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Basic Information:
Course Title: Environmental magnetism
Lecturer: prof. DSc. Diana Jordanova
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Email: diana_jordanova77@abv.bg
Total Teaching Hours: 30

Annotation (up to 150 words)

The course is intended for doctoral students in the field of climate change in the geological past, environmental protection and application of modern geophysical methods in ecology.

The course includes two research directions – application of sediment magnetism for reconstruction of paleoclimate in the geological past, and the use of magnetism of natural materials for assessment of the degree of anthropogenic pollution of the environment. Both methodologies are based on the relationship between the amount, size and other magnetic parameters of iron oxides, and climatic factors and/or the degree of anthropogenic pollution. The course focuses on: fundamentals of solid-state magnetism; relationships between the magnetic signal and environmental factors determining the magnetic characteristics of the materials; analysis of the magnetic fraction in waste products from various anthropogenic emissions; theories on the relationship between paleoclimate and the magnetic signal. Each of the topics includes a presentation of theoretical foundations and examples of application in practice for solving specific problems.

Course content (brief description by topics or modules)
Topic / Module 1: Ferromagnetism – basic principles, processes of magnetization of solids. Superparamagnetic particles – properties
Topic / Module 2: Major ferromagnetic minerals in soils, anthropogenic waste products and emissions. Characteristics and properties
Topic / Module 3: Theories for generation and properties of authigenic soil magnetite – link with environmental climatic factors
Topic / Module 4: Method for magnetic mapping of the degree of pollution of soils and sediments – main methodological settings, principles and limitations of the method.
Topic / Module 5: Reconstructions of palaeoclimate during the Pleistocene using magnetic studies of loess-palaeosol sequences.
Topic / Module 6: Application of magnetism of vegetation samples for estimation of environmental air quality in urban areas.

Teaching and assessment methods
Teaching: attendance of lectures if 5 or more students are present, or consultancies and self learning using the sources from the Literature list
Assessment: written exam and oral discussion

Competencies acquired as a result of training (3–5 points)
1. Acquired knowledge about the basics of magnetism of natural materials

2. Acquired knowledge and skills for analysis of geophysical magnetic data on soils and sediments
3. Competence in using specialized equipment for field measurements of magnetic susceptibility for qualitative assessment of the degree of anthropogenic environmental pollution

Literature:

Dunlop, D. and O.Ozdemir, 1997. Rock Magnetism. Fundamentals and frontiers, (D. Edwards, ed.), Cambridge Studies in Magnetism, Cambridge University Press.

Thompson, R. and F.Oldfield, 1986. Environmental Magnetism. Allen&Unwin, London.

Evans, M. and F.Heller, 2003. Environmental Magnetism. Principles and Applications of Enviromagnetics. Academic Press, California, USA.

Maher, B., 1998. Magnetic properties of modern soils and Quaternary loessic paleosols: paleoclimatic implications. Palaeogeogr., Palaeoclim., Palaeoecol., 137, 25-54.

Petrovsky, E. and B. Elwood, 1999. Magnetic monitoring of air-, land- and water pollution. in: Quaternary Climates, Environments and Magnetism, eds. B. Maher and R. Thompson, Cambridge Univ. Press, 279 - 322.

Walden, J., Ofdfield, F. and Smith, J. (editors), 1999. Environmental magnetism. A practical Guide. Technical Guide No6. Quaternary Research Association, London.

Jordanova, N., 2017. Soil Magnetism: Applications in Pedology, Environmental Science and Agriculture, pp. 1–445, Elsevier.

Additional information (optional) (e.g., special requirements, laboratory equipment, prior knowledge)

Within the course, participants have the opportunity to become familiar with the specialized equipment in the Paleomagnetic Laboratory at the National Institute of Geophysics and Geophysics and conduct practical measurements of magnetic characteristics of samples of natural materials.