GI261 Cyclostratigraphy and Astrochronology

**Faculty of Science**  
Autumn 2022

**Extent and Intensity**

1/1/0. 3 credit(s). Type of Completion: zk (examination).  
Taught in person.

**Teacher(s)**

Jeffrey Over (lecturer), [Mgr. Tomáš Kumpan, Ph.D.](https://is.muni.cz/person/175438) (deputy)  
[Mgr. Tomáš Kumpan, Ph.D.](https://is.muni.cz/person/175438) (alternate examiner)

**Guaranteed by**

[Mgr. Tomáš Kumpan, Ph.D.](https://is.muni.cz/person/175438)  
[Department of Geological Sciences - Earth Sciences Section - Faculty of Science](https://is.muni.cz/lide/pracoviste?lang=en;zobrazid=14315010)  
Contact Person: [doc. Mgr. Martin Ivanov, Dr.](https://is.muni.cz/person/134057)  
Supplier department: [Department of Geological Sciences - Earth Sciences Section - Faculty of Science](https://is.muni.cz/lide/pracoviste?lang=en;zobrazid=14315010)

**Prerequisites** (in Czech)

G3061 Historická a stratigrafická geologie, G3021 Petrografie

**Timetable**

Thursday 13:00 - 15:00

**Course Enrolment Limitations**

The course is also offered to the students of the fields other than those the course is directly associated with.  
The capacity limit for the course is 45 student(s).  
Current registration and enrolment status: enrolled: **0**/45, only registered: **14**/45, only registered with preference (fields directly associated with the programme): **14**/45

**fields of study / plans the course is directly associated with**

there are 60 fields of study the course is directly associated with, [display](https://is.muni.cz/course/sci/autumn2022/GI261?lang=en;zobrazmatob=1)

**Course objectives** (in Czech)

Investigation of the principles and application of cyclostratigraphy and astrochronology in refinement of the geological time scale through presentations by students and faculty of current literature and research.

**Learning outcomes** (in Czech)

Upon successful completion of this course, students will have an understanding of the nature and scale of cyclostratigraphy and the applications to absolute time in the geological record.

**Syllabus**

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| Week 1 | 15 Sept | field classes |
| Week 2 | 22 Sept | Introduction to cyclostratigrpahy and astrochronology |
| Week 3 | 29 Sept | no meeting |
| Week 4 | 06 Oct | research paper/student-faculty discussion |
| Week 5 | 13 Oct | research paper/student-faculty discussion |
| Week 6 | 20 Oct | research paper/student-faculty discussion; Dr. Kateřina Kloubová – Czech Republic Fulbright Commission |
| Week 7 | 27 Oct | research paper/student-faculty discussion  Hyks / Duration of Lower Oxfordian Cordatum ammonite Zone; |
| Week 8 | 03 Nov | research paper/student-faculty discussion  Hazmuka; |
| Week 9 | 10 Nov | research paper/student-faculty discussion  Dubjelova; |
| Week 10 | 17 Nov holiday | no meeting |
| Week 11 | 24 Nov | research paper/student-faculty discussion  Damborsky; Kozakova |
| Week 12 | 01 Dec | research paper/student-faculty discussion Sobek; Sotorrio Gonzalez |
| Week 13 | 08 Dec | research paper/student-faculty discussion  Rajnoch; Khoshyar |
| Week 14 | 15 Dec | review and summary |

Nečas, Fojt, Barchanek

**Literature**

***Required literature***

Hinnov, L.A., Hilgen, F.J., 2012. Chapter 4. Cyclostratigraphy and Astrochronology. *In* Gradstein, F.M., Ogg, J., Schmitz, M., Ogg, G. (eds.), The Geologic Time Scale 2012, Elsevier. p. 63–83.

Laskar, J., 2020. Astrochronology. *In* Gradstein, F.M., Ogg, J.G., Schmitz, M., Ogg, G. (eds.), The Geologic Time Scale 2020. Elsevier, Amsterdam, p. 139-158.

Strasser, A., Hilgen, F.J., Heckel, P.H., 2006. Cyclostratigraphy - concepts, deﬁnitions, and applications. Newsletter in Stratigraphy 42:75–114.

***Not specified***

see below

**Teaching methods** (in Czech)

Theoretical lectures, assignments, group discussion and presentations

**Assessment methods** (in Czech)

Evaluation of presentation and discussion

**Language of instruction**

English

**Further Comments**

The course can also be completed outside the examination period.  
The course is taught only once.  
The course is taught: every week.

