

# Geothermal trail Cerknno

GRETA Final Conference, Lyon, 7th November 2018

Dušan Rajver, Joerg Prestor, Jernej Jež, Simona Pestotnik (Geological Survey of Slovenia)



## 1 Shallow geothermal energy on the surface, 0 m

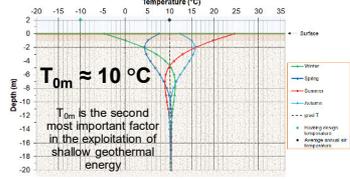
Springs bring geothermal energy to the Earth's surface.

The intermittent spring (also: rhythmic spring) close to the hamlet of Straža near Cerknno is one of rare springs whose flow of water is subject to rhythmic fluctuations as a result of special hydraulic conditions there. The water from the springs can be used to heat and cool houses or, for instance, to heat a pool.



## 2 Shallow geothermal energy just beneath the surface, 1 - 20 m

Shallow geothermal energy is renewed by solar radiation and the Earth's heat flow.

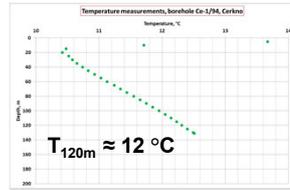
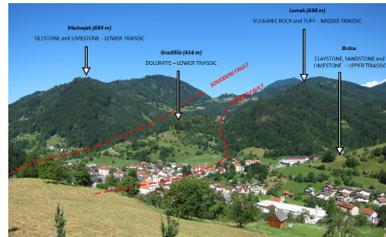


The elementary school of Cerknno features an ecological chalet that shows the ways different sources of renewable energy are used, including shallow geothermal energy. The latter explains its phenomenon from 0 to 20 m.

By installing a horizontal heat exchanger at a depth of a mere 1.5 to 2 m, we can heat a building with shallow geothermal energy.

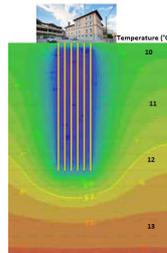
## 3 Shallow geothermal energy down to a depth of about 100 m

Geothermal borehole Ce-1/94 - at Rajda provided information on geology of surrounding areas. The soil temperature in the Cerknno region rises by about 2 °C for each 100 m of depth.



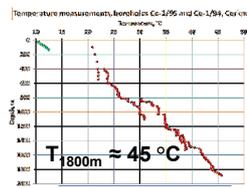
Tectonics has a significant role in the geomorphology of the area.

The Centre for school and extra-curricular activities (CSECA) is located in an older building, heated and cooled by means of shallow geothermal energy, extracted via a field of 12 borehole heat exchangers with a depth of 100 metres. The elementary school and the CSECA are public buildings whose heating systems rely on a combination of biomass and shallow geothermal energy.

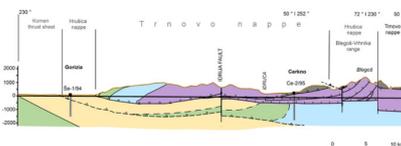


## 5 Deep geothermal energy, 2000 m

Extraction of geothermal energy from depths of more than 300–400 m is called deep geothermal energy production. The deepest operating geothermal borehole in the western part of Slovenia, designated as Ce-2/95, is located at Hotel Cerknno.



Due to its favourable temperature, chemical composition and very high quality, the water from the Ce-2/95 borehole can be directly used to fill pools. Such quality is exceptional in boreholes that are so deep, and is the result of the excellent recharge dynamics from the Blegoš massif.



The transversal geological cross-section shows thrust faults and ages of geological units down to a depth of 2 km.

## Geothermal properties of the rocks in the Cerknno region

The thermal conductivity of rocks is the most important factor in the exploitation of shallow geothermal energy; therefore, we must have a good knowledge of the geological conditions of the area.

The municipality of Cerknno boasts one of the most diverse geological settings in Slovenia. Cross-section of geological strata that form the territory of the central and southern part of the Cerknno region – the hamlet of Straža:



Rock diversity in the Cerknno region is the cause of diverse thermal conductivity. Rock with the lowest thermal conductivity have a similar one as concrete. Those with the highest have up to 3 or 4-times higher thermal conductivity compared to the one of concrete.

Locality	Lithology of the surface	Age of surface rocks	Thermal Conductivity (W/m.K)
Črni vrh	siltstone & shaly claystone	Middle Triassic	1.78
Brdica	siltstone to mudstone	Upper Triassic	1.95
Raba	limestone	Lower Triassic	2.64
Brdica	sandstone	Upper Triassic	2.75
Min	quartz sandstone w. conglomerate	Carboniferous	3.91
Tabla	massive crystalline dolomite	Middle & Upper Triassic	5.59
Thermal conductivity of various substances (ice 10°C)	wood		0.08
	water (10°C)		0.6
	brick		0.8
	concrete		1.4
	ice (10°C)		2.38

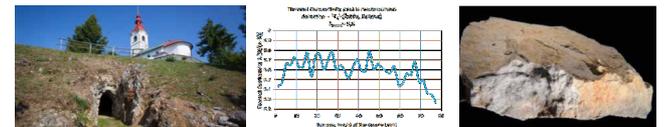
The tectonically deformed geological layers are equally suitable for geothermal boreholes; however, it must be examined whether the area is prone to landslides.



## 10 Potential of shallow geothermal energy in the Cerknno region

With a borehole heat exchanger 100 m deep it is possible to extract about 5 to 16 MWh of shallow geothermal energy per year from the Earth, at various places in the municipality of Cerknno. The highest natural potential for borehole heat exchangers is located in the western part of the municipality.

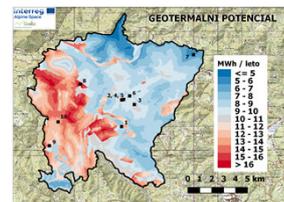
The most favourable rocks for the exploitation of shallow geothermal heat are found on the Šebrelje plateau, which is largely formed of massive grainy dolomite dating from the Middle and Upper Triassic (about 240 to 230 million years).



The municipality of Cerknno boasts one of the most diverse geological settings in Slovenia, and built the first geothermal nature trail in Slovenia.

Geothermal trail leading us from lower geothermal potential (blue) to the higher (red).

By being observant while strolling the 10 geothermal points, one can recognize many specificities of Shallow geothermal energy and its possibilities of exploitation.



### 10 points of geothermal trail:

- 1 - Intermittent spring of Zaganjalka near Straža
- 2 - Eco-energy park with log cabin displaying renewable energy sources at the elementary school
- 3 - Geothermal borehole Ce-1/94 - at Rajda
- 4 - Borehole heat exchanger field at the Centre of school and extra-curricular activities
- 5 - The deepest operating geothermal borehole in the western part of Slovenia, designated as Ce-2/95, is located at Hotel Cerknno.
- 6 - Cross-section of geological strata that form the territory of the central and southern part of the Cerknno region – the hamlet of Straža
- 7 - Cross-section of the geological strata forming the territory of the northern part of the Cerknno region – Črni vrh mountain
- 8 - Cross-section of geological strata at depths of 95 to 365 m below Hotel Cerknno – Brdica
- 9 - Cross-section of tectonically deformed oldest rocks in the municipality of Cerknno – Padruša brook
- 10 - Territory with the best rock thermal conductivity in the Cerknno region – the village of Šebrelje

