Dust sources and emission dynamics from different geomorphic units during the Quaternary and at present 1

Terrestrial Processes, Deposits and History

Time: 9:00 - 10:45

Date: 29th July 2019

Location: Wicklow Hall 2A (Level 2)

Posters will be on display on Monday 29th July in Liffey Hall A and B and the abstracts are available to download in the poster session for Monday.

Chairperson: Onn Crouvi

Crouvi Onn

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Position:

Researcher
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Research interests:

- Eolian and coastal geomorphology.
- Soil formation.
- Quaternary geology.
- Soil erosion.
- Geo-archaeology.

O-3043 09:00 - 09:15

The geomorphology, controls and dynamics of southern African dust sources.

Frank Eckardt
Univesrity of Cape Town, Cape Town, South Africa

O-3044 09:15 - 09:30

Intersections between wind regimes, topography and sediment supply: Perspectives from Central Asian dunes and dust

Kathryn Fitzsimmons[1], Maike Nowatzki[1,2], Hartwig Harder[1], Aditi Dave[1], Charlotte Prud'homme[1], Tobias Sprafke[3], Yue Li[4], Saida Nigmatova[5]
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O-3045 09:30 - 09:45

Loess, dust, parna: unravelling the conceptual continuum in Australasia for improved paleoenvironmental reconstruction in the Quaternary.

Carol Smith[1], Stephen Cattle[2]
[1]Lincoln University, Christchurch, New Zealand. [2]University of Sydney, Sydney, Australia

O-3046 09:45 - 10:00

New Zealand as a potential source of mineral dust to the atmosphere and ocean during glacials

Bess Koffman[1,2], Steven Goldstein[2], Gisela Winckler[2], Michael Kaplan[2], Louise Bolge[2], Merry Cai[2], Toby Koffman[2], Cristina Recasens[3]
[1]Colby College, Waterville, USA. [2]Lamont-Doherty Earth Observatory, Palisades, USA. [3]Almac Group, Craigavon, United Kingdom

O-3047 10:00 - 10:15

Automated static image analysis technique to identify Saharan dust particles within unconsolidated eolianites on Fuerteventura

György Varga[1], Christopher-Bastian Roettig[2]
[1]Geographical Institute, Research Centre for Astronomy and Earth Sciences (MTA) , Budapest, Hungary. [2]Institute of Geography, Dresden University of Technology, Dresden, Germany

O-3048 10:15 - 10:30

Loess deposition and remobilization in an ice-marginal landscape

Randall Schaetzl[1], Garry Running[2], Phil Larson[3], Tammy Rittenour[4], Douglas Faulkner[2], Jarrod Knauff[1], Christopher Baisch[1], Samantha Kaplan[5]
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O-3049 10:30 - 10:45

A tale of two dune fields: dust emission processes from White Sands, New Mexico and Monahans, Texas, USA

Mark Sweeney[1], Steven Forman[2], Eric McDonald[3]
[1]University of South Dakota, Vermillion, USA. [2]Baylor University, Waco, USA. [3]Desert Research Institute, Reno, USA

O-3120 11:30 - 11:45

A review of Lake-Dust-Snow dynamics “from sources to sinks” in the semi-arid Bonneville Basin, Utah, USA

Kathleen Nicoll
University of Utah, Salt Lake City, USA

O-3121 11:45 - 12:00

Short-range aeolian transport in high mountain environments: an overlooked phenomenon

Guido Stefano Mariani[1], Andrea Zerboni[1], Onn Crouvi[2], Mauro Cremaschi[1], Luca Trombino[1]
[1]Dipartimento di Scienze della Terra "Ardito Desio", Università degli Studi di Milano, Milan, Italy. [2]Geological Survey of Israel, Jerusalem, Israel

O-3122 12:00 - 12:15

The provenance of loess-palaeosol sequences along the Middle and Lower Danube

Kaja Fenn[1], Ian Millar[2], Julie Durcan[1], David Thomas[1,3,4]
[1]University of Oxford, Oxford, United Kingdom. [2]NIGL, British Geological Survey, Keyworth, United Kingdom. [3]University of Witwatersrand, Johannesburg, South Africa. [4]East China Normal University, Oxford, China

O-3123 12:15 - 12:30

Comparative study of silt production under Natural and Simulated conditions

Raj Kumar
Geology and Mining Department , Jammu, India

O-3124 12:30 - 12:45

Why are soils in Loess-Paleosol-Sequences in Southern Tunisia sandy?

