

Course Syllabus



1	Course title	Clastic Sedimentary Rocks	
2	Course number	0305731	
3	Credit hours	3	
	Contact hours (theory, practical)	3	
4	Prerequisites/corequisites	Applied sedimentary rocks	
5	Program title	Graduate Geology	
6	Program code		
7	Awarding institution	The University of Jordan	
8	School	Science	
9	Department	Geology	
10	Course level	Master 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	English	
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	20/8/2024	

17 Course Coordinator:

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18 Other instructors: None

Name:

Office number:

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Contact hours:

Name:

Office number:

Phone number:

Email:

Contact hours:

19 Course Description:

As stated in the approved study plan.

Clastic Sedimentary Rocks 0305731

Dept. of geology

Course outline

Jordan University

1st semester 2024/2025

Contents:

1. Introduction to Siliciclastic sedimentary rocks.

2. Texture:

a- Grain size and grain size parameters.

b- Grain morphology

c- Grain surface-textures

d- Grain Fabric

e- Textural maturity.

3. Sedimentary structures:

- a- Erosional sedimentary structures
- b- Depositional sedimentary structures
- c- Post depositional sedimentary structures
- d- Biogenic sedimentary structures.
- e- Paleocurrent analysis.

4. Light mineral composition:

- a- Quartz: non-undulose monocrystalline, undulose monocrystalline, and polycrystalline.
- b- Feldspar: orthoclase, microcline and plagioclase.
- c- Rock fragments: volcanic, plutonic, and sedimentary.

5. Heavy minerals:

- a- Ultrastables: zircon, tourmaline, and rutile.
- b- Metastables: apatite, staurolite, epidote, and garnet.
- c- Unstables: biotite, chlorite, pyroxene, and hornblende.

6. Factors influencing mineral composition of sandstone:

- a- Provenance.
- b- Tectonic setting.
- c- Climate-dependent weathering.
- d- Mean and distance of transport.
- e- Depositional environment.
- f- Diagenesis and intrastratal solution.
- g- Classification of sandstone.

7. Diagenesis:

- a- Mechanical diagenesis including orientation of grains, compaction, pressure solution, and microstylolites development.
- b- Chemical diagenesis including quartz overgrowth, feldspar overgrowth, synsedimentary glauconitization, kaolinite neoformation, illite authigenesis, smectite neoformation, dolomite-calcite cementation, late diagenetic glauconite formation, and iron oxy-hydroxy cementation.

8. Depositional environments.

- a- Continental environments including alluvial fans, braided rivers, meandering rivers, lakes, deserts, and glacial-fluvioglacial.
- b- Transitional environments including deltas, beaches, barrier islands, estuaries, and tidal- intertidal flats.
- c- Shallow marine environments including epeiric seas, shallow marine shelves, continental slopes- rises.
- d- Continental margins and deep marine environments including pelagic, hemipelagic, turbidities, tempestites, Bouma sequence, and abyssal plains.

9. Geochemical attributes:

- a- Major elements significance in provenance analysis, chemical weathering in source rocks, recycling, hydraulic sorting, and neoformation of TiO_2 minerals (anatase- rutile-brookite), and apatite.
- b- Trace elements significance in provenance analysis, and neoformation of various heavy minerals.
- c- Rare Earth elements significance in provenance analysis, and neoformation of various heavy minerals.

10. Siliciclastic lutites:

- a- Textures and structures of mudstones including diagenetic structures.
- b- Mineral composition: clay minerals, diagenesis, and provenance.
- c- Depositional environments: from continental to deep marine.

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) **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.
- 9) 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.
- 10) **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.

- 11) 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.
- 12) 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.
- 13) 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.
- 14) 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.
- 15) 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.
- 16) 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>
- 17) 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 siliciclastic carbonate rocks.
- 4- To understand the geochemical attributes of siliciclastic sedimentary rocks.

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.

SLO2- Identify the mineral composition and comprehend the diagenesis and classification of the siliciclastic sedimentary rocks.

SLO3- Interpret the genesis of siliciclastic sedimentary rocks in terms of provenance, weathering, tectonism, transportation, deposition, and diagenesis.

SLO4- Determine the depositional environments of the siliciclastic sedimentary rocks.

SLOs SLOs of the course	SLO (1)	SLO (2)	SLO (3)	SLO (4)
1	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: grain size and parameters.	SLO1	Face to Face				Tucker, 2001; Amireh, 2015; Saffarini and Amireh, 2016.
	1.2	Texture of siliciclastic sedimentary rocks: morphology and packing.	SLO1	Face to Face				Tucker, 2001; Amireh, 2015; Saffarini and Amireh, 2016.
	1.3	Texture of siliciclastic sedimentary rocks: interpretations.	SLO1	Face to Face				Tucker, 2001; Amireh, 2015; Saffarini and Amireh, 2016.
2	2.1	Structures of siliciclastic sedimentary rocks.	SLO1	Face to Face				Tucker, 2001; Amireh, 1997; Amireh et al., 1994.
	2.2	Structures of siliciclastic sedimentary rocks: conglomerate and sandstone.	SLO1	Face to Face				Tucker, 2001; Amireh, 1997; Amireh et al., 1994.
	2.3	Structures of siliciclastic sedimentary rocks: conglomerate and sandstone.	SLO1	Face to Face				Tucker, 2001; Amireh, 1997; Amireh et al., 1994.
Week								

