EBSD analysis.

Even though all as-is samples appeared to be the strongest compared to 0.1 and 0.2 wt% H_2O added samples, the strength difference is within the experimental error. In terms of samples with more than 0.2 wt% H_2O added, results are much more scattered in the stress-strain field and their general strength is ambiguous. Some of those samples showed distinctly weaker behavior, while another ones were stronger than as-is samples. As-is and 0.1 wt% H_2O added strain rate steeping experiments had shown surprisingly low stress exponent, with the highest value of 2.26. Temperature stepping experiments, within the same range, gave activation energy values of 177 kJ/mol and 198 kJ/mol. In all studied samples, the strain increases towards the sample centers exhibiting a significant grain size decrease from initial 250 – 300 μm. Three principal deformation mechanisms contributing to the bulk strain were identified: 1) crystal plasticity of original grains manifested by flattening, undulatory extinction, and development of subgrains, 2) cracking of the original grains demonstrated by fluid inclusion trails and 3) dynamic recrystallization via subgrain rotation recrystallization indicated by misorientation analysis from EBSD data. Distribution of misorientation axes across the low angle grain boundaries of grains reconstructed from EBSD data revealed dominance of prismatic <a> slip system and less dominant rhomb <a> slip system. Regardless of added H_2O or as-is samples, most of deformed original grains showed relative H_2O concentration between 0 and 400 H/10^6Si, implying significant decrease of H_2O content from the original 600 to 2000 H/10^6Si measured in undeformed grains. Average H_2O concentration in grain boundaries is increasing corresponding to the trend of H_2O adding. Plasticity is most visible in CL-images, as well as higher degree of grain fragmentation and crack density in samples with more H_2O added. The ubiquitous presence of fluid along the grain boundaries, demonstrated by FTIR results, may have facilitated sliding along grain boundaries which, in turn, could explain the low stress exponent derived from our strain rate stepping experiments.

Engineering-geological assessment of the dam construction works in the area of Giant and Jizera Mountains in the first quarter of the 20th century

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The presentation is mainly about Intze´s dam construction in the 1st quarter of the 20th Century, located in the area of Giant and Jizera Mountains. The area of interest is briefly introduced and characterized. Subsequently, the technical principles of Ing. Otto Intze, dr. h. c. are mentioned in the presentation together with the design solutions of the principles. History, construction, technical parameters and engineering geological aspects of single dams are described in detail. An evaluation of the quality and the current state of the cuntructions are mentioned in conclusion.

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Fuzite layers in main lignite seam of the central Most basin – new potential indicator of paleoclimate changes in lower Miocene

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In main lignite seam in central Most tertiary basin, there are located several layers of natural charcoal called fuzite. These forms of coal are mainly defined as a mark of a fire during the sedimentation of these layers. This study will be about detailing mapping of these layers in the Bílina, Vršany, Československá armáda, Doly Nástup Tušimice open pit mines with detailed makropetrographic analysis combined with interpretations of non-core drilling information. After that, there will be task to correlate these horizons through the basin with SEM analysis to dedicate paleoclimate and its changes in the lower Miocene period. These conditions can be parallel with nowadays swamps in the southwest USA.

Fig. 1: Main lignite seam in the Bílina mine hiding its fuzite horizons Photo by Jan Šulc

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Multi-phase reactivation of the northeastern Bohemian Massif reflected in the depositional record of Late Paleozoic and Mesozoic sedimentary basins

