Isotope Analysis in Geosciences

– COURSE SYLLABUS

1.	**Course title:** *Isotope Analysis in Geosciences*	
2.	**Lecturers:** *Dr inż. Alicja Wudarska – course leader (ING PAN)* *Prof. dr hab. inż. Maciej Manecki (AGH Kraków)* *Dr hab. Maciej Krajcarz, prof. ING PAN (ING PAN)* *Dr hab. Maciej Bojanowski, prof. ING PAN (ING PAN)* *Dr Beata Gebus-Czupyt (ING PAN)* *Dr Ilona Sekudewicz (ING PAN)* *Dr Michael Wiedenbeck (GFZ Helmholtz Centre for Geosciences)* *Dr Maria Rosa Scicchitano (GFZ Helmholtz Centre for Geosciences)*	
3.	**Field, type and level of studies, year of study:** *geology, geochemistry – full-time doctoral studies*	
4.	**Course character:** *compulsory lectures, seminars and discussion classes*	
5.	**Teaching method:** ***ONLINE*** *(interactive contact with lecturers in real time)*	
6.	**Language:**	*English, Polish depending on the audience and the lecturer*
7.	**Course type and number of hours:** *Lecture with seminar elements (30h)*	
8.	**Estimated load of student's independent work:**	*15h*
9.	**Total workload and number of ECTS points:**	*45h, 2 ECTS*
10.	**Short description and main focus of the course:** *This course focuses on instrumental techniques for isotope analysis in geosciences, specifically for geological, environmental, fossil, and archaeological materials. It covers both the theoretical and practical aspects of in situ and bulk analysis methods, including sample preparation, documentation, and data reduction, equipping students with the knowledge necessary for planning and executing their own lab work and research projects. Additionally, the course introduces key concepts in geoanalytical metrology, reference materials, and inter-laboratory bias, as well as presents selected applications of isotope analysis in geosciences.*	

	Our lectures, seminars and discussion classes will include these topics: *i. Introduction to isotope geochemistry (M. Manecki)* *ii. Secondary ion mass spectrometry (M. R. Scicchitano, A. Wudarska)* *iii. Inductively coupled plasma mass spectrometry (I. Sekudewicz)* *iv. Gas source isotope ratio mass spectrometry (B. Gebus-Czupyt)* *v. Sample preparation and documentation (A. Wudarska)* *vi. Geoanalytical metrology (A. Wudarska)* *vii. Reference materials (A. Wudarska)* *viii. Inter-laboratory bias (A. Wudarska)* *ix. U-Pb geochronology (M. Wiedenbeck)* *x. Stable isotope analysis of carbonates (M. Bojanowski)* *xi. Stable isotope analysis of fossil bone collagen for paleoecology (M. Krajcarz)*	
11.	**References:** *Fayek M. (2009) Secondary Ion Mass Spectrometry in the Earth Sciences. Gleaning the Big Picture from a Small Spot, Mineralogical Association of Canada, Short Course Series, vol. 41, pp.150* *Hoefs J. (2018) Stable Isotope Geochemistry, Springer, pp. 437. https://doi.org/10.1007/978-3-319-78527-1* *Holland H.D. and Turekian K.K., eds. (2014) Treatise on Geochemistry 2nd edition, Volume 15: Analytical Geochemistry/Inorganic INSTR. Analysis, Elsevier Science, pp. 454.* *Sharp Z. (2017). Principles of Stable Isotope Geochemistry, 2nd edition. https://doi.org/10.25844/h9q1-0p82* *Thomas R. (2013) Practical Guide to ICP-MS: A Tutorial for Beginners, Third Edition. CRC Press. https://doi.org/10.1201/b14923* *van der Heide P.(2014) Secondary Ion Mass Spectrometry. An Introduction to Principles and Practices, Wiley, pp. 386* *The "GGR Handbook of Rock and Mineral Analysis with chapters by various authors, continuously published in Geostandards and Geoanalytical Research since 2024 (Volume 48, Issue 3): https://onlinelibrary.wiley.com/journal/1751908x* *The IAG Guide to the use of Metrological Terminology: https://www.geoanalyst.org/glossary/*	
12.	**Prerequisites:** *Knowledge of isotope geochemistry, general geology, mineralogy*	
13.	**Educational outcomes:**	**PQF level 8 codes:**
	Knowledge: *The student has basic knowledge of selected isotope systems and their applications in geosciences, as well as an understanding of methods for determining isotope ratios and the terminology used for describing and presenting data.*	*P8S_WG*
	Practical Skills: *This course offers a comprehensive introduction to the fundamental principles of isotope geochemistry, with a focus on advanced measurement techniques such as secondary ion mass spectrometry, inductively coupled plasma mass spectrometry, and gas source isotope ratio mass spectrometry. Students will gain proficiency in methodologies for preparing and documenting various*	*P8S_UW, P8S_UU*

	sample types, tailored to the specific requirements of the selected instrumental techniques.	
	Social Skills: *The student can critically evaluate the presented material, ask questions, and recognize the importance of selecting appropriate methods for sample preparation and documentation. They are able to apply the acquired knowledge to plan future research activities and choose suitable measurement methods.*	*P8S_KK*
14.	**Evaluation of the educational outcomes:** *Presentation, student's commitment during the classes, discussions during lectures and seminars.*	
15.	**Criteria to complete the course:** *Minimum 80% of attendance, final grade depends on the presentation and the student's commitment during the classes.*	
16.	**Contact with the course leader/lecturer:** *ndgiera@cyf-kr.edu.pl (no major time restrictions), meetings on Zoom are possible upon earlier agreements.*	