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	**Applied geochemistry**						
2.2 Teacher responsible for lectures	**Conf. dr. habil. Ferenc L. Forray**						
2.3 Teacher responsible for seminars	**Conf. dr. habil. Ferenc L. Forray**						
2.4 Year of study	1	2.5 Semester	2	2.6. Type of evaluation	E	2.7 Course framework	Ob.

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

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

Allocation of study time:	h
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	69
3.9 Number of credits	20

4. Preconditions (where applicable)

4.1 Curriculum	• Geochemistry, Mineralogy, Chemistry and Mathematics
4.2 Competences	• Handling laboratory equipment/labware and sample preparation • References handling (database search, use of reference manager)

5. Conditions (where applicable)

5.1 Conducting lectures	• Lectures format (pdf) • Conference room with computer/laptop, video projector and software (PowerPoint, Word, multimedia, Internet browsers)
5.2 Conducting seminars / laboratory classes	• Instrument use: CRDS H_2O and CO_2 ± Aurora TIC/TOC, ICP-MS/XRD/SEM • Thermodynamic calculations using various software • Minimal 80% attendance required

6. Specific competences acquired

Professional competences	• Recognition of geochemical processes • Modelling geochemical processes
Transversal competences	• Participation in research groups; • Solving problems and making decisions; • Organizing teamwork.

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

7.1 The general objective of the course	• Understanding geochemical processes • The geochemical significance of the elements in water, soil and minerals. • Creation of phase diagrams, Eh-pH diagrams, representation and interpretation of isotopic analyses • Application of geochemistry in environmental studies (soil and water pollution, climate change, etc.)
7.2 Specific objectives	• Geochemical classification of elements, their frequency in the lithosphere and hydrosphere • General concepts of chemical equilibrium, acid-base reactions, solubility of minerals in aqueous solutions, thermodynamic principles and construction of mineral stability fields in specific diagrams • Emphasis will be placed on redox processes and the construction of Eh-pH diagrams • Isotopic fractionation of the most important elements (C, O, S, H, etc.), as well as their importance in geochemical, hydrogeological, paleo medium and paleoclimate processes.

8. Content

8.1 Lectures	Teaching methods	Comments
1. Introduction	Presentation, discussion, case studies, exercises	
2. Distribution of elements in nature		
3. Thermodynamics I		
4. Thermodynamics II		
5. Thermodynamics III		
6. Mineral solubility		
7. Thermodynamics of the mineral-water interface		
8. Colloids		
9. Redox processes		
10. Oceans geochemistry		
11. Geochemical processes in sediments		
12. Stable carbon isotopes		

13. Stable hydrogen isotope fractionation		
14. Stable oxygen isotope fractionation		

Bibliography:

1. Holland H.D. (2004) Treatise on Geochemistry. Vol. 1-10. Elsevier Pergamon. Geology library, UBB, Cota: 12831
2. Clark, I.D., Fritz, P., (1997) Environmental isotopes in hydrogeology. CRC Press, Boca Raton, 352 pp. Geology library, UBB, Cota: 11091
3. Hoefs, J., 2018. Stable isotope geochemistry. Springer, 437 pp.

8.2 Seminars / laboratory classes	Teaching methods	Comments
Case studies prepared with the doctoral students, based on their individual doctoral research topics	Presentation, discussion, exercises	

Bibliography:

1. Holland H.D. (2004) Treatise on Geochemistry. Vol. 1-10. Elsevier Pergamon. Geology library, UBB, Cota: 12831
2. Clark, I.D., Fritz, P., (1997) Environmental isotopes in hydrogeology. CRC Press, Boca Raton, 352 pp. Geology library, UBB, Cota: 11091
3. Hoefs, J., 2018. Stable isotope geochemistry. Springer, 437 pp.

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 course is comparable with the content of the discipline at other universities in the country and abroad and provides applicable knowledge in the field of geology.

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	45
	Assessment of knowledge	Ongoing tests	5
10.5 Seminars / laboratory classes	Activity during seminars	Discussions, answers to questions	5
	Assessment of knowledge	Written exam	45
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
29/09/2021	Conf. dr. habil. Ferenc L. Forray	

Date of approval by the doctoral school council — Signature of the doctoral school director