IIT(BHU) VARANASI

STUDENTS' NOTES

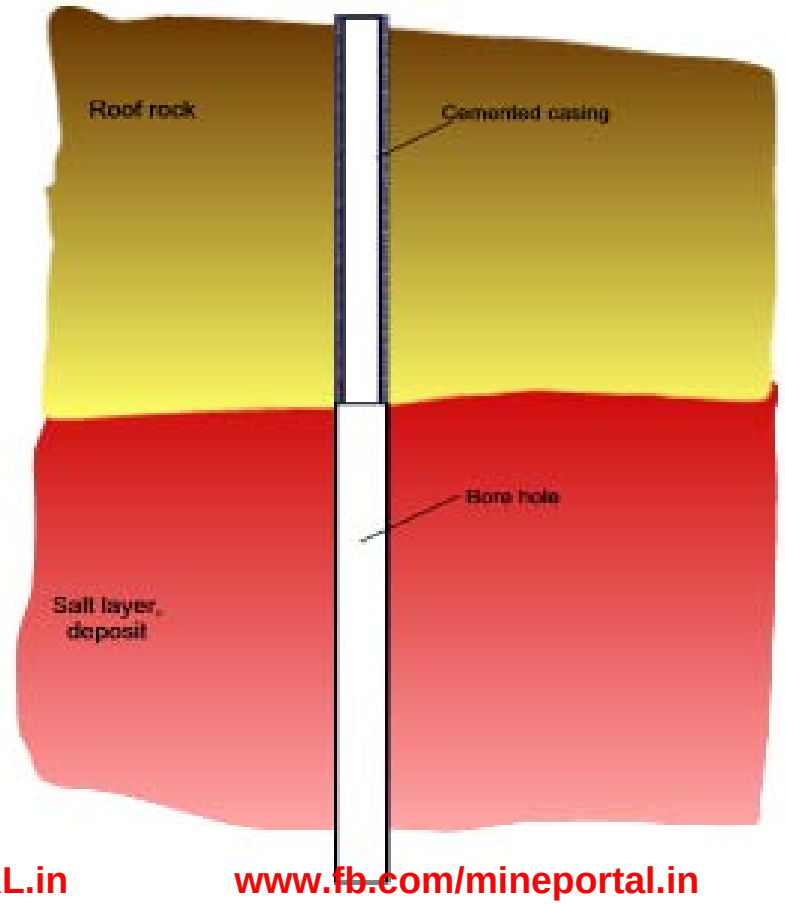
UNDERGROUND METALLIFEROUS MINING

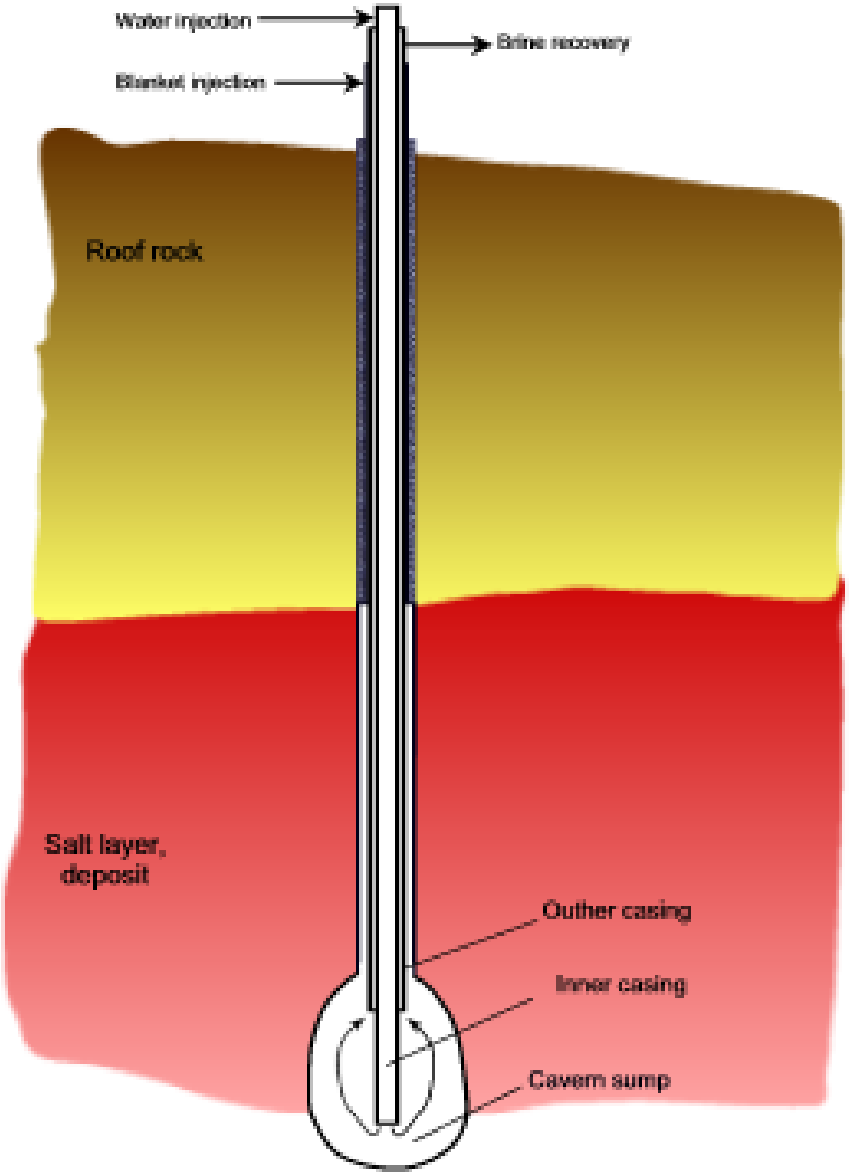
TOPIC-DEEP SALT MINING

Salt Mining

- The method of solution mining is a very old technological process. Natural brine sources were already used in antiquity.
- Brine was produced by squirting water into mining chambers as well as by injection of water in the deposit through wells.
