UTD	**Course**	GEOS 5318 – Minerals and Metals for Sustainability
	Professor	Dr. Robert J. Stern
	Term	Fall 2025
	Meetings	M 1-3:45 pm on line/ROC 2.103 exam days

Professor's Contact Information

Office Location & hours	TEAMS,W 1:00-2:00 or TBA
Email Address	rjstern@utdallas.edu
T. A.	Clint Crowley - Clinton.Crowley@UTDallas.edu

General Course Information

Pre-requisites, Co-requisites, & other restrictions	None, Tectonics, petrology and geophysics recommended
Course Description	GEOS 5318 Minerals for Sustainability (3 semester credit hours) Modern civilization depends on all 92 elements in the periodic table and most of these are extracted from mineral deposits. The transition to a green economy is increasing our need for these elements. This lecture course provides on overview of how the elements formed, how these are concentrated in different types of mineral deposits, how these deposits formed, and the ways in which we use different elements today. (3-0)
Learning Outcomes	Students will learn the various modes of formation of mineral deposits.
Required Texts & Materials	Muller, Groves, Santosh *METALLIC MINERAL RESOURCES The Critical Components for a Sustainable Earth* Elsevier 2025 435 p. Can be downloaded from UTD library.
Video lectures	See "playlists" on https://www.youtube.com/@UTDGeoscienceStudios
TEAMS LINK	https://teams.microsoft.com/l/meetup-join/19%3ameeting_OTYzMzZkOGEtZTQ1OS00YWUxLTkxYTYtZTkwNjYyYzU1NTMy%40thread.v2/0?context=%7b%22Tid%22%3a%228d281d1d-9c4d-4bf7-b16e-032d15de9f6c%22%2c%22Oid%22%3a%228078e4d8-9f28-4446-83d5-2bd0c96706e0%22%7d

Important Message: We will frequently refer to eras (Paleozoic, Mesozoic, Cenozoic) and periods (Cambrian, Triassic, etc.) and also ages of events in millions of years (Ma) and billions of years (Ga) ago. These ages are likely to show up on exams. If you are not comfortable with this terminology, print out and study the latest timescale https://www.geosociety.org/documents/gsa/timescale/timescl.pdf You can bring this to exams.

JOIN FACEBOOK GROUP "MINERALS AND METALS FOR SUSTAINABILITY" – I post news articles and other items of timely interest there.

Grading

25% for each of 3 exams. (2 midterms, 1 final), questions are from the book and supplementary lectures and especially study guides posted on e-learning.

5% for 1 paragraph proposal for presentation (due Oct. 20)

15 % for oral presentation

5% for class participation

EXTRA CREDIT: 2 points extra credit is offered for UTD students who complete the on-line course evaluation.

- INFO ABOUT PRESENTATIONS: Oral presentation will be one talk given on some problem in Minerals and Metals for Sustainability. You will identify a problem and submit a short (few sentences) written proposal on Oct. 20. After approval by professor, you will present this to the class on Dec. 8. **Each presentation must consist of a total of exactly 9 powerpoint slides, including 1 title slide and 1 reference slide (references must be in the format of Economic Geology) as well as 1 location slide created in GeoMapApp http://www.geomapapp.org**. *GeoMapApp* is an Earth science exploration and visualization application that is part of the Marine Geoscience Data System at the Lamont-Doherty Earth Observatory of Columbia University (The application accesses the Global Multi-Resolution Topography compilation that hosts high resolution bathymetry and topography.) ***The other 6 slides must be made by the student and each must contain one and only figure.*** Figures do not need to be computer-generated, they can be sketched or traced but they **must** be generated by the student; points will be taken off if any figures are not made by student presenter. The total presentation can take no more than 10 minutes plus 5 minutes for questions.

- INFO ABOUT EXAMS & LECTURES: Exams are multiple choice, questions are from lecture topics and often are not in book; when book covers topics, many questions are from book but also from lecture. Exam questions come especially from study guides posted in e-learning. Powerpoints will be posted on e-learning. Video recordings will also be posted on Youtube. Exams will be handed back and gone over in class but no recordings are allowed. All exams must be returned. Anyone not returning their exam will receive a zero for that test.

