Mines, tunnels and lakes sources/sinks of energy, heating/cooling, examples

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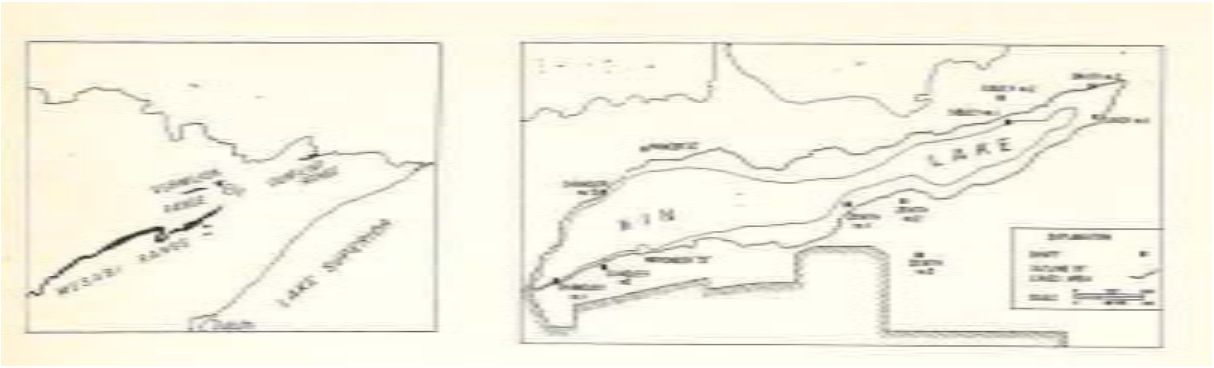
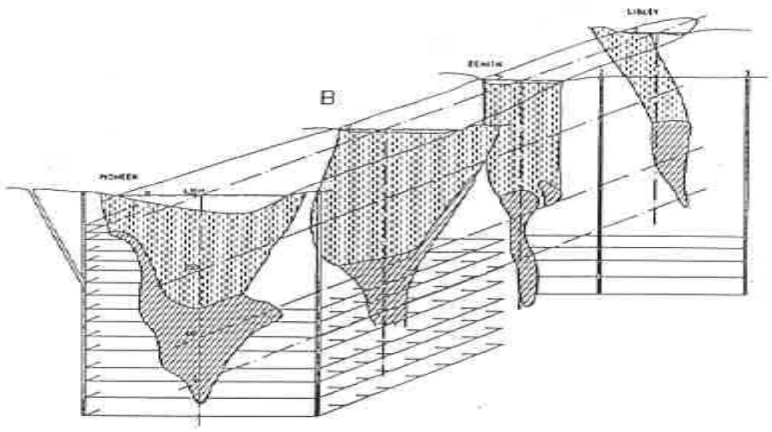
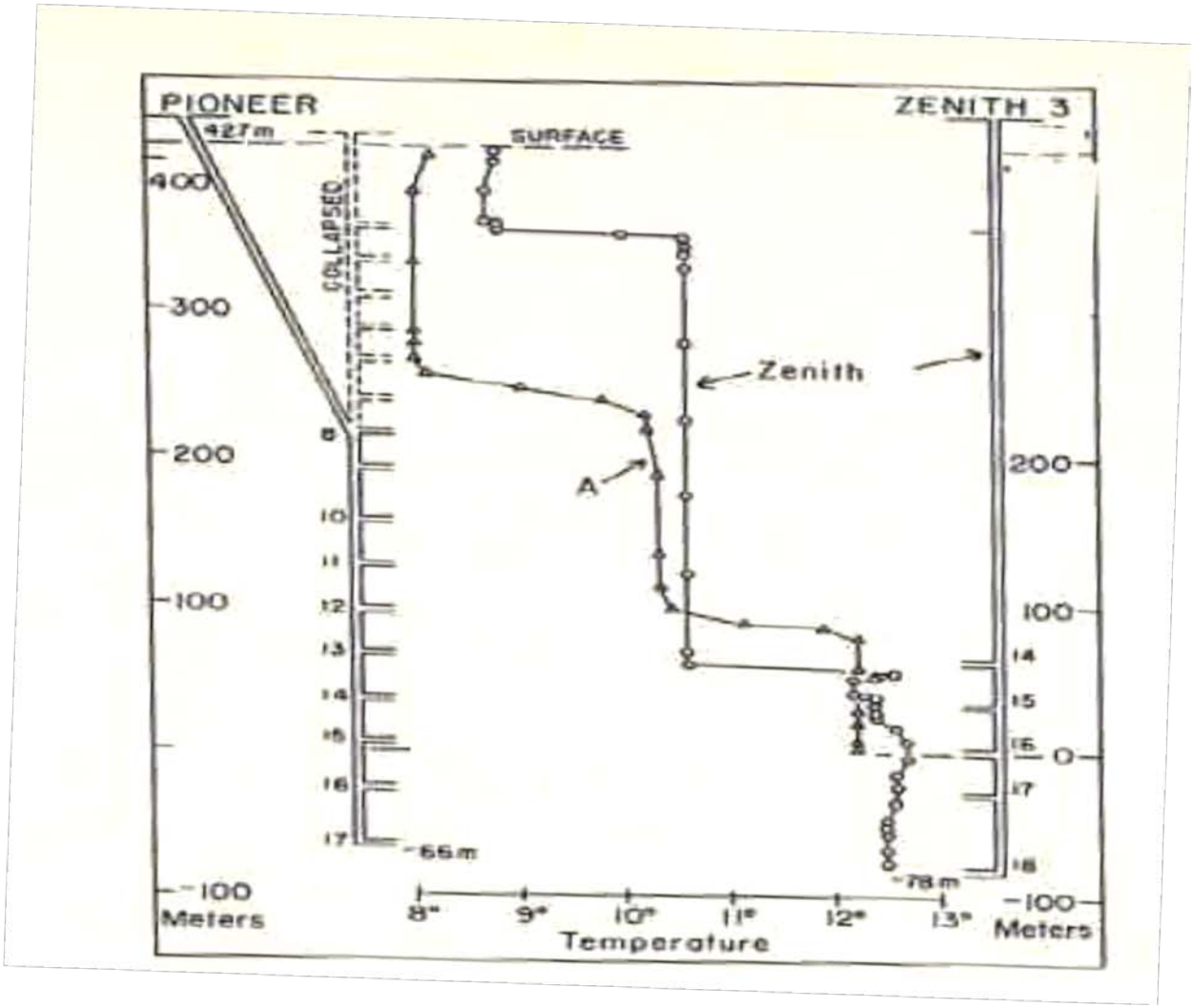
Near Ely northern Minnesota south of the Canadian border, Lake district, an abandoned and flooded mine is situated. US Geological survey and VIAK AB (today SWECO) made a survey to compare cost of heat from water to heat from traditional sources such as wood, oil and natural gas.



