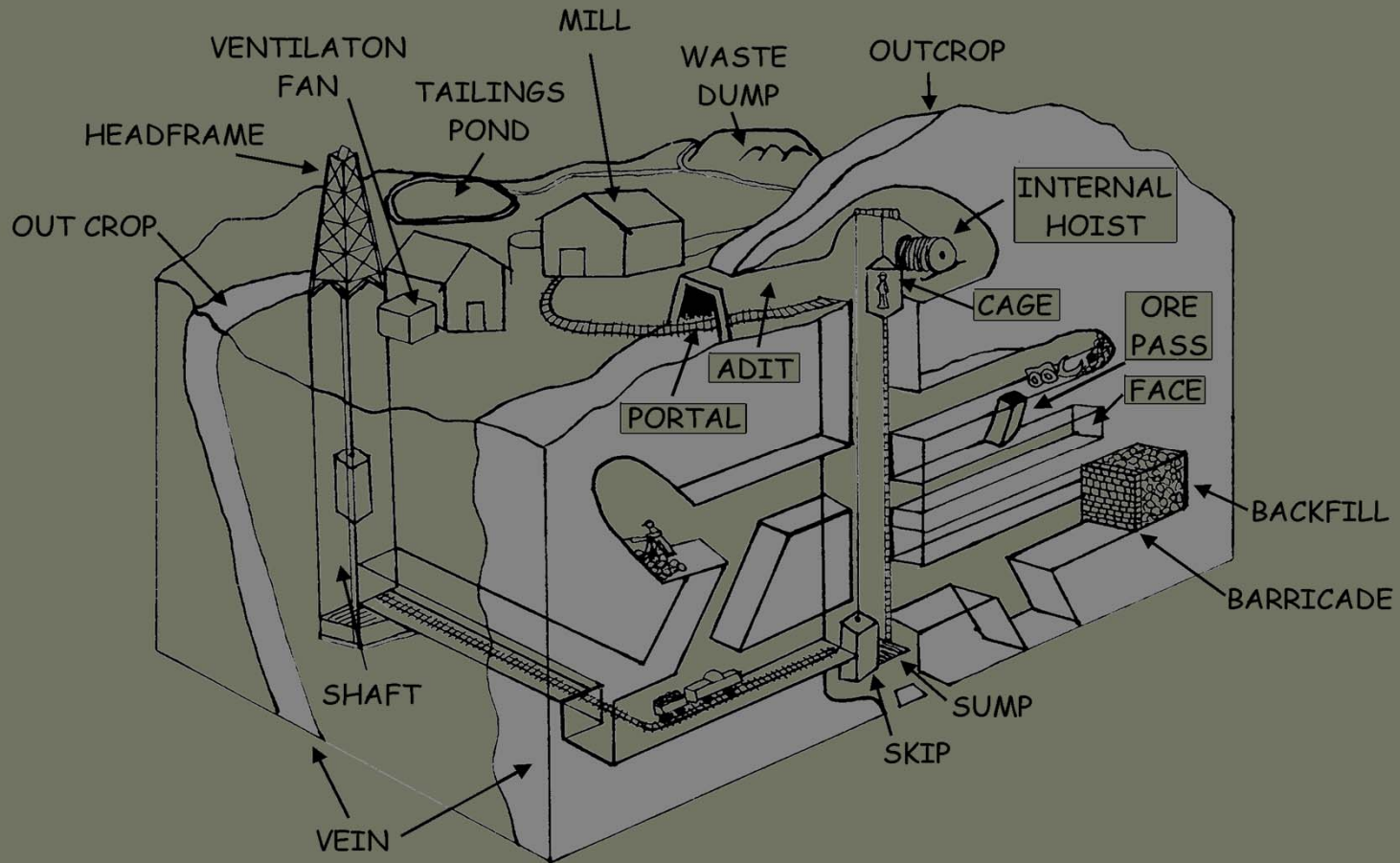


Underground Mining



Underground mines are developed by excavating *shafts* (vertical) or *adits* (horizontal) to reach buried ore bodies. So-called *drifts* are tunnels created by mining ore; *stopes* are vertical shafts created by mining ore. The surrounding waste rock is left behind.



1 – This is an aerial view of the head frame at Myra Falls Mine in Strathcona Park on Vancouver Island.



2 – Miners go to work underground via the *skip*, an elevator car that takes them down to the level underground that they are working, and returns them to the surface at the end of their shift.



