Cosmogenic $^3$He dating of the giant landslide of Tacna (Andes western margin, Peru)

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**Introduction - goal of the study**

Several giant landslides are reported on the western margin of the Andes, in Peru and northern Chile. It is important to understand the dynamics and the timing of these Quaternary formations, not only because landslides are natural hazards, but also because they could be used to get constraints on paleoclimate variations and, possibly, on the occurrence of past earthquakes. However, none of these landslides is directly dated and little is known about their triggering mechanisms. The goal of this work is thus to test the possibility of applying cosmogenic $^3$He dating to these landforms. Here we focus on the giant landslide of Tacna (Southern Peru).

**Geological settings**

The giant landslide of Tacna is placed on conglomerate of the western margin of the Andes, in Peru. The substratum conglomerate (Moquegua formation) is dated at ~2 Ma (Astin, pers. communication), which provides a maximum age for the landslide. The landslide is mainly made of cobble and boulders (see pictures), which are typical material of debrisflow. Many boulders are from andesite rock bearing pyroxenes and amphiboles, which are well-suited mineral for cosmogenic $^3$He dating.

**Conclusions**

Preliminary cosmogenic $^3$He ages from the giant landslide of Tacna indicate that:

* The erosion rate over this period of time remain limited (<5 m/Ma$^{-1}$), suggesting that the present-day hyper-arid conditions persisted during a long period of time.

**Future work**

* The measurement of another radioactive nuclide (such as $^{10}$B, $T_{1/2} = 1.3$ Ma) will permit to solve the production equation for both erosion and time.

* Numerical modeling of the landslide dynamics will probably permit to place constraints on the climatic conditions contemporaneous to the landslide emplacement: was this landslide the results of wetter conditions or a giant earthquake?

* Cosmogenic dating of other landslides in this region will provide important constraints about the recurrence time of these events.

**Cosmogenic $^3$He results**

These ages are calculated using a sea-level high latitude spallation production rate of 128 at/g/a (Blard et al., 2006). Geographic and geomagnetic scaling were done using (Stone, 2000) and (Dunai, 2001), respectively. These ages were obtained using an erosion rate of 0.1 m/Ma. The production from thermal neutron capture on $^6$Li by $^3$He was calculated following Phillips et al., 2001 and Dunai et al., 2007 and using a Matlab code kindly shared by Willy Amidon.