Dominik Faust[1], Alexander Fülling[2], Georg Mettig[1], Maximilian Pachtmann[1], Joes Manuel Recio Espejo[3], Sascha Meszner[1]
[1]TU-Dresden, Dresden, Germany. [2]Humboldt-Universität Berlin, Berlin, Germany. [3]Universidad de Córdoba, Córdoba, Spain

O-3125 12:45 - 13:00

Fingerprinting the sources of aeolian deposits in northern China by using trace elements composition of detrital quartz

Yuan Shang[1,2,3], Anu Kaakinen[2], Tobias Fusswinkel[4], Maarten A. Prins[3], Christiaan J. Beets[3]
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O-3126 13:00 - 13:15

The Central Andes primary dust sources of the Chaco-Pampean loess (South America)

Daniela M. Kröhling
CONICET , Santa Fe , Argentina. Universidad Nacional del Litoral , Santa Fe, Argentina

Intersections between wind regimes, topography and sediment supply: Perspectives from Central Asian dunes and dust

Kathryn Fitzsimmons[1], Maike Nowatzki[1,2], Hartwig Harder[1], Aditi Dave[1], Charlotte Prud'homme[1], Tobias Sprafke[3], Yue Li[4], Saida Nigmatova[5]
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ABSTRACT

The widespread aeolian deposits of the Central Asian steppes and piedmonts offer great potential to better understand the dynamics of, and interactions between, the major northern hemispheric climate subsystems of Eurasia over Quaternary timescales. However, there is a problem with established assumptions linking climate processes with dust generation and aeolian deposition in the arid Central Asian context. Emerging datasets from the Tien Shan piedmont suggest that 1) hypotheses assuming a connection between increased loess accumulation and cold glacial conditions do not hold for this region, and 2) mass accumulation rates, and the timing of peak dust flux, are highly variable from one site to another. These results raise questions as to the nature of the relationship between loess accumulation, aeolian flux and palaeoclimate.

Here we investigate the relationship between wind regimes and the distribution, morphology and timing of dunes and dust in the Ili Basin, spanning southeast Kazakhstan and western China. Our findings, based on GIS and geomorphic mapping, wind trajectory reconstruction, geochemical provenancing and loess chronostratigraphy, indicate that:

- Dominant wind strength and aeolian transport capacity varies strongly across the basin, most likely in response to the obstructing influence of the Tien Shan mountain ranges;
- Ripples overlying linear dunes in the central basin directly correspond to short-term wind-storm events;
- Linear dunes preserve variable orientation across the basin, reflecting variability in the vector of dominant sand-shifting winds, over timescales where sand supply was plentiful;
- Dust sources for loess deposits vary across the basin depending on wind regime and supply, indicating more dominant local supply in the east, and increasing distal contributions to the west;
- The timing of loess accumulation varies substantially across the basin; there is no uniform, contemporaneous draping of dust along the piedmont.

Our integrated approach provides more nuanced information about aeolian processes in relation to wind regimes not otherwise available from site-specific case studies, and highlights a need to interrogate climate-driven models for aeolian deposits.

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- Group Members
- Publications

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Curriculum Vitae

Profile Kathryn E. Fitzsimmons

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Loess, dust, parna: unravelling the conceptual continuum in Australasia for improved paleoenvironmental reconstruction in the Quaternary.

Carol Smith[1], Stephen Cattle[2]
[1]Lincoln University, Christchurch, New Zealand. [2]University of Sydney, Sydney, Australia

ABSTRACT

There are a variety of both mechanisms and geomorphic processes which generate, sort and concentrate silt-sized grains: entrainment by wind, then deposition by aeolian processes follow. This can occur in semi-arid to temperate to periglacial geomorphic units. Loess is an accepted term in New Zealand for aeolian, silt-sized deposits of glacial origin. In Australia, a varied terminology ranging from parna, to dust to lithogenic fluxes are all employed to describe aeolian silt sized deposits, generally accepted to be sourced from semi-arid environments.

This range of terminology can be a source of confusion and has likely arisen from historical constructs during the development of loess research world-wide. But what we do know is that aeolian sediments and their associated soils in both Australia and New Zealand encompass a wide range of particle size, mineralogy and geochemistry. This reflects differences in the dust source of the contributing regional geomorphic units, dynamics of dust emission from the differing geomorphic units as well as post sedimentary changes to the dust deposits (pedogenesis) driven by gradients of aridity and weathering.

We aim to demonstrate that despite these differences, loess, dust, parna also exist on a continuum, influenced by gradients of aridity, weathering and particle size. We will do this by deconstructing some specific examples in Australia and New Zealand. We compared the different provenance, formation pathways, mineralogy and geochemistry for these sediments using a range of techniques including optical micromorphology, granulometric analysis and QEMSCAN® analysis.

In Australia (southern NSW), microfabric analysis demonstrated a continuum of pedogenesis of the associated parna soils along gradients of aridity and weathering. In New Zealand, the transport pathway for the loess mantled landscape in the Manawatu district (North Island) is generally accepted, but the morphological and chemical difference between the soils developed on the drier terraces (Tokomaru) compared to those on the moister terraces (Dannevirke) is still not fully understood. On comparing the mineralogy and geochemistry, the dust / parna in Australia is dominated by quartz and clay, and little plagioclase feldspar. While in New Zealand (Manawatu), the grain size distribution of the two soils are very similar. The Dannevirke soil mineralogy is dominated by kaolinite and chlorite while the Tokomaru soils have a greater proportion of weatherable mineral grains.

We discuss the results in terms of the conceptual differences in the transport pathways and pedogenesis of loess and how this can inform our ability to reconstruct Quaternary paleoenvironments, and ultimately contribute to improved numerical models of the dust cycle.