- The present status of equipment of the well was developed.

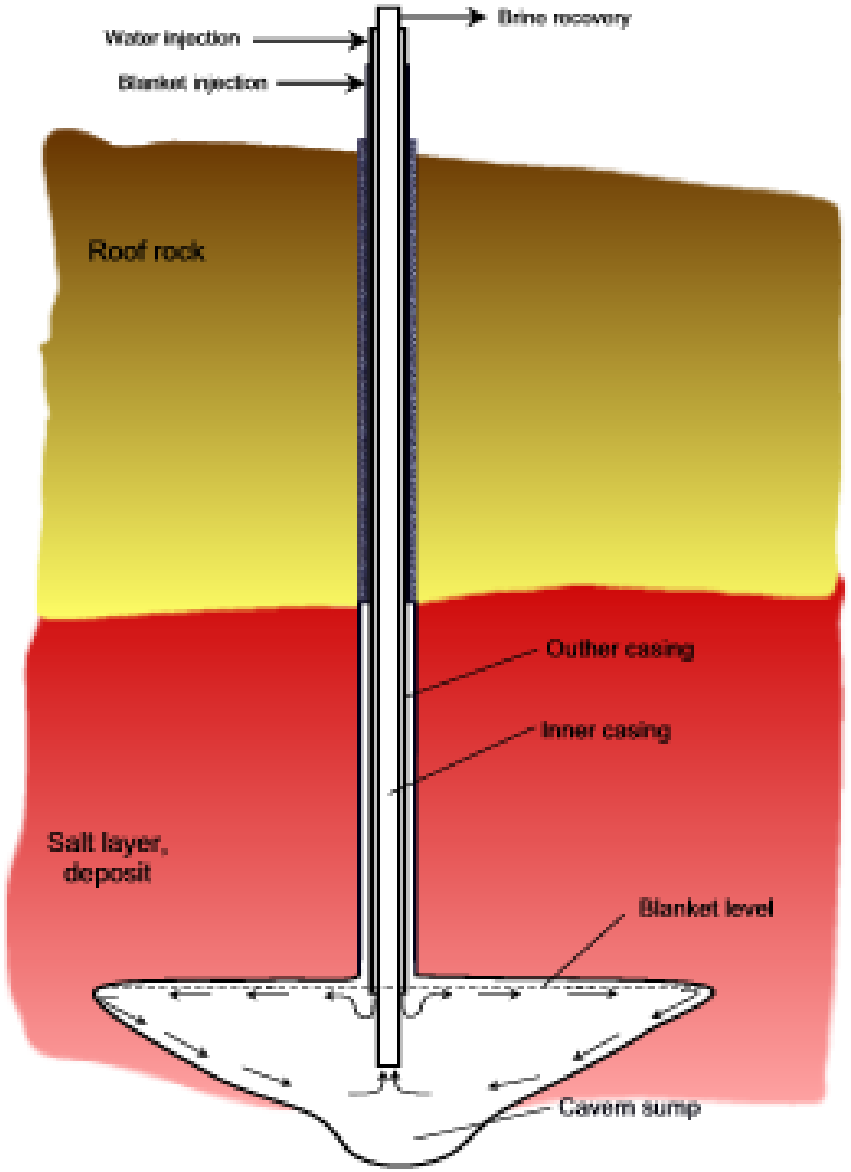
- A bore hole was drilled from the surface of the earth to the bottom of the salt layer.
- A casing was worked in the bore well and was cemented from the surface to the top side of the deposit.
- The cement must shut tight against the pressure of the blanket.
- The surface of the bore hole in the area of the deposit is free. The salt can be dissolved.