Iron ore. Plan of lake.

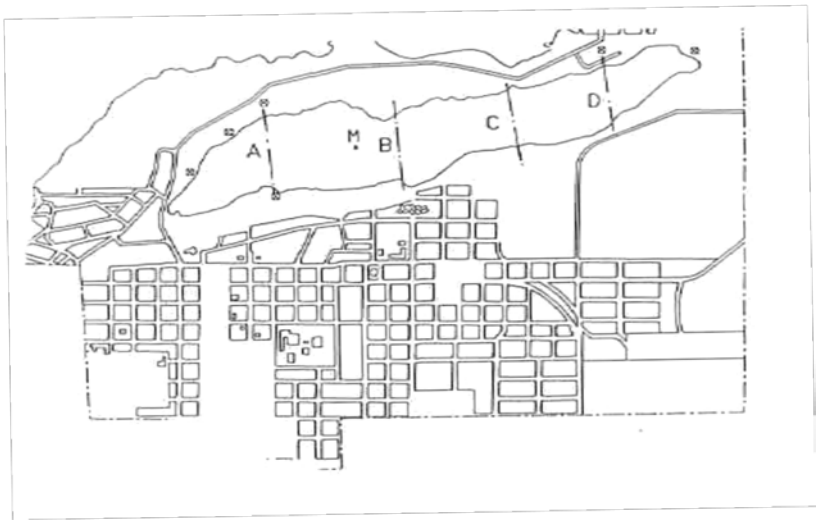


3D of mine with its ore and connecting shafts.Depths around 450 m.

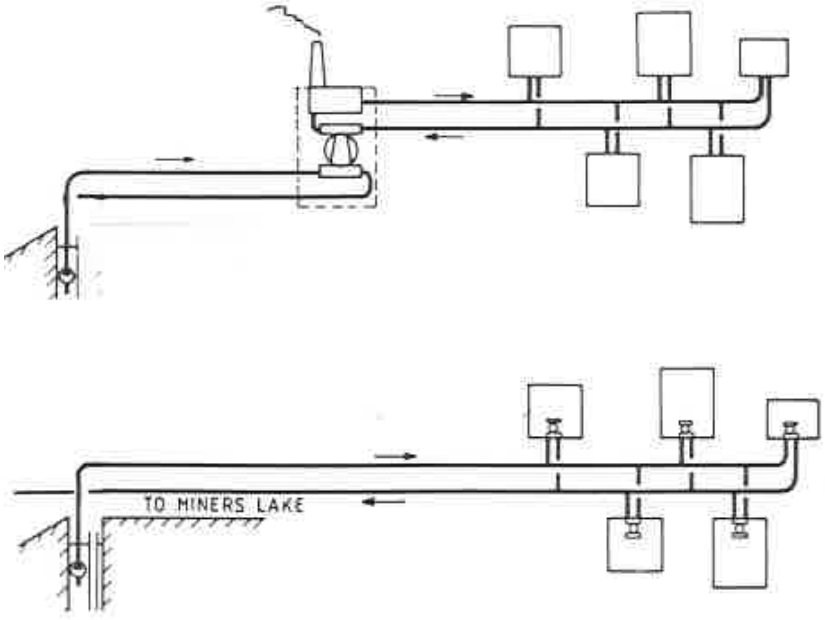


Temperatures of water were measured by two methods. Direct conducting with sensor drowned and pumping water from bottom during continuously metering on ground. One could have dreamed of Jose´s method with DST!

Thermoclines, haloclines and different minerals or salts were mapped, see reference. Heat in one way or another could of course be gained or stored. Distribution of energy were recommended. Simply two alternatives were suggested.



City plan.



Alternatives suggested distributed heat or minewater to individual heat pumps.

Storage of heat…..

Many mines, tunnels and lakes are in use today. Cole mine in Billesholm recently installed a heatpump.

”Det var länge sedan kolgruvorna under kommunen var till någon större nytta för samhället ovan jord. Men i Billesholm kommer de gamla gångarna till användning igen. Här ger de energisnål och klimatsmart

