

Course Syllabus



1	Course title	Sedimentary Rocks	
2	Course number	0305932	
3	Credit hours	3	
	Contact hours (theory, practical)	3	
4	Prerequisites/corequisites	Clastic sedimentary rocks (Master)	
5	Program title	Graduate Geology	
6	Program code		
7	Awarding institution	The University of Jordan	
8	School	Science	
9	Department	Geology	
10	Course level	Doctorate Graduate	
11	Year of study and semester (s)	2024, 1 st .	
12	Other department (s) involved in teaching the course	None	
13	Main teaching language	Englisch	
14	Delivery method	<input checked="" type="checkbox"/> Face to face learning <input type="checkbox"/> Blended <input type="checkbox"/> Fully online	
15	Online platforms(s)	<input type="checkbox"/> Moodle <input type="checkbox"/> Microsoft Teams <input type="checkbox"/> Skype <input type="checkbox"/> Zoom <input type="checkbox"/> Others.....	
16	Issuing/Revision Date	18/8/2024	

17 Course Coordinator:

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18 Other instructors: None

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19 Course Description:

As stated in the approved study plan.

Sedimentary Rocks 0305932

Dept. of geology

Course outline

Jordan University

1st semester 2024/2025

Contents:

A. Siliciclastic sedimentary rocks: Rudaceous, Arenaceous, and Lutaceous Siliciclastic.

1- Depositional environments.

2- Textures and structures.

3- Provenance revealed from mineral composition.

4- Diagenesis and burial history.

5- Geochemical implications.

B. Carbonate rocks: Limestones and Dolostones.

- 1- Facies and carbonate depositional environments and models.
- 2- Skeletal and non-skeletal components, and carbonate structures.
- 3- Carbonate microfacies.
- 4- Carbonates classification and diagenesis including dolomitization.
- 5- Carbonate sequences.

C. Evaporites:

- 1- Present and geologic past distribution.
- 2- Evaporite depositional environments and models.
- 3- Textures and structures of gypsum-anhydrite, halite, K-Mg evaporites.
- 4- Petrography and diagenesis of evaporite sequences.
- 5- Evaporite sequences.

D. Siliceous Sedimentary Rocks:

- 1- Bedded, nodular cherts and other non-marine siliceous deposits.
- 2- Recent siliceous oozes.
- 3- Mineralogy of silica-rich sedimentary deposits.
- 3-Chert petrography, chertification and diagenesis.

E. Sedimentary Phosphorites:

- 1- Present and geologic past distribution of sedimentary phosphates.
- 2- Mineralogy and textures of nodular and bedded phosphorites.
- 3- Phosphogenesis.
- 4- REEs content and geochemistry of phosphatic deposits.
- 5- Jordanian phosphorites.

F. Iron-bearing Sedimentary Rocks:

- 1- Sources, transportation of iron, and deposition of sedimentary iron rocks.
- 2- Phase diagrams of the principal iron minerals.
- 3- Petrography and geochemistry of the sedimentary iron deposits.
- 4- Precambrian banded iron-formations versus Phanerozoic ironstones.

G. Carbonaceous Sedimentary Rocks:

- 1- Kinds of organic matter in organic-rich sedimentary rocks.
- 2- Classification of carbonaceous sedimentary rocks and the coalification series.
- 3- Coal petrography.
- 4- Bituminous shales and carbonates.
- 5- Synopsis of petroleum genesis, migration, trapping and accumulation.

Requirements:

- 1- Mid-term exam (30 marks)
- 2- Presentation of a related topic and a fieldtrip report (20 marks)
- 3- Final exam (50 marks).