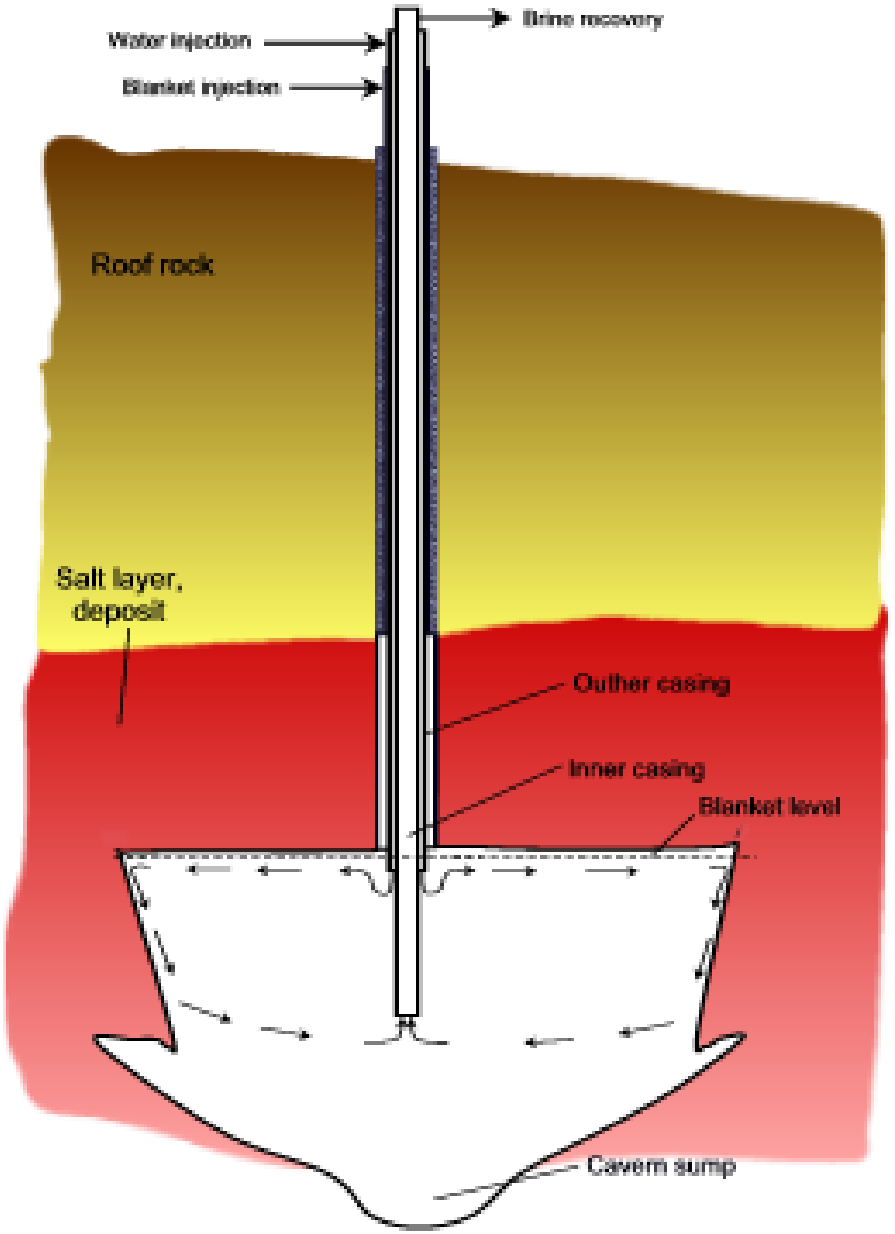


- The dissolution of the salt begins with the solution of a cavern sump. The sump shall be accommodate the insolubles of the deposit near the casings in the well.

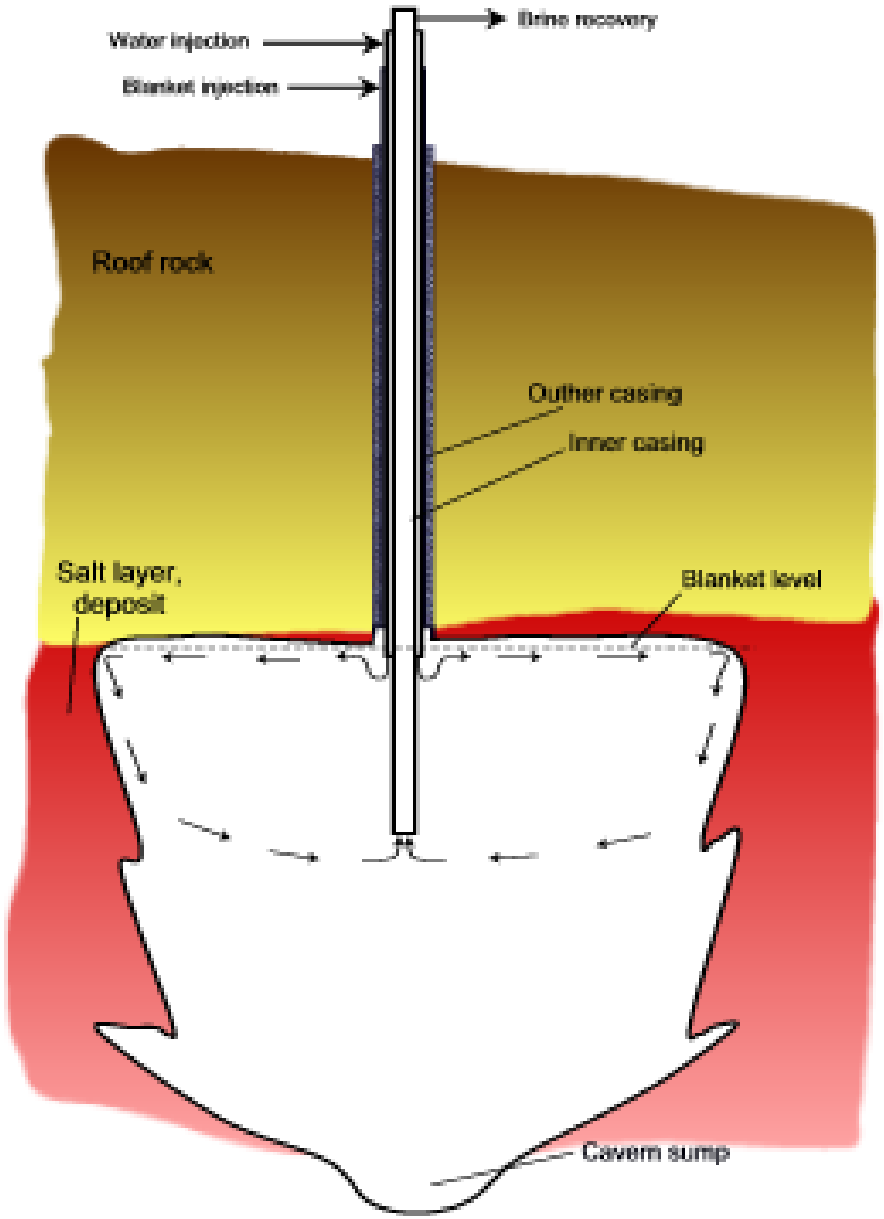
- During the solution of the sump only water is used .
- The water current is directly, that means that the current of brine in the cavern has the same direction as in the production casing.
- The solution of the sump can be ended if the diameter of the cavern is 5 – 10 m.

