Geophysical Research Abstracts
Vol. 16, EGU2014-10387, 2014
EGU General Assembly 2014

A persistent Moisture Barrier on the Tibetan Plateau – Implications for the Northward Extent of Monsoonal Precipitation

Arne Ramisch (1), Bernhard Diekmann (1), Kai Hartmann (2), Frank Lehmkuhl (3), Gregori Lockot (2), Philipp Schulte (3), Georg Stauch (3), Bernd Wünnemann (2,4), and Yongzhan Zhang (5)

(1) Alfred Wegener Institute Helmholtz Centre for Polar and Marine Research, Potsdam, Germany, (2) Institute of Geographical Science, Free University of Berlin, Berlin, Germany, (3) Department of Geography, RWTH Aachen University, Aachen, Germany, (4) Nanjing Integrated Centre for Earth System Science, Nanjing, China, (5) School of Geography and Oceanography, Nanjing University, Nanjing, China

The spatial extent of monsoonal precipitation generated by air masses of the Indian Summer Monsoon (ISM) has great impact on glacier dynamics, river water budgets and vegetation dynamics on the Tibetan Plateau. There are immanent problems to determine the northward extent of ISM precipitation based on climatological evidence. These difficulties arise because of overlapping monsoonal systems and the lack of suitable provenance indicators of air-borne waters. So far, limiting factors are only known in a theoretical sense. Here we present paleoenvironmental evidence for a temporally persistent limitation for the northward migration of moisture bearing air masses on the Tibetan Plateau as evidenced by lacustrine sediments.

We analyzed the provenance of inorganic lacustrine sediments of Lake Heihai (Northern Tibetan Plateau) located in an intramontane basin in between two east-west orientated mountain ranges, perpendicular to the main trajectory of ISM influence: the Kunlun mountains in the south and the Burhan Buda Mountains in the north. We collected surface samples from alluvial fans, creeks and rivers of the catchment and applied a Fuzzy C-Means (FCM) clustering algorithm on the mineralogical composition of the minerogenic detrital fraction. Three major potential sources of inorganic sediment supply are inferred: (a) glacially mediated, far-distant transport from the southern mountain range, (b) precipitation-generated, local runoff from the southern mountain range and (c) close-distant transport of granite weathering products from the northern mountain range. The mineralogical similarities of Holocene lacustrine sediments to clusters a-c reveal a spatial asymmetry in sediment supply to Lake Heihai: while precipitation-generated and glacial melt-water runoff from the southern range are predominant sources of inorganic lacustrine sediments throughout the Holocene, sediment supply from the northern mountain range is insignificant. The findings suggest a northward blockage of moisture-bearing air masses through an orographic effect, induced by the Kunlun Mountain barrier.

We quantified the orographic effect by modelling the mean vertical uplift of air masses migrating along the main ISM trajectory across the barrier at the study site. A preliminary supra-regional comparison of the results implies that the barrier extends further in latitudinal direction with equal or higher orographic forcing on air masses compared to the study area. The spatial and temporal persistency of the moisture barrier suggests that there are regional orographic constraints on the maximum extent of ISM precipitation over the Tibetan Plateau.