Coarse-grained mineral dust deposition provides evidence of increased wind speeds associated with more intense cyclogenesis during warm intervals of the late Holocene period in arid and semi-arid tracts of North America

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Date: May 8, 2020
Paper no: EGU 2020-190
Session: AS3.8– Aeolian dust: Initiator, player and recorder of environmental change

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Acknowledgements: A. Pollen, A. Pedrazza, LaCore, J. Sickman and J. Neff for providing samples and assisting with analyses

Background: Semi-arid regions across the world are expected to become drier over the coming decades. In several regions, particularly in the United States, megadroughts, which are known to have significant impacts on soil loss, are projected to become more frequent. As such, it is critical that we understand how environmental (rainfall, wind patterns, soil moisture, etc.) and human (land use changes such as agriculture and grazing) factors intersect in terms of dust emission in the dry regions of the United States. Such studies will have implications for understanding soil loss, air quality and regional climate impacts (both direct and indirect effects of mineral dust on radiative and cloud formation processes.

Objective: The goal of this study is to geochemically fingerprint and track deposition of fine and coarse fractions of mineral dust in alpine lakes of the arid and semi-arid interiors of the United States in order to understand how environmental and human factors in dust emission patterns

Sites and samples: We use samples from six well-studied cores (spanning the late Holocene) previously collected from alpine lake sites distributed across the arid and semi-arid regions of west, southwest, and the Great Plains of North America. Previous work with these cores has demonstrated that sediments in these sites are predominantly detrital and reflect aeolian processes with little to no impact of fluvial processes.

Methods: We have applied grain size analysis, followed by separation into fine and coarse fractions, and elemental analysis (major, minor and trace) to the fine and coarse fractions (using ICP-MS) in about 90 samples (~ 15 samples per site).

Results: We find that there are two major modes of grain size: less than 0.03 microns (fine) and greater than 60 microns (coarse). Furthermore, we find that the coarse grained fraction represents the bulk of total sedimentation rates. Elemental geochemistry documents that the coarse grained fraction was regionally sourced. The fine fraction was more difficult to finger print in terms of regional vs. remote sources

Conclusion: We find that more rapid accumulation of the coarser grain size fractions, sourced regionally, occurred during wetter intervals over the Holocene, which is consistent with scenarios of higher windspeed events, such as tornadoes, associated with stronger cyclogenesis (usually associated with increased wetness and moisture supply to the region). It is possible that intensive land use increased during wetter intervals leading to large particle transport during these intervals Bhattacharya et al (in prep)