International Conference on Sustainable Aggregates Planning in South East Europe

- contributions to the EU minerals policy framework -

Field Trip Guide

22nd – 24th OCTOBER 2014

Hotel Park, Bled, Slovenia

Organised by:

ISKRIVA institute for development of local potentials

GeoZS

Time table

9:00 - 20:00	FIELD TRIP
9:00 - 09:30	**Start at 09:00 in back of the Hotel Park (1), Drive to Jesenice (2)**
09:30 - 14:00	**Visit of the Stara Sava museum and Acroni steel plant**
14:00 - 15:00	**Drive to Kranjska Gora (3)**
15:00 - 17:00	**Lunch break**
17:00 - 17:30	**Drive to the Planica**
17:30 - 18:00	**Overview of the Geology of Julian Alps (4)**
18:00 - 19:00	**Zelenci Springs (Sava River springs) (5)**
19:00 - 20:00	**Drive back to Bled**

Point 2 - A short history of mining and smelting in Slovenia with an overview of smelting tradition in Jesenice

Text from (copy/paste): Žibret & Šajn (2008). Impacts of the mining and smelting activities to the environment – Slovenian case studies. In: Mikel L. Sanchez - Causes and Effects of Heavy Metal pollution. New Yourk: NOVA Science publishers, 1-79 pp.

OVERVIEW

The mining and smelting tradition in Slovenia (Figure 1) has a long history. Some archaeological artifacts - findings of the mining tools on Pohorje region (Tržan, 1989) - suggest that mining and metal smelting started in Bronze Age. In the Iron Age period - hallstadt period (800 - 300 B.C.) - there have been numerous evidences of iron mining and smelting (findings of molds, tools etc...). The land has been rich in iron ore and mining, smelting and forgery have been wide spread. Also the iron tools and armory from that region has been recognized in the Roman Empire after its quality and this province, called Noricum, has maintained independence and the status hospitum publicum (friends of Rome) for the long period. After annexation of the Noricum and Illyricum provinces to the Roman Empire the beginning of the exploitation of lead and copper ore has taken place.

The exploatation of the biggest ore deposits started in the middle ages. The main branch was the iron smelting. The ore has been collected on the surface and inside small mining shafts. The known bigger mining operations have been in Idrija, Mežica and Litija. After the fall of feudalism and construction of railways in 1850 the iron smelting activities has increased drastically. Also, the production of other metals, such as Pb, Zn, Hg, Cu and Sb, has gained in its importance. The production reached peak between 1850 and 1900 when taking into account the number of known mining pits. Especially Idrija mercury mine had the great importance in the Habsburg monarchy. At the peak of mercury production the mine contributed as much as 50% of the monarchy's annual budget.

