COURSE SYLLABUS

1. Data about the program

1.1 Higher education institution	Babeș-Bolyai University
1.2 Faculty	Faculty of Biology and Geology
1.3 Doctoral school	Theoretical and Applied Geology
1.4 Field of study	Geology
1.5 Study cycle	Doctorate
1.6 Study program / Qualification	Doctoral training / PhD in Geology

2. Course data

2.1 Name of discipline	**Isotope Geology**						
2.2 Teacher responsible for lectures	Prof. dr. Bogdan P. Onac						
2.3 Teacher responsible for seminars	Prof. dr. Bogdan P. Onac						
2.4 Year of study	1	2.5 Semester	2	2.6. Type of evaluation	E	2.7 Course framework	Opt

3. Estimated total time of teaching activities (hours per semester)

3.1 Hours per week	4	3.2 Out of which: Lectures	2	3.3 Seminars / Laboratory classes	2
3.4 Total hours in the curriculum	48	3.5 Out of which: Lectures	24	3.6 Seminars / Laboratory classes	24

Allocation of study time:	hours
Study supported by textbooks, other course materials, recommended bibliography and personal student notes	30
Additional learning activities in the library, on specialized online platforms and in the field	20
Preparation of seminars / laboratory classes, topics, papers, portfolios and essays	15
Tutoring	2
Examinations	2
Other activities:	-

3.7 Individual study (total hours)	65
3.8 Total hours per semester	117
3.9 Number of credits	10

4. Preconditions (where applicable)

4.1 Curriculum	• Geochemistry, Mineralogy, Chemistry, Physics
4.2 Competences	• Sample preparation and familiarity with the main course-specific analysis tools • Preparation of literature review • Generation of complex plots

5. Conditions (where applicable)

5.1 Conducting lectures	• Printed and digital textbooks • Class room with videoprojector, WIFI, and software • Personal laptop
5.2 Conducting seminars / laboratory classes	• Use of inductive coupled plasma-mass spectrometer • Calculation of isotopic fractionation and radioactive ages • Attending at least 80% of the laboratory works is mandatory in order to enter in the practical and theoretical exam

6. Specific competences acquired

Professional competences	• Recognition of processes that cause fractionation of radioactive isotopes • Knowledge of major isotope pairs (U/Pb, Nd/Sm, K/Ar., etc.) • Learning analytical methods specific to radioactive isotopes • Use of radioactive age calculation software (IsoplotR, UThwigl, etc.)
Transversal competences	• Developing the ability to work in a team • Formulate research hypotheses and test them • Multi- and interdisciplinary interpretation of isotopic results

7. Course objectives (based on the acquired competencies grid)

7.1 The general objective of the course	• Understanding isotopic pairs and processes that affect their fractionation • Plot and interpret isotopic results • Understanding radiometric dating methods • Applications of radioactive isotopes in various geological enviros
7.2 Specific objectives	• Understanding the factors that change the isotopic composition • Representation of global and local weather lines • Generating 2D and 3D isochrons, as well as ^{234}U age models

8. Content

8.1 Lectures	Teaching methods	Comments
1. Introduction	Presentation, discussion, case studies, exercises	
2. Natural radioactivity		
3. Collection of samples for isotopic analysis		
4. Chemical methods specific to isotopic analyzes		
5. Analytical tools		
6. Dating methods - cosmogenic radionuclides		
7. Uranium series dating		
8. Dating based on radiation effects on minerals (thermoluminescence, OSL, ESR)		
9. Dating based on isotopic couples (K / Ar, Ar / Ar, Rb / Sr, Sm / Nd, U / Pb, etc.)		
10. Isotopes stable in nature. Generalities, standards and isotopic fractionation (H, C, N, O, S)		
11. Hydrogen and oxygen isotopes in the atmosphere and hydrosphere		
12. Isotopes of carbon and oxygen in inorganic and biogenic carbonates		
13. Use of nitrogen and sulfur isotopes		
14. Chemical dating methods (amino acids, obsidian)		

Bibliography:
1. Onac, B.P. 2004. *Clepsidrele geologie. Introducere în geocronologia izotopică*. Ed. Presa Univ. Clujeană, Cluj-Napoca, 176 p.
2. Văsaru, V., Cosma, C. 1998. *Geocronologie nucleară. Metode de datare prin fenomene nucleare natur*ale. Ed. Dacia, Cluj-Napoca, 349 p.
3. White, W.M. 2015. *Isotopic geochemistry*. Wiley, 478 p. (digital)

8.2 Seminars / laboratory classes	Teaching methods	Comments
1-4. Calculations of isotopic fractionation and precipitation temperature	Presentation, discussion	Exercises and homework
5-6. Sample collection, preparation, and standards		
7-9. Operation and use of TIMS / (MC) ICP-MS		
10-12. Absolute age determinations (including isochrone method)		
12-14 Plot and interpretation of results		

Bibliography:
1. Onac, B.P. 2004. *Clepsidrele geologie. Introducere în geocronologia izotopică*. Ed. Presa Univ. Clujeană, Cluj-Napoca, 176 p.
2. Văsaru, V., Cosma, C. 1998. *Geocronologie nucleară. Metode de datare prin fenomene nucleare natur*ale. Ed. Dacia, Cluj-Napoca, 349 p.
3. White, W.M. 2015. *Isotopic geochemistry*. Wiley, 478 p. (digital)

9. Aligning the contents of the discipline with the expectations of the epistemic community representatives, professional associations and standard employers operating in the program field

- The content of the discipline is similar to those taught at other universities in the country and abroad and provides applicable knowledge in the field of Earth Sciences.

10. Examination

Activity type	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Weight in the final grade
10.4 Lectures	Assessment of knowledge	Written exam	40%
	Assessment of knowledge	Quizzes	10%
10.5 Seminars / laboratory classes	Activity during seminars	Discussions, answers to questions, assignments	20%
	Assessment of knowledge	Written exam / Reports (3)	30%
10.6 Minimum performance standard			
• Passing the theoretical and practical exam • Knowledge and understanding of at least 50% of the theoretical information of the course			

Date of issue	Signature of the teacher responsible for lectures	Signature of the teacher responsible for seminars
23.02.2022	……..	……..

Date of approval by the doctoral school council

25.02.2022

Signature of the doctoral school director