New Zealand as a potential source of mineral dust to the atmosphere and ocean during glacials

Bess Koffman[1,2], Steven Goldstein[2], Gisela Winckler[2], Michael Kaplan[2], Louise Bolge[2], Merry Cai[2], Toby Koffman[2], Cristina Recasens[3]
[1]Colby College, Waterville, USA. [2]Lamont-Doherty Earth Observatory, Palisades, USA. [3]Almac Group, Craigavon, United Kingdom

ABSTRACT

The geochemical composition of sediments and dust can be used to trace their provenance, thereby providing insights into a range of Earth surface processes. During past glacial climates, much of New Zealand was blanketed by temperate erosive glacier systems, which produced significant volumes of sediment. To trace the extent of subsequent aeolian and oceanic transport of this material, and thus its potential impact on climate and ecological systems, we characterized the geochemical composition of sediments. We present geochemical analyses, including Sr-Nd-Pb isotopes and major/trace elements, of more than 20 fine-grained (<5 μm diameter) sediments from the major dust- and sediment-producing regions of the South Island. We find that sediment composition strongly reflects local lithology. The central South Island, including the Canterbury Plains and Mackenzie Basin, has a relatively homogenous isotopic composition, with $^{87}Sr/^{86}Sr$ = 0.7095-0.7165, εNd = -6.5 to -4.0, $^{208}Pb/^{207}Pb$ = 2.470-2.485, and $^{206}Pb/^{207}Pb$ = 1.198-1.215. The southern South Island, including Southland and Otago, has an isotopically younger and more variable composition, reflecting the presence of Paleozoic volcanic complexes. Here $^{87}Sr/^{86}Sr$ = 0.7041-0.7140, εNd = -4.0 to +5.3, $^{208}Pb/^{207}Pb$ = 2.463-2.483, and $^{206}Pb/^{207}Pb$ = 1.196-1.208. We make comprehensive comparisons to available isotopic data from other Southern Hemisphere mid-latitude dust sources, finding that while isotopic fields often overlap, the combination of Sr, Nd, and Pb isotopes offers improved ability to discriminate between potential source areas. We estimate the expansion of glacial outwash plains based on a sea level lowering of 130 m at the Last Glacial Maximum (LGM), and find that the Canterbury Plains likely covered an estimated 38,500 km^2 while the Southland/Otago Plains may have extended to 50,500 km^2. Considering New Zealand's extreme uplift and erosion rates (~10 m kyr^{-1}), we suggest that the South Island, though limited in extent compared to larger Southern Hemisphere landmasses, may have served as an important dust source to the high-latitude atmosphere and ocean during glacial periods.

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Areas of Expertise

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- Sediment geochemistry
- Ice cores
- Climate change
- Radiogenic isotopes
- Atmospheric dust

Automated static image analysis technique to identify Saharan dust particles within unconsolidated eolianites on Fuerteventura

György Varga[1], Christopher-Bastian Roettig[2]
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[2]Institute of Geography, Dresden University of Technology, Dresden, Germany

ABSTRACT

The identification of windblown dust in regions located relatively far from major dust source areas is an intriguing problem of sedimentary studies. The identification of external mineral particles is rather challenging, however, in certain cases the geological-geomorphological environment provide suitable conditions. The island of Fuerteventura is free from quartz and just bears basaltic rocks and carbonate sands originating from the shallow shelf. Therewith the islands dune sequences are placed best to serve as a natural laboratory for our investigations of quartz-rich, silt-sized Saharan dust deposits.

An automated static image analysis method completed with Raman spectroscopy was applied in this study to identify and separate Saharan mineral particles from Upper Pleistocene sedimentary units.

The captured high-resolution grayscale images of ~50,000 individual mineral particles per samples allowed us to apply different independent approaches. Beside bulk grain size and grain shape characterization, (a) sedimentary subpopulation partition by parametric curve-fitting, (b) Raman spectroscopy based quartz particle identification, and (c) grayscale intensity mean values of particles (relatively high values were used as a proxy for quartz grains due to the finding of a strong correlation between light transmissivity of grains and chemical identity) were used.

The presented set of methods provided new data on the granulometric character, the depositional mechanisms and the admixture of dust material to sandy units. Joint applications of several size, shape and grayscale intensity values and mathematical techniques allowed the separation of quartz grains from other mineral particles.

Support of the National Research, Development and Innovation Office NKFIH K120620 (for G. Varga) is gratefully acknowledged.

Research Centre for Astronomy and Earth Sciences
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Profile | Publications | Projects

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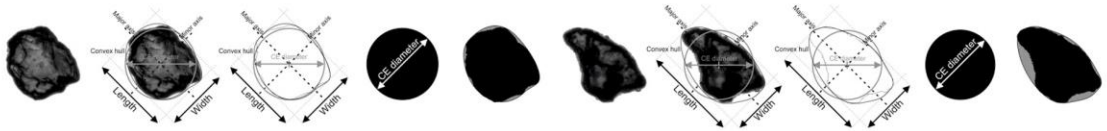
Research topics:
Paleoenvironmental and paleoclimatic reconstructions based on aeolian dust deposits; complex analyses of recent and past dust stroms, dust episodes



Automated static image analysis technique to identify Saharan dust particles within unconsolidated eolianites on Fuerteventura

CSFK

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Loess deposition and remobilization in an ice-marginal landscape

