

PTYS595B-002 (4 UNITS) – ISOTOPE COSMOCHEMISTRY

Kuiper Space Sciences Room 7 (basement)

Mondays & Wednesdays 09:00-10:40 am

Instructor and Contact Information: Jess and Pierre are the instructors for this course.

- Prof. Jessica (Jess) Barnes, jjbarnes@arizona.edu, Kuiper Space Sciences, Room 540. LPL web page: <https://www.lpl.arizona.edu/faculty/jessica-barnes>
- Prof. Pierre Haenecour, haenecour@arizona.edu, Kuiper Space Sciences, Room 530. LPL web page: <https://www.lpl.arizona.edu/faculty/pierre-haenecour>

Course Website: Course materials will be uploaded to the PTYS 595B-002 course page on D2L (<https://d2l.arizona.edu/d2l/home/1043237>, NetID login is required) as the semester progresses.

Course Prerequisites:

None

Course Description: Isotopic variations among extraterrestrial materials provide great insights into the origin and evolution of the solar system. In this course, we will take a system-by-system approach to gain knowledge of the processes that took place in the molecular cloud, during the formation of our solar system and its subsequent evolution. Students will be introduced to the extraterrestrial materials available for laboratory study, the sample preparation techniques and methods used to measure isotopic compositions, and how to use and interpret cosmochemical data.

This is a four-credit special topics course designed for graduate students.

Course Objectives: During this course, the students will be exposed to all the main isotopic systems (including both stable and radiogenic isotopes) used to study planetary materials, including the associated analytical techniques and sample preparation. Additional topics to be covered include the history of isotopes discoveries & isotope cosmochemistry, the chart of nuclides, the fundamentals of isotopic fractionations, the key roles of isotopic anomalies in understanding Solar System dynamics, early Solar System chronology from short- and long-lived nuclei, chondritic meteorite components as clues to solar nebula and asteroid evolution, as well as planetary formation and chronology (e.g., Moon, Mars, Earth). The students will have the opportunity to interpret isotopic cosmochemical data in the context of Solar System formation, early solar system formation, and planetary body formation and evolution. Students are expected to answer questions about and describe these topics during lectures, in homework assignments, and in quizzes.

Expected Learning Outcomes: Upon completion of this course, students will be able to interpret isotopic cosmochemical data, and to put radiogenic age dating in the context of protoplanetary disk formation and early solar system evolution.

Course Modality: The course is scheduled to be taught in-person. Depending on schedule, some lectures might be pre-recorded/Zoom.

Class Time and Location: 9:00AM to 10:40AM on Mondays and Wednesdays in Kuiper Room Conference Room 7.

Office Hours: Office hours (in-person or virtual) can be scheduled on an as-needed basis via email to the instructors.

Schedule of Topics:

| Date | Topic | Date | Topic |
|-------|---|-------|------------------------------------|
| 01/11 | Course logistics, cosmochemistry framework, & discovery of isotopes | 03/13 | Other moderately volatile elements |
| 01/16 | Martin Luther King Jr Holiday - no classes | 03/15 | Zr |
| 01/18 | Cosmochemistry basics | 03/20 | Fe-Ni |
| 01/23 | Concepts in isotope geochemistry | 03/22 | Ca, Ti (+Cr &Mg) |
| 01/25 | Theories & experiments | 03/27 | Hf-W |
| 01/30 | Analytical techniques - part 1 | 03/29 | Mn-Cr |
| 02/01 | Analytical techniques - part 2 | 04/03 | I-Xe |
| 02/06 | O | 04/05 | Al-Mg |
| 02/08 | O | 04/10 | Rb-Sr |
| 02/13 | C, N, H, He, Li | 04/12 | U-Pb, Pb-Pb |
| 02/15 | C, N | 04/17 | Sm-Nd |
| 02/20 | H | 04/19 | Re/Os HSEs |
| 02/22 | S | 04/24 | Ar-Ar, K-Ar |
| 02/27 | Cl | 04/26 | Cosmogenic isotopes |
| 03/01 | Fe, K | 05/01 | Big picture & future of the field |
| 03/06 | Spring recess – no class | 05/03 | Course summary and evaluations |
| 03/08 | Spring recess – no class | 05/08 | Finals Week |

Assignments and Examinations: Schedule/Due Dates

There are three exams, four quizzes, two problem sets, and four student presentations. The due dates for assignments are as follows*:

- Syllabus Quiz: 01/18
- Problem Sets: 02/27 and 04/19
- Mid-semester exams: 02/06, 03/22 and 05/01
- Student Paper Presentations (×4): 15-min presentation followed by 25 min Q&A. Students will sign up for specific presentation times on a dedicated Google Sheet.

As part of the class participation grade, everyone in the class is expected to read the paper and to come to class prepared with questions/evaluations to participate in the discussion. Students should also submit a one-paragraph summary of the key points presented in each reading assignment. The summaries should be submitted on D2L (assignment tab) before the start of the class.

*Updates to the schedule will be communicated in class and posted on D2L.

Final Exam: There is no final exam for this class.