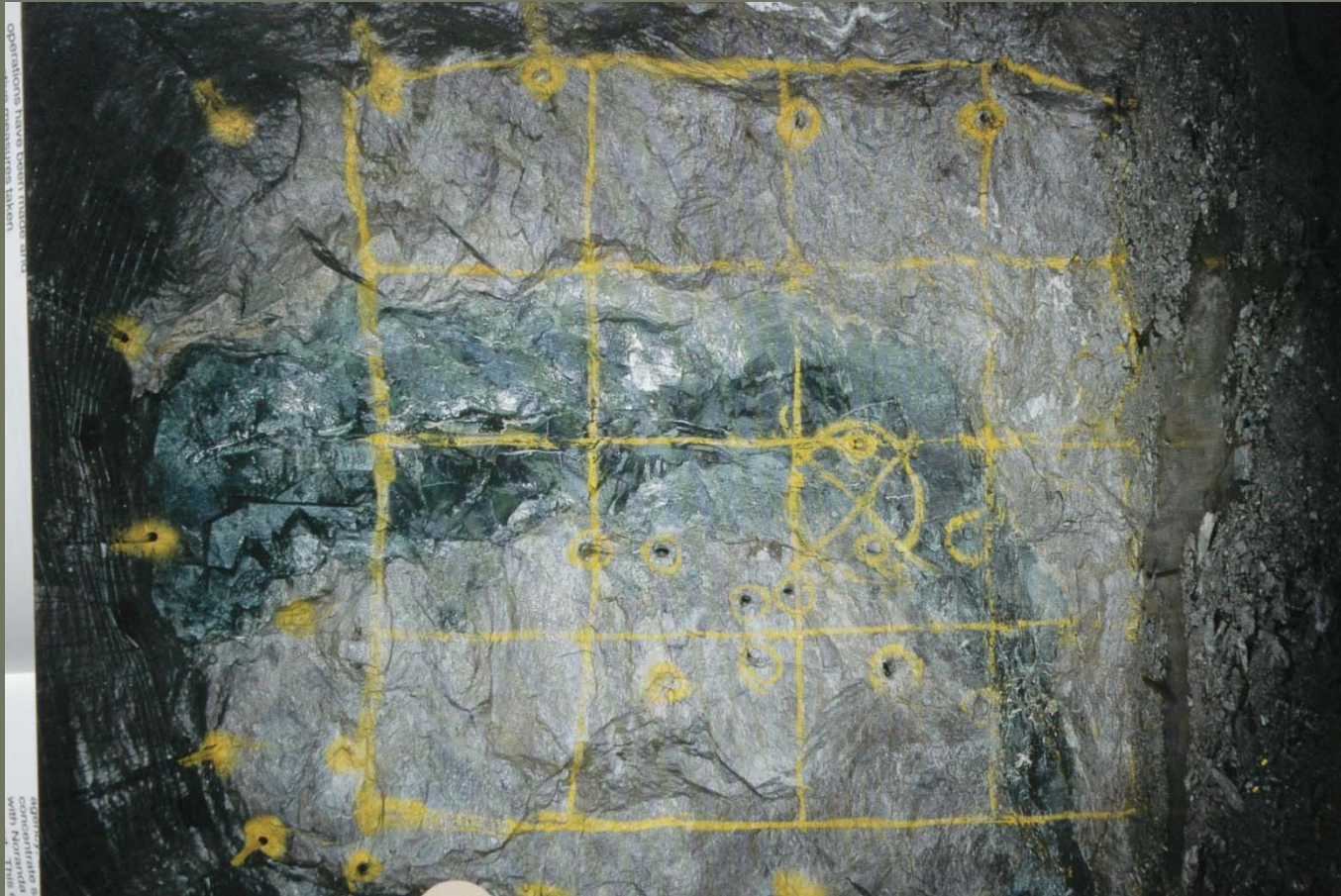
3 - Working from plans developed by geology and engineering departments, the rock is prepared for drilling by miners. In a hard rock mine, like one for gold, copper or zinc, large stationary drills or mobile machines called *jumbos*, as shown here, drill 6-7 cm holes 2.5-3.5 m into the rock face.



4 – Once all the holes are drilled they are filled with *explosives* - either ANFO (ammonium nitrate fuel oil) or dynamite sticks - and blasting caps.



5 - Blasting caps (shiny metal ends) attached to fuses (yellow wires).



6 - The **blast pattern**, here visible by the yellow fuses, depends on the size of the rock face and nature of the rock. The holes are generally placed to break the rock and blow it out away from the rock face. During shift change when the mine is evacuated the entire pattern is set off remotely by a **driller-blaster**. Although more than 100 explosions may be set off, one after the other, the blast sequence is completed in several seconds.



7 - After the blast, rock dust and gases are sucked out via the main tunnel while fresh air is delivered via a ***ventilation duct*** on the tunnel ceiling.



8 - Before mucking out a drift, loose rock is removed from the roof and walls. Known as *scaling*, it can be done by using a hand-held, steel prying bar, or by using a jackhammer-like *hydraulic breaker*, a rotating *cutting head*, or a *steel wedge mounted on a boom*, as shown here.



9 - Blasted ore, referred to as *muck*, is mucked out, that is, scooped up and loaded into carts by specialized *scoop trams*.



10 – Miner at the controls of a scoop tram.



11 – The ore may be loaded onto a **conveyor system** or into **carts** that are hauled to a shaft. In some mines, scoops are used to load small train cars that move the ore along rails to the shaft. In all cases, underground equipment is designed to operate in small spaces, and is commonly low and narrow.