References:

- 1) Tucker, M.E., 2001. Sedimentary Petrology, 3rd edition, or a newer edition. Blackwell Science, Oxford, UK, 262 p.
- 2) **Amireh, B.S.**, 1992. Sedimentology and Mineral Composition of the Kurnub Sandstone in Wadi Qsieb, SW Jordan. Sediment. Geol. 78, 267-283.
- 3) **Amireh, B.S.**, 1994. Heavy and clay minerals as tools in solving stratigraphic problems: A case study from the Disi Sandstone (Early Ordovician) and the Kurnub Sandstone (Early Cretaceous) of Jordan. N. Jb. Geol. Paläont. Mh., 4, 205-222.

- 4) **Amireh, B.S.**, Schneider, W., Abed, A., 1994a. Evolving fluvial-transitional-marine deposition through the Cambrian sequence of Jordan. *Sediment. Geol.*, 89, 65-90.
- 5) **Amireh, B.**, Schneider, W., Abed, A., 1994b. Diagenesis and burial history of the Cambrian-Cretaceous sandstone series in Jordan. *N. Jb. Geol. Paläont. Abh.*, 192, 151-181.
- 6) **Amireh, B.S.**, 1997. Sedimentology and palaeogeography of the regressive-transgressive Kurnub Group (Early Cretaceous) of Jordan. *Sediment. Geol.*, 112, 69-88.
- 7) **Amireh, B.S.**, Abed, A. 1999. Depositional environments of the Kurnub Group (Early Cretaceous) in northern Jordan. *Journal of African Earth Sciences*, 29, 449-468.
- 8) Abed, A., **Amireh, B.S.**, 1999. Sedimentology, geochemistry, economic potential and palaeogeography of an Upper cretaceous phosphorite belt in the southeastern desert of Jordan. *Cretaceous Research*, 20, 119-133.
- 9) **Amireh, B.S.**, 2000. The Early Cretaceous Kurnub Group of Jordan: Subdivision, characterization and depositional environment development. *N. Jb. Geol. Paläont. Mh.*, 2000 (1), 29-57.
- 10) Jarrar, Gh., **Amireh, B.S.**, Zachman, D., 2000. The major, trace and rare earth element geochemistry of glauconites from the early Cretaceous Kurnub Group of Jordan. *Geochemical Journal*, 34, 207-222.
- 11) **Amireh, B.S.**, Schneider, W., Abed, A., 2001. Fluvial-shallow marine-glaciofluvial depositional environments of the Ordovician System in Jordan. *Journal of Asian Earth Sciences*, 19, 45-60.
- 12) **Amireh, B.**, Amaireh, M., Abed, A, 2008. Tectono Sedimentary Evolution of the Umm Ghaddah Formation (late Ediacaran - early Cambrian) in Jordan. *Journal of Asian Earth Sciences*, 33/3-4, 194-218.
- 13) Abul Khair, H., Abed, A. **Amireh, B.S.**, 2008. Hydrocarbon Prospectivity of Al-Sirhan Basin, SE Jordan. *Dirasat (Science Journal of the University of Jordan)*, 35, 2, 161-174.
- 14) Abed, A., Arouri, Kh., **Amireh, B.S.**, Huwari, Z., 2009. Characterization and Genesis of Oil Shale from Jordan. *Dirasat (Science Journal of the University of Jordan)*, 36, 1, 7-17.
- 15) Makhlof, I., **Amireh, B.S.**, and Abed, A. 2010. Sedimentology and morphology of Quaternary alluvial fans in Wadi Araba, Jordan. *Jordan Journal of Earth and Environmental Sciences*, 3, 2, 79-98.
- 16) **Amireh, B.S.**, 2015. Grain size analysis of the Lower Cambrian-Lower Cretaceous clastic sequence of Jordan: Sedimentological and paleo-hydrodynamic implications. *Journal of Asian Earth Sciences*, 97, 67-88.
- 17) Saffarini, Gh., **Amireh, B.S.**, 2016. Distinguishing depositional environments of the Lower Cambrian-Lower Cretaceous clastic sequence of Jordan using geostatistical techniques: A proposal. *Arabian Journal of Geosciences*, 9, 1-16.