Randall Schaetzl[1], Garry Running[2], Phil Larson[3], Tammy Rittenour[4], Douglas Faulkner[2], Jarrod Knauff[1], Christopher Baisch[1], Samantha Kaplan[5]
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ABSTRACT

Considerable loess research has focused on systems of silt generation and eolian transport, and their ties to paleoclimate. In our study area in western Wisconsin, USA, just outside the Last-glacial margin, most of the silt was derived from broad outwash valleys and transported on westerly winds, often assisted by saltating sand. Normally, such systems lead to continuous blankets of loess downwind from the source area. Across the hilly, sandstone landscapes of western Wisconsin, this initial phase of loess deposition probably began shortly before the last glacial maximum and continued through the early period of glacial recession, ca. 23-18 ka. Across this ice-marginal landscape, much of this loess was deposited on ground rife with permafrost. We will argue that the landscape underlying this initial loess deposit was later destabilized by thawing permafrost, leading to widespread slumping and mass movement of loess across steep hillslopes, exposing loess deposits to strong winds and saltating sands. Our data will show that this combination of events and circumstances led to widespread landscape instability, facilitating reentrainment of this "initial" loess during a secondary period of silt transport. Much of this loess, which we refer to as "secondary" loess, was deposited at sites farther downwind. Because of the hilly topography and assumedly strong winds at this time, transport and deposition of much of this secondary loess was strongly influenced by the bedrock topography. Thick deposits of secondary loess, often burying "primary" loess below, formed in protected sites on the lee (SE) sides of the highest hills. These deposits approach thicknesses of 7 m. Conversely, the northwest-facing hillsides were windswept and are today loess-free. Ventifacts are commonplace on this landscape, attesting to a period of strong winds and widespread erosion. The result of these eolian depositional-erosional events is a loess cover that is highly spatially variable, and in places, of two distinct ages.

We report on stratigraphic data from one of the thickest loess sites in the region, where >5 m of loess cap a hilltop. Western and northwestern flanks of this hill are loess-free. Our down-core data on texture and geochemistry, as well as OSL ages, clearly indicate a stack of younger, sandier loess overlying a siltier, older unit. The broader implications of this loess "stack," all of it entirely postglacial in age, will be the focus of this paper.

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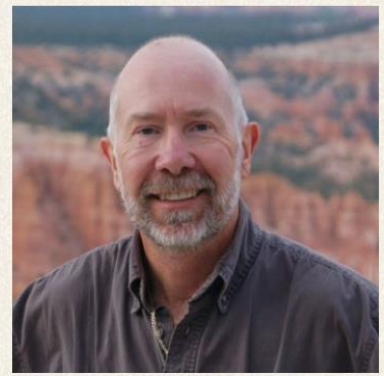
Randall J. Schaetzl



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A tale of two dune fields: dust emission processes from White Sands, New Mexico and Monahans, Texas, USA

Mark Sweeney[1], Steven Forman[2], Eric McDonald[3]
[1]University of South Dakota, Vermillion, USA. [2]Baylor University, Waco, USA. [3]Desert Research Institute, Reno, USA

ABSTRACT

Research focusing on dust emissions from eolian dunes has recently increased as researchers recognize the importance of improving global emissions estimates and detailed characterization of dust sources. The well-sorted nature of eolian sand has precluded dunes from being considered as major sources of dust because most dune fields contain a very low percentage of dust-sized material. However, dust emission potential of dune fields can be quite variable on a landform scale, related to grain size distribution, mineralogy, and processes contributing to grain abrasion during saltation transport. We used the Portable in situ Wind Erosion Lab (PI-SWERL) to measure the PM-10 dust emission potential from a variety of geomorphic units comprising two dune fields: the White Sands dune field in New Mexico, dominated by gypsum, and the Monahans dune field in West Texas, dominated by quartz. These dune fields contain landforms with variable sedimentologic properties, including large active dunes, protodunes and sand sheets, stabilized and vegetated dunes, and fine-grained interdunes. Deflation of playa at White Sands leads to low-relief protodunes to well-developed dunes. The eolian sand is well sorted and contains <1.5% fines. The Monahans dunes are sourced from the Pecos River and transition from low relief vegetated sand sheets with >10% fines, to vegetated parabolic dunes, to active and partially stabilized dunes containing <3% fines at the dune field core. PI-SWERL tests reveal that Monahans sand sheet would be a prolific dust emitter if the vegetation was destabilized (1.21 mg m^{-2} s^{-1} PM-10). Vegetated parabolic dunes are moderately emissive (0.31 mg m^{-2} s^{-1}), while active dunes have relatively low dust fluxes (0.03 mg m^{-2} s^{-1}). White Sands dunes are moderately emissive (0.36 mg m^{-2} s^{-1}), with fluxes comparable to vegetated parabolic dunes of the Monahans. Dust emissions from the Monahans sand sheets and parabolic dunes are largely driven by the liberation of resident fines during saltation. Dust emissions from the dune field core are likely driven by abrasion of sand that removes grain coatings, as well as minor chipping and spalling. White Sands dust emissions are likely driven by significant chipping and spalling of soft gypsum grains that become more equant downwind. Active dunes likely contribute to high ambient dust concentrations in desert environments, but with persistent drought or landscape disturbance by the growing oil and gas industry in West Texas, sand sheets could become significant dust producers in the future. White Sands occasionally generates large dust storms that cause visibility and respiratory problems for nearby populations. Conditions during the 1930s Dust Bowl drought may have resulted in wide-scale deposition of White Sands-derived dust. Our results indicate that dust emissions from dune fields can be highly variable, highlighting the importance of landscape-scale properties in dust emission estimates.