Performance Metrics:

| Task | % final grade |
|---|---------------|
| Class participation (reading, discussions, Q&A, etc...) + Syllabus Quiz | 5% |
| Problem set (x2)* | 25% |
| Mid-term exams (x3)* | 30% |
| Student paper presentation (x4)* | 40% |

*graded equally.

Grading Scale (%):

| | |
|---|----------|
| A | ≥ 90 |
| B | 80 to 89 |
| C | 70 to 79 |
| D | 60 to 69 |
| E | < 60 |

Makeup policy: Students who register after the first class may make up missed assignments/quizzes with a due date defined by instructors.

Textbook: There is no formal textbook assigned for the course, however, students will be required to read on average 1 to 2 papers per week as assigned in class. Resources like e-books, review papers, papers for in-class discussion, etc will be made available on D2L under the 'Readings' tab.

Recording Classes: Some classes might be recorded and distributed via D2L. D2L is secure and requires UA NetID to access. Students will be able to download the Zoom recordings from D2L or play them directly on D2L by selecting the 'View Topic' option beside each video. Such class recordings are for instructional purposes only and students are prohibited from sharing these with anyone outside of the class. *Please note that students may not modify content or re-use content for any purpose other than personal educational reasons. All recordings are subject to government and university regulations. Therefore, students accessing unauthorized recordings or using them in a manner inconsistent with UArizona values and educational policies are subject to suspension or civil action.*

Equipment and Software Requirements: For this class you will need daily access to the following hardware: laptop or web-enabled device with webcam and microphone; regular access to reliable internet signal; ability to download and run the following software: Zoom, web browser, Adobe Acrobat, Microsoft Word (or similar) etc. To process data, you will need access to Microsoft Excel or similar software.

Missed Deadlines: It is recommended that work be uploaded in a timely manner to avoid upload issues or technical problems. If circumstances beyond your control prevent you from completing an assignment or uploading/submitted material by the due date this must be communicated to the instructors on the due date via email (jjbarnes@arizona.edu and haenecour@arizona.edu).

Incomplete (I) or withdrawal (W): Requests for incomplete (I) or withdrawal (W) must be made in accordance with University policies, which are available at <http://catalog.arizona.edu/policy/grades-and-grading-system#incomplete> and <http://catalog.arizona.edu/policy/grades-and-grading-system#Withdrawal>.

Dispute of Grade Policy: Any disputes regarding a grade on a paper, project or exam must be communicated to the instructor within one week of receiving the grade.

Classroom Attendance:

- If you feel sick, or may have been in contact with someone who is infectious, stay home. Except for seeking medical care, avoid contact with others and do not travel.
- Notify your instructor(s) if you will be missing a course meeting or an assignment deadline.
- Non-attendance for any reason does **not** guarantee an automatic extension of due date or rescheduling of examinations/assessments.
 - Please communicate and coordinate any request directly with your instructor.
 - If you must miss the equivalent of more than one week of class, you should contact the Dean of Students Office DOS-deanofstudents@email.arizona.edu to share documentation about the challenges you are facing.

Statement on compliance with COVID-19 mitigation guidelines: As we enter the Fall semester, the health and wellbeing of everyone in this class is the highest priority. Accordingly, we are all required to follow the university guidelines on COVID-19 mitigation. Please visit www.covid19.arizona.edu for the latest guidance.

Academic advising: If you have questions about your academic progress this semester, please reach out to your academic advisor (<https://advising.arizona.edu/advisors/major>). Contact the Advising Resource Center (<https://advising.arizona.edu/>) for all general advising questions and referral assistance. Call 520-626-8667 or email to advising@arizona.edu

Classroom Behavior Policy: To foster a positive learning environment, students and instructors have a shared responsibility. We want a safe, welcoming, and inclusive environment where all of us feel comfortable with each other and where we can challenge ourselves to succeed. To that end, our focus is on the tasks at hand and not on extraneous activities (e.g., texting, chatting, making phone calls).

Life/Academic Challenges: If you are experiencing unexpected barriers to your success in your courses, or have questions about this class, please contact the instructors as soon as possible and we will work to sort something out. Your faculty mentor and/or advisor will also be happy to talk with you about any issues that may arise during the semester; we understand this is a challenging time for everyone.

Physical and Mental-Health Challenges: If you are facing physical or mental health challenges this semester, please note that Campus Health provides quality medical and mental health care.

For medical appointments, call (520-621-9202. For After Hours care, call (520) 570-7898. For the Counseling & Psych Services (CAPS) 24/7 hotline, call (520) 621-3334.

Academic Integrity Policy: The Student Code of Academic Integrity prohibits plagiarism: deanofstudents.arizona.edu/policies-and-codes/code-academic-integrity.

Nondiscrimination and Anti-Harassment Policy: Please see University Policy 200E on prohibited behaviors: <http://policy.arizona.edu/human-resources/nondiscrimination-and-anti-harassment-policy>

Threatening Behavior Policy: The UA policy on threatening behavior prohibits threats of physical harm to any member of the University community: <https://policy.arizona.edu/education-and-student-affairs/threatening-behavior-students> .

A complete list of all University Policies can be found here: <https://academicaffairs.arizona.edu/syllabus-policies> .

Disclaimer: The information contained in this course syllabus, other than the grade and absence policies, may be subject to change with reasonable advance notice, as deemed appropriate by the instructor.