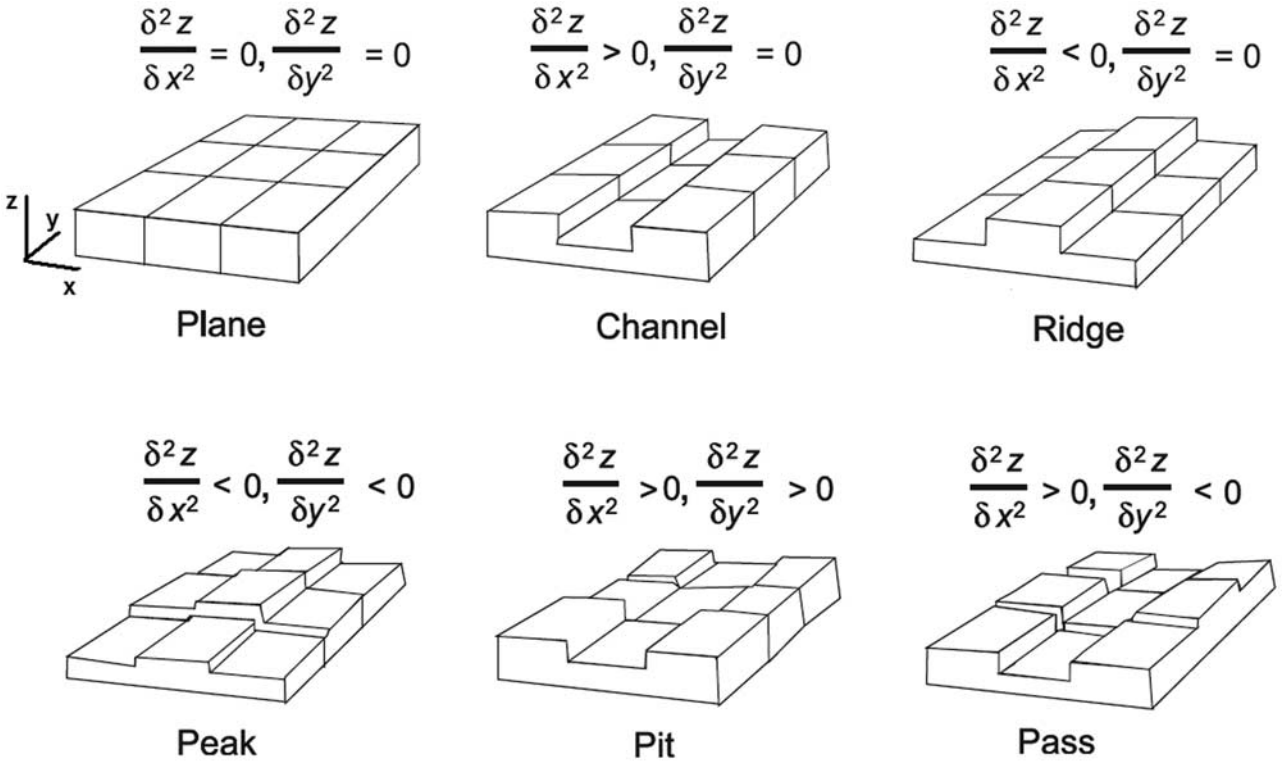

Figure 4. The six morphometric classes as defined by the second derivatives in the x and y directions. Classes are shown for a window size of 3 × 3 pixels. (Modified from *Wood* [1996] and *Bolongaro-Crevenna et al.* [2005].)

That is, the values for RMS height or RMS deviation scale as

$$\xi(L) = \xi_0 L^H$$
or
$$v(\Delta d) = v_0(\Delta d)^H.$$

These values of H are obtained from a variogram, a log-log plot of RMS deviation as a function of point to point distance. Low H values mean terrain smoothes rapidly as scale increases while high values indicate the surface maintains its roughness. Natural surfaces at the landscape scale typically have H values ~0.5, although many surfaces display "breakpoints" in scaling behavior where different H values apply over different scales. This is thought to be due to the dominance of different geomorphic processes at different spatial scales [*Shepard et al.*, 2001; *McClean and Evans*, 2000].

[28] For this study, RMS height and RMS deviation were calculated over multiple scales for boulder mold surfaces and deviogram log-log plots were produced. To ensure a sufficient number of independent samples, statistics were computed only from the sampling interval up to no more than 1/10th the scale of the entire surface. Using deviograms, breakpoints were identified and slopes evaluated to obtain H values of fractal scaling behavior. RMS deviation is reported at 1 mm and 1 cm intervals while RMS height is reported over square windows of side length 1 mm and 1 cm (areas 1 mm^2 and 1 cm^2).

3.3.2. Morphometric Classification of Geomorphic Features

[29] Surface relief can be described by the occurrence of distinct landforms [*Fisher et al.*, 2004; *Bolongaro-Crevenna et al.*, 2005]. *Wood* [1996] developed a methodology for landscape analysis of digital elevation models (DEMs) by creating a six class set of simple, mathematical morphometric forms: ridge, channel, plane, peak, pit, and pass. The numerical representations of these forms are based on the second derivatives in orthogonal directions at the central point over a given window size (Figure 4). Window sizes can be 3 × 3 pixels, 5 × 5 pixels, or greater to calculate the frequency of these morphometric forms at different spatial scales. These surface forms can be mapped on a digital elevation model (Figure 5).

[30] Each morphometric form is a "landform" which in the context of analysis of a boulder surface may correspond to a specific surface feature, e.g., a peak of a protruding phenocryst, a pit caused by impacts during fluvial transport, or channel-like depressions left by dissolution as water flows over a boulder surface. Morphometric class distribution may be related to the rock breakdown processes acting on the surface. The distribution of feature classes present in a landscape varies as a function of the scale of observation. To investigate such scaling behavior, we computed feature classification for a set of window sizes appropriate to the resolution of the digital elevation surface model and the size of the sample. Using *Wood*'s [1996] methodology and software (LandSerf, version 2.2, 2006, Copyright J. Wood 1996–2005, downloaded November 2005, available at