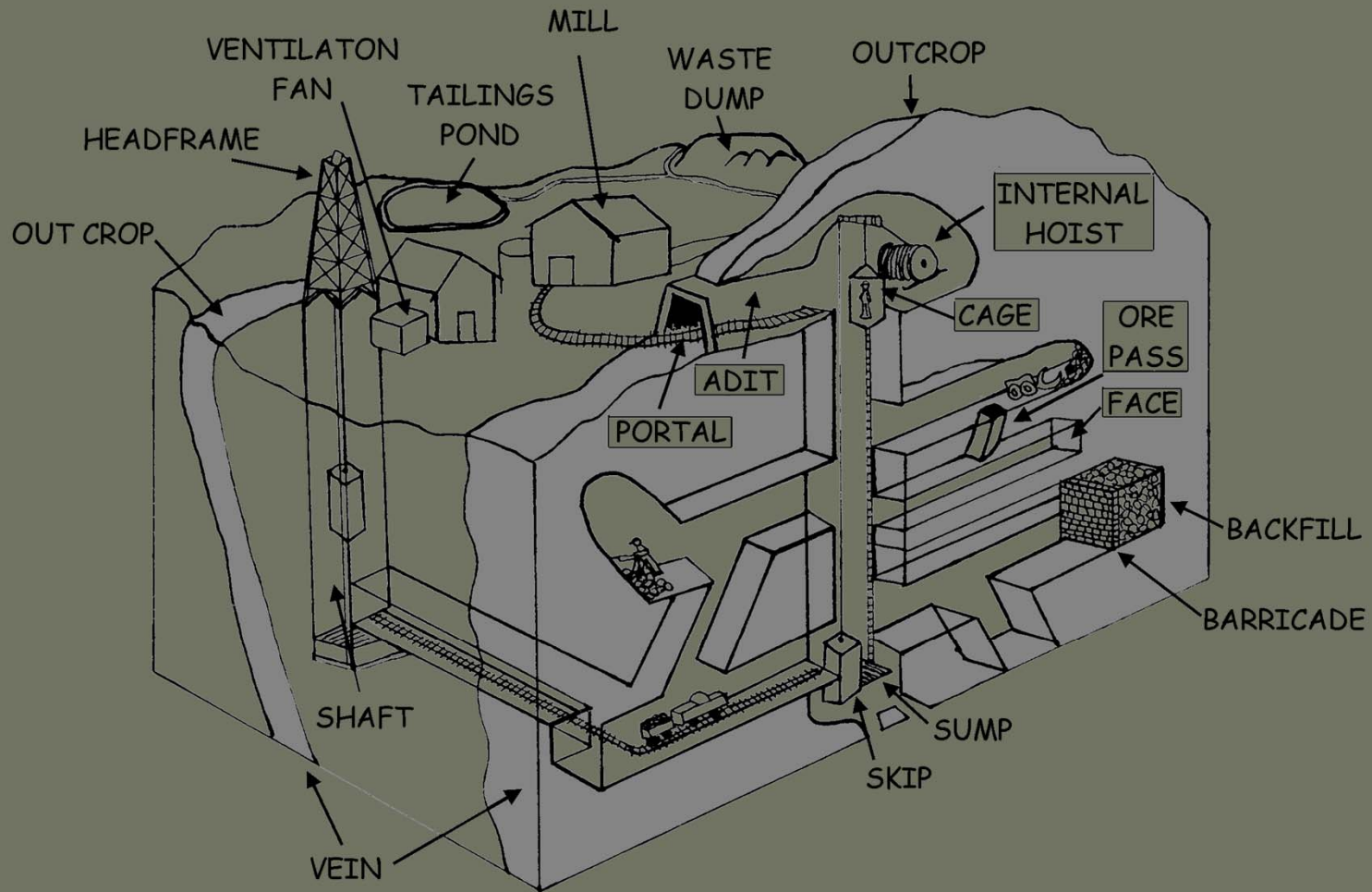
12 – After the blasted ore is mucked out, **rock bolters** are used to secure the walls and ceiling and allow safe passage to proceed in developing the **drift**. This special equipment, also commonly mounted on **jumbos**, drills 2.4-6m deep holes into the rock. A **steel rod** with a wedge threaded on the inside end is inserted in to the hole, and a **steel plate** and large **nut** are fastened to the outside. When the rod is turned it draws the wedge and steel plate closer together, bolting the rock wall in place.



13 – In this **rock bolted drift** the rock bolts also secure a **steel screen** over the rock face to prevent pieces of rock loosened by further working in the drift from falling.



14 - Where mining is carried out in a *stope* with a high ceiling, the ore is commonly mucked out using a *remote controlled scoop*.



15 – At the shaft, the ore is dumped into a large bucket called a *skip*. The skip, which is somewhat like an elevator car, is hoisted to the surface to dump the ore. The ore is then transported on to the next processing station by conveyor belt, truck or train. Once mucked out, a permanent barrier, referred to mining as a *bulkhead*, is built at the entrance to a drift. Stopes may be filled with *hydraulic backfill*, a mixture of sand and cement that is piped underground from the backfill plant on the surface.