COURSE OF DOCTORAL STUDIES

Course title	Field of science (branch) code	University / Faculty	Institute / Department
Palaeontological data analyses	Natural Sciences (Geology) N 005	Vilnius University / Faculty of Chemistry and Geosciences	Institute of Geosciences /
Study methods	Number of credits allocated	Study methods	Number of credits allocated
Lectures		Seminars	
Individual work	**9**	Consultations	

Course annotation

The aim of this subject is to acquaint the doctoral student with the broad perspective on methods of paleontological data research, the nature of paleontological data and ways to use these methods in solving geological, evolutionary, ecological, paleoanthropological, climatological and oceanographic problems.

The nature of paleontological data. The science of taphonomy - preservation of remains, postmortem alteration, sedimentation, transport, biostratinomy, diagenesis. Completeness and adequacy of paleontological data. Biases of paleontological data and methods for the bias elimination. Paleoecological, stratigraphic, paleogeographical and phylogenetic significance of preservation of remains.

Morphological description of individual fossils. Morphometrics and mathematical foundations of the theory of form. Linear and geometric morphometrics. Harmonic methods in 2D and 3D shape analysis - elliptic and ellipsoidal Fourier analysis. Analysis of morphological disparity. Theoretical and empirical concepts of morphospace.

The relation of paleontology to methods of classification and phylogenetic reconstruction. Species in the context of the science of paleontology and different ways of defining a species. Greedy (Parsimony), Maximum Likelihood, and Bayesian methods for searching phylogenetic trees. Comparative phylogenetic method. Stratophenetic and stratocladistic methods of phylogeny reconstruction. Phylogenetic trees and supertrees. Research methods of reticulated evolution. Reconstruction of the macroevolutionary process (extinction and origination rates) using phylogenetic data of fossil and modern taxa. Using ancient DNA and other geobiomolecular data in phylogenetic analyses. Advantages and disadvantages of phylogenetic analysis of total data (morphology, molecular data, temporal distributions of taxa).

The concept of the environment (niche) of a taxon. Ecospace and ecomorphology. Reconstruction of taxon ecology. The method of modern analogues. The comparative method. Biomechanical modeling. Reconstruction of food webs and models of network interactions.

Paleoecological methods in environmental reconstruction. Revealing environmental gradients using nonmetric multidimensional scaling, and factor analysis methods. Methods of transfer functions for the purpose of reconstruction of paleoenvironmental parameters. Model robustness testing and taxon selection. The significance of taphonomy of remains in the reconstruction of environmental factors. Isotopic paleobiology and paleobiogeochemistry.

Paleogeography and paleobiogeography. Studies and reconstructions of paleobiogeographical distributions of species. Use of paleobiogeographical data in paleoclimatology, tectonic reconstructions, and phylogenetic analysis.

Paleontological data and biostratigraphy. Numerical methods in stratigraphic correlation and the nature of paleontological data. Stratigraphic paleobiology and its relationship to sedimentology, ecology, stratigraphy, and taphonomy.

Methods of time series analysis in the detection of paleocommunity periodicities and biofacies segmentation. Testing models of evolutionary, ecological, paleogeographic processes using time series methods.

The doctoral student chooses one of the presented groups of research methods. Later, he prepares a half-hour presentation on the selected topic, which examines in detail the latest methodological achievements, possible limitations of the methods, and finally presents his insights for the further development of the given methodological direction of research.

Required readings

Hammer O., Harper D. 2006. Paleontological data analysis. Blackwell Publishing, 351 p

Zelditch, M.L., Swiderski, D.L. and Sheets, H.D., 2012. Geometric morphometrics for biologists: a primer, 2nd Edition. Academic Press. 488 p.

Claude, J., 2008. Morphometrics with R. Springer Science & Business Media, 335 p.

Cronin, T.M., 2009. Paleoclimates: understanding climate change past and present. Columbia University Press. 448 p.

Adrain, J.M., Edgecombe, G.D. and Lieberman, B.S. eds., 2002. Fossils, phylogeny, and form: an analytical approach. Springer Science & Business Media, 416 p

Upchurch, P., McGowan, A.J. and Slater, C.S. eds., 2011. Palaeogeography and palaeobiogeography: biodiversity in space and time. CRC Press, 239 p.