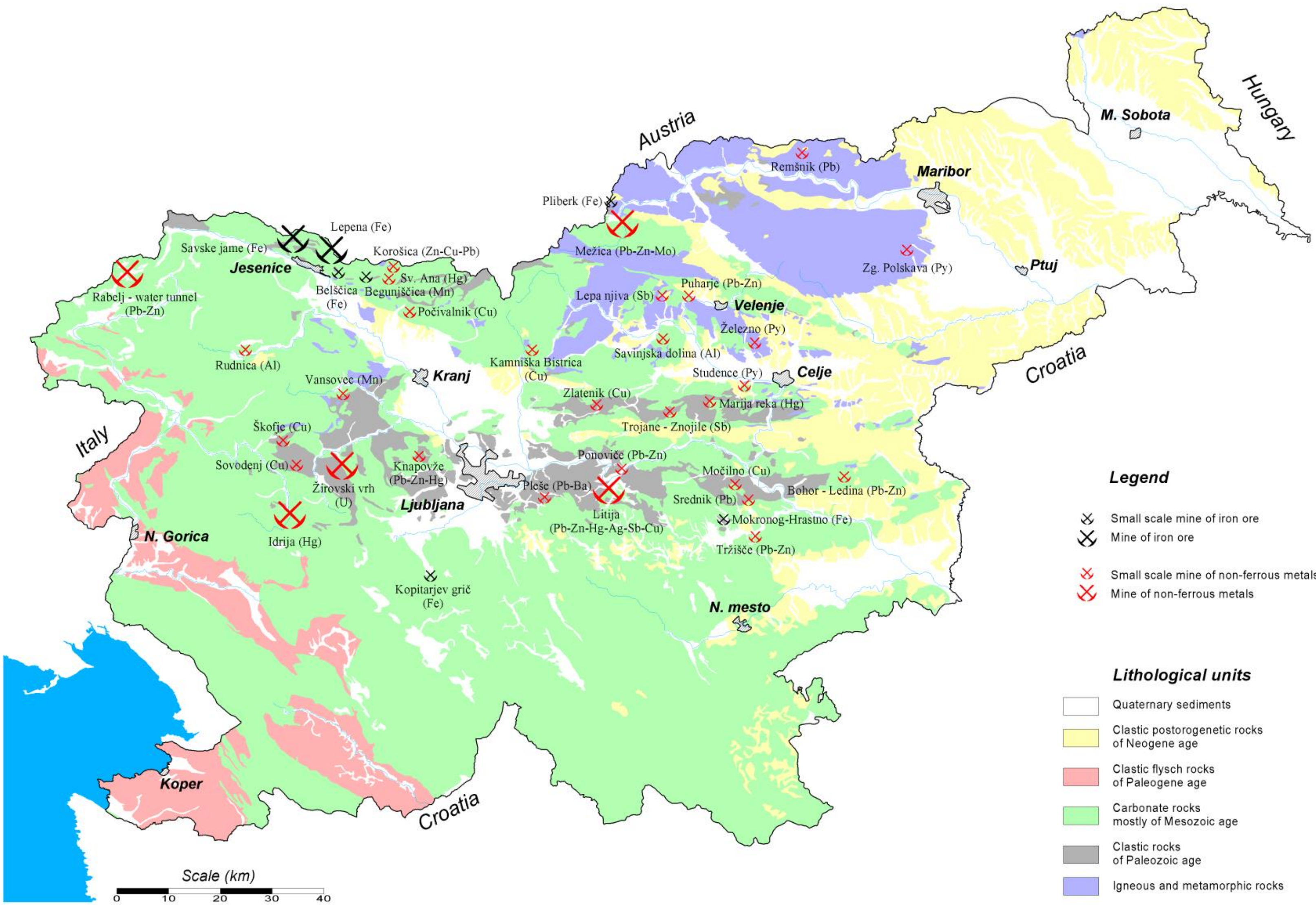
In the beginning of 20th century many of operating mines and connected smelters have been closed down due to small ore quantities and its low grade. Only the biggest ones have prevailed. The new, but short-term impulsion to the metal production has been the period of First World War because of the lack of base metals supply. Between both world wars almost all metal production in the territory of Slovenia has been halted, especially after 1929's great depression. Only Mežica Pb-Zn mine was still in operation. Until the end of Second World War the Idrija and Litija mines have been reopened.

After the arrival of communist regime after the end of Second World War the authorities put the great emphasis of on the mineral prospection, but no new large metal deposits has been discovered. The exception was only the opening of Žirovski vrh uranium mine. As the ore processing capacities all over the country have exceeded the mining capacity a lot of metal ore have been imported from other mines in Yugoslavia. In more recent times due to small price of the metals on market and bigger environmental awareness all of the mines and smelters have been closed. Nevertheless larger mines still have the capacity to be reopened because not all of the resources have been exploited. From the times of Roman empire to present 49 different mines and 25 ore processing plants have been recognized (Figure 2). 4 of them were large (Idrija, Mežica-Topla, Litija and Žirovski vrh). There ware also 33 ironworks nearby the iron ore deposits, 3 of them are still operational (Jesenice, Štore, Ravne na Koroškem).

