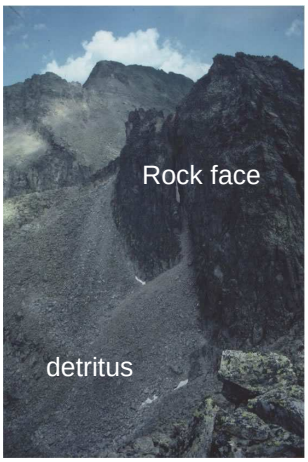
Experiment: Construction of a model of a rock glacier

What is a rock glacier?
A rock glacier is not a usual glacier, which mainly consists of ice. It is a mixture of big and small stones, rocks, sand and ice in the hollow spaces in between. You can find rock glaciers in the high mountains because the ice needs to be frozen the whole year.

In the high mountain's climate, the wind, the water and **frost shattering** (spallings of rocks through freezing of water in rock fissures) are responsible for the decomposition of the compact rocks into smaller pieces which accumulate in talus below the rock faces (see the picture on the right side).



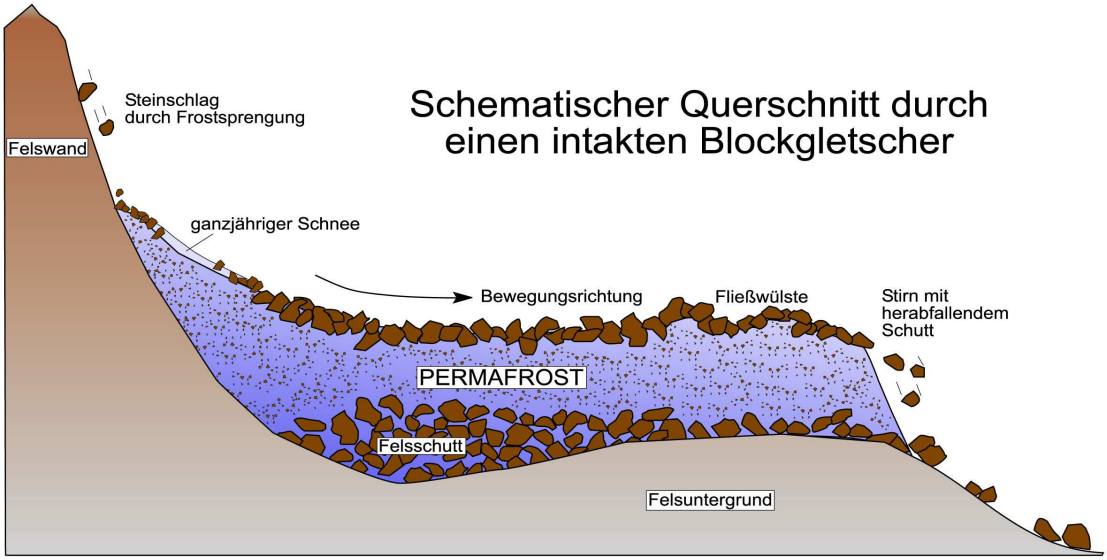
The average annual temperature is between -1℃ and -3℃ in the area of these detritus (at a height of about 2400 – 2700 meters above the sea level). Because of this, the majority of the humidity in the debris is frozen over the whole year. This phenomenon is called permanent frost or in other words **"permafrost".**

If the ice-rock-mixture starts to move downhill a rock glacier develops. But this movement is smaller than the movement of a **"real glacier".** A rock glacier flows only a few decimeters per year and because of this it takes several thousands of years until it forms a real snout.

Because of the flow of the rock glacier, **bulges** emerge on its surface and a scarp emerges on its front. This is called an **"intact rock glacier".** If the ice in a rock glacier is already melted, it is called a **"fossil rock glacier".**

Basically you can find fossil rock glaciers mainly in areas which developed in colder times of the past. Intact rock glaciers, on the other hand, can be found in higher mountain areas where the climate is still cold enough. Consequently, it can be said that rock glaciers are witnesses of the climate.

The picture below shows the cross-section or profile of an intact rock glacier.



With the following instruction you can simulate the movement of a rock glacier. For this experiment we use a mixture of different materials instead of frozen debris because otherwise it would take to long.

