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KATEDRA GEOGRAFII FIZYCZNEJ
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Workshops

Workshops are dedicated to three innovative methods that are increasing in importance in Quaternary geology. Each of them is useful in sedimentological interpretations or may be used to determine the age of the deposits. hGRS (handheld gamma-ray spectrometry) is the field equivalent of the GRS method used in well logging applications to investigate lithological properties of sedimentary rocks. TCN dating is an analytical technique used in age estimation of ground surfaces or deposits exposed to cosmogenic radiation. µCT (microcomputed tomography) is a novel method used mainly to analyse the internal structure of sediments in undisturbed samples. Each workshop comprises theoretical background, possible applications presentation, and exercises for participants.

hGRS- handheld gamma-ray spectrometry

The method uses a portable device based on scintillation spectrometry. The device is put directly to the outcrop wall in an approximately perpendicular position. Measurements are usually performed with an interval of 0.2 m and last 120–180 s. Natural radiation from the target volume reaches the device. Then, based on built-in algorithms and calibration data, the spectrometer provides information about radioactivity. The method helps derive the concentration of natural radioactive elements, artificially introduced radioisotopes, or monitor

radioactivity changes in various applications. In geology, it is mainly used to calculate total gamma radiation GR and provide concentrations of, e.g., potassium-40, uranium-235 and 238, thorium-232, cesium-134 and 137. The data obtained is useful in e.g. discriminating basic lithologies and sedimentary environments, tracking weathering processes and palaeoclimate changes, supporting stratigraphic interpretation and correlations, and recognising radiogenic hazards.

TCN dating- terrestrial cosmogenic nuclide dating

This dating technique uses cosmogenic nuclides (e.g., ^{10}Be, ^{26}Al, ^{36}Cl) produced *in-situ* in rocks exposed to cosmic radiation due to nuclear reactions occurring within crystal lattice of minerals. The “shower” of secondary cosmic rays reaches the surface of the lithosphere and produces cosmogenic nuclides within exposed rocks. The production rate (atoms per year) of a particular nuclide can be estimated, and the concentration of a particular nuclide may be measured in a rock sample, so the exposure age of rocks may be calculated. Surface exposure dating with TCN is widely used in glacial geomorphology and geology, mainly to constrain the timing of glaciers/ice-sheets retreat. Glacial chronologies may be constructed by sampling the surface of stable, intact erratic boulders resting on moraines and/or glacially eroded bedrocks. TCN dating may also be used to investigate the chronology of other geological processes, such as: tectonic movements, mass movements, and volcanic eruptions. In fact, in all cases where the duration of rocks surfaces, exposition is relevant. If cosmogenic nuclides produced in-situ within rocks are unstable and have their characteristic radioactive decay, their concentration within sediments profiles may be used as an indicator of burial time for deposits – i.e. age of deposition.

µCT- microcomputed tomography

Microcomputed tomography or microtomography (µCT) is a powerful 3D-imaging technique that obtains a remarkably high-resolution reconstructed image using a small radiation spot. Sedimentary rock samples (monoliths) are collected in aluminium containers (10 × 10 × 10 cm) and are scanned using a computer microtomograph. The µCT method allows acquiring the data without disturbing the original structure of the monoliths collected. These samples may be used later for multiple analyses (e.g., macroscopic or micromorphological analysis). A 3D volume of the sample representing the x-ray attenuation (sensitive to composition

and density) is produced, allowing observation and quantification of various components and textures. In the three-dimensional image, using dedicated µCT software, areas that differ in density and structure can be distinguished and studied. It is possible to determine the size, area, volume or directional features in collected monoliths. Computer microtomography is a developing method and, in the future, may become a key research analysis used in Quaternary geology and geomorphology.