Taras Shevchenko National University of Kyiv

Institute of Geology

Department *Geology of Mineral Deposits*

«APPROVED»
Deputy director on academic work

____
«____» ___________ 2025

WORK PROGRAMME OF DISCIPLINE

Earth's evolution (Еволюція Землі)

for students

Branch of knowledge:	**E – Natural Sciences, Mathematics and Statistics**
Training direction:	**E4 – Earth sciences**
Educational level:	**Master**
Educational program:	**Geology**
Type of discipline:	**Obligatory**

Teaching mode	**full-time studies**
Academic year	**2025/2026**
Semester	**1**
Number of credits ECTS	**3.0**
Language of teaching, learning and evaluation	**English**
Form of final control	**final test**

Lecturer(s): *Vitalii SYDORCHUK, PhD in geology, assistant professor, Department of Geology of Mineral Deposits*

Prolonged to: 20__/20__ a.y. _________ (___________) «__» ___ 20__
(Signature, Name, Date)

20__/20__ a.y. _________ (___________) «__» ___ 20__
(Signature, Name, Date)

20__/20__ a.y. _________ (___________) «__» ___ 20__
(Signature, Name, Date)

KYIV – 2025

Author(s): Vitalii SYDORCHUK, PhD in geology, assistant professor, Department of Geology of Mineral Deposits

Approved

Head of Department of Geology of Mineral Deposits

_________________ (Volodymyr MYKHAILOV).

Record of the Department meeting
№ «1», «28» 08 2025

Approved by the Scientific and Methodological Commission of the Institute of Geology

Record of the meeting № «1», «29» 08 2025

Head of the Scientific and Methodological Commission _____________ (Vsevolod DEMYDOV).

Aim of the discipline – to introduce students with general principles and concepts about the Earth as integrated planetary system that consists of different components – lithosphere, core, mantle, hydrosphere and atmosphere. These interconnected components act as a whole system from the point of view of planetary evolution of the Earth in time and space.

Preliminary requirements:

1. knowledge of the theoretical foundations of regional and global geology
2. be able to analyze current ideas about earth evolution in time and space

Annotation of discipline:

The academic discipline encompasses a comprehensive set of modern concepts concerning the origin, development, and structure of the Universe, the Solar System, and the Earth. During the course, students become familiar with the most well-known theories and hypotheses regarding the formation of the Early Earth and its internal structure. Special attention is devoted to the differentiation of matter (the atmosphere, oceans, and continents) during various stages of Earth's evolution and its influence on the formation of different types of mineral deposits. The course also extensively discusses the results of studying the geological history of the planet using absolute and relative dating methods of rock complexes and individual minerals. Students have the opportunity to analyze the Earth as an integrated system and to independently explore the most significant problems of its structure and development.

The tasks of the discipline – to highlight the following issues:

- ideas about the Earth as a unique planet of the Solar system;
- current ideas about evolution of the early Earth;
- peculiar features of Hadean period of Earth evolution;
- typical characteristics of Archean cratons with Ukrainian Shield as one of the examples;
- formation of supercontinents during Proterozoic and associated events;
- modern style plate tectonics as tectonic regime typical of Phanerozoic time of Earth evolution

The results of study:

Results (1. to know; 2. to be able to)		*Methods of teaching and learning*	*Assessment methods*	*Percentage in the final assessment of the discipline*
1.1	*Current ideas about Earth evolution in time and space*	*Lecture*	*Seminar*	*up to 10 %*
1.2	*Current ideas about Earths in the Solar system and the Universe*	*Lecture*	*Seminar*	*up to 10 %*
1.3	*Current ideas about meteorite classification and primitive Earth composition, giant impact model and Moon formation.*	*Lecture*	*Seminar*	*up to 10 %*
1.4	*Current ideas about Hadean Earth – Earth's core formation, terrestrial magma oceans, early Earth crust*	*Lecture*	*Seminar*	*up to 10 %*
1.5	*Current ideas about Archean Earth – cratons, greenstone belts, komatiites, reduced atmosphere, flat sugduction and sugduction mode;*	*Lecture*	*Seminar*	*up to 10 %*
1.6	*Current ideas about Earth in Proterozoic – supercontinental cycles, atmosphere oxygenation (GOE – great oxidation event), global glaciations (snowball Earth)*	*Lecture*	*Seminar*	*up to 10 %*
1.7	*Current ideas about Earth in Phanerozoic – modern style plate tectonics, large igneous provinces, mass extinction events*	*Lecture*	*Seminar*	*up to 10 %*
2.1	*Analyze general trends, features and peculiarities of Earth's evolution in time and space*	*Seminar*	*Seminar*	*up to 10 %*