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Kinematic evolution of multiply reactivated intra-plate faults is usually complex. This is greatly exemplified by a system of NW–SE-trending, originally Variscan faults (e.g., the Elbe Fault Zone and Lusatian Fault) that cross-cut the northeastern Bohemian Massif. A direct evidence for pre-late Cretaceous movements on these faults is missing, however, the depositional record of nearby basins suggests multiple phases of reactivation during the Late Paleozoic and Mesozoic. A superposition of the preserved basin fills as well as temporal and spatial evolution of source areas suggest that five generations of sedimentary basins may have been developed in this region and their deposition was controlled by fault movements. The early Permian development of the Krkonoše Piedmont Basin (KPB) is characterized by reactivation of marginal as well as intrabasinal normal faults and formation of an E–W-oriented half-graben. The infill of the KPB correlates with the Česká Kamenice Basin, which, in turn, does not correlate with the adjacent Permian outliers preserved as tectonic slivers along the Lusatian Fault. We interpret these outliers as remnants of a small pull-apart basin formed within a transtensional basin system (together with Döhlen Basin) governed by sinistral slip on the NW–SE faults. Subsequent reactivation in dextral regime produced the Trutnov–Náchod sub-basin (eastern KPB). The early Permian (late Asselian) shift from extension to transtension was likely caused by far-field stress transfer from the Uralian Orogeny, while the latter (‘Saxonian’, Sakmarian–Artinskian) resulted from large-scale extension in the Southern Permian Basin. At least two periods of deposition occurred during the Mesozoic (Middle–Late Jurassic, Late Cretaceous), interrupted by tectonic reactivation of basement faults and shift of depositional and sources areas. The Middle–Upper Jurassic successions were deposited in the Lusatian Basin, covering the Lusatian Block, that formed by reactivation of the Lusatian Fault, driven by stress transfer from the North Atlantic Rift in conjunction with overall trend of sea-level rise during the Late Jurassic. Deposition likely continued towards the Early Cretaceous when large amounts of clastic material filled the basin as a result of tectonic acceleration. As indicated by the depositional record of basins surrounding the Bohemian Massif, the basin was eventually inverted by Aptian/Albian. Its fill was completely eroded during progressive unroofing of the Lusatian Block into the successor Bohemian Cretaceous Basin. The latter may have been formed as a compressional “intraplate foreland basin” controlled by far-field effect Alpine thrusting or convergence of Iberia, Africa and Europe during Late Cretaceous times.

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Morphologically distinct ozarkodinids (Conodonta) at the Silurian/Devonian boundary

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The study is focused on the ozarkodinid taxa that belongs to the genus *Zieglerodina*, with a distinct morphology that might have a great potential for an approximation of the Silurian-Devonian boundary as well as the correlation of the earliest Devonian. The taxa *Zieglerodina paucidentata* and *Zieglerodina petrea* share similar morphological characteristics at the P1 element (a distinct gap in their denticulation). Apart from a few previously described ozarkodinid species around the Silurian-Devonian boundary, this characteristic is very easily recognizable in otherwise rather morphologically stable or undistinguishable spathognathodontid (ozarkodinid) elements. This study revises their taxonomy, and it also treats transitional morphologies and ambiguous specimens that formerly had been described under these names. The ambiguity in the description of *Z. paucidentata* (a lowermost Lochkovian taxon) could affect precision in the recognition of the Silurian-Devonian boundary. The taxonomic relationships between these two species, their biostratigraphic range, and their paleogeographic distribution would be discussed in the presentation. New occurrences of these prominent taxa were confirmed: the first records of *Z. petrea* in the Cellon section from the Carnic Alps, and *Z.* cf. *paucidentata* from the Atrous section in Morocco. The revised data have shown that some specimens previously described as *Zieglerodina paucidentata* or *Zieglerodina* cf. *paucidentata* probably belong to different taxa; and therefore their applicability for correlation of the Silurian-Devonian boundary is limited.

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Calibration of the stable carbon isotope analysis and application to palaeorecontruction of Mesozoic ecosystems

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Mesozoic coastal ecosystem preserved in Bohemian Cretaceous sedimentary basin contains rich plant communities preserved as fossils. Based on the sediment characteristics, these plants were growing on a salinity stress gradient, where the most stressed plants were growing on the salt-marsh-like coast. In contrast, less stressed plants inhabited riverbanks or sand bars within the deltaic environment. We use stable carbon isotopes analysis of specific compounds – *n*-alkanes – from leave waxes to determine the salinity or drought stress for separate species. Thus, this approach allows us to reconstruct species-specific autecology in developing coastal environment through time.