Jesenice Steel Producing area

Jesenice is located on the NW part of Slovenia nearby Austrian border inside the Sava River valley between Karavanke and Julian Alps mountain ranges (figure 1). Historical background is presented according to the Acroni Jesenice steel factory web page (http://www.acroni.si/si/index.php?cat_id=38) with additional references where mentioned.

Archaeological evidences indicate that iron smelting dated back to 1000 BC. The first document, which mentions iron smelters in this area, is Otenburg document from 1318. Extensive iron smelting activities are reported from 14th century on. Industrial revolution in 19th century forced small ironworks companies to unify as Karniola industrial company (Kranjska industrijska družba - KID) between 1869 and 1872. In 1872 there has been a big breakthrough as the process for producing ferromanganese in classical smelting furnaces has been developed which give the KID worldwide reputation. At the end of 19th century the cooperation with the German ironworks extended the iron production widely. Another extension of production dates between 1937 and 1940 when the company produced 100.000 tons of steel annually. Extensions ware also in 1966, 1976 and 1987. After breakup of Yugoslavia the company lost its markets and the production decreased. Since then the production of steel increased drastically again. The company investments lead into 200.000 tons of annual steel production in 1999. Today the Acroni steel factory is second biggest producer of steel sheets in Europe and is a part of state-owned Industrial Metallurgical Holding (as in Ravne case).


Austria
Hungary
Italy
Croatia
Croatia
M. Sobota
Maribor
Ptuj
Velenje
Celje
Jesenice
Kranj
Ljubljana
N. Gorica
Koper
N. mesto
Remšnik (Pb)
Pliberk (Fe)
Mežica (Pb-Zn-Mo)
Zg. Polskava (Py)
Lepena (Fe)
Savske jame (Fe)
Korošica (Zn-Cu-Pb)
Sv. Ana (Hg)
Begunjščica (Mn)
Belščica (Fe)
Počivalnik (Cu)
Rabelj - water tunnel (Pb-Zn)
Lepa njiva (Sb)
Puharje (Pb-Zn)
Železno (Py)
Savinjska dolina (Al)
Kamniška Bistrica (Cu)
Rudnica (Al)
Vansovce (Mn)
Studence (Py)
Zlatenik (Cu)
Marija reka (Hg)
Trojane - Znojile (Sb)
Škofje (Cu)
Sovodenj (Cu)
Žirovski vrh (U)
Knapovže (Pb-Zn-Hg)
Ponoviče (Pb-Zn)
Pleše (Pb-Ba)
Litija (Pb-Zn-Hg-Ag-Sb-Cu)
Močilno (Cu)
Srednik (Pb)
Bohor - Ledina (Pb-Zn)
Mokronog-Hrastno (Fe)
Tržišče (Pb-Zn)
Idrija (Hg)
Kopitarjev grič (Fe)
Legend
Small scale mine of iron ore
Mine of iron ore
Small scale mine of non-ferrous metals
Mine of non-ferrous metals
Lithological units
Quaternary sediments
Clastic postorogenetic rocks of Neogene age
Clastic flysch rocks of Paleogene age
Carbonate rocks mostly of Mesozoic age
Clastic rocks of Paleozoic age
Igneous and metamorphic rocks
Scale (km)
0
10
20
30
40

