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Impact of mass movements on valley shape and profile. Two examples from the Swiss Prealps and the Massif des Ecrins

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In many mountain areas, mass movements represent the main postglacial process regarding the geomorphologic evolution and reshaping of slopes and valley long profiles, more than fluvial processes. Two examples will be shown to illustrate two different evolution types related to different geological settings :
- The Vallée des Ormonts (Préalpes vaudoises, Switzerland) develops in sedimentary rocks (limestone and flysch). Around 30 % of the slopes (much more in the flysch zone) are affected by large scale mass movements (slides and DSGD) that have totally reshaped the U-shaped glacial valley slopes and induced long profile irregularities. Thanks to borehole data, the volumes of some of the main slides can be estimated. Numerous datings show that the largest movements started at the beginning of the Holocene.
- The valley of the Romanche and of the Vénéon (Massif des Ecrins, France) develops mainly in hard rocks (granite and gneiss). The deep U-shaped valley profile is preserved, but large localized mass movements (mainly rockfalls, but also slides and complex debris cones) dammed the main river at several locations, creating large alluvial plains. Almost all alluvial plains in the massif are due to mass movement dams. They represent large sediment traps. Their volume can not be estimated yet, due to the lack of geophysical data. The dating of several rockfalls is in progress, but the first results indicate mid-holocene ages.

The two examples permit to define two different evolution types : a slide dominated evolution in soft sedimentary rocks, and a rockfall dominated evolution in hard cristalline/metamorphic rocks. In the first case, fluvial and torrential processes are present but play a minor role. In the second case, torrential processes are very present and prominent regarding lateral inputs into the river system, together with debris supply by talus. In both cases, fluvial processes in the main chanel are strongly influenced by either progressive or sudden damming by mass movements.

Compared to general geomorphological evolution models, mass movements induce an opposite evolution, both on slopes and on river long profiles :
- On slopes, general models predict an evolution to convexo-concave slope profiles, whereas slides and DSGD, and in a lesser extent rockfalls, induce a concavo-convex profile, which increases with time in the case of slow and long lasting processes.
- On river long profiles, general models predict a smoothing towards a concave « equilibrium » profile, through the erosion of positive irregularities and the filling of negative ones. Mass movements induce damming effets that increase positive irregularities and induce large steps which raise in the case of progressive movements.
These effects of mass movements on landscape evolution are largely ignored by most of the classical geomorphology textbooks.

Regarding glacial geomorphology, mass movements can induce missleading landforms. The Vénéon and Romanche valley shows a long profile with alternating flat alluvial plains and steeper steps, a shape that has often been considered typical for glacial valleys. In this case however, and althoug it is obviously a glacial valley, almost all flats and steps are due to mass movement dams. There is only one identified rock knob (riegel).