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Research Interests:

I conduct a variety of research projects related to sedimentology & geomorphology. My expertise is in the generation, transport and deposition of dust.

A review of Lake-Dust-Snow dynamics “from sources to sinks” in the semi-arid Bonneville Basin, Utah, USA

Kathleen Nicoll
University of Utah, Salt Lake City, USA

ABSTRACT

The Great Basin physiographic province is the largest desert region in the USA, and a known source area for windblown dusts, including aerosols, black carbon, nutrients, and mineral particles. This paper reviews what is known about dust composition, atmospheric loading and fluxes “from sources to sinks.” Within this semi-arid region, intermountain cyclonic storms and aeolian dynamics are important drivers of dust entrainment and transport. In the 1930s, Utah newspapers reported spring cold front passages and dust storms that caused it to “rain mud.”Various studies on the prevailing winds and synoptic meteorological conditions relate the development of strong intermountain cyclones with elevated wind speeds and dust storm events. Dust event days (DEDs) peak in frequency during spring months (March-April) when southerly ‘Hatu winds’ blow.

Key source areas providing dust for transport downwind to the populated regions of Utah were identified by assessing 51 DEDs that affected air quality in Salt Lake City during the 2004-2010 period. Among the recurrently active “hotspot” areas prone to dust emission are: barren and sparsely vegetated land; fallow fields; playa (ephemeral lake) surfaces relict from Pleistocene Lake Bonneville (per G.K. Gilbert); and areas disturbed by wildfire, agriculture, vehicular traffic, and military activities. Intensified winds enhance dust outputs downstream of mountain gaps, or along fetches with higher wind speeds from terrain contouring. Enhanced dust production occurs after severe drought and/or disturbance by wildfire, agriculture, and military activity. The 2007 Milford Flat Burned Area (Utah’s largest wildfire) actually generated more dusts after revegetation techniques disturbed soil via drilling, chaining, and herbicide use.

Dust storms may deposit materials on montane snowpack; Dust-On-Snow (DOS) affects surface albedo and radiative properties and may increase melt rates, causing an earlier “snow-free” date by up to a month, causing higher peak streamflows. Dust-forced changes in hydroclimatology can adversely impact Salt Lake City, which relies on seasonal snowpack in the Wasatch Mountains as their main water supply.

An intense intermountain cyclone affected the Salt Lake City, UT region on 14-15 April 2015, providing a case study of a DED from inception to dust deposition on montane snowpack. Analyzing the “Black Tuesday” storm from “cradle to grave” or “source to sink” enabled real-time documentation of storm development, dust-source emission and associated DOS in the Wasatch Mountains. We resolved particle size, elemental composition, albedo and radiative properties of samples of a single specific dust storm event layer . Plumes observed on MODIS imagery indicate dust mobilization from known point sources in the Escalante Desert, Sevier Lake region and modern playas within Paleolake Bonneville Basin. Snowpack dust includes metals sourced to urban and industrial activities, including heavy metals (Cu, Pb, As, Cd, Mo, Zn) common in regional mine operations.

Associate Professor, Geography Department

Affiliated Faculty, Middle East Studies Program

Curriculum Vitae

Biosketch

Short-range aeolian transport in high mountain environments: an overlooked phenomenon

Guido Stefano Mariani[1], Andrea Zerboni[1], Onn Crouvi[2], Mauro Cremaschi[1], Luca Trombino[1]
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ABSTRACT

Wind action in mountain environments is a topic seldom investigated from geomorphological and geopedological standpoints. Mountainous environments are known as a loess source during glacial phases and as a potential sink for long-range (hundreds to thousands of km) contribution of dust and volcanic ashes (e.g., Saharan dust to the Alps and Pleistocene tephras over European mountains). However, the short-range (tens to hundreds of km) transport of aeolian materials within mountain environments during cool and dry phases is poorly understood and in general downplayed in the larger system of wind deposition dynamics. When climatic conditions shift towards increasing aridity, the potential for aeolian activity in these environments greatly increases. Moreover, the complexity of topography in these regions offers ideal conditions for development of intense localised air fluxes. As a result, systems of micro-sources and micro-sinks take form, changing in intensity and shifting in space with the variation of local air circulation patterns, often climate induced. Processes of denudation and loss of vegetation cover as a consequence of cool and dry periods strongly contribute to the mobilization of aeolian material and its redeposition over short distances.

We investigated the geomorphological setting of a mountain ridge in the high Northern Apennines (Cusna Ridge, Italy) characterised by strong constant winds perpendicular to the direction of the ridge itself. A detailed field geomorphological and soil survey allowed to find evidence for aeolian sources and deposits. On the summit of the ridge, we found multiple deflation areas tens of meters wide, which signal the action of intense wind erosion. Evidences of dust deposition were found in the adjacent soils: a discontinuous and distinct layer of recently deposited fine sand and silt covers the ridge top itself. We relate this layer to a combination of low-energy colluvial activity and short-range wind transport from lower elevations. In one soil sequence, analytical data from sedimentological and micromorphological analyses allowed to observe four different phases of deposition with possible aeolian contributions. These phases potentially correspond to short-timed Holocene periods of denudation and deflation triggered by enhanced wind strength.

