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CRE dating on the scarps of the large landslide of Séchilienne (French Alps): a synthesis to constrain the slope kinematics

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The 60 106 m3 Séchilienne landslide (Belledonne Massif, French Alps) is located on the right bank of the East-West trending Romanche valley that was shaped by glacial and alluvial processes during the Quaternary. The landside affects a mean 30° slope made of micaschists and overlooked by a glacial plateau at an elevation of 1100 m a.s.l. The plateau and the slope locally exhibit polished rocks resulting from the glacier erosion and are locally covered by till deposits and peat bogs. The 40 m high headscarp was dated by Le Roux et al. [2009], using the Cosmic Ray Exposure (CRE) method. Results revealed that the initiation of instability did not immediately follow deglaciation but occurred several thousand years after ice down-wastage in the valley, during the warm and wet Optimum Climatic period. More than 50 additional samples were collected from internal and lateral scarps, as well as on polished rock surfaces, with the aim of dating the glacier erosion effect and the kinematics of the landslide. The data analysis and interpretation turned out to be a sensitive work, owing to the regular block fall activity, which has locally refreshed some outcrops, and to the probable existence of thin moraine deposits that have masked the bedrock before being eroded. The interpretation of this exceptional set of 63 dating data provided the main following results:
1. The oldest ages obtained on polished rocks along the slope yield a glacial retreat rate of about 0.08 m/yr from 1120 to 873 m a.s.l.
2. Dating data on other major gravitational scarps support the first interpretation, that is, the initiation of the Séchilienne landslide occurred between 4.7 to 7.5 10Be ka.
3. Internal scarps and counter scarps were generally found to be significantly younger (1.6 to 3.5 ka), suggesting that the internal deformation took place after the headscarp gravitational rupture.
4. Numerous ages measured on samples from polished rock surfaces are unexpectedly young, confirming the presence of till deposits, the thickness of which could have reached a few meters.

Reference

Le Roux, O., S. Schwartz , J.-F. Gamond, D. Jongmans, D. Bourles, R. Braucher, W. Mahaney, J. Carcaillet, and L. Leanni (2009). CRE dating on the head scarp of a major landslide (Séchilienne, French Alps), age constraints on Holocene kinematics. Earth and Planetary Science Letters, Vol. 280, 236-245.