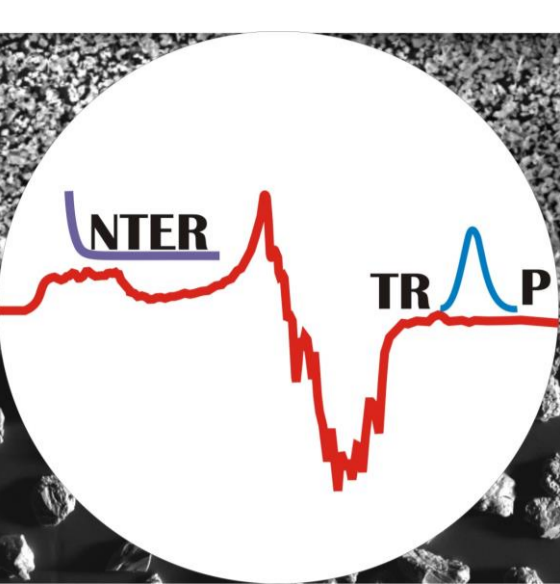


Integrated absolute dating approach for terrestrial records of past climate using trapped charge methods

INTERTRAP ERC Starting Grant
STG 678106, 2016-2022

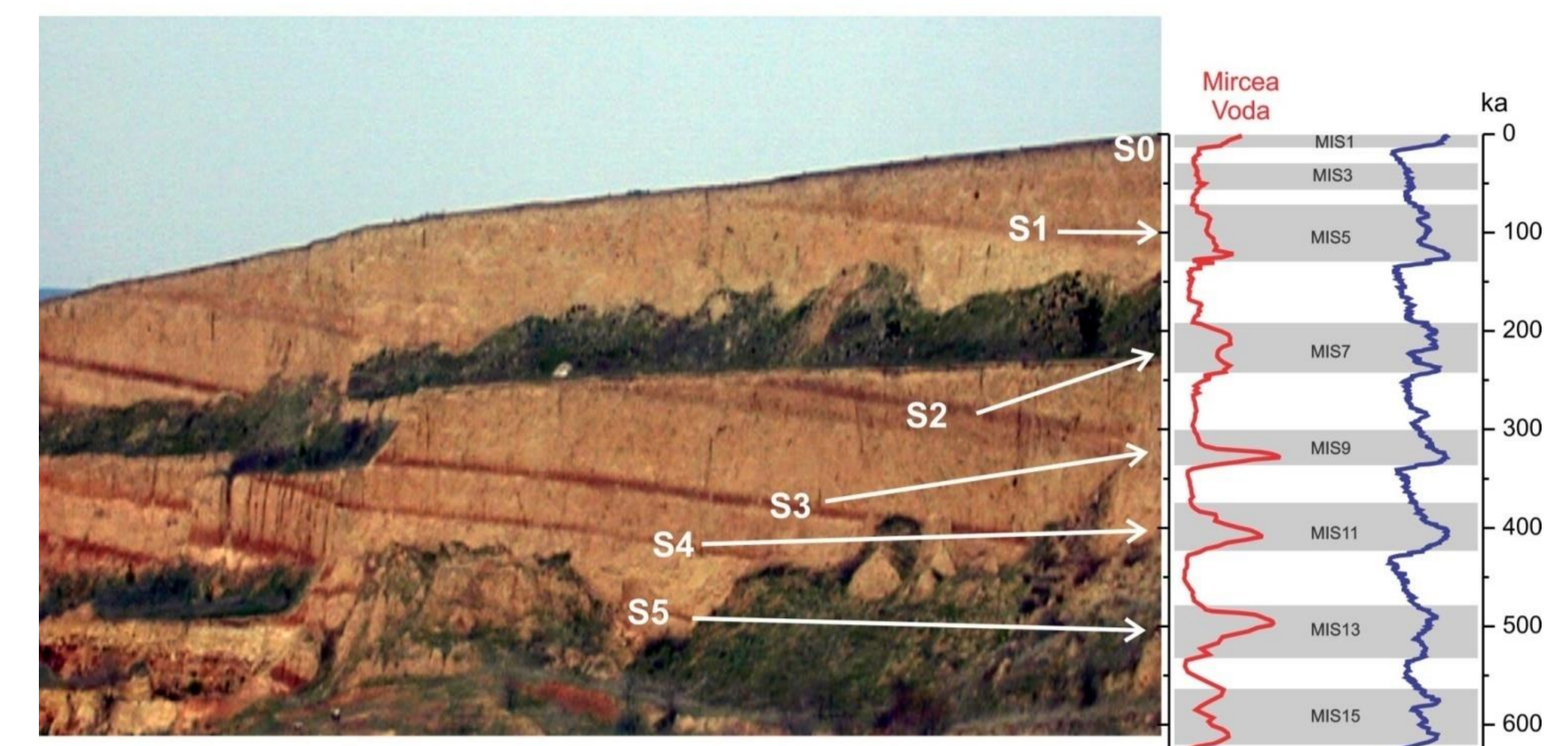
Principal Investigator: Professor Alida Iulia Gabor