The provenance of loess-palaeosol sequences along the Middle and Lower Danube

Kaja Fenn[1], Ian Millar[2], Julie Durcan[1], David Thomas[1,3,4]
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ABSTRACT

Sediment provenance can be a powerful tool in understanding sediment system dynamics, and through them, climate. Loess sequences preserve evidence of source regions, and therefore can be used to investigate and quantify the production, transport and deposition of dust during the past. These investigations can also provide insights into sedimentary dynamics on a range of scales, from local to continental. By complimenting these understandings of sediment processes and provenance with chronologies, we can quantify rates of process over the longer term, which is crucial when using loess as palaeoclimatic and palaeoenvironmental proxies.

Here we present the results of a provenance analysis from three loess-palaeosol sequences along the Danube. Erdut (Croatia), Surduk (Serbia), and Slivata (Bulgaria) were selected to investigate source variability along the Danube River. This research is predominately focused on single grain detrital zircon techniques, which have greatly advanced our understanding of the Chinese Loess Plateau's provenance (c.f. Nie et al., 2015). We provide the results of U-Pb dating combined with Hf isotopes from single grain zircons obtained from multiple loess-palaeosol units. By supplementing this work with chronologies based on Optically Stimulated Luminescence (OSL) dating we are able to investigate provenance changes over time at each site. Finally, single grain zircon analysis is combined with the results of bulk sample trace elements, and Nd-Sr isotopes to achieve a better understanding of source regions. We also compare our new single-grain zircon datasets with existing published potential source geochemical records to explore the primary sediment sources and sediment transport pathways on a source to sink scale.

Why are soils in Loess-Paleosol-Sequences in Southern Tunisia sandy?

Dominik Faust[1], Alexander Fülling[2], Georg Mettig[1], Maximilian Pachtmann[1], Joes Manuel Recio Espejo[3], Sascha Meszner[1]
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ABSTRACT

The Sahara is the world's largest hot desert and therefore it is and was one of the biggest global dust emitter today and during the past. Several environmental archives indicate fluctuations of aridity during the Quaternary. The interpretation of Loess-Paleosol-Sequences (LPS) may help to enlarge our understanding of this fluctuations.

Thick and widespread distributed Desert Margin Loess-deposits are quite rare. In surrounding areas of the village of Matmata in southern Tunisia, Quaternary Loess deposits are still preserved. Especially valley and depression floors are covered by up to 30 m of clayey and silty Loess with intercalated sandy Paleosols.

Our first results from the Matmata loess area in Southern Tunisia will be presented aiming to reconstruct the Quaternary environmental changes between Loess deposition and soil formation.

More than 11 LPS have been investigated so far in order to build up a solid loess stratigraphy for this region. The deposits show a clear internal stratigraphy of loess units interrupted by intercalated reddish sandy paleosols. These soils have clear features of $CaCO_3$-leaching in the main soil horizon, whereas lower parts show a strong enrichment of carbonate (Cc-Horizon).

These features should be a result of more humid conditions under which soil formation could happen in contrast to arid loess forming environments. However, soils and loess within the same sequence show distinct analytical results. A look into the sediment sources may contribute to understand this phenomenon.

Our chronostratigraphy frame will be based on several OSL age estimations.

Fingerprinting the sources of aeolian deposits in northern China by using trace elements composition of detrital quartz

Yuan Shang[1,2,3], Anu Kaakinen[2], Tobias Fusswinkel[4], Maarten A. Prins[3], Christiaan J. Beets[3]
[1]East China Normal University, Shanghai, China. [2]University of Helsinki, Helsinki, Finland. [3]Vrije Universiteit Amsterdam, Amsterdam, Netherlands. [4]RWTH Aachen University, Aachen, Germany

ABSTRACT

The thick loess and Red Clay deposits in northern China preserve unique records of past climate changes and atmospheric circulation during the Quaternary and Late Neogene. Provenance analysis of these sediments is essential for understanding the wind patterns, climate conditions and tectonic activities of northern China during the Cenozoic Era. A variety of tools have been applied to investigate the sources of these aeolian deposits, including grain-size analysis, whole bulk geochemistry, heavy mineral assemblage, isotopic composition and single grain zircon U-Pb chronology. Among these methods, detrital zircon U-Pb dating has been increasingly used because of its advantage in distinguishing multiple sources for the sediments. However, as a heavy mineral, zircon grain cannot be transported with bulk sediments over long distance. Such hydraulic/ density property of zircon may bias the results interpretation towards proximal source regions.