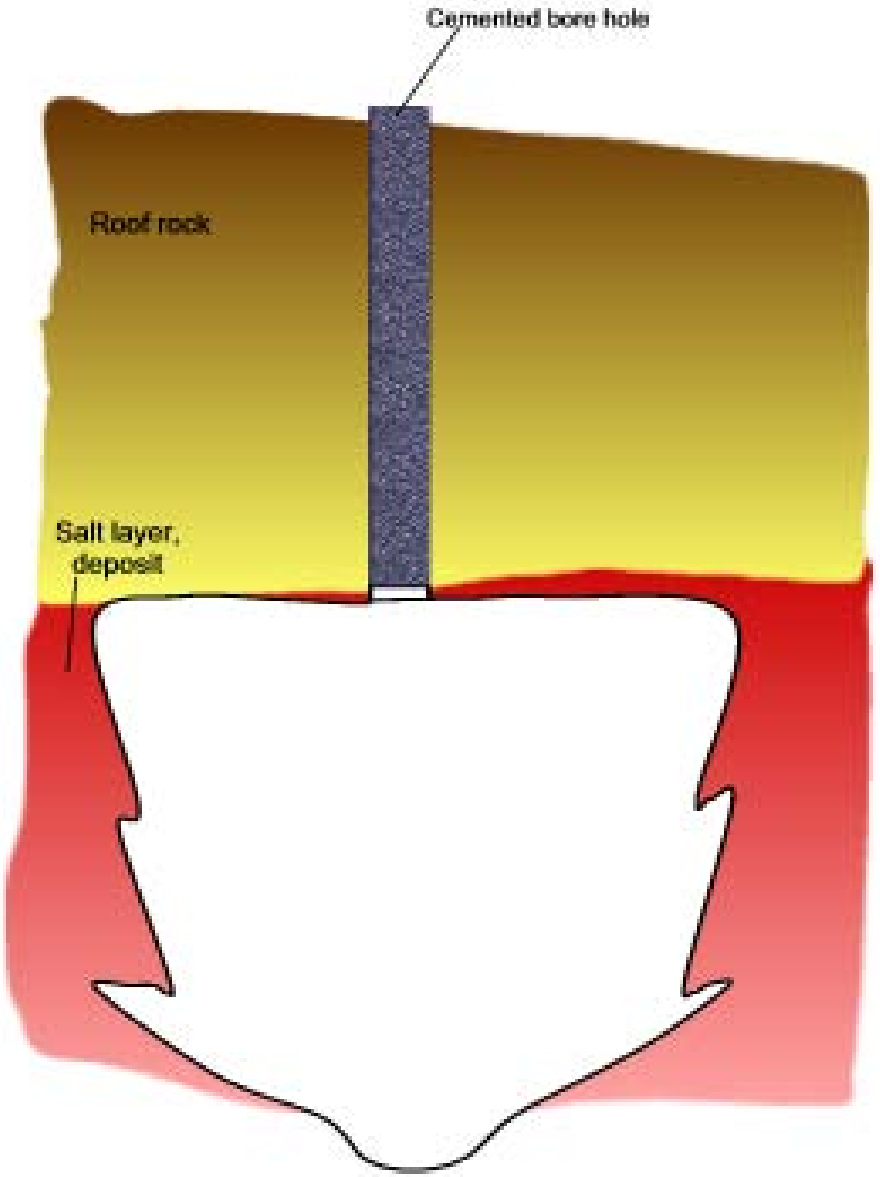


- The next step is the undercut phase. The injected water is going trough the outer casing and the brine leave the cavern trough the inner casing. This current direction is named indirectly.
- Important for the forming of the cavern is the precise controlling of the blanket level.