Host Institution: Universitatea Babeş-Bolyai, Cluj-Napoca, Romania



INTRODUCTION

The type of mineral dust that accumulates as terrestrial sediments is known as loess and covers about 10 percent of the continental surfaces. Loess contains clay and coarse-size particles derived from upper crustal source rocks. The loess-paleosol (buried soils) alternations record the paleoenvironmental information on the Quaternary geological period, the last ~ 2 million years. Loess-paleosol sequences can provide paleoclimate data with loess yielding information about the glacial periods and paleosols about the interglacial and interstadial periods. Direct dating of loess-paleosol sequences is possible through luminescence methods and electron spin resonance. These methods use physical properties of constituent minerals such as quartz and feldspars. Understanding the links between dust and climate in the past will be crucial to evaluate the future impacts of dust on the Earth's climate system.



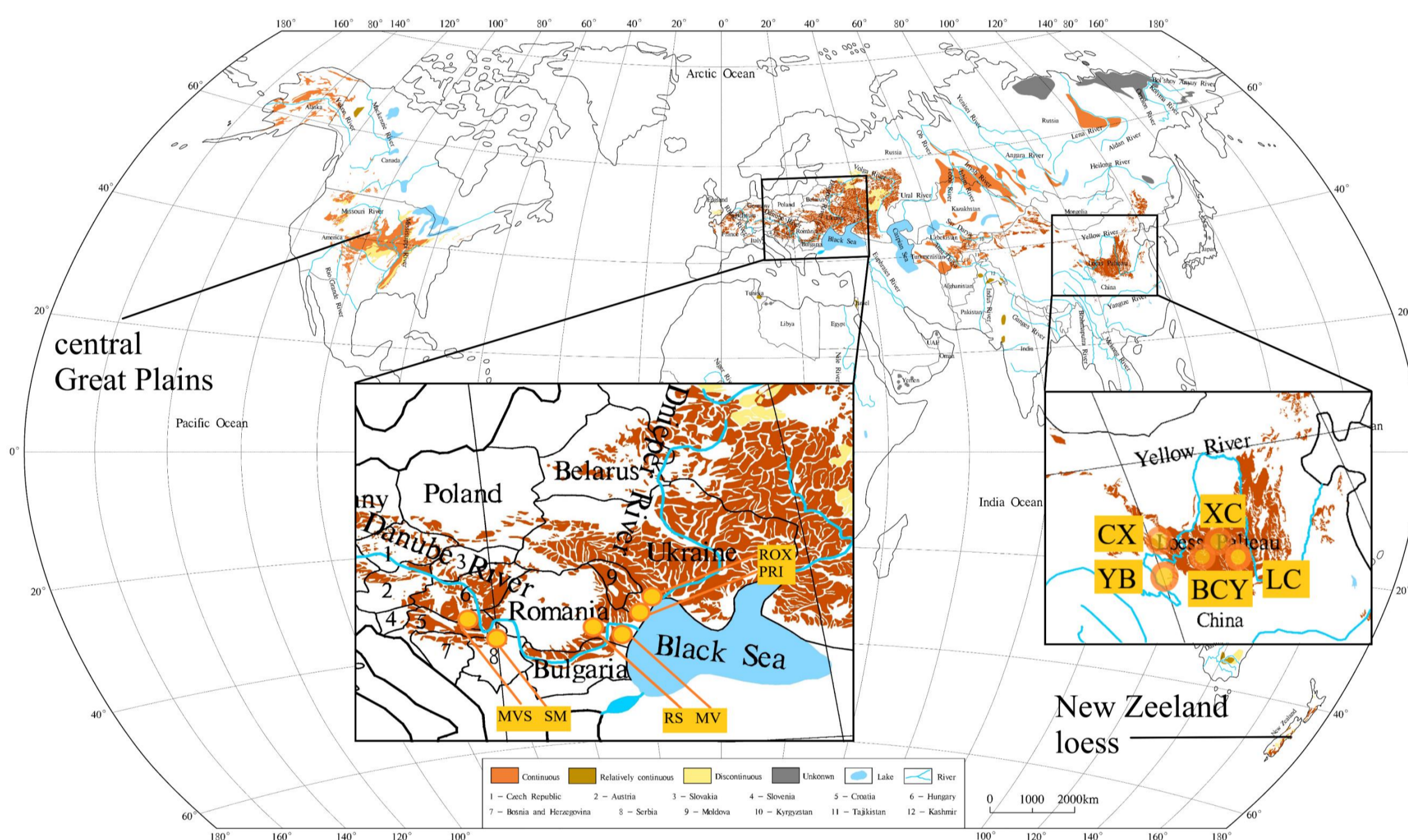
A loess-paleosol sequence in Southeastern Romania. Dark layers represent paleosols that formed during warm and moist periods in the past.