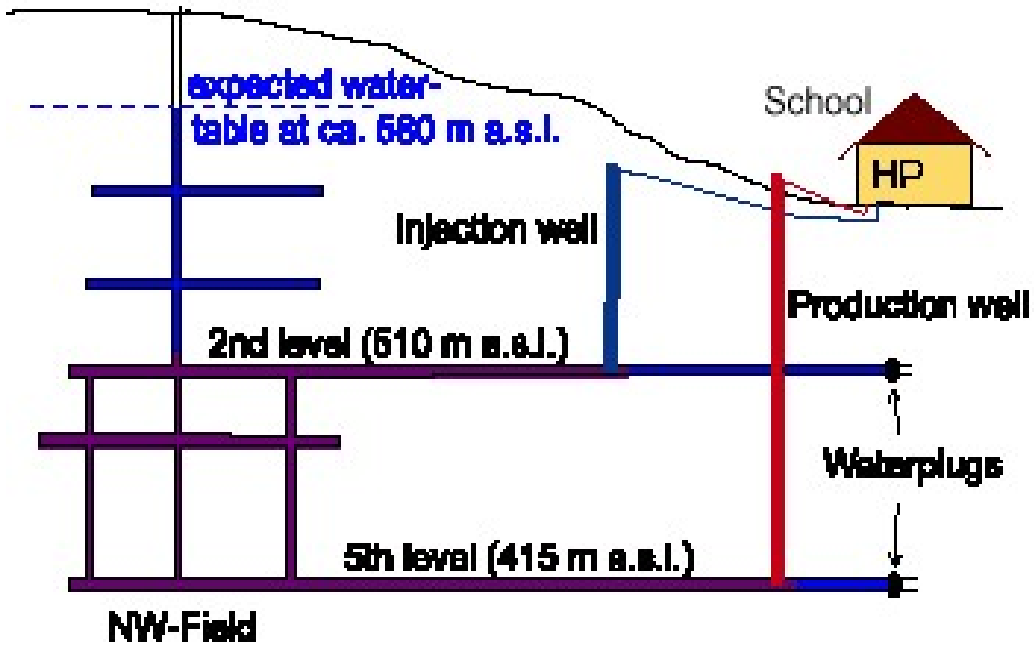
uppvärmning”

Mining industry Boliden Mineral AB cooperate with Siemens.

”Som ett led i Boliden Mineral AB:s miljöengagemang har parterna tecknat ett Performance Contracting avtal. Energiprojektet innebär minskade driftskostnader, förbättrad inomhusmiljö och minskad miljöbelastning.
Gaspannan ersätts med en värmepump som tar sin värme från dräneringsvattnet som pumpas upp från gruvan”

Road departements

„Moore examples from Saxonia in Germany and Canada were tunnel water is used. In the village of Oberwald at the Western entrance of the Furka rail tunnel in Switzerland and in Airolo, where water from the Gotthard road tunnel provide the heat source for a heat pump in the road maintenance facility. With the huge tunnel constructions ongoing in the Alps, new potential for this type of heat source is developing“



Ehrensfridersdorf, Germany.

What happened in Ely? An area or district with careful will to invest.

As far as we know nothing was installed.

Newsline

The magical value of heat pump systems

Magicians may pull rabbits out of hats, but many homeowners perform captivating acts of their own by taking natural heat and cooling power from air and earth to transform it into conditioned comfort. Yet this act doesn't involve any sleight-of-hand trickery. It simply requires a heat pump.

Millicent O'Connell (right) says the tubing for ground source heat pumps looks like a big "hula-hoop." The O'Connells' "hula-hoop" coils were buried 8.5 feet into the ground, which provides their home with comfortable and efficient heating and cooling. Her daughter, Rita [illegible] initiated the project in 2011.

ground loops that I invited the neighbors to come watch too." She and her daughter, Rita O'Connell, hired a certified contractor to install a ground source heat pump at their home and have been enjoying the savings over fuel oil since December 2011.

Heat pumps move heat into residences during winter and out of them in summer, trimming overall home heating and cooling costs by as much as 40 percent, according to the U.S. Department of Energy (DOE). A national study revealed 11 percent of homes use a heat pump as their primary heating/cooling system. For all-electric homes this jumps to 29 percent.

Heat pumps are environmentally friendly as well, which was another intriguing "plus" for Rita, being a professor of biology and environmental science at Lake Superior College.

