Supplementary Material

This supplementary material provides figures and movies complementary to those presented in the main manuscript. More specifically, supplement 1 gives information about mass transfer monitoring. Supplement 2 presents the physical properties of the granular material used in this study. Supplement 3 provides movies showing the evolution of two analog models with stable and stick-slip fault behavior.

Supplement 1 - Flow transfer monitoring

Figure S1 displays the evolution of the sediment mass for all analog experiments. This mass is measured on a scale to maintain a constant flux during the experiment (section 2.1). The sedimentary flux is controlled manually. The experiments last between 2 hours 15 minutes and 2 hours 30 minutes. In the first 15 minutes, the mass increases. Next, the mass stabilizes, ensuring a nearly constant sedimentary flux during all the experiments. One can note the exception of the Creep-2-a experiment, for which the sedimentary flux is not constant with a deviation peak of 2 grams after one hour.

Supplement 2 - Material physical properties

The physical properties of the used material are quantified using a modified Hubbert-type direct shear apparatus (Graveleau et al., 2011) to measure internal friction and cohesion under dry and wet conditions. Measurements are made using a water saturation of 20 ± 1% to reproduce the experimental conditions. Internal friction coefficient, cohesion, and density of the analog material are $\varphi = 20° \pm 10°$, $C = 600 \pm 400$ Pa, and $d = 1.5 \pm 0.1$ g.cm^{-3}, respectively.

Supplement 3 - Movie of the analog experiments

We provide two movies of analog experiments. These are made with snapshots every 30 s with the camera CCD Panasonic Gx80. Each snapshot has a resolution of 1000 x 635 pixels. The pictures are taken above the analog device and assembled with Quicktime pro. One second in the movie corresponds to 6 photographs; that is to say, one second in the movie equals 3 minutes in the experiment. Each movie lasts 50 seconds, 2.5 h in for the analog model.

The movie S3 is for the experiment Creep-2-b, and the movie S4 is for the experiment Earthquake-2-b (see figure S1 for the nomenclature of experiments). In the first 30 seconds of the two movies, the alluvial fan grows with no tectonics. Even at the beginning, the direction of sedimentary flux changes at the outlet, typical of an alluvial fan building. At 30 seconds (after 1.5 h of fan building), the tectonic begins. For the movie Creep-2-b, the increment of displacement is 6.2 microns every 2.23 seconds, and for the movie Earthquake-2-b, the increment of displacement is 500 microns every 180 seconds. In the tectonic phase, the fault appears on the surface 10 cm right from the outlet. A new alluvial fan in the footwall is formed. Also, the sedimentary flux is concentrated in the center of the hanging wall, and a central valley is formed. The tectonic phase lasts 20 seconds in the movie (00:30s to 00:50s), representing 1 hour in the analog model.

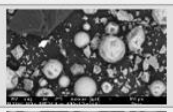
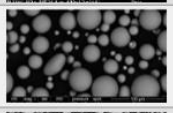
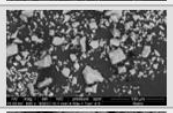
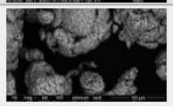
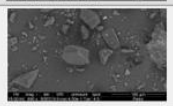
Material	Grains morphology (SEM)	Granulometry	Cohesion (Pa)	Internal angle friction (°)
Total mix		0 – 250µm D_{50} ≈ 75 µm	600 ± 400	20 ± 10
Glass microbeads		0 – 50µm D_{50} ≈ 25 µm	40	33
Silica powder		0 – 80µm D_{50} ≈ 43 µm	-	-
PVC		63 – 250µm D_{50} ≈ 147 µm	-	-
Pumice stone powder		0 – 40µm D_{50} ≈ 20 µm	50	43
Anthracite		0 – 160µm D_{50} ≈ 80 µm	-	-

Table S1. Material and component characteristics. The second column is a picture of the total mix and each ingredient on the electron scanning microscope (SEM). A part of the physical parameter measurements such as granulometry are taken from Graveleau et al. (2011).

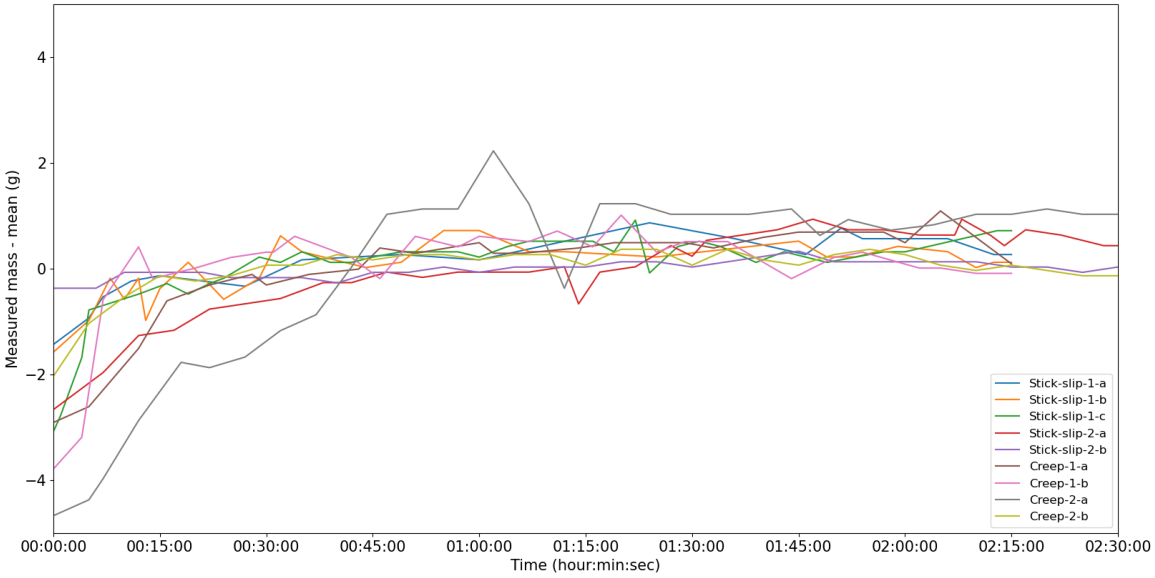


Figure S1. Time evolution of the mass of sediment during the analog experiments. The variations are relative to the mean mass measured over the first hour of the deposition period. The naming convention of experiments is (1) the fault slip mode stick-slip or creep, (2) the experiment sets number 1 or 2 - Set 1 has 1 hour of fan building phase and 1 hour and 15 min of tectonic forcing phase. Set 2 has 1 hour 30 minutes of fan building phase and 1 hour of tectonic forcing phase - (3) the letter a, b, or c for the order of the experiment in its set.