3	3.1	Mineral composition of sandstone and conglomerate: light minerals.	SLO2	Face to Face				Tucker, 2001; Amireh, 1992; Amireh, 2018.
	3.2	Mineral composition of sandstone and conglomerate: light minerals.	SLO2	Face to Face				Tucker, 2001; Amireh, 1992; Amireh, 2018.
	3.3	Mineral composition of sandstone and conglomerate: light minerals.	SLO2	Face to Face				Tucker, 2001; Amireh, 1992; Amireh, 2018, 2020.
4	4.1	Mineral composition of sandstone and conglomerate: heavy minerals.	SLO2	Face to Face				Tucker, 2001; Amireh, 1992, 1994, 2018, 2020; Amireh et al., 2022.
	4.2	Mineral composition of sandstone and conglomerate: heavy minerals.	SLO2	Face to Face				Tucker, 2001; Amireh, 1992, 1994, 2018, 2020; Amireh et al., 2022.
	4.3	Mineral composition of sandstone and conglomerate: heavy minerals.	SLO2	Face to Face				Tucker, 2001; Amireh, 1992, 1994, 2018, 2020; Amireh et al., 2022.
5	5.1	Diagenesis of sandstone and conglomerate.	SLO2	Face to Face				Tucker, 2001; Amireh, 1992, 1994, 2018, 2020; Amireh et al., 1994a, 2022.
	5.2	Diagenesis of sandstone and conglomerate.	SLO2	Face to Face				Tucker, 2001; Amireh, 1992, 1994, 2018, 2020; Amireh et al., 1994a, 2022.

	5.3	Diagenesis of sandstone and conglomerate.	SLO2	Face to Face				Tucker, 2001; Amireh, 1992, 1994, 2018, 2020; Amireh et al., 1994a, 2022.
6	6.1	Provenance revealed from mineral composition	SLO3	Face to Face				Tucker, 2001; Amireh, 2018, 2020; Amireh et al., 2007, 2020.
	6.2	Provenance revealed from mineral composition	SLO3	Face to Face				Tucker, 2001; Amireh, 2018, 2020; Amireh et al., 2007, 2020.
	6.3	Provenance revealed from mineral composition	SLO3	Face to Face				Tucker, 2001; Amireh, 2018, 2020; Amireh et al., 2007, 2020.
7	7.1	Mid-term Exam						
8		Topic	Intended Learning Outcome					
	8.1	Geochemical attributes of siliciclastic rocks: significance of major elements.	SLO3	Face to Face				Tucker, 2001; Jarrar et al. 2000; Amireh, 2020; Amireh et al., 2020.
	8.2	Geochemical attributes of siliciclastic rocks: significance of trace and rare Earth elements.	SLO3	Face to Face				Tucker, 2001; Jarrar et al. 2000; Amireh, 2020; Amireh et al., 2020.
	8.3	Geochemical attributes of siliciclastic rocks: provenance analysis.	SLO3	Face to Face				Tucker, 2001; Jarrar et al. 2000; Amireh, 2020; Amireh et al., 2020.

9	9.1	Alluvial depositional environments of conglomerate and sandstone	SLO4	Face to Face				Tucker, 2001; Abed and Amireh, 1998; Makhluaf et al., 2010.
	9.2	Alluvial depositional environments of conglomerate and sandstone	SLO4	Face to Face				Tucker, 2001; Abed and Amireh, 1998; Makhluaf et al., 2010.
	9.3	Transitional depositional environments of sandstone	SLO4	Face to Face				Tucker, 2001; Amireh, 1997, 2000.
10	10.1	Transitional depositional environments of sandstone	SLO4	Face to Face				Tucker, 2001; Amireh, 1997, 2000.
	10.2	Shallow marine depositional environments of sandstone	SLO4	Face to Face				Tucker, 2001; Amireh et al., 1994a, 2001.
	10.3	Shallow marine depositional environments of sandstone	SLO4	Face to Face				Tucker, 2001; Amireh et al., 1994a, 2001.
11	11.1	Textures, structures of mudstones, and diagenetic structures.	SLO1	Face to Face				Tucker, 2001; Amireh, 1992, 2015.
	11.2	Mineral composition: clay minerals, and types of mudstones.	SLO2	Face to Face				Tucker, 2001; Amireh, 1994.
	11.3	Depositional environments of mudstone:	SLO4	Face to Face				Tucker, 2001; Amireh et al., 2001.

		continental to marine.						
12	12.1	Topics presentation.	SLO1, SLO2, SLO3, SLO4	Face to Face				All above references and online texts.
	12.2	Topics presentation.	SLO1, SLO2, SLO3, SLO4	Face to Face				All above references and online texts.
	12.3	Topics presentation.	SLO1, SLO2, SLO3, SLO4	Face to Face				All above references and online texts.
13	13.1	Topics presentation.	SLO1, SLO2, SLO3, SLO4	Face to Face				All above references and online texts.
	13.2	Topics presentation.	SLO1, SLO2, SLO3, SLO4	Face to Face				All above references and online texts.
	13.3	Topics presentation.	SLO1, SLO2, SLO3, SLO4	Face to Face				All above references and online texts.
14	14.1	Topics presentation.	SLO1, SLO2, SLO3, SLO4	Face to Face				All above references and online texts.
	14.2	Topics presentation.	SLO1, SLO2, SLO3, SLO4	Face to Face				All above references and online texts.
	14.3	Topics presentation.	SLO1, SLO2, SLO3, SLO4	Face to Face				All above references and online texts.

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

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: 21/8/2024	
Head of Curriculum Committee/Department: -----	Signature: -----

Head of Department: -----	Signature: -----
-	
Head of Curriculum Committee/Faculty: -----	Signature: -----
-	
Dean: -----	Signature: -----