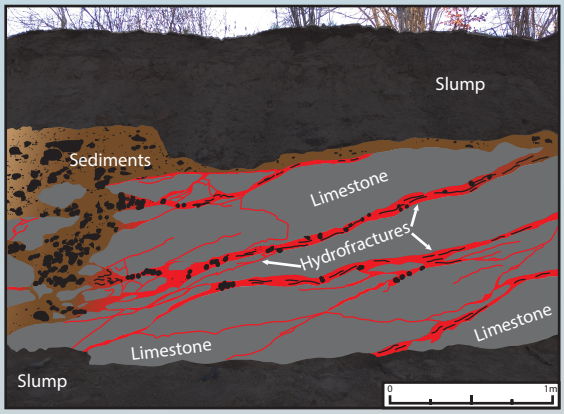
Oscar Juliusson

Hydrofracturing
Nature's bedrock breaker

The Scandinavian landscape and a lot of its surroundings have been heavily reshaped and altered by the inland ice sheets during the ice ages. It is through these processes that the landscape has attained a lot of its beauty. From the majestic fjords of Norway to the far stretching planes of Scania, the now long-gone ice masses have left their mark. There are still a lot to discover about the complicated dynamics of such ice masses, and interesting new observations have shed light on how some water, can make even the bedrock crumble.

In the now closed limestone quarry located at Ullstorp, Scania, southern Sweden, the bedrock has been fractured and subsequently infilled with sediments from above. As you walk along the quarry wall you can see how pieces of fractured bedrock have been plucked away, leaving behind sediments where the bedrock slabs used to be.



So how has the bedrock been fractured and displaced?

Inland ice sheets, despite seeming frozen solid at first glance, house a vast liquid water system. This flowing water exist both on, within, and under the ice (*subglacially*). The *subglacial* water is under huge pressure due to the km thick overlying ice. Thus, the water is trying to escape these high pressures. When there is nowhere for the water to escape, it creates its own pathway by fracturing the bedrock to escape downwards(*hydrofracturing*). In the *subglacial* environment, there are also a lot of sediments which are transported along with the water as a slushy mixture. It is this slush that fills the fractures and keeps them open, even after the water has escaped.

When looking at a *DEM* (*Digital Elevation Model*), it is easy to see why these fractures have formed at Ullstorp. The quarry is situated right at the base of the Nävlingeåsen Horst, a tectonically uplifted area. The horst likely acted as a threshold for the ice sheets, stopping the flow of water. This raised the *subglacial* water pressure which resulted in *hydrofracturing* of the bedrock.

So, what are the effects of these processes?

Very little is known about these fracture systems and the details of how they are formed. However, we do know that they seem to exert a powerful influence on the shaping of bedrock and the production of loose sediments. In extension, they likely play a big part in the production of large-scale landforms such as the fjords of Norway and the planes of Scania.

As mentioned earlier, not much is known about these fractures and this is even more true from an engineering perspective. For example, how these systems affect the structural integrity and groundwater dynamics of bedrock are future research topics still up for grabs. Therefore, it will be interesting to see in what way they potentially aid or trouble our society.

Master's Degree Project in Geology 45 credits 2021
Department of Geology, Lund University
Supervisor: **Dr. Sven Lukas**