- USEFUL WEB LINKS

USGS-CanGeolSurvey "Critical Minerals in Ores (CMiO) Database
2 pager: https://pubs.usgs.gov/fs/2025/3002/fs20253002.pdf
Global database: https://portal.ga.gov.au/persona/cmmi

VIDEOS:
Reflected Light Microscopy videos
https://www.youtube.com/playlist?list=PLl80V9_5ExLhfQCVoUse04rQkR4knF4xJ

Mineral Deposit Overview video course

https://www.youtube.com/@GeologyUpSkill

Government's Love-Hate Relationship with Mining (8 min)
https://www.youtube.com/watch?v=pDwAso6aGac&ab_channel=GeologyUpSkill

45 min video about Carlin-type deposits
https://www.youtube.com/watch?v=MnrXwiiYObs&ab_channel=SprottEDU

90 min video: The Modern Gold Rush in Nevada
https://www.youtube.com/watch?v=r0xOQ4niOq4&ab_channel=GSNSymposium

30 min video about Colorado Mineral Belt
https://www.youtube.com/watch?v=E_Vip8x49k8&t=3s&ab_channel=MesaCountyLibraries

Other Resources
We have other resources, mostly readings, for downloading. Contact the TA for information about how to access this.

Class Schedule

M Aug. 25. Syllabus (RJS)
Lecture 1A Re-Emergence of Metals (50 slides RJS)
Lecture 1B Introduction to Critical Minerals (50 slides ML)

M Sept 1 NO CLASS

M Sept. 8.
Lecture 2A Origin of Elements and Distribution in Earth (35 slides RJS)
Lecture 2B What is a Metal (25 slides RJS)
Lecture 2C Ions and Bonding (25 slides ML)
Lecture 2D Fluids and Complexes (25 slides ML)

M Sept. 15
Lecture 3A Ph and Redox reactions (39 slides ML)
Lecture 3B What is a Mineral? (25 slides RJS)
Lecture 3C Mineralizing Systems (25 slides ML)
Lecture 3D Mineral Formation and Goldschmidt's Rules (25 slides RJS)

M Sept. 22
Lecture 4A Isotope Overview & Stable Isotopes (53 slides ML)
Lecture 4B Radiogenic Isotopes and Geochronology (38 slides RJS)

M Sept. 29
Lecture 5A: Muller Ch. 2 Heterogeneous Distribution of Metal Resources (13p/ 10 slides ML)
Lecture 5B: Muller Ch. 3 Industrial Use of Metals (34p/54 slides RJS)
Start Lecture 6A: Muller Ch. 4

M Oct. 6 MIDTERM #1 covers lectures 1-5
Lecture 6A: Ch. 4 Abundant Metal Systems (48 p/74 slides/2 videos RJS)
Lecture 6B: Ch. 5 Scarce Critical Mineral Systems (98 p/69 ML)

M Oct. 13
Go over Midterm 1
Continue Lecture 6B/Ch. 5
Lecture 7: Ch. 6 Rare Critical Mineral Systems (64p/90 slides RJS)

M Oct. 20 PROJECT PROPOSALS DUE
Continue Lecture 7/Ch. 6
Lecture 8: Ch. 7 Trace Critical Mineral Systems (15 p/11 slides RJS)

M. Oct. 27 Lecture 9: Ch. 8 Precious Metal Systems (64 p/108 slides RJS)

M. Nov. 3:
Lecture 10: Ch.9 Temporal Distribution of Metallic Mineral Resources (40 p/92 slides RJS)

M Nov. 10: Equity and Justice guest speaker (ML)? Environmental concerns (ML)?
Lecture 11: Ch. 10 The Future of Metal Mineral Resources and their Exploration (21 p.)
Asteroid Mining (RJS 33 slides + 18 min video)

M Nov. 17: Equity and Justice guest speaker? Seafloor mining (ML) Environmental concerns?

M Nov 24 NO CLASS – FALL BREAK

M Dec. 1- Midterm # 2: covers lectures 6-10; Guest speakers?

M Dec. 8 Go over Midterm 2
Student presentation

WEEK OF Dec. 15 TBD: Final Exam