Geophysical Research Abstracts,
Vol. 11, EGU2009-13996, 2009
EGU General Assembly 2009

Understanding the erosion of semi-arid landscapes subject to vegetation change: a combined approach using monitoring, isotope and ^{14}C analysis

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The degradation of grasslands is a common problem across semi-arid areas worldwide. Over the last 150 years much of the South-Western USA has experienced significant land degradation, with desert grasslands becoming dominated by shrubs and concurrent changes in runoff and erosion which are thought to propagate further the process of degradation. Field-based experiments were carried out to determine how runoff and erosion vary at stages over a transition from a black grama (*Bouteloua eriopoda*) grassland to creosotebush (*Larrea tridentata*) shrubland at the Sevilleta NWR LTER site in New Mexico. ^{14}C and δ^{13}C analyses were carried out to investigate the age and potential provenance of eroded sediment.

Results show an overall increase in runoff and erosion over the transition from grassland to shrubland, associated with an increase in connectivity of bare, runoff-generating areas, although these increases do not appear to follow a linear trajectory. Erosion rates increased over the transition from grassland to shrubland, related in part to changes in runoff characteristics and the increased capacity of the runoff to detach, entrain and transport sediment. Over all plots fine material was preferentially eroded which has potential implications for nutrient cycling since nutrients tend to be associated with fine sediment. There are significant differences in the isotopic signatures of eroded sediment between the grass- and shrub-dominated plots. The positive correlation between event runoff and δ^{13}C signatures of eroded sediment that is consistent over plots 1, 3 and 4 suggests that the δ^{13}C signatures can be used to distinguish between changes in erosion dynamics over events of different magnitudes and over different vegetation types. ^{14}C analysis of sediment revealed that sediment eroded from all plots is considerably younger than the surface soils over all plots, which is likely to indicate that eroded sediments tend to source form very near surface areas that are enriched by the bomb spike ($>$105% modern), but also contain a mixture of eroded soils which are less enriched.