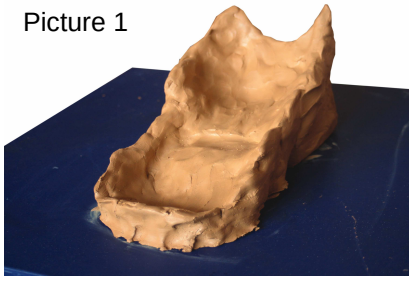
Material:

- clay
- sand and grit
- wallpaper glue
- water
- bowl and a spoon
- blue food coloring
- powdered sugar

How to do it:

<u>1st step:</u>
Form a valley made of clay through which the rock glacier can flow. At the top of the construction you should build some summits and down to this there should be a cirque as you can see it in the real high mountains. The valley can have steep and plain steps (picture 1). At the end of the construction it should get complanated and it also should have a little uphill grade.

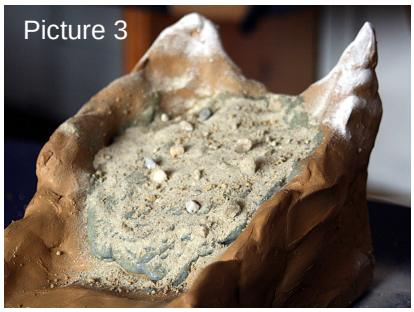
Picture 1



<u>2nd step:</u>
Now you should mix all the ingredients to a mass that you use as a rock glacier flowing down the mountain. For the mixture put two spoons wallpaper glue with a little bit of water so that you get a papescent mass. Now you have to add grid and sand as well as the blue food coloring to simulate ice (picture 2). Here you can try out different mixtures. The thinner the mass is the faster it flows. A real rock glacier flows very slowly and because of this the mass should be viscous.

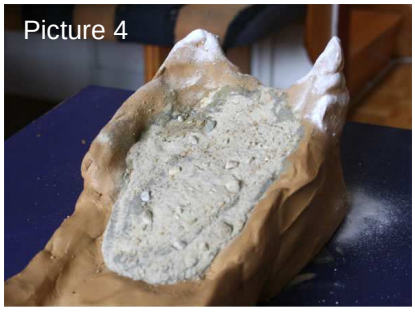
Picture 2

Picture 3



<u>3rd step:</u>
During the third step the table on which the model is positioned should be slightly tilt backward so that the mixture or mass doesn't start flowing immediately. Now you should fill the cirque with the mass of sand, grid and wallpaper glue. Don't forget to disperse some grid to the mass so that it looks more realistic (picture 3). With the powdered sugar you can simulate the snow on the summits.

Picture 4



<u>4th step:</u>
Now you should put the table into its original position (straight) so that the mass can start to flow.

5th step:

After a short period of time you can see a tongue-shaped structure of the mass. This is because the rock glacier flows faster in the middle. You can also notice the first bulge (picture 4).

Picture 5

6th step:

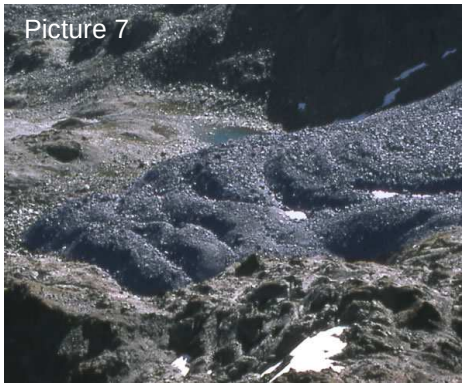
Now you should make a chart where you note how far the rock glacier is in 1, 5 and 10 minutes. You should also note how the shape of it changes. After some minutes the rock glacier has nearly reached the valley. It flows faster in the steep terraces than in the flatter ones. But the speed of the rock glacier also depends on the steepness of the ground – the steeper the ground model made of clay is the faster is the rock glacier.

Picture 6

Because of the movement some pieces of rock will roll over the tongue (picture 5). This also happens with real rock glaciers.

7th step:

If the rock glacier has reached the end of the model the mass gets bawled out and certain bulges develop (picture 6).
Picture 7 shows a real rock glacier in the national park “Upper Tauern” which also shows these special bulges (the rock glacier got colored blue so that you can see it better).


Picture 7

8th step:

With a very viscous mass or mixture the experiment can take up to 1 or 2 hours. When the experiment is over you can remove the mass with a spoon.