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A brief insight into a new records of lower Turonian ammonites from Bohemian Cretaceous Basin

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According to present knowledges, the Turonian ammonites from the Bohemian Cretaceous Basin (BCB) starts within the Mammites nodosoides ammonite Zone. It is in the strong contrast to the stratigraphic distribution of ammonite fauna in European basins, as well as the West Interior Seaway (WIS), north Africa and other regions. The majority of the middle/upper Lower Turonian ammonites in BCB are represented by the index species *Mammites nodosoides* (Schlüter) and other taxa of this Zone. Our new records of the genus *Fagesia* (Mantell) (10 specimens), *Paramammites* (Barbaer) (4 specimens) and *Watinoceras* (Henderson) (2 specimen), however clearly document older strata than previously suggested. These samples were collected in the first half of the 20th century and they come from area around "Žďánice u Kouřimi". Unfortunately, these very important localities are not exposed at present time. Based on these records, we extend the ammonite zonation down to the base (or to the lowermost strata) of the Turonian in the BCB. This significantly rises correlational potential, especially within ammonite faunas from the NW Tethys and WIS.

Few other interesting species of the Turonian ammonites were recognized in older collections – i.e. *Prionocyclus albinus* (Fritsch). The taxonomic validity of species *Mammites curimensis* (named after Kouřim) is also discussed.

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Geochronological constraints on Saxothuringian accretionary wedge formation and its reactivation (Erzgebirge Mts., Bohemian Massif)

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The metasediments surrounding the Erzgebirge crystalline complex (Saxothuringian unit) remain scarcely studied, although they well-preserved the record of Variscan structural and metamorphic evolution. Detailed geochronological (monazite U-Pb and mica ^{40}Ar–^{39}Ar dating), structural and petrological investigations were performed along three cross-sections from low-grade phyllites to high-grade micaschists and gneisses. Three distinct tectonometamorphic events have been identified: 1) formation of the accretionary wedge under HP-LT conditions (24 kbar, 560°C), 2) exhumation and ductile thinning of the wedge (8 kbar, 600°C) and 3) late shortening and folding. The early S1 fabric reflecting accretionary wedge architecture is preserved in metasediments, and it is progressively transposed to secondary sub-horizontal metamorphic foliation S2 towards the structurally lower micaschists. Here the fabric is developed under MP-MT M2 metamorphism. The last deformation event D3 is manifested by post-metamorphic upright folding with ENE-WSW trending fold axes.

Nine samples representing individual metamorphic fabrics have been analyzed by *in-situ* monazite geochronology with laser-ablation split-stream inductively coupled plasma mass spectrometry allowing to obtain REE composition from the same measured spot. Monazites are mostly discordant and a common Pb correction was applied to give the following ages. In phyllites, there is a prominent single group of ages around 350–340 Ma. In micaschist samples that have strong S2 metamorphism, there are two groups of ages and REE patterns. The monazites located in the recrystallized M2 matrix or included in the rim of garnet were dated to 330 Ma, while few grains in the locally preserved domains of high-pressure matrix M1 or enclosed in the garnet core are older, around 340 Ma. ^{40}Ar–^{39}Ar geochronology on micas was used to date 2 samples using step-heating and *in-situ* UV-laser ablation. The preliminary results are consistent with monazite dating. The northern phyllites preserve older ages of 343 Ma, while in micaschist the age is 330 Ma. The whole geochronological results allow us to associate the HP event in phyllite and micaschist units to 350–340 Ma, corresponding to the formation of the accretionary wedge. Later, the micaschists experienced a strong metamorphic overprint around 330 Ma corresponding to the development of the MP-MT fabric S2, interpreted as the exhumation and thinning of the wedge.

