COLLEGE OF SCIENCE
Geosciences

LOWELL PROGRAM IN
ECONOMIC GEOLOGY

# THE GRADUATE CERTIFICATE IN MINERAL RESOURCE GEOLOGY

Student Handbook

Last updated: 4/15/2025

University of Arizona

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## Overview

The Graduate Certificate in Mineral Resource Geology has been designed to provide early career professionals and upper-division undergraduates with a focused introduction to mineral resource geology principles and applications. By taking the certificate, participants will gain insights into ore deposit models, geochemistry, mineralogy, and petrology of mineral deposits, structural geology for exploration and mine geology, and advanced field mapping. The certificate also gives the opportunity to dive deeper into other areas of interest (mining, mineral processing, mining law, environment, health, and safety) that complement the core curriculum.

The expected learning outcomes for this program include:

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| **Learning Outcome #1**: Demonstrate graduate level understanding of ore deposit types, their global distribution, and formation processes |
| **Concepts**: Recognize the major types and classification of ore deposits, distribution in time, space (geologic and tectonic setting), ore and alteration minerals, major rock types, and genetic processes in magmatic, metamorphic, and sedimentary systems; physical drives and energy sources and source-transport-trap (or dispersion) model, fluids and ligands, PTX conditions of ore formation. |
| **Competencies**: Demonstrate fundamental knowledge of ore systems classification using mineralogy, alteration and ore-related paragenetic sequences, geochemistry, and structural characteristics and their time-space space relationships. |
| **Learning Outcome #2**: Demonstrate the ability to produce accurate geological maps and sections using industry best-practice geological mapping and logging methods |
| **Concepts**: Report essential mapping information: lithology, morphology of rock bodies, and relationship between units; structural geometry (veins, faults, joints, folds, fabrics, etc.) and kinematics; mineralogy of hydrothermal alteration zones, ore minerals, and host rocks. |
| **Competencies**: Construct geological, lithological, structural, and hydrothermal alteration maps by applying the “Anaconda” (graphic) mapping to linear (bench, drill core) and areal (plan) mapping problems. |
| **Learning Outcome #3:** Debate literature on deposit geology and integrate contradictory and controversial evidence and interpretations. |
| **Concepts:** Think critically, life-long learning, application of concepts, research skills |
| **Competencies:** Explain research articles and their strengths and/or weaknesses and be able to critically analyze professional peer-reviewed literature and apply concepts and knowledge in the profession. |
| **Learning Outcome #4:** Contextualize and communicate minerals industry information to professional and non-professional audiences. |
| **Concepts:** Interdisciplinary communication, presentation skills, written communication (e.g., reporting) |

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| **Competencies**: Demonstrate ability to utilize observations, measurements, and data to draw and communicate geologic conclusions to mining professionals and non-professional audiences. |
| **Learning Outcome #5:** Support industry decision-making by providing professional insights based on geological and regulatory expertise while considering ethical, social, and environmental factors. |
| **Concepts:** Geological expertise, regulatory acumen, ethical decision-making, integrity, social awareness, impacts on communities, environmental stewardship, communication. |
| **Competencies:** Integrate ethical, social, and environmental factors while demonstrating a comprehensive understanding of geological principles and regulatory framework relevant to industry decision-making. |
| **Learning Outcome #6:** Contextualize and explain the linkage between ore systems, geodynamic context, and igneous, metamorphic, and sedimentary processes. |
| **Concepts:** periodic table, crystal chemistry, systematic mineralogy, phase diagrams, thermodynamics, isotopes, fluids and mass transfer, igneous, metamorphic and sedimentary processes, environments and links to metallogeny, ore and alteration mineralogy |
| **Competencies:** Summarize the main classifications, types, mineralogy, distribution (time and space), processes, and origins of igneous, metamorphic and sedimentary rocks and related types of ore deposits |
| **Learning Outcome #7:** Demonstrate fundamental understanding of geometallurgy and the value of mineralogical characterization in mine planning, ore processing, and mine development. |
| **Concepts:** spatial distribution and variability of minerals in ore deposits, mineral behavior and element deportment during ore processing, and industry practices in geometallurgical sampling, testing, materials characterization, and planning, mineral characterization |
| **Competencies:** Understand how improved geometallurgy can advance forecasting, reduce technical risk, enhance economic optimization of mineral production, and improve the sustainability of mining operations. |

## Eligibility

To be considered for the Graduate Certificate in Mineral Resource Geology, candidates must meet these criteria at the time of application:

- Hold a BS or equivalent geoscience-related degree and meet the admission criteria of the Graduate College.
- Have a minimum cumulative GPA of 2.75

## Applying for the Graduate Certificate

Applications for the Graduate Certificate are accepted twice a year. The deadline is 4:59 PM Mountain Standard Time (MST) on **July 1 for the Fall Term** and **December 1 for the Spring Term**. The application must be completed and submitted by this deadline. Due to visa processing constraints, international students are recommended to submit their applications three months before the deadline thus, April 1 and September 1, respectively. Please read the Graduate College Guidelines for more information.