"I figured that I better put my money where my mouth is," said Rita. "Part of the reason we opted for the ground [illegible] heat pump was to get away from [illegible] fuels. But

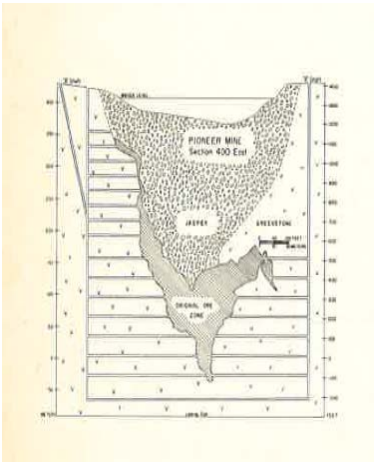
wearing two sweaters or a jacket to stay warm," said Millicent. "Because fuel oil cost too much, I kept the temperature low to save on heat. The ground source heat pump has made our home warm and comfortable with an even heat – even the basement is cozy and warm."

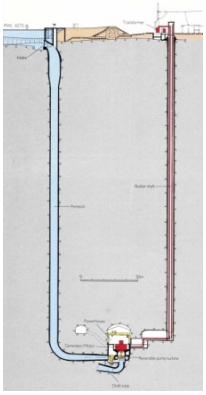
Geothermal heat pumps move a special liquid through pipes buried in the ground, then into a home. There are two types of ground source units: a groundwater (open-loop) system uses well or pond water, while an earth-coupled (closed-loop) model uses a water and antifreeze solution. Systems can be installed horizontally or vertically, depending on available space.

Geothermal efficiency depends on climate, soil and water conditions, and landscaping. For example, soil that transfers heat easily requires less piping. Rocky terrain may require a vertical loop system instead of a more economical [illegible] loop system.

…..in connection to storage of mechanical energy

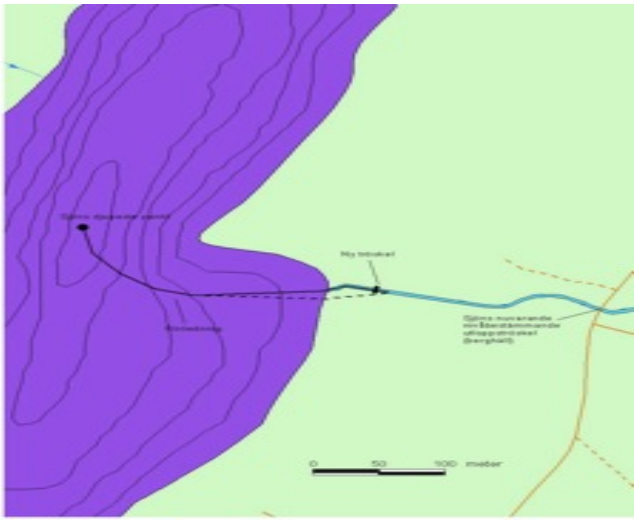
We suggested hydro pump storage e g Juktan Blaiken, northern Sweden, more bang for the buck while electrical energy could be stored! Value around ten times more than heat!





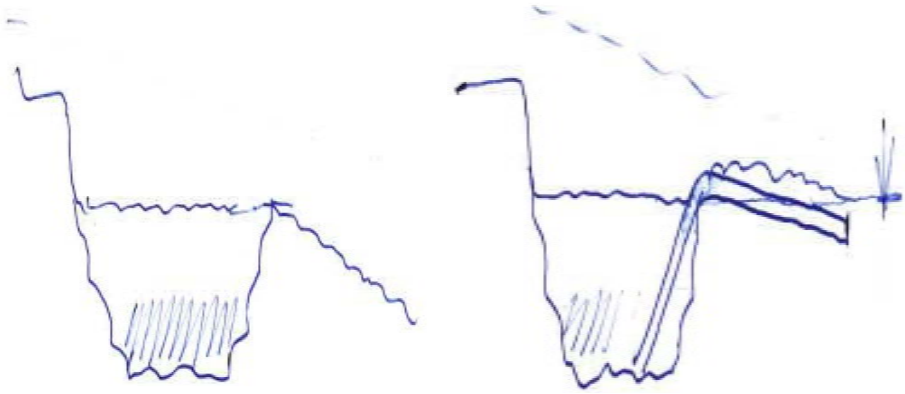
The mine could be tighten to its surrounding. Half of water volume should be taken away. Water could then be stored either in mine and shafts or in lake. When power is nedded, water passes turbines. When excess power, low price, turbines are used as pump.