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Mass balance of Y+REEs during atoll garnet formation in eclogite

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Mass balance of Y and rare earth elements (REEs) during garnet growth and dissolution appeared to be an important tool for a reconstruction of multistage and atoll garnet development. For this study were used high pressure metabasites with atoll garnets from the central part of the Krušné hory Mts. (Saxothuringian Zone, Bohemian Massif). Peak-pressure phases are represented by garnet, omphacite, quartz, amphibole, rutile and talc. Relicts of early developed zoisite were also observed. Between common retrograde minerals belongs ilmenite, plagioclase, chlorite and younger amphiboles.

Based on the compositional profiles and maps of main and trace elements were distinguished two zones of garnet. Interior garnet (I) is represented by Ca rich central parts of grains and rim garnet (II) by abundant Mg content on the rims or replacing central garnet I during atoll formation. Prograde development is marked by decreasing Ca and Mn and increasing Mg content from core toward the rims in the interior garnet I. The rim garnet II indicates elevated concentration of Mn in comparison to the marginal parts of the interior garnet I. Because garnet is main phase carrying higher amounts of Mn, we assume that content of Mn released from garnet I during its dissolution was incorporated into forming garnet II.

To confirm an idea of incorporating elements from dissolving garnet I into growing garnet II, the Y+REEs concentrations in garnet were investigated. Especially heavy REEs (HREEs) and Y, which have good compatibility in garnet and low diffusion coefficients, record well break-down of Y+REEs carrying phases and subsequent incorporation of these elements into the garnet. Interior garnet I shows decreasing concentration of Y+HREEs from its core toward a rim which corresponds to the Rayleigh fractionation. Rim garnet II shows mostly lower concentrations of Y+HREEs, but higher light REEs (LREEs) contents.

Two approaches were considered for a mass-balance of Y+REEs between garnet I and II. One applied for a large single garnet grain and second for several smaller grains across relatively large-scale field in thin section. The results combined with the observed compositional and textural relations and thermodynamic modelling with pressure-temperature path constraints indicate that the concentrations of Mn+Y+H(M)REEs in garnet II and the concentration peaks at the interface of these two garnets were controlled by a complex mechanism that included dissolution of garnet I during formation of atoll texture, stepwise growth of garnet during pressure and temperature increase and decomposition of phases with high concentrations of trace elements, such as zoisite/epidote or lawsonite.

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Archean enriched reservoir and supercontinent cycles evidenced by global carbonatites

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Carbonatites are considered to be derived directly from the volatile enriched mantle and/or by liquid immiscibility from CO_2-rich silicate melt (*1*). Today's conception is based on a variable portion of enriched mantle components (EM I, EM II, HIMU, and FOZO) (*2*) and recycled crustal material as carbonates or sediments (*3*). Along with our data, we used data from Geochemical Rock Database-Query and find out that approximately one-third of carbonatites do not isotopically correspond to the mantle region. One branch has been identified as carbonatites with a considerable amount of marine/sediments (high $e_{Sr}(i)$, $d^{13}C$, $d^{18}O$, and low $e_{Nd}(i)$). The other with unradiogenic $e_{Nd}(i)$ that can't be explained by crustal contamination and require old incorporated component with low Sm/Nd and Sr/Rb ratios implemented in source. We propose that this part of the mantle was metasomatized by TTG-like melts and is evolving even in recent mantle regions. Moreover, a comparison of zircon distribution in the continental crust during the last 3Ga years, super-continents breakups, and carbonatite frequency give us clear evidence that those events are certainly linked.

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Miocene volcanic rocks from the Uherský Brod area: unique example of volcanic association in the transitional zone between two orogenic systems