- For winning of the salt in the deposit the level of the casings and the blanket was arranged higher.
- Because in the cavern the density of the brine increases from the top to the bottom, the brine current goes from the end of the outer casing under the blanket level to the side and then it flows to the inner casing and to the surface.
- The last step is reached, if the cavern arrives the top of the deposit.





Pros

- In the most cases solution mining has a very high economic efficiency because:
- The investment costs are low. The demand of manpower is low
- The drilling of the bore holes are running costs
- Solution mining can also used by difficult hydrogeological conditions.
- The first step of the potash mill (hot leaching) is in the underground. There are no costs for this equipment.
- Residue and high concentrated brine stays in the cavern, therefore there environmental burdens are low

Cons:

- If the geological and tectonical conditions are very difficult, the solution mining is not usable.

Geological conditions

- The very best to use the solution mining technology is:

  - a great height of the deposit

  - and a low depth

- Using new developed technologies the winning of mineral salts in deposits with low height is possible. This new technology is named solution mining with „tunnel caverns“.
- In this case one bore hole was drilled verticaly and the other was drilled at first verticaly and then it follows in the deposit the direction of the salt layer with a deviation.

- This technologie is not usable if the deposit has tectonical breakdown and other disturbances or great changes in the direction.
- The drilling of the bore holes can be complicated and expensivly if the overburden contains gas or water

Potash

- **Potash** (K_2O) refers to a group of potassium bearing minerals, the most common being potassium chloride (KCl).
- Potassium (K) is the seventh most common element in the earth's crust, and is found in every cell of plants and animals and is essential to their growth

- Potash is mined from naturally occurring ore deposits which can often be covered by several thousand feet of earth.

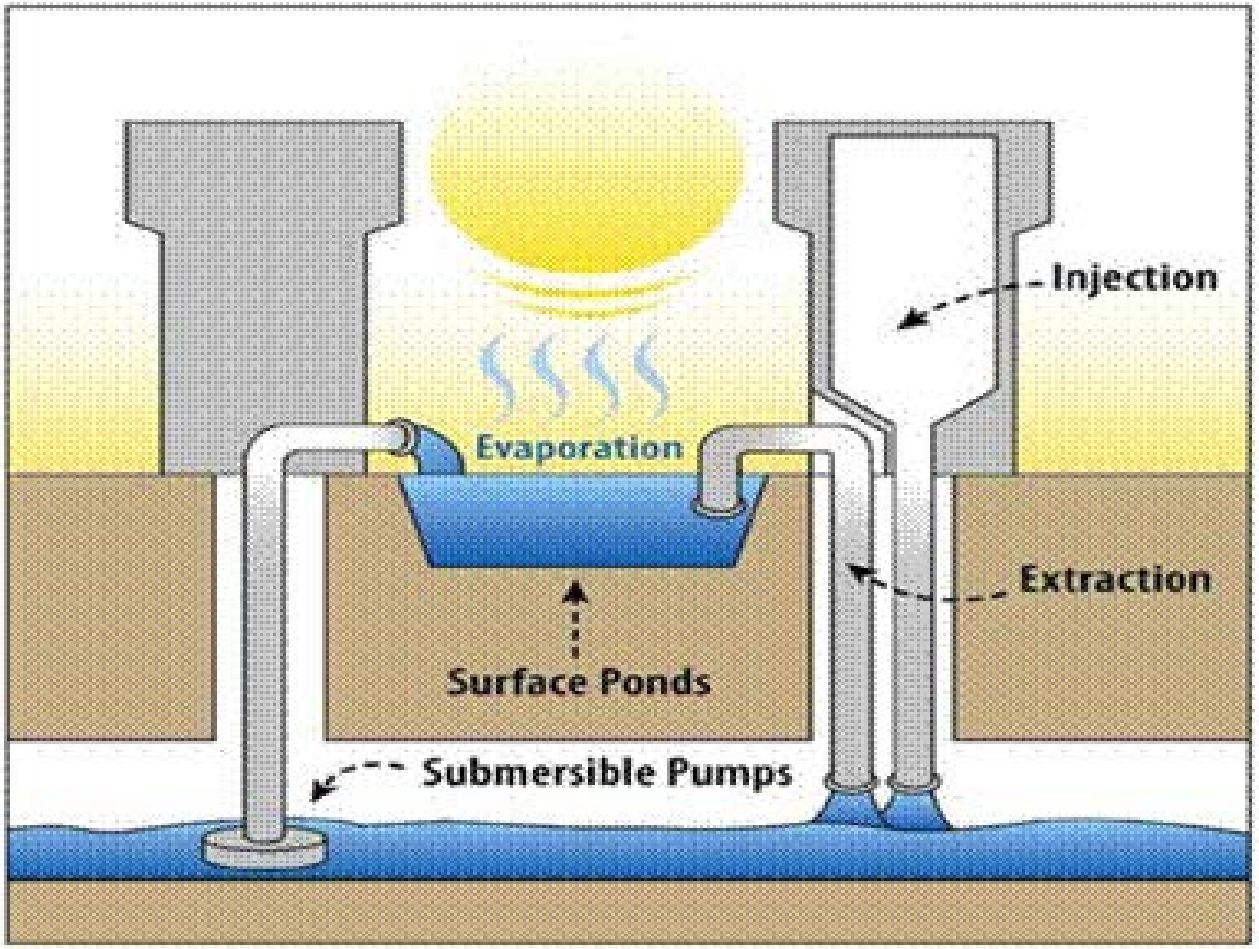
- These evaporates are essentially made up of a mixture of sylvite and halite called sylvinite, which is the most frequently mined mineral compound due to its potassium-rich composition, with Sylvite containing 63.2% K2O equivalent.
- Halite (NaCl), or sodium chloride, appears as a mass of interlocking crystals.
- It is transparent, colorless or sometimes has a smoky grey or brownish hue. Sylvite (KCl), potassium chloride, is similar in appearance to halite but has the characteristic of relatively greater solubility.
- Sylvite crystals are clear or cloudy and can vary in color from white to pink, light orange or red