Quartz is one of the primary rock-forming minerals during the rock cycle and is relatively resistant to weathering during transport. Compared to the heavy zircon, it has a much lower density, which means that it can be easily transported over long distances during aeolian processes, and can thus be potentially indicative for the relatively distal source areas. The major advantage of using quartz for provenance analysis is that it is the major component of the Asian dust and it travels with the bulk of the sediments. Therefore, provenance analysis based on quartz grains will provide more complete information about the dust sources and travel history of the sediments, compared to that of zircon. In this study, we introduce a new approach based on *in-situ* trace element analysis of detrital quartz, using laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS) to characterise the provenance of the Chinese aeolian loess and Red Clay deposits.Three trace elements in quartz: Li, Sc and Ti are analysed. The comparison of trace elements in quartz between desert sand of the potential source areas, the Quaternary loess and late Miocene-Pliocene Red Clay has yielded results that are consistent with zircon U-Pb ages. The results indicate Qaidam Basin has a similar trace element distribution in the quartz to that of the Quaternary loess of the Mangshan Plateau and also suggest a possible dust supply from the Taklimakan Desert to the Baode Red Clay. This study sheds new light on the application of in situ quartz trace element analysis by LA-ICP-MS in tracking the sources of the bulk of wind-blown sediments.

Yuan Shang
11.96 · PhD

Overview | Research | Experience New | Scores

About Yuan

Disciplines

Geology | Paleoclimatology | Geochemistry

Skills and expertise (8)

Climate Change | Sediments | Isotope Geochemistry | Climate Reconstruction | Sediment Transport | Sedimentary Geochemistry | Grain Size Analysis | Monsoon

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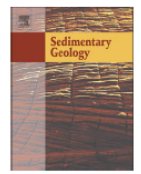

Special Issue Contribution: ANALYSIS OF SEDIMENT PROPERTIES AND PROVENANCE

Aeolian silt transport processes as fingerprinted by dynamic image analysis of the grain size and shape characteristics of Chinese loess and Red Clay deposits

Yuan Shang [a,b,*], Anu Kaakinen [a], Christiaan J. Beets [b], Maarten A. Prins [b,**]

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The Central Andes primary dust sources of the Chaco-Pampean loess (South America)

Daniela M. Kröhling
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ABSTRACT

The loess of the Chaco-Pampa Plain (Argentina) is the most extensive and voluminous dust archive in the Southern Hemisphere, providing mineralogical, physical and chemical information on transported dust. The Pampean Aeolian System (PAS) generated during the Last Glacial Maximum (LGM), represents the largest Quaternary aeolian system of South America (ca. 600,000 km^2), forming by a loess belt and a sand sea. Stratigraphic and sedimentological studies of Pampean loess units have been applied to understand the provenance of dust. The grain-size trend in SW-NE direction, the mineralogical association, and the geochemical data are indicators of multiple sources of the LGM loess. Some geomorphological units of the Central Andes were identified and characterized as the main primary sources. Dust emission of key areas of the Andes and the characteristics of their dust sink region in the Late Quaternary sedimentary archives (loess, wetlands and soils) were investigated. A significant geomorphological control on dust emission is observed. Field studies on representative areas, the installation of sediment sampling towers linked to a meteorological station, and GPR surveys have enhanced the understanding of surface process geomorphology on present-day dust sources identified by other authors using remotely sensed products. The hyper-arid Altiplano/Puna Plateau, ca. 1,500 km long and 300 km wide and with an average elevation of ca. 4,100 m a.s.l., is one of the main dust sources of the Central Andes, also being a present active area of dust. It comprises extensive sedimentary basins that are internally drained, formed by ignimbritic rocks and volcanic calderas. Tectonic depressions are occupied by Quaternary dry lakes (playas), alluvial fans, sand dunes, outwash plains and hypersaline lakes. The Southern Puna Plateau (25°-27°S; 68°30´-66°30´W) shows impressive Late Quaternary aeolian landforms as the largest megaripples on Earth, gravel dunes, yardangs and aeolian scars indicating a NW–SE wind direction. Particularly, the Purulla depression (NW Argentina) represents a unique natural laboratory for the evaluation of the dust exported to the lowlands, with a registered net loss of ca. 4 m of volcanoclastic sediments and ignimbrites. Salt pans of Puna also show large evidence of deflation process during the Holocene. Other important dust areas in South America are the arid Southern Central Andes and North Patagonia (Western Argentina). Silt-producing mechanisms as frost weathering, glacial grinding and fluvial comminution, mainly in the Andean upper basin of the Bermejo–Desaguadero–Salado fluvial system during the LGM, generated large volumes of clastic sediments that were transported by meltwaters along the eastern Andean piedmont and spreading out in terminal sand flats, ephemeral streams and wide alluvial plains. Their deposits were deflated by SW winds to the Pampa region. Changes in dust emission and mobilization reflect the occurrence of different processes.

O-3043 09:00 - 09:15

The geomorphology, controls and dynamics of southern African dust sources.

Frank Eckardt
Univesrity of Cape Town, Cape Town, South Africa

O-3044 09:15 - 09:30

Intersections between wind regimes, topography and sediment supply: Perspectives from Central Asian dunes and dust

Kathryn Fitzsimmons[1], Maike Nowatzki[1,2], Hartwig Harder[1], Aditi Dave[1], Charlotte Prud'homme[1], Tobias Sprafke[3], Yue Li[4], Saida Nigmatova[5]
[1]Max Planck Institute for Chemistry, Mainz, Germany. [2]University of Tübingen, Tübingen, Germany. [3]University of Bern, Bern, Switzerland. [4]Institute of Earth Environment, Chinese Academy of Science, Xi'an, China. [5]Institute of Geological Sciences K Satpaeva, Almaty, Kazakhstan

O-3045 09:30 - 09:45

Loess, dust, parna: unravelling the conceptual continuum in Australasia for improved paleoenvironmental reconstruction in the Quaternary.