Applications for the Graduate certificate are submitted directly through the UA Graduate College (UA Grad App) and students must select “Certificate Program” under “Program Category” (Figure 1), Mineral Resource Geology (Certificate NDP) under the “Program of Study” (see Figure 2), and then select the term they are interested in starting the program (Figure 3).

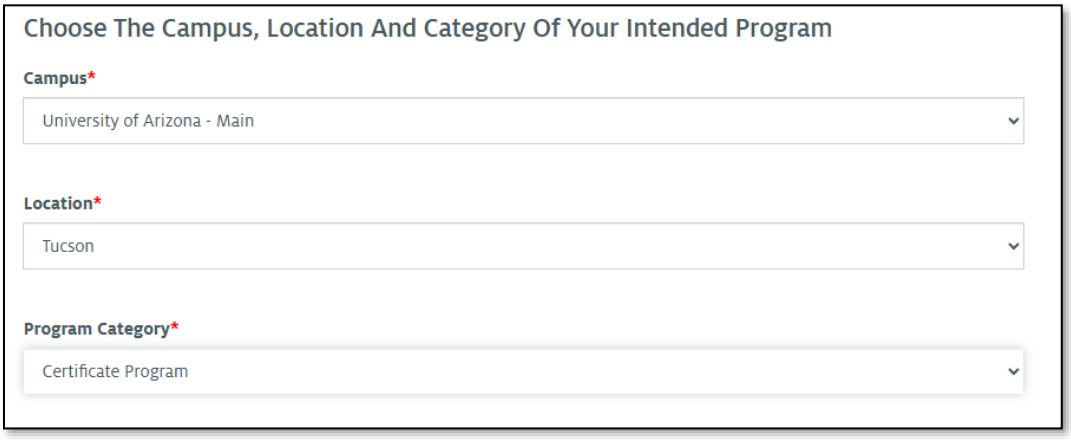


**Figure 1** Screenshot of *GradApp* showing how to select the Certificate Program

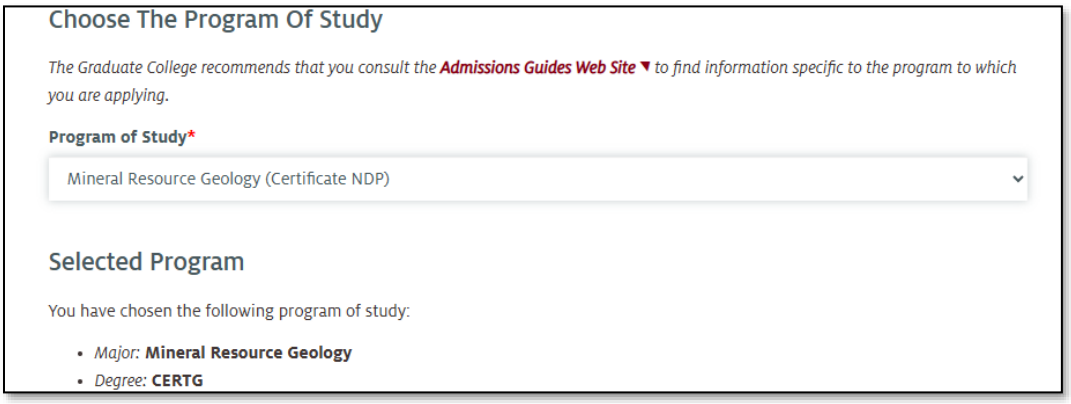


**Figure 2** Screenshot of *GradApp* showing how to select the Certificate Program

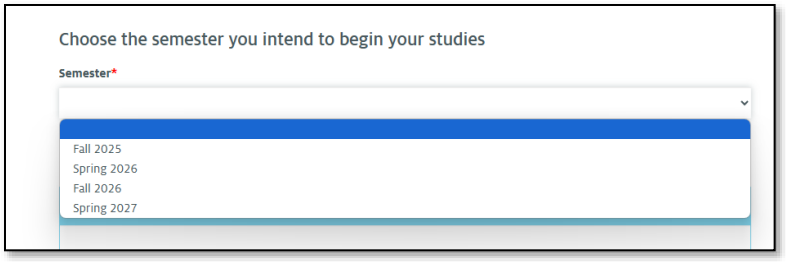


**Figure 3** Screenshot of *GradApp* showing how to select the term.

The formal admission application requires the following:

1. **Statement of Purpose**

Your statement of purpose should be **no more than one page**. We recommend that you discuss why you are interested in the certificate, what your career goals are, any specific geoscience-related interests, including the field of studies, and why you believe you are a strong candidate for the program.