Conventional Underground Mining

- Most potash occurrences are too deep underground for open-cast mining and thus this type of mining is therefore called underground mining.
- In deep mining, the "room and pillar" method progresses along the potash seam, while pillars and timber are left standing to support the potash mine roof.
- Blasting methods utilize explosives to blast and break down ore, and are most often applied in cases where potash seams are extremely variable or other limiting factors make continuous mining techniques impractical.

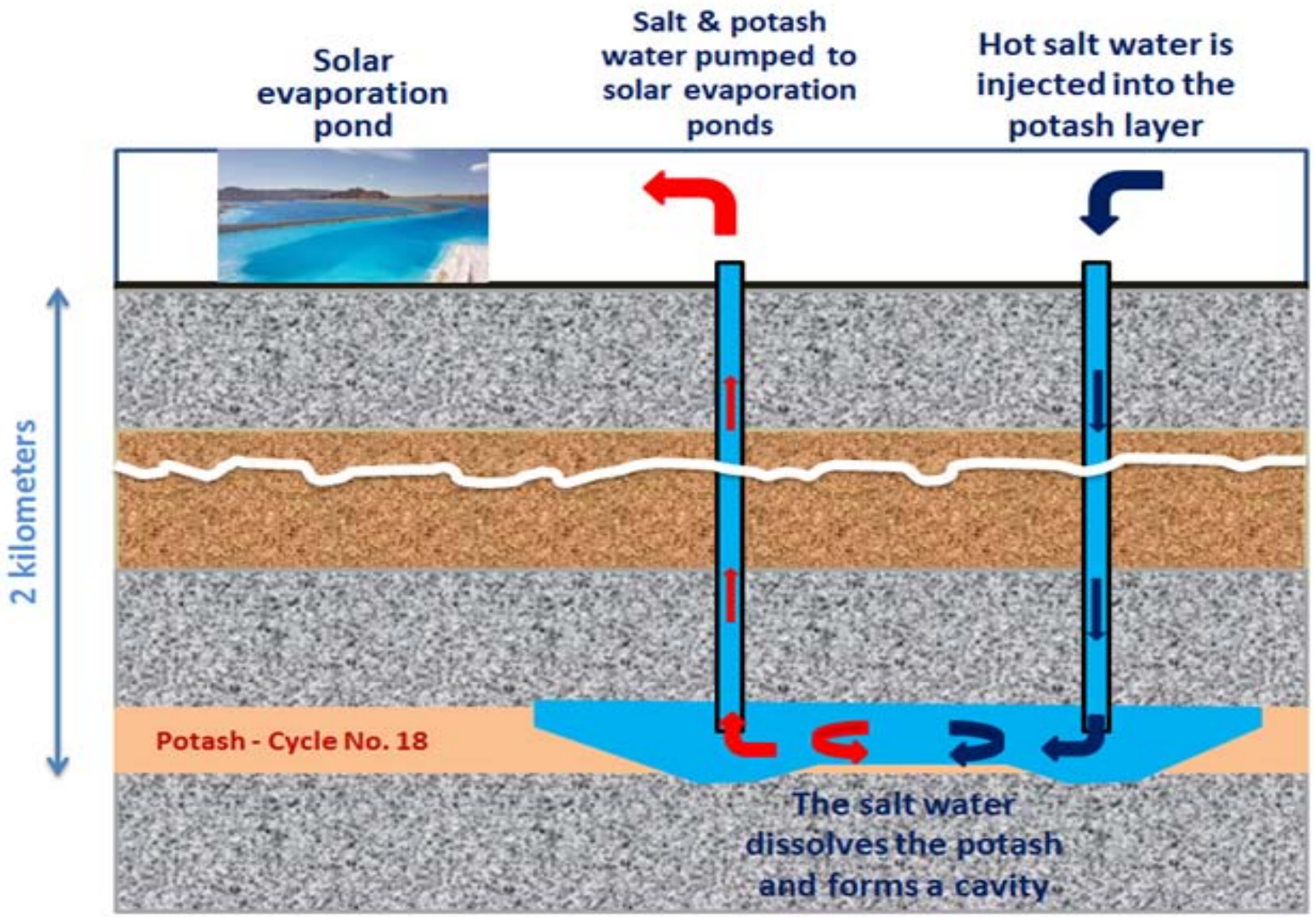
- Solution mining is completed by pumping liquid underground between two impermeable layers of rock that contain the potassium ore.
- Potassium salts within the Potash are dissolved into the liquid and pumped to surface into a drying pond.
- Typically these orebodies can be 6 to 25 metres thick and contain approximately 20% potassium oxide.
- Orebodies with grades lower than 15% potassium oxide typically do not meet economic feasibility requirements.

- Using solution mining, the total recovery of the orebody is significantly lower than with underground mining, normally between 40 and 60%.
- This leaves a major portion of the ore underground, and can be seen as a “waste” of a resource.
- Solution mining is normally only used when the orebody is too deep and too wet to be economically mined by underground methods.
- Given this mentality the resource may have been ignored and completely wasted if not for solution mining.



- In contrast, solution mining is used when underground mines are very deep, have irregular deposits, or have become flooded and workable.
- The primary reasons to utilise solution mining is based on the thickness of mineralization, the grade of the potash bed, the depth of burial, the presence of faults, and the dip of potash beds, as an excessive dip can limit recovery.

- In solution mining, heat brine, a salt water solution, is injected into the mine and circulated throughout to dissolve potash and salt from the walls.
- Once the compounds have dissolved, submersible pumps transport the solution to an evaporation pond, where the liquid cools and potash and salt crystals consequently settle to the bottom.
- This potash is eventually collected with floating dredges and then pumped to a mill for further processing.



White Salt Production

- The table salt in your saltshaker and the salt used in food production is the end product of a two-step process of extraction and refinement – called Solution Mining and Brine Evaporation

- In solution mining, salt is extracted by forcing water under pressure into a bore-hole drilled into an underground salt bed or dome.
- The salt dissolves, turning the water into brine and creating a cavern in the salt-bed. The brine is then pumped back to the surface and on to the purification plant where calcium, magnesium and other impurities are removed before beginning the brine evaporation process.