2.2	*Analyze geological paper published in current periodicals in English with following preparation of brief summary;*	*Seminar*	*Seminar*	*up to 10 %*
2.3	*Prepare a presentation in English about fundamental principles of geology with using computer technology and acquire the ability to present a presentation to the audience.*	*Seminar*	*Seminar*	*up to 10 %*

Structure of discipline*: lectures, seminars, independent study of students.*

Learning Outcomes and scheduled results of tuition:

Learning Outcomes / ***Program results of the tuition***	***1.1***	***1.2***	***1.3***	***1.4***	***1.5***	***1.6***	***1.7***	***2.1***	***2.2***	***2.3***
PO1. To analyze the development and structure of geological systems, the features of the structure, distribution and formation of mineral deposits.					+	+	+	+	+	+
PO7. To know modern methods of research of the geological environment and mineral resources, to be able to apply them in industrial and research activities.	+	+	+	+				+	+	+

Scheme of grade formation:

Forms of students' knowledge evaluation:

1. Semester grading:

1) Modular test 1 – (min - 6, max - 10 points)
2) Modular test 2– (min - 6, max - 10 points)
3) Presentations – (min - 38, max - 60 points)

2. Final assessment in form of written final test (min - 12, max - 20 points). Maximum score is 20 points, boundary minimum score is 12 points. During the test, the degree-seeking student provides information about the Earth as a unique planet in the Solar System and modern ideas about the evolution of the Early Earth; demonstrates knowledge of the Earth's evolution over geological time, models of plate tectonics, and movement of supercontinents.

The final assessment in the form of written final test is not mandatory; if the applicant refuses to participate in this form of assessment, the applicant will not receive the corresponding points for the final assessment.

The results of the students' educational activities are evaluated on a 100-point scale.

Final grade is based on the results of the student's work as the sum (simple or weighted) of points for systematic work throughout the semester.

Procedure and evaluation system

	Semesters points	**Final test**	**Final grade**
Min	*48*	*12*	*60*
Max	**80**	**20**	**100**

Students that obtained total grade less than critically-calculated minimum of 40 points are not permitted to taking the final test.

Grading: Control is carried out according to the modular rating system and includes: preparation and presentation of reports at seminars and completing two modular tests. The final assessment is carried out in the form of a written final test.

Compliance scale

Passed	60-100
Fail	0-59

STRUCTURE OF THE DISCIPLINE
PLAN OF LECTURES AND SEMINARS

N	Theme	Hours		
		Lectures	Seminars	Independent study
	Module 1. *Formation of the Earth as planetary system*			
1	**Theme 1.** Earth as evolving planetary system.	2	2	8
2	**Theme 2.** Earth in the Universe	2	2	8
3	**Theme 3.** Solar system and origin of the Earth	2	2	8
4	**Theme 4.** Early Earth and the Moon	2	2	6
	Modular test 1			2
	Module 2. *Earth's evolution in geologic time*			
5	**Theme 5.** Hadean Earth. Magma ocean and early crust	2	2	10
6	**Theme 6.** Archean Earth. Greenstone belts and cratons	2	2	8
7	**Theme 7.** Proterozoic and Phanerozoic Earth. Supercontinents in the Earth's history and modern style plate tectonics	2	2	8
	Modular test 2			2
	Total	**14**	**14**	**60**

Total hours of the discipline *– 90, that include:*
Lectures – 14
Seminars – 14
Consultations – 2
Independent study – 60

Themes for the independent study:
1. The Universe evolution in time – stages and their characteristics.
2. Classification of meteorites – chondrites, achondrites, iron meteorites and stony irons.
3. Models and mechanisms of the Earth's core formation.
4. Prebiotic chemistry and the emergence of life on the Earth.
5. Ancient Archean life – molecular fossils, stromatolites.
6. Major Proterozoic meteoritic impacts.
7. Mass extinction events in Phanerozoic