Upload your electronic statement to your Graduate College online application.

2. **Two Letters of Recommendation**

Please note that recommendation letters are submitted electronically and should be produced on official letterheads. Individuals should be well acquainted with you and be able to comment on your qualifications and promise of a career in Economic Geology or related field.

Recommendation letters are submitted using the recommendation module in the Graduate College online application. It is important to note that you can only input the recommender's name and email address. The recommender received then a link with instructions to upload the letter.

3. **Resume or Curriculum Vitae**

Your resume or CV must include any relevant work experience, research, publications, and/or activities that demonstrate your potential as a graduate student.

Use the Graduate College online application form to upload your electronic resume or CV.

4. **Unofficial Transcript**

Upload your unofficial copies of transcripts showing all your coursework to the online application. If you are a UA student, these can be obtained via UAccess Student Center. Please note that transcripts must be current up to the point of application.

## Program requirements

The following requirements apply to this program:

- Students must earn at least **12 graduate credits** (courses numbered *5XX* and *6XX*). One-half of the required units must be in courses in which regular grades (A, B, C) have been earned. Students must earn a C or better in the courses used to complete the certificate.
- A student must have a **cumulative GPA** in all graduate coursework of **at least 3.0** to graduate.
- The majority of the coursework must be done within the Geosciences Department (3 units can be substituted with the program manager's approval). *The curriculum is shown below.*
- This program **does not allow unit transfer** from other programs or universities, students can, however, apply up to 6 units towards the certificate earned as a non-degree-seeking student.
- Students **may apply** all completed units toward the **MS degree** in Geology or the **PSM** degree in Economic Geology should they be successfully admitted to the graduate program.
- All requirements for a graduate certificate **must be completed within 4 year**s. Time-to-completion begins with the earliest coursework to be applied toward the degree. Work more than 4 years old is not accepted toward meeting certificate requirements.

## Plan of Study

Each student is responsible for developing a Plan of Study within the first months enrolled in the program. The Plan of Study must be submitted to the Graduate College no later than the second semester. The Plan of Study identifies:

1. The student's faculty advisor

2. The student's expected graduation term
3. Courses the student intends to transfer from other institutions
4. Courses already completed at The University of Arizona which the student intends to apply toward the graduate certificate; and
5. Additional coursework is to be completed to fulfill certificate requirements.

The student's faculty advisor and Director of Graduate Studies (DGS) must approve the Plan of Study before it can be reviewed by the Graduate College.

Students must submit a completed plan of study through GradPath. All forms are submitted in GradPath through the University of Arizona UAccess Student Center System. UAccess Student Center is accessed from: https://uaccess.arizona.edu/ and GradPath guides can be found at https://grad.arizona.edu/gsas/gradpath/gradpath-user-guides.

**Source**: Graduate College

## Curriculum

The Graduate Certificate in Mineral Resource Geology requirements are listed below

| Graduate Certificate in Mineral Resource Geology | | |
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| | Requirements | Minimum Units |
| Core | **GEOS 546** (3) Economic Mineral Deposits *(in person)* | 3 |
| Electives | **GEOS 504B** (1-2) Lowell Program Topics in Ore Deposits Mapping *(in person)*<br>**GEOS 504C** (1-2) Lowell Program Topics in Mineral Deposit Types *(in person)*<br>**GEOS 504D** (1) Geological Inputs to Integrated Planning *(in person)*<br>**GEOS 504E** (1) Mine Engineering Inputs to Integrated Planning *(online)*<br>**GEOS 504F** (1) Metallurgical Inputs to Integrated Planning *(online)*<br>**GEOS 504G** (1-2) Structural Geology for Exploration and Mine Geologists *(in person)*<br>**GEOS 504H** (3) Hyperspectral Imaging for Mining and Mineral Resources *(in person)*<br>**GEOS 518** (3-4) Geometallurgy *(in person or online)*<br>**GEOS 581A** (1-4) Mineralogical Principles for Resource Geology *(in person)*<br>**GEOS 581B** (1-4) Petrological and Geochemical Principles for Resource Geology *(in person)*<br>**GEOS 646** (4) Advanced Ore Deposits Geology *(in person or online)* | 9 |
| Total | | 12 |

## Funding as Graduate Students

The Geosciences department does not guarantee graduate funding for the Graduate Certificate students. However, the Lowell Program in Economic Geology provides limited scholarships to eligible students. Please contact the program manager for more information.

## Contact Information

Any questions regarding the Graduate Certificate in Mineral Resource Geology may be directed to:

***Dr. Marta Codeço***

***Manager, LPEG***

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***mscodeco@arizona.edu***