OBJECTIVE: INTERTRAP conducted detailed investigations of loess samples from three continents collected in close proximity to the transition to the recent soil, with the purpose of obtaining a temporal quantification of the ending of the Late Tardiglacial and the beginning of the Holocene. It developed methodological studies using optically stimulated luminescence, thermoluminescence and electron spin resonance investigations to mitigate the discrepancies in chronological dating. It aimed at unravelling the mechanism responsible for the observed discrepancies and developing innovative trapped charge dating measurement protocols based on quartz that would yield reliable ages for and beyond the last glacial-interglacial cycle.

METHODOLOGY AND INSTRUMENTATION:

Sampling:

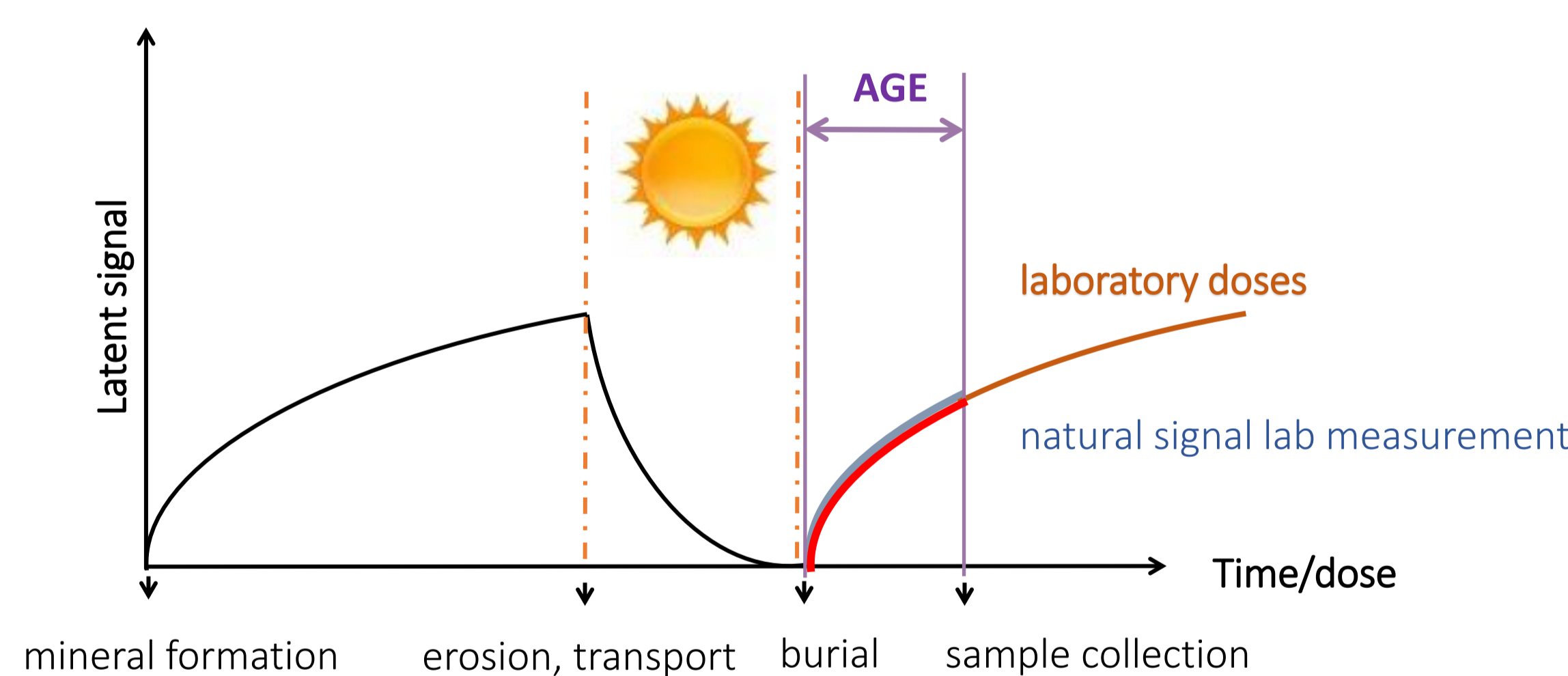
The sites investigated in the INTERTRAP project marked on a map of worldwide loess distribution.



Methodological Approach:

Trapped charge dating methods - Luminescence and Electron Spin Resonance

Luminescence dating methods is based in the property of quartz mineral grains to store the energy deposited within the grain following the exposure to the natural radioactive field and emit it in the form of light upon stimulation with light and heat.



STATE OF THE ART: Chemical preparation and Measurement Laboratories



Electron Spin Resonance spectrometer

New equipment ~ 1 million Euro worth

- 3 Risø – DA 20 TL/OSL Readers two of which are single grain readers, violet stimulation attachment, DASH.
