

Video 6: Deep Underground Concept — Part 3: Little Rodents

A basic postulate of the Deep Underground concept requires construction in good geological conditions only, preferably in quality rock materials. Some rocks have compressive strength as high as half of the compressive strength of steel and several times higher than the compressive strength of concrete, so we need robust methods to break them.

The usual methods to break such rock are mechanical excavation using heavy machinery or the drill and blast method using explosives. Such methods produce excavated material in the form of large pieces, and rough structures require additional support before anyone can enter them. These excavation techniques are not suitable for the Deep Underground concept, which requires:

- Small-sized particles that can be removed with ventilators, fans, or pumps.
- Smooth boundaries where there is no danger of rock fall.

Several methods have the potential for excavating and removing rock suitable for the Deep Underground concept. The techniques based on past studies include methods that do not require mechanically induced forces to excavate rock material. These techniques can be separately applied or combined to remove material in the desired manner.

Let's discuss some obvious candidates.

- **Heat**

High heat can affect the rock through phenomena like melting, changing the aggregate state of rock ingredients, and recrystallization. The device for such excavation would require a local source of high heat traveling close to the borehole boundaries, weakening the rock at a depth of 1-2 cm for easy removal and transportation to the surface.

- **Cold**

Extreme cold can also harm the rock, and in some cases, a gas with an extremely low temperature in the borehole could weaken the rock on the boundaries, making it easily removable and transportable to the surface.

- **Combination of heat and cold**

A combination of both heat and cold can be even more effective than each on its own.

- **Water jet cutters**

These machines use water with high pressure and speed to cut small particles of rock.

- **Lasers**

Lasers can serve as a source of heat and can either melt the rock or make water within the rock evaporate, causing the rock to break.

- **Cavitation**

Cavitation is a destructive process that causes a substantial amount of damage to the turbines. Bubbles are created in the water, implode close to the wall, and create significant local pressure. A lesser known fact is that the power of cavitation is also used to improve the drilling efficiency, which helps to crack rock in the drilling direction and clean dirty surfaces.

Cavitation can be caused in several ways. One possibility is to use lasers to create bubbles close to the surface, affecting the rock.

- **Ultrasonic/Sonic Drilles (USDC)**

Ultrasonic drilling was developed by NASA to drill on the Moon or Mars, as it can make small drill holes with low energy consumption. This effective technique produces small particles in the form of dust.

- **Other technologies**

Other technologies that use electric power, electromagnetic fields, and microwaves have been tested and proven to have a destructive impact on rock.

There are many techniques that can affect rock in the desired way, some of which are already used for drilling or cracking the rock.

The core idea of this concept is to use smooth techniques to achieve the same results as current techniques. Even a small daily advancement of 1.5 cm in the widening of a vertical drill hole is enough to achieve the same speed of construction of deep shafts as we have today.

Therefore, in our borehole, we need equipment capable of milling the boundaries. A fan or ventilator at the bottom could bring small particles to the ground. It should look like a steel beam with milling devices rotated at different levels to cut the material. There should be a bag for dust at the bore hole's top. The next video will show what we can do with what we've learned so far.