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Author(s):

Häusler, Mauro ; Glueer, Franziska ; Burjánek, Jan; Fäh, Donat

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Chasing a hidden fracture using seismic refraction tomography: case study Preonzo, Switzerland

Mauro Häusler¹, Franziska Glüer¹, Jan Burjánek², and **Donat Fäh**¹

¹Swiss Seismological Service, ETH Zurich, Zurich, Switzerland (mauro.haeusler@sed.ethz.ch)

²Institute of Geophysics of the Czech Academy of Sciences, Prague, Czech Republic

The Preonzo rock slope instability in southern Switzerland partly collapsed in 2012, releasing a volume of ~210'000 m³ and leaving behind an unstable rock mass of about 140'000 m³. Shortly after the collapse, a small-aperture seismic array measurement was performed on the remaining unstable volume. The analysis of these data showed a fundamental resonance frequency of about 3.5 Hz and strong wavefield amplifications with factors of more than 30 in direction perpendicular to open tension cracks. Normal mode analysis by frequency domain decomposition using the fundamental and several higher modes allowed for mapping the fracture network of the instability.

However, the observed amplification factors and mode shapes could not be explained solely by the open tension cracks visible at the surface. Strong amplifications, especially at frequencies of higher modes, were observed on the uphill part of the rear fracture, which was supposed to be outside the presumed unstable area. The zone where amplifications rapidly decreased in the uphill direction coincides roughly with a geomorphological lineament in the field, interpreted as an additional, but hidden, rear fracture.

We performed active seismic refraction tomography across this lineament and discovered distinct low velocity anomalies in the transition zone from high to low amplifications, supporting the interpretation of an additional fracture. Considering this new finding, the volume of the unstable rock mass increases by about 40 %.