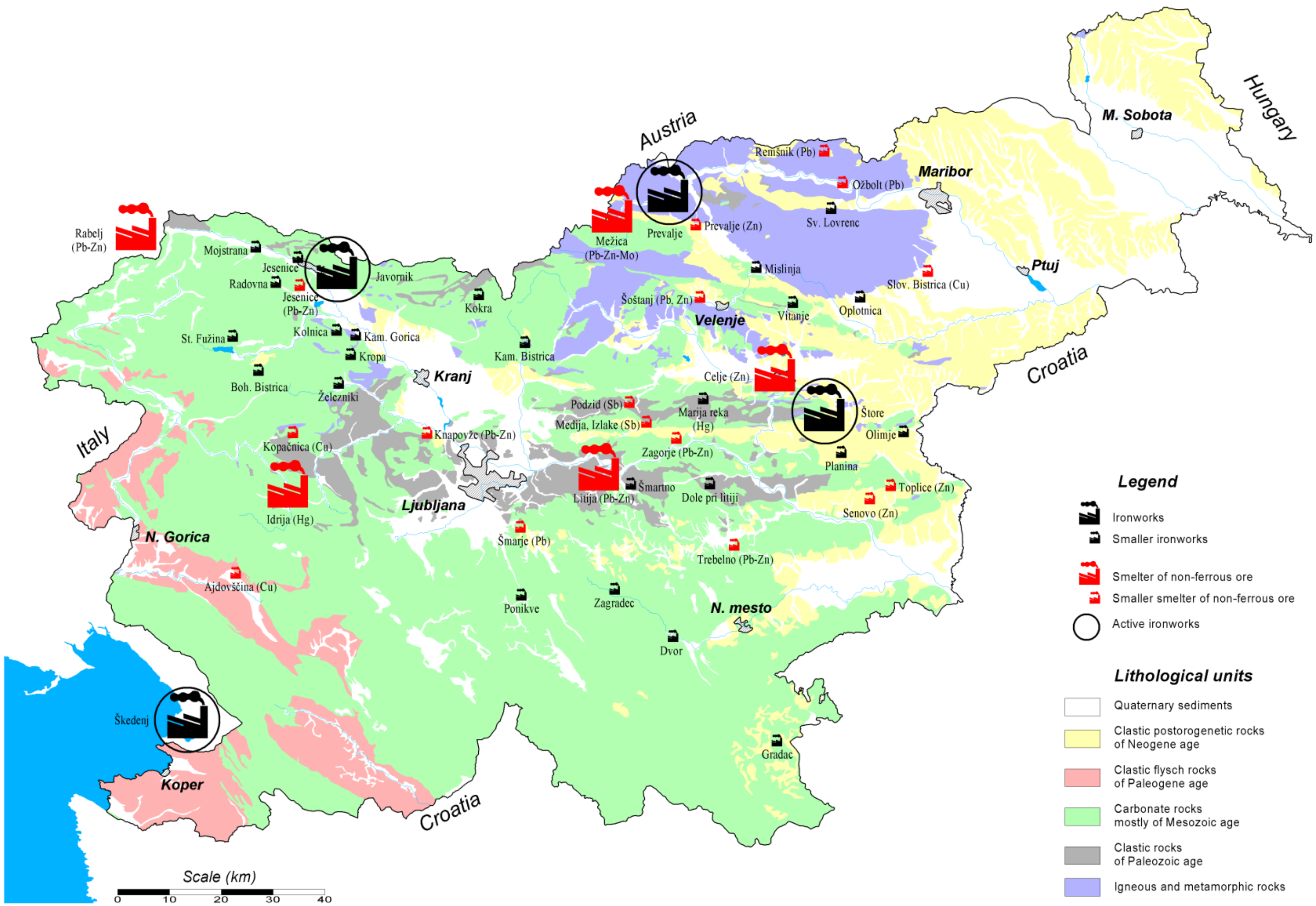


Figure 2: Locations of the past metal mines and smelters (Budkovič et al., 2003).

The emissions of heavy metals in Jesenice area is mainly because of ironworks. Earlier data (Šipec, 1990) reports daily dust emissions of 48 tons in 1971. Also about 270 tons of ash produced daily should be added. The Jesenice ironworks has been recognized in that time for its red dust emissions. Between 1971 and 1987 the company took partial remediation and modernization which decrease daily dust emissions. The abandoning of the Siemens-Martins furnaces in 1987 decrease the daily emissions to 2 tons of dust and 950 kg of SO_2. In recent days the emissions from Jesenice steel plant are insignificant.