Carol Smith[1], Stephen Cattle[2]
[1]Lincoln University, Christchurch, New Zealand. [2]University of Sydney, Sydney, Australia

O-3046 09:45 - 10:00

New Zealand as a potential source of mineral dust to the atmosphere and ocean during glacials

Bess Koffman[1,2], Steven Goldstein[2], Gisela Winckler[2], Michael Kaplan[2], Louise Bolge[2], Merry Cai[2], Toby Koffman[2], Cristina Recasens[3]
[1]Colby College, Waterville, USA. [2]Lamont-Doherty Earth Observatory, Palisades, USA. [3]Almac Group, Craigavon, United Kingdom

O-3047 10:00 - 10:15

Automated static image analysis technique to identify Saharan dust particles within unconsolidated eolianites on Fuerteventura

György Varga[1], Christopher-Bastian Roettig[2]
[1]Geographical Institute, Research Centre for Astronomy and Earth Sciences (MTA) , Budapest, Hungary. [2]Institute of Geography, Dresden University of Technology, Dresden, Germany

O-3048 10:15 - 10:30

Loess deposition and remobilization in an ice-marginal landscape

Randall Schaetzl[1], Garry Running[2], Phil Larson[3], Tammy Rittenour[4], Douglas Faulkner[2], Jarrod Knauff[1], Christopher Baisch[1], Samantha Kaplan[5]
[1]Michigan State University, East Lansing, USA. [2]University of Wisconsin - Eau Claire, Eau Claire, USA. [3]Minnesota State University, Mankato, USA. [4]Utah State University, Logan, USA. [5]University of Wisconsin - Stevens Point, Stevens Point, USA

O-3049 10:30 - 10:45

A tale of two dune fields: dust emission processes from White Sands, New Mexico and Monahans, Texas, USA

Mark Sweeney[1], Steven Forman[2], Eric McDonald[3]
[1]University of South Dakota, Vermillion, USA. [2]Baylor University, Waco, USA. [3]Desert Research Institute, Reno, USA

O-3120 11:30 - 11:45

A review of Lake-Dust-Snow dynamics “from sources to sinks” in the semi-arid Bonneville Basin, Utah, USA

Kathleen Nicoll
University of Utah, Salt Lake City, USA

O-3121 11:45 - 12:00

Short-range aeolian transport in high mountain environments: an overlooked phenomenon

Guido Stefano Mariani[1], Andrea Zerboni[1], Onn Crouvi[2], Mauro Cremaschi[1], Luca Trombino[1]
[1]Dipartimento di Scienze della Terra "Ardito Desio", Università degli Studi di Milano, Milan, Italy. [2]Geological Survey of Israel, Jerusalem, Israel

O-3122 12:00 - 12:15

The provenance of loess-palaeosol sequences along the Middle and Lower Danube

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[1]University of Oxford, Oxford, United Kingdom. [2]NIGL, British Geological Survey, Keyworth, United Kingdom. [3]University of Witwatersrand, Johannesburg, South Africa. [4]East China Normal University, Oxford, China

O-3123 12:15 - 12:30

Comparative study of silt production under Natural and Simulated conditions

Raj Kumar
Geology and Mining Department , Jammu, India

O-3124 12:30 - 12:45

Why are soils in Loess-Paleosol-Sequences in Southern Tunisia sandy?

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O-3125 12:45 - 13:00

Fingerprinting the sources of aeolian deposits in northern China by using trace elements composition of detrital quartz

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[1]East China Normal University, Shanghai, China. [2]University of Helsinki, Helsinki, Finland. [3]Vrije Universiteit Amsterdam, Amsterdam, Netherlands. [4]RWTH Aachen University, Aachen, Germany

O-3126 13:00 - 13:15

The Central Andes primary dust sources of the Chaco-Pampean loess (South America)

Daniela M. Kröhling
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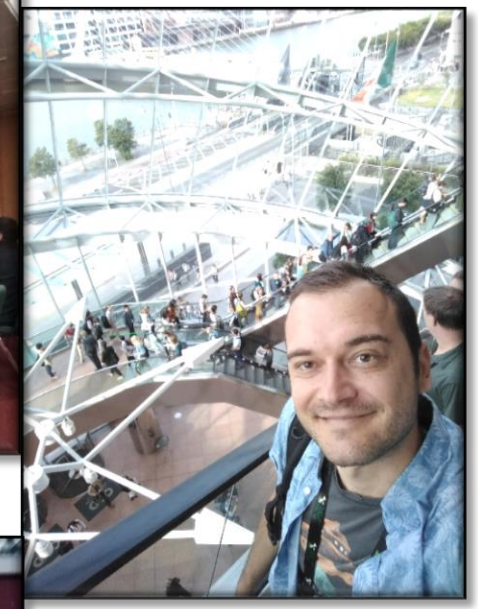


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