EROSION OF SURFACE-MINE-DISTURBED LAND AT HENRYETTA, OKLAHOMA: SOME PRELIMINARY RESULTS

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Today, over one half of America's coal is produced by strip-mine operations (1). In 1968, a national survey of surface-mine-disturbed lands indicated that 44% caused sediment pollution problems in the surrounding landscape. (2) This paper describes the preliminary results from a continuing study designed to discover the quantity and distribution of soil loss from some unreclaimed surface-mine-disturbed lands in eastern Oklahoma. The spoil banks selected for study are located near the town of Henryetta (S9 T11N R13E). They were created by the activities of two strip-mine operations: an Alkonak mine which operated from 1916 until 1924 and a mine opened by the McGinnis and Grafe Coal Company which operated from 1948 until the late 1950s. The two mines employed the same technique (3) to strip the same coal seam buried beneath the same amount (10-12 meters) of similar overburden (D^{50}, 0.1-1.0 mm) (cf. Figure 1). The two sites are adjacent and have a similar surface topography.

Two slopes were selected for study. One slope was situated on the older mine dumps, the other on the younger mine dumps. The two slopes were selected as being "typical" of ungullied, unvegetated, east-facing slope profiles in the area. The slopes have a local relief of 3.5 m, a length of 8 m, and a three-meter-maximum slope angle of approximately 34°. All these slope statistics lie very close to the current sample means computed during continuing morphometric studies of this area.

Erosion was monitored by means of erosion pins. (4) An erosion pin is a marker, in this case, a steel rod 600 mm long and 5 mm in diameter, driven into the soil to an exposure of *circa* 15 mm. The head of the erosion pin is counted a fixed reference and changes in its height are interpreted as changes in the elevation of the surrounding ground surface. Fifteen erosion pins were placed in five rows of three along each slope profile. Rows were established at two-meter intervals from basal channel

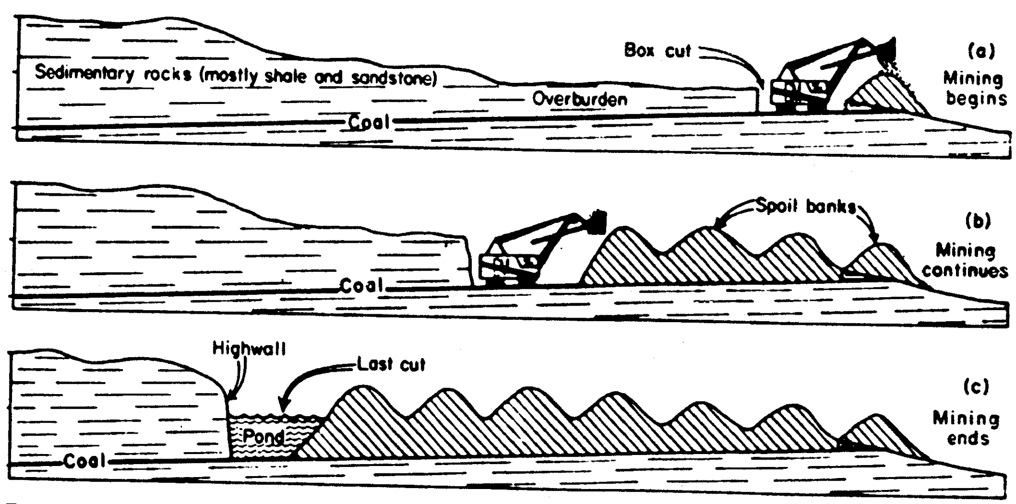

FIGURE 1. Creation of surface-mine spoil banks (3).

