An empirical model is used to extract information on topography and geomorphic processes on the Cima Volcanic Field and associated pediment slopes. The three-dimensional model is based on cellular automata and implements a power law sediment transport rule. Using Digital Elevation Models (DEMs) as input, discrete particles, or waterbots, are routed over the topography and allowed to erode, transport, and deposit sediment. Because DEM resolution does not allow for distinction between channels and slopes, identical sediment transport rules are applied to each topographic cell of similar geology. Regions of capping basalt or pediment are assigned based on aerial photographs and field observations. The model is applied at time intervals sufficiently great to average over individual storms; thus, waterbots represent accumulated discharge events.

The current model yields insights into the erosional evolution of Cima Volcanic Field basalt flows and associated pediment slopes. Modification of waterbot sediment carrying capacity in areas of basalt together with flow concentration effects produces deep canyons that penetrate the capping basalt flows and underlying pediment. Denudation of the surrounding pediment proceeds unaltered. Steep-sided and locally flat floored canyons are produced by creating sediment transport thresholds in slope and waterbot concentration. Basalt flows are first dissected by headward eroding stream channels due to satisfaction of waterbot concentration thresholds. The basalt flow length-to-width ratio and surface roughness are shown to influence waterbot concentration and subsequent canyon spacing. As the surrounding pediment surface denudes and canyon incision progresses, waterbot concentration effects are reduced and the canyons widen due to satisfaction of the slope threshold. In addition, deflection of overland flow by features such as cinder cones and basalt flows produce upslope areas of decreased erosion or even deposition on the pediment surface. These stagnation zones result from the decrease in local slope associated with drainage deflection around the obstruction. Both canyons incised in basalt flows and stagnation zones are observable within the study area. Model outputs reproduce these features and suggest how a simple interplay between slope and concentration can produce complex geomorphic features.