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Volcanic rocks from the wider vicinity of Uherský Brod (UB, Moravia) in the Czech Republic mostly represented by hypabyssal sills and dykes, are subject of interest due to their extraordinary geotectonic position. They are regarded as transitional between the rift-related alkaline magmatism of the Bohemian Massif foreland and the dominantly calc-alkaline magmatism of Carpathian-Panonian Region (Nejbert et al., 2012). Representative samples covering all petrographic types of the Miocene subsubvolcanic andesitic rock association from the UB area were studied. UB volcanic area is associated with the Klippen Zone situated in the vicinity of the contact of the Carpathian–Pannonian Block with the Bohemian Massif (Lustrino and Wilson, 2007; Macdonald et al., 2018). Volcanic rocks from the UB area only partly resemble the rocks in a similar structural position in the coeval Pieniny area in Poland (Nejbert et al., 2012). The Miocene volcanic rocks of the Klippen Belt from the UB area form a basaltic–trachytic differentiation series generated by magmatic assimilation and fractional crystallization. Major temperature and pressure ranges calculated for the amphibole phenocrysts crystallization in the andesitic rocks of the UB area are 910–990°C ± 24°C and 0.4–1.2 GPa, corresponding to a depth of ca. 15–45 km. UB rock series show alkaline and subalkaline chemical characteristics, while the andesites from the Pieniny area are of calc-alkaline character. The distribution of incompatible elements such as the Nb, Ta, U, Th, ΣREE and LaN/YbN ratios as well as the Sr–Nd–Pb isotopic signatures of the andesitic rocks from the UB and Pieniny areas differ substantially. Basaltic–trachytic series from the UB area lack of isotopic component sampled by Miocene andesitic rocks from the Carpathian–Pannonian region and characterised by very high 87Sr/86Sr (~0.709) and 207Pb/204Pb (~15.7) initial values (Krmíček et al., 2020). The low contents of incompatible trace elements in the andesitic rocks from the Pieniny area correspond mostly to the calc-alkaline characteristics for andesitic rocks from the Carpathian–Pannonian block. Nevertheless, the andesitic rocks from the UB, rich in these elements, resemble (including Sr–Nd–Pb isotopes) the alkaline Miocene volcanic rock series of the Cheb–Domažlice Graben in the Bohemian Massif.

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Giftkies mine: Appendix of Jáchymov ore deposit or an intersection of regional ore districts?

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Giftkies site is a former medieval mine for arsenic, located in the valley of Veseřice creek, nearby Jáchymov (Krušné hory Mts.). Arsenic is here represented by arsenopyrite mineralization, which is developed in the highly silicified metasomatic body within metamorphic rocks of Klínovec formation (mica schists, gneiss), accompanied by less significant uraninite mineralization with carbonates as gangue minerals. Thanks to close proximity of Jáchymov, it may seem that arsenopyrite refers to arsenide and/or arsenic-sulfide stage found at Jáchymov and uraninite refer to the carbonate-uraninite stage also found at Jáchymov. Therefore, Giftkies site is by swift judgment nothing more than the elongation of Jáchymov ore district. But there is some major counter-evidence. Jáchymov ore veins (aka midnight veins) are trending in the N-S direction, an opposite direction of the metasomatic body. There is no arsenopyrite in the arsenide and arsenic-sulfide stage. Carbonates in Jáchymov are mostly dolomites, but in Giftkies you find equally dolomite and siderite. So if we take a wider look, we find out that there are another two sites in the valley, Schönerz and Unruhe (aka Neklid). Those three mines represent extremely diverse mineralogical palates in such a small space (hundreds of square meters as maximum). Thus, the valley is surrounded by several ore districts, namely: Jáchymov (S-NW) Ag-Bi-Co-Ni-As and U hydrothermal vein deposit, Boží dar (N) Jáchymov-type veins and Sn-W (Mo) greisen, Vejprty-Nové zvolání district (NNE) Ag-Cu-Co hydrothermal vein deposit. Přísečnice-Měděnec-Kovářská distric (NE-E) with Fe scarns, Q-barite-flourite vein system and Q-hematite system. Vykmanov (S) W (Bi) greisen and last feature which is worth mentioning is Niederschlag-Kovářská fluorite-barite vein deposit. This vein trending from NNW-SSE is 4-12 m thick, approximately 700 meters deep and almost 2.5 km long, cut Přísečnice-Měděnec-Kovářská distric, Vejprty-Nové zvolání district and continues further north to Niederschlag in german part of Krušné hory Mts. Shallow parts of the vein (first 70 meters) consist of Ag-Bi-Co-Ni-As mineralization, the rest of the vein is built by massive barite and fluorite. With that being said, another preliminary explanation could be that the valley of the Veseřice creek is possibly an overlap area, where ore-forming processes from other ore districts could have taken place. This hypothesis will hopefully be further explored and validated in the future.

