Geophysical Research Abstracts,
Vol. 10, EGU2008-A-05062, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-05062
EGU General Assembly 2008

The significance of hilltop, eolian loess sequences in reconstructing dust sources, accretion rates and chronology: example from the Negev desert, EM

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Most studies of desert loess, including the loess of the northern Negev margins in southern Israel, Eastern Mediterranean, have focused on the relatively thick and ubiquitous valley-fill loess that integrates eolian and fluvial deposition and erosion histories in local drainage basins. Such mixed loess sequences can be ineffective and sometimes misleading in reconstructions of chronology and rates of dust deposition. Therefore, we focus on the identification and characterization of hilltop, primary eolian loess that is as close as possible to the dust itself. We used spectral remote sensing images (Landsat TM and ASTER sensors) and GIS analysis to distinguish between different loess types and to map the loess distribution. Five eolian loess sequences examined so far have very similar pedo-sedimentary units that are correlative across the 150 km of loess area. Using laser diffraction particle size analysis we found that all sequences have bimodal distribution with modes at 50-60 μm and 3-7 μm. The coarse mode is composed mostly of quartz grains and its amplitude increases in all sequences with time. This indicates an enhancement of a time-transgressive proximal dust source. As carbonates cover most of the Negev, the only potential proximal dust source for coarse silt – fine sand quartz grains are the sands that advanced into Sinai and the Negev concurrently to the loess accretion during the late Pleistocene, probably as a result of the Mediterranean shelf exposure. Therefore, we propose that coarse quartz grains of the loess were formed through eolian abrasion within and at

the margins of the advancing sand sea. The OSL ages indicate that the primary loess accretion begun in the middle Pleistocene (200-165 ka) as finer grain loess prior to the well cited loess formation period (70-10 ka). The loess accretion rates vary according to the distance and direction away from the sand dunes. These findings emphasize the importance of studying hilltop loess sequences for determination of dust sources and dust accretion chronology and suggest a clear association of loess with sand seas. We suggest that using the methodology developed in this study, of identifying hilltop loess sequences using remote sensing and GIS, combined with detailed field and laboratory analyses, will shed light on many loess regions in the world and their association with other eolian deposits.