RECOMMENDED LITERATURE

Basic:

1) Archean crustal evolution. // Edited by Condie K.C. et al. in: Developments in Precambrian geology, V. 11 – Amsterdam: Elsevier Academic Press – 1994. – 528 p.
2) Best M.G. Igneous and metamorphic petrology. – Malden, USA: Blackwell Science Ltd. – 2003, 2nd ed. – 729 p.
3) Boggs S.Jr. Petrology of sedimentary rocks. – Cambridge, UK: Cambridge University Press. – 2009, 2nd ed. – 600 p.
4) Condie K.C. Plate tectonics and crustal evolution. – Oxford: Butterworth -Heinemann. – 2003, 4th ed. – 282 p.
5) Condie K.C. Earth as an evolving planetary system. – Amsterdam: Elsevier Academic Press – 2005. – 447 p.
6) Earth's oldest rocks. // Van Kranendonk M.J.R. et al. in: Developments in Precambrian geology, V. 15 – Amsterdam: Elsevier Academic Press – 2007. – 1307 p.
7) Proterozoic crustal evolution. // Edited by Windley B.F. et al. in: Developments in Precambrian geology, V. 10 – Amsterdam: Elsevier Academic Press – 1992. – 537 p.
8) Rogers J. J.W., Santosh M. Continents and supercontinents. – New York, USA: Oxford University Press. – 2004 – 289 p.
9) Rollinson H. Early Earth systems: a geochemical approach. – Malden, USA: Blackwell Publishing Ltd. – 2003. – 285 p.
10) Taylor S.R., McLennan S.M. Planetary crusts: their composition, origin and evolution. – Cambridge, UK: Cambridge University Press. – 2009. – 378 p.
11) The Precambrian Earth: tempos and events. // Edited by Naqvi S.M. et al. in: Developments in Precambrian geology, V. 12 – Amsterdam: Elsevier Academic Press – 2004. – 941 p.
12) Wilson M. Igneous petrogenesis. – Dordrecht, The Netherlands: Springer – 2007, 8 ed. – 466 p.

Additional:

13) Allegre C.J. Isotope geology. – Cambridge: Cambridge University Press – 2008. – 512 p.
14) Biogeochemistry // Edited by Schlesinger W.H. et al. in: Treatise on Geochemistry. V. 8 – Amsterdam: Elsevier Academic Press – 2003. – 682 p.
15) Bucher K., Grapes R. Petrogenesis of metamorphic rocks. – Berlin: Springer-Verlag – 2011. – p. 428.
16) Evolution of the Earth. // Edited by Stefenson D. et al. in: Treatise on Geophysics. V. 9 – Amsterdam: Elsevier Academic Press – 2003. – 320 p.
17) Faure G. Principles and applications of geochemistry: A comprehensive textbook for geology students (2^{nd} edition) – Prentice Hall. Publ. – 1998. – 600 p.
18) Fountain D.M., Arculus R., Kay R.W. Continental lower crust. – Amsterdam: Elsevier – 1992. – 486 p.
19) Ganguly J. Thermodynamics in earth and planetary sciences. – Berlin: Springer-Verlag – 2008. – p. 501.
20) Gill R. Igneous rocks and processes. A Practical Guide. – Oxford: Blackwell Publishing. – 2010. – 428 p.
21) Hoef J. Stable isotope geochemistry. – Berlin: Springer-Verlag. – 2009. – 285 p.
22) The oceans and marine geochemistry// Edited by Elderfield H. et al. in: Treatise on Geochemistry. V. 6. – Amsterdam: Elsevier Academic Press – 2003. – 625 p.
23) The Crust // Edited by Rudnick R.L. et al. in: Treatise on Geochemistry. V. 3 – Amsterdam: Elsevier Academic Press – 2003. – 659 p.
24) The Mantle and Core. // Edited by Carlson W.R. et al. in: Treatise on Geochemistry. V. 2 – Amsterdam: Elsevier Academic Press – 2007. – 568 p.