- 18) Amireh, B.S.,** 2018. Petrogenesis of the NE Gondwanan uppermost Ediacaran-Lower Cretaceous siliciclastic sequence of Jordan: Provenance, tectonic, and climatic implications. *Journal of Asian Earth Sciences*, 154, 316-341.
- 19) Amireh B.S.,** Mutterlose, J., Amaireh, M.N., Tobias Puettmann, T., Abed, A.M., 2018. Biostratigraphy and paleogeography of the southeast desert phosphorites of Jordan. *Journal of Arabian Geosciences*, 11, 425-. doi.org/10.1007/s12517-018-3768-z.
- 20) Amireh, B.S.,** Amaireh, M.N., Abu Taha, S., Abed, A.M., 2019. Petrogenesis, provenance, and rare earth element geochemistry, southeast desert phosphorite, Jordan. *Journal of African Earth Sciences* 150, 701–721.
- 21) Amireh, B.S.,** 2020. Weathering, recycling, hydraulic sorting and metamorphism/metasomatism implications of the NE Gondwana lower Cambrian-Lower Cretaceous siliciclastic succession of Jordan. *Journal of Asian Earth Sciences* (2020), doi: <https://doi.org/10.1016/j.jseaes.2020.104228>
- 22) Amireh, B.S.,** Saffarini, G.A., Amaireh, M.N., Jarrar, G.H. & Abed, A.M., 2022. Rare-earth and trace elements of the lower Cambrian–Lower Cretaceous siliciclastic succession of NE Gondwana in Jordan: from provenance to metasomatism. *Annales Societatis Geologorum Poloniae*, 92: 109–158. doi: <https://doi.org/10.14241/asgp.2022.05>

20 Course aims and outcomes:

A- Aims:

A- Aims:

- 1- To comprehend the textures, structures, mineral composition, and diagenesis of rudaceous, arenaceous, and lutaceous siliciclastic sedimentary rocks.**
- 2- To distinguish between the fluvial, transitional and shallow marine depositional environments of siliceous sedimentary rocks.**
- 3- To comprehend the mineralogy, classification, diagenesis and depositional environments of carbonate rocks, evaporites, and phosphorites.**
- 4- To understand the geochemical attributes of siliceous, and phosphatic sedimentary rocks.**
- 5- To comprehend the source, methods of transport, and chemical depositional conditions of sedimentary iron deposits.**
- 6- To know the mineralogy, structures and depositional environment of cherts and siliceous deposits and sedimentary iron deposits.**
- 7- To comprehend the mineralogy, structures and depositional environments of coal and organic-rich sedimentary deposits.**

B- Students Learning Outcomes (SLOs):

Upon successful completion of this course, students will be able to:

SLO1- Identify the textures and describe the structures of the rudaceous, arenaceous, and lutaceous siliciclastic sedimentary rocks, carbonate rocks, evaporites, phosphatic rocks, cherts and siliceous sedimentary rocks, organic-rich, and iron-rich sedimentary rocks.

SLO2- Identify the mineral composition and comprehend the diagenesis and classification of the siliciclastic sedimentary rocks, limestones and dolostones, evaporites, phosphorites, cherts, organic-rich, and iron-rich sedimentary rocks.

SLO3- Interpret the genesis of siliciclastic sedimentary rocks, limestones and dolostones, evaporites, phosphorites, cherts, organic-rich, and iron-rich sedimentary rocks.

SLO4- Determine the depositional environments of the siliciclastic sedimentary rocks, carbonates, evaporites, phosphorites, cherts, organic-rich, and iron-rich sedimentary rocks.

