SYMS 2: Session II

Time: Thursday 14:00–16:00 Location: A 001

Invited Talk SYMS 2.1 Th 14:00 A 001

Cosmogenic and anthropogenic radionuclides in the Earth Surface Sciences — •Tibor Dunai — School of Geosciences, University of Edinburgh, UK

Cosmogenic nuclides have become a widely used tool to address scientific questions in Earth surface sciences. Major advances in AMS-technology in the late 1980s have brought analytical sensitivity, accuracy and precision that made application to problems in Earth sciences feasible. In particular, widespread use of in-situ produced cosmogenic nuclides, such as 10Be, 26Al and 36Cl, has revolutionised Earth surface sciences in the last 15 years. The capabilities to quantify the geomorphic stability of surfaces exposed to cosmic rays and to determine long-term erosion rates were quickly adopted to address, and resolve for the first time, a wide range of first-order problems in the fields of geomorphology, glaciology, palaeoclimatology, palaeoseismology, soil science, volcanology and geohazard research. The ongoing innovation in analytical techniques and interpretative tools has further extended the time-range of where AMS-methodology can be usefully applied to Earth Surface sciences. With the emergence of in-situ 14C and 53Mn methodology, and utilization of fallout 139Pu, the entire time-range of Earth Surface processes, present-day to ancient (>10 Ma), can now be addressed using AMS-related methodology. The presentation will provide an overview of applications of these nuclides to Earth Surface sciences, highlighting novel methodological developments.

Invited Talk SYMS 2.2 Th 14:30 A 001

Pushing the limits of high-precision radiocarbon measurements — •Lukas Wacker[1], Georges Bonani[1], Irena Hajdas[1], Bernd Kromer[2], and Hans-Arno Synal[1] — [1]Ion Beam Physics, Physics Department, ETH Zurich, Switzerland — [2]Heidelberg Academy of Sciences, Germany

Accelerator Mass Spectrometry (AMS) is mostly used for radiocarbon dating, because it allows determining efficiently ^{14}C without isobaric or molecular background. While for many years these measurements were performed on large tandem accelerators (3 - 6 MV), this has changed over the last 10 years and compact AMS systems (<500 kV) are now preferably used. The MIni CArbon DAting Systems (MICADAS) developed at ETH Zurich (200 kV) goes beyond what is generally accepted as high-precision radiocarbon measurements and represents the state of the art. The reason for this originates in the compact design that shows more similarities to a stable isotope mass spectrometer than to an accelerator based AMS system.

The perspectives of MICADAS are demonstrated on an example of highest-precision measurements of wood samples for the radiocarbon calibration curve. Inflation in radiocarbon dating is expected, when single compounds isolated by analytical techniques like HPLC or GC can be measured. Unfortunately the isolated material is limited to a few micro-gram. MICADAS is equipped with a gas ion source for the direct measurement of CO_2 and allows for the first time precise routine radiocarbon dating of micro-gram samples. The impact of the new-generation compact radiocarbon dating systems will be discussed.

Invited Talk SYMS 2.3 Th 15:00 A 001

Precise and accurate analysis of U-series isotopes by MC-ICPMS — •Denis Scholz — Institut für Geowissenschaften, Johannes-Gutenberg-Universität Mainz, Germany

The reconstruction of past climate variability provides important information for the determination of the magnitude of both temporal and spatial natural climate variability. Furthermore, paleoclimate data provide constraints for climate model simulations and may also be used to validate the predictions of those.

An important issue of paleoclimate reconstruction is the precise determination of the timing and duration of past climate changes. One of the most precise dating methods for the period of the last 600,000 years is Th/U-dating. The application of MC-ICPMS allows both very precise and accurate determination of U-series isotope ratios, high sample throughput, and to work with small sample sizes.

However, the raw isotope ratios measured by MC-ICPMS are affected by several instrumental biases, such as ion-counter-Faraday-cup gain, ion counter darknoise, Faraday cup baseline, peak tailing ("abundance sensitivity") and mass fractionation, which need to be corrected. In this talk I will discuss these various effects and outline appropriate correction methods.

Finally, I will exemplarily show the application of MC-ICPMS Th/U-dating to stalagmites, which are one of the best suited materials for U-series dating, and discuss the implications in terms of past climate variability.

Invited Talk SYMS 2.4 Th 15:30 A 001

Progress of inorganic mass spectrometry in environmental and life sciences — •J. Sabine Becker — Forschungszentrum Jülich

Laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS) has become established as a very efficient and sensitive trace and surface analytical technique in geology, material research, environmental and life sciences. We used LA-ICP-MS to produce images for investigating the spatial element distribution as well as the layered structures and inhomogeneities in thin tissue sections (e.g., human and rat brain tissues) to study neurodegenerative diseases or for biomonitoring of toxic metals in animal and plant samples in environmental research with a spatial resolution at micrometre scale. Furthermore, the possibility of the nanometre scale analysis of elements in tissues using a laser microdissection system or the application of the near-field effect in LA-ICP-MS will be discussed. These novel analytical techniques in LA-ICP-MS open up a new challenging path for future applications in the imaging of elements in life sciences and environmental research.