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Depicting the historical pollution in a Pb-Zn mining/smelting site in Kabwe (Zambia) using tree rings

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Historical Pb-Zn mining and smelting in Kabwe in Zambia have made it one of the most polluted cities in the world. Four soil profiles were collected around the smelter and in remote locations, and two pine trees (Pinus montezumae L.) were sampled for tree ring cores. These were analyzed for Pb, Zn and Cu contents and Pb isotopic ratio. Furthermore, the C isotopic composition of tree rings was also assessed. High concentrations of metals are present only in the top layers of soil and are larger in soils closer to the smelter (up to 16000 mg kg^{-1} Pb; 14000 mg kg^{-1} Zn; 600 mg kg^{-1} Cu) compared to remote soils (up to 194 mg kg^{-1} Pb; 438 mg kg^{-1} Zn; 46 mg kg^{-1} Cu). Metals are also present in trees and the one located furthest from the slag dump contains higher metal concentrations (up to 6.48 mg kg^{-1} Pb; 10.6 mg kg^{-1} Zn; 10.2 mg kg^{-1} Cu), possibly due to the deposition of wind-blown particles. Results of a sequential extraction procedure (SEP) showed that metal contaminants are not available for tree root uptake and the above-ground processes must be more important. The Pb isotopic ratios of slags, tree rings, and topsoils average at $^{206}Pb/^{207}Pb = 1.15$, corresponding to the signature of local ores and smelting slags, thus confirming that the mine and smelter are the main sources of contamination in the area. The results were compared to the historical records of smelter production. Tree ring Pb and Zn concentrations, $\delta^{13}C$ and $^{206}Pb/^{207}Pb$ reveal linear dependence on production with different statistical significance.

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Wildfires affect metal(loid)s in polluted African topsoils

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Wildfires contribute to global emissions of trace elements. This study focuses on highly polluted areas near an operating copper smelter and old mine-tailing disposal sites in Tsumeb (semi-arid north of Namibia), where wildfires frequently occur. Capturing of particulates windblown from the ore processing and smelting areas by vegetation (trees, grass) leads to the topsoil enrichment with metal(loid) contaminants (up to 7090 mg/kg Cu, 2070 mg/kg As, 4820 mg/kg Pb, 3480 mg/kg Zn, 75 mg/kg Cd, 7.66 mg/kg Hg). Experimental samples corresponding to representative biomass-rich topsoils (bushland with acacia and marula trees, grassland) were investigated using a combination of mineralogical and geochemical methods. Wildfires were simulated using a thermodesorption (TD) technique (75-670 °C; Hg) and an experimental setup composed of a temperature-controlled furnace (250-850 °C), an aerosol-filtering unit and a gas-trapping device (As, Cd, Cu, Pb, Zn). The obtained ashes were investigated to depict any mineralogical and chemical transformations to understand temperature-dependent release of metal(loid) contaminants during the simulated wildfire.
Thermodesorption experiments indicated that more than 90% of Hg was released at ~340 °C, corresponding to prevailing grassland-fire conditions. A comparison with the Hg reference compounds' TD curves confirmed that the Hg in the biomass-rich topsoils occurs as a mixture of Hg bound to the organic matter and nanocrystalline metacinnabar (black HgS), which exhibited similarities with the TD pattern of smelter flue dust residue. Temperature-dependent release of other metal(loid)s (As, Cd, Cu, Pb, Zn) is dependent on their solid-state speciation. Cadmium is released at ~750 °C, corresponding to the thermal decomposition of carbonates, in which Cd is mainly bound. Arsenic exhibits complicated remobilization curves. The first release occurs at <270 °C (decomposition of As-bearing hydrous ferric oxides, HFO) and the second step at 350 °C corresponds to the instability of arsenolite, organic matter and some arsenates. Remobilization of As during higher temperatures corresponds to the decomposition of enargite (Cu_3AsS_4). Other contaminants (Cu, Pb, Zn) were mainly bound in carbonates, slag particles and sulfides/sulfosalts. During the simulated wildfire, they were mainly retained in the ash and were remobilized to a lesser degree at >650 °C. Nevertheless, it has been demonstrated that contaminated African sites deserve attention and protection against wildfires.