SLOs SLOs of the course	SLO (1)	SLO (2)	SLO (3)	SLO (4)
1	x	x	x	X
2	x	x	x	X
3	x	x	x	
4				
5	x	x	x	X
6	x	x	x	X

21. Topic Outline and Schedule:

Week	Lecture	Topic	Intended Learning Outcome	Learning Methods (Face to Face/Blended/ Fully Online)	Platform	Synchronous / Asynchronous Lecturing	Evaluation Methods	Resources
1	1.1	Texture of siliciclastic sedimentary rocks	SLO1	Face to Face				Tucker, 2001; Amireh, 2015; Saffarini and Amireh, 2016.
	1.2	Structures of siliciclastic sedimentary rocks	SLO1	Face to Face				Tucker, 2001; Amireh, 1997;

								Amireh et al., 1994.
	1.3	Mineral composition of sandstone and conglomerate	SLO2	Face to Face				Tucker, 2001; Amireh, 1992; Amireh, 2018.
2	2.1	Mineral composition of sandstone and conglomerate	SLO2	Face to Face				Tucker, 2001; Amireh, 2020.
	2.2	Diagenesis of sandstone	SLO2	Face to Face				Tucker, 2001; Amireh et al, 1994b
	2.3	Diagenesis of sandstone	SLO2	Face to Face				Tucker, 2001; Amireh, 2018, 2020
Week	Lecture	Topic	Intended Learning Outcome	Face to Face				
3	3.1	Provenance revealed from mineral composition	SLO3	Face to Face				Tucker, 2001; Amireh, 2018; Amireh et al., 2007.
	3.2	Provenance revealed from mineral composition	SLO3	Face to Face				Tucker, 2001; Amireh, 2020.
	3.3	Provenance revealed from chemical composition	SLO3	Face to Face				Tucker, 2001; Amireh et al., 2022.
4	4.1	Geochemical attributes of	SLO3	Face to Face				Tucker, 2001;

		siliciclastic rocks						Amireh, 2020.
	4.2	Geochemical attributes of siliciclastic rocks	SLO3	Face to Face				Tucker, 2001; Jarrar et al., 1989; Amireh et al., 2022.
	4.3	Geochemical attributes of siliciclastic rocks	SLO3	Face to Face				Amireh, 2020; Amireh et al., 2019; Amireh et al., 2022.
5	5.1	Alluvial depositional environments of conglomerate and sandstone	SLO4	Face to Face				Tucker, 2001; Abed and Amireh, 1998; Makhluaf et al., 2010.
	5.2	Transitional depositional environments of sandstone	SLO4	Face to Face				Tucker, 2001; Amireh, 1997, 2000.
	5.3	Shallow marine depositional environments of sandstone	SLO4	Face to Face				Tucker, 2001; Amireh et al., 1994a, 2001.
6	6.1	Textures, structures of mudstones.	SLO1	Face to Face				Tucker, 2001; Amireh, 1992, 2015.

	6.2	Mineral composition and types of mudstones	SLO2	Face to Face				Tucker, 2001; Amireh, 1994.
	6.3	Depositional environments of mudstone.	SLO4	Face to Face				Tucker, 2001; Amireh et al., 2001.
7	7.1	Mid-term Exam		Face to Face				
	7.2	Components of limestone and dolostone	SLO1	Face to Face				Tucker, 2001; Amireh et al., 2019.
	7.3	Carbonate microfacies and classification.	SLO1	Face to Face				Tucker, 2001; Amireh et al., 2019.
8	8.1	Carbonate textures and structures	SLO2	Face to Face				Tucker, 2001; Amireh et al., 2019.
	8.2	Diagenesis of carbonates.	SLO2	Face to Face				Tucker, 2001; Amireh et al., 2019.
	8.3	Diagenesis of carbonates.	SLO2	Face to Face				Tucker, 2001; Amireh et al., 2019.
9	9.1	Dolomitization and genesis of dolostone.	SLO2, SLO3	Face to Face				Tucker, 2001; Amireh et al., 2019.
	9.2	Facies and depositional environments of limestone	SLO4	Face to Face				Tucker, M., 2001; online