.....in connection to aeriation/oxygenize water



Rasjön, depths and piping lay out.

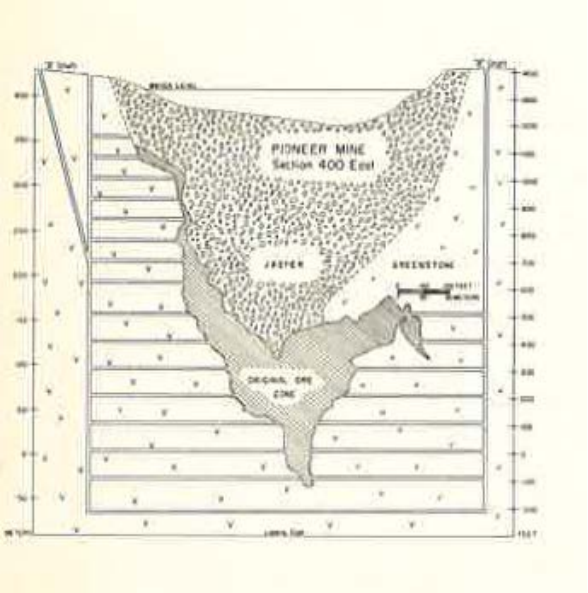
Part of Rasjön had some years ago oxygen deficit. By connecting pipes like the outlay in picture, natural turn around were reached. At the same time a heat exchanger could be connected. Small amount of added power input would be necessary and parasitic losses would be neglible.



Natural circulation in Rasjön.

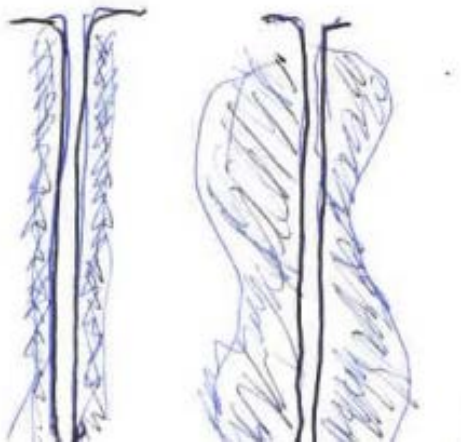
Future work

Find a mine were surface water could be circulated and used as a solar collector



The open lake is quite hot during summer/autumn.

A yearly water turn around could use ground more efficient, compare aquifers. See air lift pump application to increase circulation in traditional wells.



Active volume without and with circulation.

…… in connection to cleaning of water

Ground water many times damaged from chemicals from mining. Prytz and Stjerne also Vildevik 2013 underline the future need of cleaning.

Concluding

Mines/tunnels and lakes

Often natural circulation of water

Permission many times exists

Pipe structures often already exists

Often large quantities

- Vattenomsättning naturligt och för brytning, för syresättning, i vissa fall självfall
- Vattendom m fl tillstånd finns ofta
- Färdiga anslutnings hål
- Gruvor stora volymer även berg i kontakt med vatten

Combinations better pay off

Better pay off if two problems solved simultaneously. E g is heat and cleaning or oxygenizing.

References

Walton M & McSwiggen 1983, *Heat Accumulation, Storage and Recovery in Flooded Mine at Ely, Minnesota, USA*. Subsurface Heat Storage in Theory and Practice. Procced Swedish Counsil for Building Research. Sthlm june.

Prytz U & Stjärne A 2013 *Förorenade områden gamla gifter från förr ger skador i miljön i dag*. Härnösand.

Vildevik C 2013 *Förorenad mark –miljömål uppfyllse*. Lunds univeristet. Lund