- 1 HpGe planar Gamma detector
- 1 HpGe wellGamma detector
- BRUKER EMX-EPR X band and Q band
- modern chemical preparation lab



Chemical preparation room (under red-light conditions)



OSL/TL Risø Readers

Research Team



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PhD student



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Added value



PhD students:

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V. Tecsa



K. Szabolcs



O. Trandafir Antohi

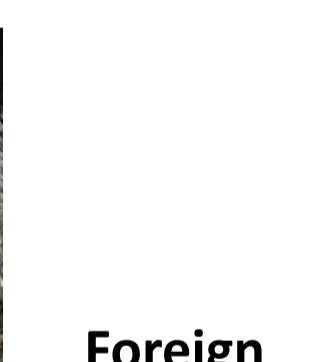


Researchers:

A. Lazar



R. Balc



Foreign visitors:



A. Dave



L. Villalonga



J. Bosken-Nett

PROJECT RESULTS:

- **The paleoclimate approach of INTERTRAP**
We have shown that the magnetic susceptibility (used as a proxy to correlate loess palaeosol sequences) reflects a gradual transition from the Last Glacial to the Holocene and that the onset of the magnetic signal enhancement produced by pedogenesis started before the stratigraphic Pleistocene/ Holocene transition dated at 11.7 ka in ice core records.
- **The methodological approach of INTERTRAP**
We report that quartz luminescence dating methods are limited to about 200 Gy, the use of feldspars can extend the measurable range up to 400 Gy, while ESR dating can in principle allow accurate dating up to ages that correspond to a total accrued dose of about 1000 Gy.
- The total publication output of INTERTRAP is: 27 scientific articles published in peer-reviewed journals, 5 PhD theses, 2 articles in journal dedicated to the public.