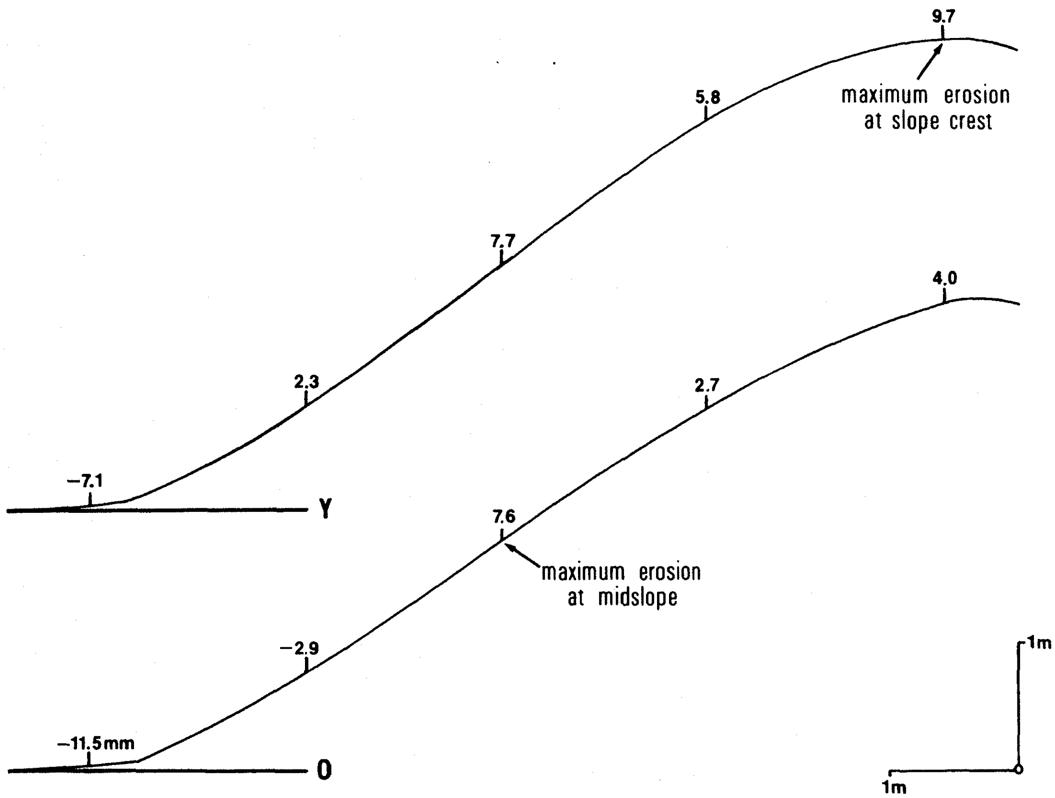

FIGURE 2. Erosion on instrumented slopes on surface-mine-disturbed land near Henryetta, Oklahoma. Ticks on profile shown position of rows of erosion pins; numbers indicate depth of erosion in millimeters; profile 'Y' is located on the younger site, 'O' on the older site.

to slope crest (Figure 2). The internal spacing within each row was one meter.

Data collection proceeded as follows: prior to recording a washer was lowered over the erosion pin and down to the ground surface. The function of this washer was to even out irregularities in the ground surface surrounding the pin. The difference in elevation between the washer's surface and the head of the erosion pin was recorded by means of a depth gauge. (4) Two records were gathered at each pin, one to its left, the other to its right, and the results averaged. Repeated recordings suggest that these records are accurate to 0.7 mm.

This experiment was begun on March 26, 1976. The first data collection was undertaken on July 14. The two records are separated by 121 days and the bulk of Oklahoma's spring rains. Okmulgee County receives an average rainfall of ca. 1030 mm. Normally, perhaps 45% (470 mm) of this might be expected to fall during the period of observation. However, these spring rains are characterized by their variability (range: 135-960 mm). Actual rainfall was 367 mm. Individual rainfall events tend to be intense. (5)

The data record suggests that both slopes suffered a very considerable soil loss during this initial period of observation. Overall, erosion was greater on the younger slope, which suffered an average surface lowering of 6.4 mm compared to 4.3 mm on the older slope. If it is assumed that the eroded soil has a specific gravity of 2.6, (6,7) then the soil loss equivalents to these ground retreat data are 166 tonnes/hectare and 112 tonnes/hectare respectively. These results are comparable with most of those gathered in similar studies of North American badlands (8, 9, 10) but are much smaller than the results gathered by Schumm's often cited classic study of disturbed lands near Perth Amboy, New Jersey. (11) This study reported a surface lowering of 28.9 mm (ca. 750 tonnes/hectare) in ten weeks of observation.

Figure 2 displays averages of the surface lowering measurements recorded for each row of erosion pins on both the younger (Y) and older (O) slope profiles. The mean deviation of individual records from their appropriate mean is 3.0 mm. Many studies of the erosion of disturbed land have reported that it is the slope crest where erosion is greatest. (11, 12, 13) These observations are echoed by the results from the younger of the instrumented slopes at Henryetta. The results from the older slope, however, show that erosion was greatest on the steepest part of the midslope. This observation is more in accord with the predictions of the classical soil loss equations which correlate erosion with slope angle. (14, 15)

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