Kelley, P., Kowalewski, M. and Hansen, T.A. eds., 2003. Predator-prey interactions in the fossil record (Vol. 20). Springer Science & Business Media, 480 p.
Patzkowsky, M.E. and Holland, S.M., 2012. Stratigraphic paleobiology: understanding the distribution of fossil taxa in time and space. University of Chicago Press. 256 p.
Demarchi, B., 2020. Amino Acids and Proteins in Fossil Biominerals: An Introduction for Archaeologists and Palaeontologists. John Wiley & Sons. 144 p.
Harries, P.J. ed., 2003. High-resolution approaches in stratigraphic paleontology (Vol. 21). Springer Science & Business Media. 485 p.
Garamszegi, L.Z. ed., 2014. Modern phylogenetic comparative methods and their application in evolutionary biology: concepts and practice. Springer, 568 p.
Lyons, S.K., Behrensmeyer, A.K. and Wagner, P.J. eds., 2019. Foundations of Paleoecology: Classic Papers with Commentaries. University of Chicago Press, 800 p.
Allmon, W.D. and Yacobucci, M.M. eds., 2016. Species and speciation in the fossil record. University of Chicago Press. 384

Consulting lecturers Name, surname	Degree	The most important works in the field of science (branch) have been published during the last 5 years
Andrej Spiridonov	**Dr.**	**Spiridonov A**, Balakauskas L, Lovejoy S. 2022. Longitudinal expansion fitness of brachiopod genera controlled by the Wilson cycle. Global and Planetary Change, 103926 **Spiridonov A.** , Lovejoy S. 2022. Life rather than climate influences diversity at scales greater than 40 million years. Nature, 607, 307–312 **Spiridonov A** , Stankevič R, Gečas T, Brazauskas A, Kaminskas D, Musteikis P, Kaveckas T, Meidla T, Bičkauskas G, Ainsaar L, Radzevičius S. 2020. Ultra-high resolution multivariate record and multiscale causal analysis of Pridoli (late Silurian): implications for global stratigraphy, turnover events, and climate-biota interactions. Gondwana Research,Volume 86, 222-249 **Spiridonov A**., Samsonė J, Brazauskas A, Stankevič R, Meidla T, Ainsaar L, Radzevičius S. 2020. Quantifying the community turnover of the uppermost Wenlock and Ludlow (Silurian) conodonts in the Baltic Basin. Palaeogeography, Palaeoclimatology, Palaeoecology, Volume 549, 109128 **Spiridonov A**, Balakauskas L, Stankevič R, Kluczynska G, Gedminienė L, Stančikaitė M. 2019. Holocene vegetation patterns in the southern Lithuania indicate astronomical forcing on the millennial and centennial time scales. Scientific Reports, 9, 14711
Sigitas Radzevičius	**Dr.**	Grendaitė, M., Michelevičius, D. and **Radzevičius, S.**, 2023. Insights into the structural geology and sedimentary succession of the Baltic Basin, Western Lithuania. Marine and Petroleum Geology, 147, p.106009. Meidla, T., Ainsaar, L., Hints, O. and **Radzevičius, S**., 2023. Ordovician of the Eastern Baltic palaeobasin and the Tornquist Sea margin of Baltica. Geological Society, London, Special Publications, 532(1), pp.SP532-2022. Cichon-Pupienis, A., Littke, R., Lazauskienė, J., Baniasad, A., Pupienis, D., **Radzevičius, S**. and Šiliauskas, L., 2021. Geochemical and sedimentary facies study–Implication for driving mechanisms of organic matter enrichment in the lower Silurian fine-grained mudstones in the Baltic Basin (W Lithuania). International Journal of Coal Geology, 244, p.103815. **Radzevičius, S**. Raczyński, P., Whittingham, M. 2020. The Lower Homerian (Silurian) Pristiograptus from Zdanów section of Bardo Mountains (Sudetes, Poland) and its palaeobiogeographic implications. Bulletin of Geosciences 95(2): 231–242. **Radzevičius, S**., Raczyński, P., Užomeckas, M., Norkus, A., Spiridonov, A. 2019. Graptolite turnover and δ13Corg excursion in the upper Wenlock shales (Silurian) of the Holy Cross Mountains (Poland). Geologica Carpathica, 70(3): 209–221.

Approved by the doctoral committee of Geology (N 005) on 1st of December 2022 (No. (7.17 E) 15600-KT-467).

Committee Chairman prof. dr. Sigitas Radzevičius