	9.3	Distribution, texture, structure of evaporites	SLO1, SLO2	Face to Face				Tucker, 2001; online texts.
10	10.1	Petrography, and diagenesis of evaporites.	SLO1, SLO2	Face to Face				Tucker, 2001; online texts.
	10.2	Depositional environments and models of evaporites	SLO4	Face to Face				Tucker, 2001; online texts.
	10.3	Bedded, nodular cherts, and other siliceous sediments	SLO1, SLO4	Face to Face				Tucker, 2001; online texts.
11	11.1	Mineralogy, diagenesis and genesis of siliceous deposits.	SLO2, SLO3	Face to Face				Tucker, 2001; online texts.
	11.2	Distribution of phosphorites	SLO1, SLO3	Face to Face				Tucker, 2001; online texts.
	11.3	Mineralogy, texture of nodular and bedded phosphorites.	SLO1, SLO2	Face to Face				Tucker, 2001; Abed and Amireh, 1999; Amireh et al., 2019
12	12.1	Phosphogenesis.	SLO4	Face to Face				Tucker, 2001; Abed and Amireh, 1999; Amireh et al., 2019

	12.2	Geochemistry, REEs content of phosphorites	SLO2, SLO3	Face to Face				Abed and Amireh, 1999; Amireh et al., 2019
	12.3	Jordanian phosphorites	SLO1, SLO2	Face to Face				Abed and Amireh, 1999; Amireh et al., 2018, 2019
	13.1	Iron-bearing sedimentary rocks: mineralogy, geochemistry, and genesis.	SLO1, SLO2, SLO3	Face to Face				Tucker, 2001; online texts.
13	13.2	Precambrian banded iron Formations, and Phanerozoic iron deposits.	SLO1, SLO2, SLO4	Face to Face				Tucker, 2001; online texts.
	13.3	Coal: ranks, series, petrography, and genesis.	SLO1, SLO2, SLO4	Face to Face				Tucker, 2001; online texts
14	14.1	Oil shale, bituminous sedimentary rocks, and petroleum.	SLO, SLO2, SLO3	Face to Face				Tucker, 2001; Abul Khair et al., 2008, Abed et al., 2009.
	14.2	Topics presentation.	SLO1, SLO2, SLO3, SLO4	Face to Face				
	14.3	Topics presentation.	SLO1, SLO2,	Face to Face				

			SLO3, SLO4					
15	15.1	Topics presentation.	SLO1, SLO2, SLO3, SLO4	Face to Face				
	15.2	Topics presentation.	SLO1, SLO2, SLO3, SLO4	Face to Face				
	15.3	Final Exam.						

22 Evaluation Methods:

Opportunities to demonstrate achievement of the SLOs are provided through the following assessment methods and requirements:

Evaluation Activity	Mark	Topic(s)	SLOs	Period (Week)	Platform
Mid-term exam	30	1-3	SLO1, SLO2, SLO3, SLO4	7 th	Face to Face
Oral presentations and a fieldtrip report	20	1-14	SLO1, SLO2, SLO3, SLO4	13 th and 14 th	Face to Face
Final Exam	50	4-14	SLO1, SLO2, SLO3, SLO4	15 th	Face to Face

23 Course Requirements

(e.g: students should have a computer, internet connection, webcam, account on a specific software/platform...etc):

24 Course Policies:



A- Attendance policies:

B- Absences from exams and submitting assignments on time:

C- Health and safety procedures:

D- Honesty policy regarding cheating, plagiarism, misbehavior:

E- Grading policy:

F- Available university services that support achievement in the course:

25 References:

A- Required book(s), assigned reading and audio-visuals:

Please see list in pages 4-6.

B- Recommended books, materials, and media:

26 Additional information:

Name of Course Coordinator: Prof. Dr. Belal S. Amireh	Signature: -----
Date: 18/8/2024	
Head of Curriculum Committee/Department: -----	Signature: -----



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