Ground Penetrating Radar Investigation of Landslide Crown Subsidence

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Keypoints:
Ground Penetrating Radar provides an image of the invisible geometry of the subsided blocks; The Iikawa landslide subsidence troughs are subsiding faster at the centre of the trough;

Introduction and objective: Landslides in soils and bedrocks can be characterized by a typical semi-circular scarp at the summit, from which the moving block slides. This process is accompanied by sets of compression –e.g. buckling -, and decompression, notably in the vicinity of the crown. Decompression is associated with local subsidence, which is best evidenced and measured using sub-surface geophysical methods and tools, because the surface data reflects both the subsidence of the blocks and the colluvium accumulating over the subsided blocks. In the present contribution, the authors are investigating this process at Iikawa landslide in Shizuoka Prefecture, in order to define the geometry of the fractured and moving blocks, which are covered by a smoothing blanket of colluvium.

Methodology: For this purpose, the authors have used a Ramac-Pro-Ex Ground Penetrating Radar (GPR) mounted with a 250 MhZ shielded antenna. The distance over the ground was measured using the coding wheel of the GPR and field geodetic measurement. This confirmation task was also performed to acquire the topography. The topographic and geophysical data were then processed using the sequence (1) time zero initialization; (2) DEWOW to reduce the ringing effect of the surface; (3) background removal to suppress regular repeats; (4) Energy decay to compensate the energy loss with depth following a 0.21 factor; (5) AGC compensation with a 100 n.s. window and factors that changed between 1.17 and 1.34 depending on the radargram (battery effects seem to be one reason in the variability). The processed data was then exported as ASCII data and jpeg files for visual examination.
Result and discussion: Results from the three cross-transects recorded from a local trough immediately above the crown of the active face of the landslide are showing that (1) the trough is linked to subsided bedrock blocks that are covered by colluvium; (2) on top of subsidence along the landslide axis, the blocks show that the subsidence is more acute near the central axis, creating a u-shape staircase. As a discussion, the result indicates that the collapse is following the velocity line, or the path of least shear resistance, with the central part of the landslide deforming faster than the sides. In term of the geometry of the landslide, the stability is thus a function of the width of the landslide and the landslide scarp, as well as the planform arc-angle of the scarp.

Keywords: Ground Penetrating Radar, Landslide, Iikawa landslide