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Phosphate from WWTP affects arsenic behavior in the streambed sediments

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Arsenic is considered one of the most toxic elements in the environment. Its release into the ground and surface waters can cause severe health problems; therefore, the recommended limit for drinking water is 10 µg/l As. Competition with phosphate is one of the leading causes of As release from sediments, and wastewater treatment plants (WWTP) are a great source of phosphate for freshwater (8 mg/l on average).

A stream with a continuous discharge of a P-enriched effluent was studied on a locality with naturally high concentrations of As in surrounding soils and sediments (> 200 mg/kg). In this environment, arsenic is mainly allocated in Fe (hydr)oxides and occasionally in Ca-Fe arsenates. The methods used were XRD, EPMA, bulk analyses, single extractions, and batch leaching experiments. Since 2013, the WWTP effluent supplies 7–23 mg/l of PO_4 into the stream and an increased concentration of As (150–180 µg/l) due to everyday usage of As-contaminated well water in the households. This study revealed that the fractionation of As and P in sediments changed due to exposure to treated wastewater. The adsorbed As fraction decreased by 9 %, whereas the adsorbed P fraction increased by 9 % in the downstream samples. As a result, the P-retention capacity decreased in the downstream samples from 16 % to 10–12 %. Results of chemical extractions are supported by a mineralogical study, which showed that P and As distribution within the Fe (hydr)oxides differed significantly between the samples taken upstream and downstream the effluent discharge point. The samples upstream showed higher As and lower P median concentration (1.3 wt % of As_2O_5 and 0.8 of P_2O_5 wt %, respectively), while the opposite behavior was observed downstream. Median concentrations in the samples exposed to treated wastewater showed decreased As 0.7 wt % of As_2O_5 and increased P 1.6 wt % of P_2O_5. These findings indicate that elevated phosphate is replaced by arsenate in the Fe (hydr)oxides, and the As is mobilized into the aqueous phase. Moreover, detailed mineralogical investigation of samples exposed to the P-enriched effluent showed newly created Fe (hydr)oxide coatings on the grains of alumosilicates and As-rich Fe (hydr)oxides. These coatings were significantly enriched in P (< 18.2 wt % of P_2O_5), Ca (< 10.9 wt % CaO) while depleted in As (< 3.3 wt % As_2O_5). Adding PO_4 into the streambed sediments revealed different behavior in upstream and downstream samples. To increase As levels in the downstream samples, 9.5 mg/l od PO_4 was required, whereas the upstream sample showed increased release of As with only 0.95 mg/l PO_4 added.

Our results showed that local sources of phosphate, such as WWTP in contaminated areas, significantly impact As behavior and may be responsible for elevated concentrations of As in surface waters.

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In vitro degradation of metabolites of polychlorinated biphenyls by ligninolytic fungi

