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Millennial oscillations in greenland dust and Eurasian Aeolian records - a paleosol-loess perspective (Hans Oeschger Medal Lecture)

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Considerable interest is brought on the abrupt climate changes that punctuated the last glacial period (∼110.6-14.62 ka). Originating in the North-Atlantic area, they have been recorded in ice, marine and terrestrial records all over the world, and especially in the Northern Hemisphere, with various environmental implications. The ice-core records, of increasingly high resolution, allow specifying more precisely the timing of these abrupt changes, which have occurred within intervals equivalent to present human generations. The continental records have been mainly interpreted so far in terms of temperature, precipitation or vegetation changes between the relatively warm ("Greenland Interstadial" - GI) and the cold ("Greenland Stadial" - GS) North-Atlantic climate phases.
In this presentation records from Greenland ice and northwestern European eolian deposits are compared in order to establish a link between GI and the soil development in European mid-latitudes, as recorded in loess sequences. For the different types of observed paleosols, the precise correlation with the Greenland records is applied to propose estimates of the maximum time lapses needed to achieve the different degrees of maturation and development. To identify these time lapses more precisely, two independent ice-core records are compared: $\delta^{18}0$ and dust concentration, indicating variations of temperature and atmospheric dustiness respectively in the Greenland area. This method slightly differs from the definition of a GI event duration applied in other studies where the sharp end of the δ^{18}O decrease gives the end of a GI. The same methodology is applied to both records (i.e., the GI last from the beginning of the abrupt δ^{18}O increase or dust concentration decrease until when δ^{18}O or dust reach again their initial value) determined both visually and algorithmically, and compare them to GI published estimates.
Focusing on the eolian/dust intervals, the analysis of δ^{18}O and dust in the Greenland ice cores, and a critical study of their source variations, reconciles these records with those observed on the Eurasian continent. This allows demonstrating the link between European and Chinese loess sequences, dust records in Greenland, and variations of the North Atlantic sea ice extent. The sources of the emitted and transported dust material are variable and relate to different environments corresponding to present desert areas in Asia, but also hidden regions related to lower sea level stands, dry rivers, or zones close to the frontal moraines of the main Northern Hemisphere ice sheets in Europe. As a conclusion of this presentation, I address the short term past climatic changes as preserved in the continental eolian records, in line with the Hans Oeschger medal description. Furthermore one can anticipate such study to be at the origin of more sophisticated and elaborated investigations of millennial and sub-millennial continental climate variability on the Northern Hemisphere.

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