**Teaching methods**

Group discussion and presentations

**Assessment methods**

Evaluation of presentation and discussion

Final grade will be S - satisfactory; F - unsatisfactory

**Cyclostratigraphy and Astrochronology**

Bard, E., Raisbeck, G.M., Yiou, F., Jouzel, J., 1997. Solar modulation of cosmogenic nuclide production over the last millennium: comparison between 14Cand 10Be records. Earth and Planetary Science Letters 150 (3-4):453–462.

Berger, A., Loutre, M.F., and Laskar, J., 1992. Stability of the astronomical frequencies over the Earth’s history for paleoclimate studies. Science 255, no. 5044:560–566, https://doi .org/10.1126/science.255.5044.560.

Bray, J.R., 1968. Glaciation and solar activity since the ﬁfth century B.C and the solar cycle. Nature 220:672–674.

Da Silva A.C., Dekkers, M.J., De Vleeschouwer, D., Hladil, J., Chadimova, L., Slavik, L., and Hilgen, F.J., 2019. Millennial-scale climate changes manifest Milankovitch combination tones and Hallstatt solar cycles in the Devonian greenhouse world. Geology 47:19-22.,

De Vleeschouwer, D., Da Silva, A.-C., Sinnesael, M., Chen, D., Day, J.E., Whalen, M.T., Guo, Z., and Claeys, P., 2017. Timing and pacing of the Late Devonian mass extinction event regulated by eccentricity and obliquity.Nature Communications 8, no. 2268, https://doi .org/10.1038/s41467-017-02407-1.

De Vleeschouwer, D., Parnell, A.C., 2014. Reducing time-scale uncertainty for the Devonian by integrating astrochronology and bayesian statistics. Geology 42:491–494.

Franco, D.R., Hinnov, L.A., and Ernesto, M., 2012. Millennial-scale climate cycles in Permian–Carboniferous rhythmites: Permanent feature throughout geologic time? Geology 40:19–22.

Hinnov, L.A., 2013. Cyclostratigraphy and its revolutionizing applications in the earth and planetary sciences. Geological Society of America Bulletin 125:1703–1734.

Hinnov, L.A., Hilgen, F.J., 2012. Chapter 4. Cyclostratigraphy and Astrochronology. In Gradstein, F.M., Ogg, J., Schmitz, M., Ogg, G. (eds.), The Geologic Time Scale 2012, Elsevier. p. 63–83.

Lakin, J., Marshall, J., Troth, I., Harding, I., 2016. Greenhouse to icehouse: a biostratigraphic review of latest Devonian–Mississippian glaciations and their global eﬀects. *In* Becker, R.T., Königshof, P., Brett, C.E. (eds.), Devonian Climate, Sea Level and Evolutionary Events. 423. Geological Society, London, Special Publications, 439–464.

Laskar, J., 2020. Astrochronology. *In* Gradstein, F.M., Ogg, J.G., Schmitz, M., Ogg, G. (eds.), The Geologic Time Scale 2020. Elsevier, Amsterdam, p. 139-158.

Meyers, S.R., 2015. The evaluation of eccentricity-related amplitude modulation and bundling in paleoclimate data: an inverse approach for astrochronologic testing and time scale optimization. Paleoceanography 30:1625–1640.

Meyers, S.R., 2019. Cyclostratigraphy and the problem of astrochronologic testing. Earth Science Reviews 190:190–223.

Mörner, N.A., 2015. The approaching new grand solar minimum and little ice age climate conditions. Nature Science Communications 7:510–518.

Pas, D., Hinnov, L., Day, J.E., Kodama, K., Sinnesael, M., Liu, W., 2018. Cyclostratigraphic calibration of the Famennian stage (Late Devonian, Illinois Basin, USA). Earth and Planetary Science Letters 488:102–114.

Strasser, A., Hilgen, F.J., Heckel, P.H., 2006. Cyclostratigraphy - concepts, deﬁnitions, and applications. Newsletter in Stratigraphy 42:75–114.

Usoskin, I.G., Gallet, Y., Lopes, F., Kovaltsov, G.A., Hulot, G., 2016. Solar activity during the Holocene: the Hallstatt cycle and its consequence for grand minima and maxima. Astronomy and Astrophysics 587, A150.