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Polychlorinated biphenyls (PCBs) are anthropogenic compounds listed in the Stockholm Convention on Persistent Organic Pollutants. It is expected that the worldwide contamination by PCBs will over time result in their transformation into products, such as hydroxylated PCBs (OH-PCBs), methoxylated PCBs, and other metabolites. Biodegradation, the use of living organisms for the breakdown of pollutants, could potentially be used to remediate PCB-contaminated matrices. Ligninolytic (white-rot) fungi have many mechanisms by which they transform and degrade natural compounds as well as many recalcitrant pollutants. Among them, extracellular enzymes, such as lignin peroxidase, manganese-dependent peroxidase (MnP), versatile peroxidase, and laccase have often been studied. These enzymes are pivotal for the natural decomposition of wood because they can break down the complex polymers of lignin. The ligninolytic fungus *Pleurotus ostreatus,* commonly known as the oyster mushroom, has shown great degrading capabilities towards PCBs. In this work, metabolites of PCBs, namely OH-PCBs, chlorobenzyl alcohols (CB-OHs), and chlorobenzaldehydes (CB-CHOs), were incubated *in vitro* with the extracellular liquid of *P. ostreatus*, which contained mainly laccase and low manganese-dependent peroxidase (MnP) activity. The enzymes were able to decrease the amount of most of the tested OH-PCBs by > 80% within 1 h; the removal of more recalcitrant OH-PCBs was greatly enhanced by the addition of the laccase mediator syringaldehyde. Conversely, glutathione substantially hindered the reaction, suggesting that it acted as a laccase inhibitor. Hydroxylated dibenzofuran and chlorobenzoic acid were identified as transformation products of OH-PCBs. The extracellular enzymes also oxidized the CB-OHs to the corresponding CB-CHOs on the order of hours to days; however, the mediated and non-mediated setups exhibited only slight differences, and the participating enzymes could not be determined. When CB-CHOs were used as the substrates, only partial transformation was observed. In an additional experiment, the extracellular liquid of another ligninolytic fungus, *Irpex lacteus*, which contains predominantly MnP, was able to efficiently transform CB-CHOs with the aid of glutathione; mono- and dichloroacetophenones were detected as transformation products. These results demonstrate that extracellular enzymes of ligninolytic fungi can act on a wide range of PCB metabolites, emphasizing their potential for bioremediation.

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Raman spectroscopy of endolithic UV-pigments in gypsum

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Endolithic microorganisms are one of model organisms in astrobiological studies. Their habitats within the mineral matrix represent hypothetical refugia of Martian biota given that Martian surface (e.g. increased UV-radiation) is very hostile to known life. On Earth, semi-translucent or translucent minerals such as gypsum seem ideal habitats for endoliths, especially phototrophs. Gypsum deposits have also been detected on Martian surface by the Mars Express OMEGA imaging spectrometer. Raman spectroscopy is highly significant in astrobiology since its miniaturized version is a part of the experimental payload of the Perseverance rover that is currently operating in the Martian surface. Dark pigmented colonized gypsum samples were collected from three areas – Sicily, Poland and Israel. Samples were investigated using laboratory-based Raman microspectrometers and portable Raman spectrometric devices for presence of UV-protective pigment of endoliths. The synthesis of specialized UV-pigments is regularly required in lithic ecosystems due to the exposure to intense solar radiation and thus play an important role in the survival strategy. Two unique UV-pigments were detected – gloeocapsin and scytonemin. Both are highly specific for cyanobacteria and therefore serve as biomarkers. Raman spectra of scytonemin were recorded with diagnostic features at 1593, 1552, 1438, and 1173 cm^{-1}. Gloeocapsin shows characteristic Raman bands at 1665, 1575, 1378, 1310, and 465 cm^{-1}.
Several rather common pigments were also detected: carotenoids were documented in major part of samples (common Raman bands at around 1525, 1157, and 1004 cm^{-1}). Raman spectra of other pigments were recorded in several zones using near infrared excitation (785 nm): chlorophyll (1326, 1285, 1188, 984 , and 745 cm^{-1}), and phycobiliproteins (1275 cm^{-1}). Raman microspectrometric investigations of colonisations allow to gather detailed information about pigment distribution in micrometric zones of gypsum samples. Portable instrumentation permits detection of carotenoids in gypsum fast and onsite under field conditions and is evaluated here. Observed shifts of positions of Raman features of carotenoids between gypsum samples (and sites worldwide) and relative to reference values are discussed and critically evaluated.

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