Geophysical Research Abstracts,
Vol. 11, EGU2009-1812-1, 2009
EGU General Assembly 2009

Reconstructing Drainage Evolution in Response to Tectonic Deformation Along an Active Rift Margin Using Cosmogenic Exposure Age Dating of Desert Pavements

B. Guralnik (1), A. Matmon (1), Y. Avni (2), E. Zilberman (2), and D. Fink (3)

(1) Institute of Earth Sciences, Hebrew University of Jerusalem, Jerusalem, Israel , (2) Israel Geological Survey, 30 Malchae Israel st., Jerusalem, Israel, (3) AMS-ANTARES, Institute for Environmental Research, ANSTO, PMB1, Menai, 2234, Australia

Fragmentation and rearrangement of drainage basins, and stream reversal occur in response to tectonic forcing such as subsidence of continental rift valleys and uplift of rift shoulders. We present new cosmogenic data from the central Negev Desert, southern Israel, that sheds light on the relations between the tectonic history of the western margins of the southern Dead Sea Rift (DSR) and drainage basin evolution since the Pliocene. In the Pliocene a major north-oriented river system drained the Negev into the Dead Sea basin and collected tributaries that originated east of the DSR and flowed westward across the central Negev. Tectonic deformation along the western margin of the DSR that began in the Pliocene caused regional eastward tilting and reversal of these tributaries by the early Pleistocene. Zero regional gradients which prevailed during the reversal stage, were accompanied by the accumulation of red beds and lake deposits, currently found on progressively lower elevations towards the rift. The present elevations of these deposits record Quaternary subsidence. To constrain the breakdown history of the Pliocene drainage system and reconstruct Quaternary subsidence, we sampled mature desert pavement from 13 abandoned alluvial surfaces associated with the Plio-Pleistocene deposits. From each surface, hundreds of chert clasts were collected and amalgamated into a single sample. Seven samples were collected from the highest windgaps along major water divides, in which remnants of the early Pleistocene surface are preserved. Five of these samples yielded exposure ages that range between 1.9 Ma and 1.5 Ma. These ages bracket the collapse of the Pliocene drainage basin and suggest the eastward migration of this process. Six other samples which yielded ages that range between 1.3 Ma and 0.5 Ma were collected from alluvial terraces inset into the early Pleistocene surface. They indicate stages of incision of the present drainage system. Under conditions of long-term hyperaridity and the absence of soil and vegetation desert pavement chert clasts are continuously exposed at the surface and do not erode. Thus, their cosmogenic isotope concentration may reflect changes in production rate due to elevation changes during exposure. The assumption that desert pavements in our easternmost samples started developing at their current elevation yields extremely rapid and unrealistic subsidence rates (500-2000 m/My). By interpreting the cosmogenic isotope concentrations measured in these samples as partially being produced at higher elevations we infer an average, and reasonable subsidence rate of ̃130 m/My since 1.3 Ma. The detection of such a change in elevation is enabled due to the unique condition of continuous exposure and no erosion of the chert clasts in the desert pavement.