

New movie, *The 33*  
... about the Chilean miners rescued in 2010



On August 5, 2010, 33 miners were trapped by the collapse of a gold and copper mine near the town Copiapó in the Atacama Desert of Chile. The miners were 2,257 feet underground. It took 17 days before rescuers, drilling holes about the width of a grapefruit, located the miners and realized that they were still alive. Food, water, medicine, and messages were sent down that tiny drill shaft and the world watched the recovery effort for 52 more days. At the time, the story and progress of the rescue, created powerful drama for the two months that it took to free the miners. That drama has been recreated today in a new movie, *The 33*.

*Here's the rest of the story ...*

After 69 days of captivity, the men were finally lifted to the surface one by one through a 28-inch wide, drilled shaft created by rescuers for Chile and the United States. A US–Chilean mining company finally successfully drilled the wider diameter shaft using drilling equipment made in Pennsylvania. NASA was brought in to suggest mental and emotional support for men trapped for such a long period in a confined space and to help devise the escape pod.

1. In miles, how far down were the miners trapped?
2. A 28-inch wide hole was dug to rescue the miners. How much ore, rock and soil was removed to create that shaft? (Figure out the amount in cubic feet.)

The collapse happened just as the men were gathered for lunch in a refuge - a space about 12 feet by 12 feet (four meters by four meters) with a fortified ceiling nearly 15 feet (4.5 meters) high. The space normally doubled as a dining room in the lower reaches of the mine. Had the collapse happened any sooner or later, some of the miners would have probably been crushed.

3. What was the volume of that chamber in cubic feet?

When the dust finally settled about five days after the collapse, the miners could see that they were trapped in a large open space, about 1,200 feet (360 meters) long, that ran up a corkscrew-shaped shaft to another workshop about 2,000 feet (600 meters) underground. The space had several mining vehicles with battery and engine power, a chemical toilet and industrial water, which together with their meager emergency food supply enabled them to survive with no help from the outside world for their first 17 days.

Thereafter, tubes pumped at least 100 liters (106 quarts) of water a day and about 114 cubic meters (4,024 cubic feet) of fresh air every hour into the mine. That enabled the miners to take showers and slightly reduce the sweltering heat down below.

The wider diameter shaft had loose rock for the uppermost 33 feet. So it was decided to add a metal casing to the top 315 feet (96 meters) of the shaft. The plan was to insert 16 steel tubes, each 6 meters (about 20 feet) long into the tunnel that had been drilled down to the miners' cavern.

4. What was the lateral surface area of that entire tube length?
5. If there were 16 6-meter long tubes inserted into the top of the mine shaft and the total weight of those combined tubes was 25 tons, how much did each tube weigh?

Chilean naval engineers, based on a NASA design, created an escape capsule. The capsule was called "Fenix". (A phoenix was a mythical bird that lived for five or six centuries and then burned itself up to rise again, from the ashes, as a renewed birth for another cycle of living).

The "Fenix" capsule had spring-loaded wheels that pressed against the shaft's walls and was lowered into the shaft via a winch.



On October 13, 2010 all 33 men were brought to the surface.

Each miner was strapped into a harness inside the 21 inches (53 cm) wide bullet-shaped capsule wearing moisture-resistant coveralls and sunglasses. The capsule included oxygen masks, heart monitors, and video cameras. Once the miner was secure inside the capsule it then ascended at a rate of 1 meter per second (2.2 mph), with an estimated travel time of 9 to 18 minutes.

Throughout the 24-hour-long operation, as each miner emerged from the mine, he was personally greeted by the President of Chile, President Piñera.

Finally, the miners were transferred in groups of four by helicopter to Copiapó Hospital, 60 kilometers (37 mi) away, for a 24–48 hour period of medical observation and treatment.

This is going to be a pretty exciting movie. I'm glad that I already know the happy ending.

Sources: [https://en.wikipedia.org/wiki/2010\\_Copiapó\\_mining\\_accident](https://en.wikipedia.org/wiki/2010_Copiapó_mining_accident)  
<http://wdp.wharton.upenn.edu/wp-content/uploads/2014/08/Leading-the-Miners-Rescue.pdf>