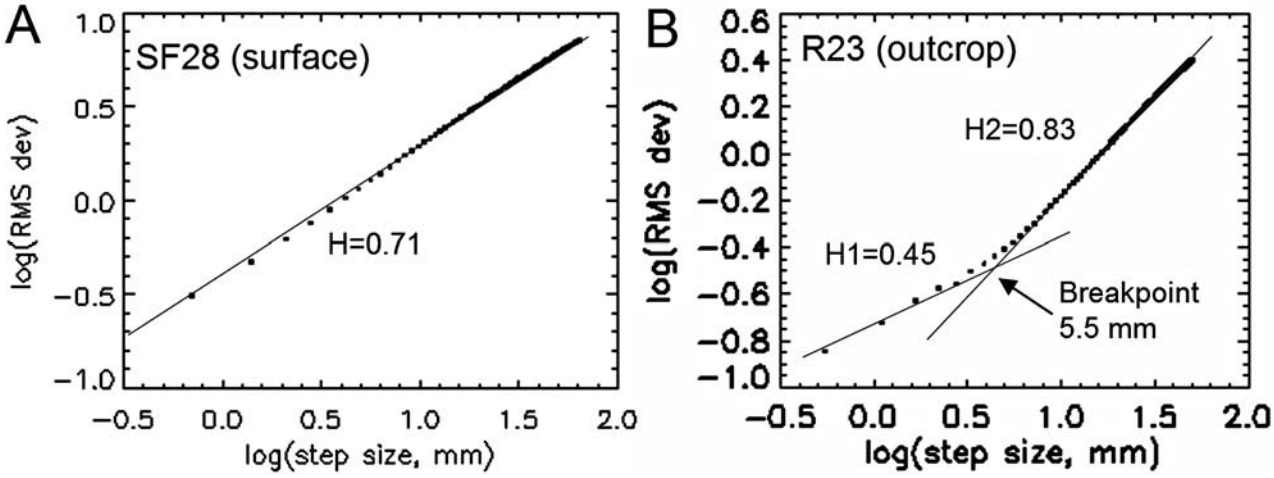

Figure 11. Sample deviograms from boulder surface digital elevation models from (a) a surface boulder mold (SF28) and (b) an outcrop boulder mold (R23). RMS deviation in millimeters is plotted in a log-log plot against the step size in millimeters. The Hurst exponent, *H*, corresponds to the slope of the line and indicates the rate at which roughness increases in the vertical direction as scale increases in the horizontal direction. In Figure 11b there is a breakpoint in scaling behavior at 5.5 mm indicating that different roughening scaling behavior exists at different scales.

seasonally and diurnally, alteration mineral distribution, and aspect of existing cracks and fractures.

[54] Incorporation of surface textural parameters provided a way to distinguish between the two flood-transported boulder populations, which was not possible considering only shape parameters. Both fractal and morphometric classification may thus be useful in assessing weathering processes and timescales. A lesson learned in acquiring boulder textural data is that future studies should generate DEMs directly from rock surfaces [e.g., *Bourke et al.*, 2008]. An artificial reduction in absolute roughness was a limitation we discovered for the molding technique. A possible explanation for the smoothness of both the cast and rock postcast in comparison to the pretreatment rock is disturbance of the uppermost millimeter of the original rock surface. Material on the original boulder may have been compressed or removed during application and peeling of the plaster. Consequently, the collected textural data set is not ideal for direct comparison with stereo data sets of rock surfaces from other sites. RMS height and deviation are likely biased lower and, therefore, in morphometric analysis, more planar features and fewer point classes (pit, peak, pass) are likely to be identified. Nevertheless, the textures of boulders at the Ephrata site can still be compared to each other with a high degree of confidence. Further, Hurst exponent and breakpoint behavior of roughness do not appear different in the rock surface versus the mold for the control rock, indicating these are likely accurate in an absolute sense.

[55] In RMS height and deviation values, quarry boulders are the smoothest and surface boulders are the roughest at all scales. This is consistent with the hypothesis that flood transported boulders were smoothed in transport but (re)roughened as breakdown proceeds in situ. Length of time of surface exposure may be proportional to roughness over the tens of thousands of years time period under consideration at the Ephrata fan. Assumed recent outcrop talus fall is smoother than boulders of the fan surface at all scales except 1 mm where they are roughly equivalent.

[56] Hurst exponent values ($H1$) may theoretically be in the range $0 \leq H \leq 1$. Hurst exponent values of $\sim$0.8 from Ephrata boulders are higher than values previously reported in the literature for topographic surfaces at much larger scales such as lava plains and lava flows (<0.7) [*Shepard et al.*, 2001]. However, this is not entirely surprising since the role of gravity in smoothing surfaces through mass wasting and erosion is more significant at meter to kilometer scales than at the submeter scales considered here.

Table 5. Summary Statistics for Fractal Behavior of Boulder Molds

		Hurst Exponent Behavior[a]			Breakpoint Behavior[b]			
	N (Deviation, Height)	$H1_{dev}$	$H2_{dev}$	$H1_{ht}$	Percent With Breakpoint	Percent With 2+ Breakpoints	Average Breakpoint 1 Scale, mm	Average Breakpoint 2 Scale, mm
Quarry	10, 10	0.80 ± 0.06	0.66 ± 0.07	0.82 ± 0.07	30	0	4.73 ± 1.76	–
Outcrop	9, 10	0.78 ± 0.06	0.63 ± 0.15	0.76 ± 0.05	56	22	3.26 ± 2.04	4.6
Surface	8, 10	0.79 ± 0.05	0.74	0.79 ± 0.06	13	0	13.18	–

[a]Here dev refers to the values from RMS deviation, and ht refers to the breakpoint value from plots of RMS height as a function of window size.
[b]Breakpoint behavior was determined from plots of RMS deviation since no breakpoints were observed over the sampling interval for RMS height.