Point 3 - THE ZGORNJESAVSKA VALLEY and KRANJSKA GORA

Source: http://www.kranjska-gora.si

The municipality of Kranjska Gora is situated in the area of the Zgornjesavska valley, sometimes spelt Gornjesavska dolina, and also known as Dolina, this is without doubt one of the most **picturesque Alpine valleys**. Located at the far north east of Slovenia where the borders of Slovenia, Austria and Italy meet, the valley is embraced on the north and south by the towering peaks of the Kravanke Mountains and the Julian Alps. In the east its border runs just below the town of Jesenice where the valley opens up towards the Radovljiska valley, extending in the west along the water-stretch between the Sava and the Zilja rivers, just west of Ratece.

The Zgornjesavska valley enjoys an **Alpine climate with** its **long, snow-abundant winters and shorter summers with moderate temperatures**, easterly winds and sufficient rain to maintain the valley's greenery. The winter usually stays in the valley for between four and five months, and the blanket of snow usually covers the valley for just around four months. **The lowest daytime temperature** in January sometimes reaches –8 ^{o}C, while on average it usually warms up during the day to just over freezing point. The average **temperature in the hottest summer months** is 10 ^{o}C in the morning, rising up to around 23 ^{o}C during the day.

In winter there are **large differences between the sunny and shady slopes** embracing the valley. The sunny slopes are ideal for trips and strolls in the beautiful sunshine while the shady slopes keep the cold and help to retain that snow blanket loved by all skiing enthusiasts.

Kranjska gora

The **history of Kranjska Gora** reaches back to the second half of the 14th century when the inhabitants began chopping down the forests to a larger extent, transforming them into farm land and pastures for sheep and cattle. The area gained strategic significance during World War I when the military road across the 1611 m high Vršič pass from the Sava to Soča Valleys was constructed by Russian prisoners. Kranjska Gora acquired its fame as a tourist region through the construction of the railroad and its first visitors. Somewhat later, ski jumping and ski flying in Planica carried the name of the area and valley throughout the world. This encouraged a blossoming tourist activity in the Kranjska Gora region especially when the first cable cars were built on the sides of the Vitranc at the end of the fifties.

Point 4 - Planica

Rateče is distinguished by its position alongside the **tri-border** of Italy and Austria and Slovenia, for the main road flows under the village bringing you across the Italian border and along Kanalski Valley (La Val Canale, Italy). On the southern side of Rateče, the vista opens up into the Planica Valley surrounded by the high peaks of the Julian Alps. At the end of the valley, lies the **Tamar** from which the first source of the Sava Dolinka, the Nadiža Waterall flows out from under Ponce.

The village has an expressed Alpine climate. Winters are long and cold, however its favourable position alongside the foothills of the Karavanke forests and pastures offers visitors an abundant number of sunny days, suitable for walking in the mountain forests and pastures.

Rateče manuscripts were discovered here dating from the second half of the 14th century. The originals are stored in Klagenfurt, while copies are on display at the church of St. Tomaž in Rateče. The manuscript of Rateče or Klagenfurt is one of the oldest written records in the Slovene language and thus an important historical recollection of the Slovene folk.

Planica is best known for one of the largest ski jumping hill in the world. It was at Planica, that the first human in history jumped over 100 m on skis, later also exceeding the 200 m distance. The Planica organisers prepare the hill for new surprising results each year. Planica is the cradle of ski-flying. Since 1934 crowds of competitors have been coming to Planica to try and break the world record. Over 60 world records have been broken in Planica, including the first jump over 100m in 1936 by the Austrian ski-jumper Seppa Bradl and the first flight over 200m by the Finnish competitor Toni Nieminen in 1994. The current holder of the world ski-flying record of 239m is Bjoern Einar Rumoeren who set the record at Planica in 2005. Ski flying competition in 2015: 19.3. - 22.3.2015.

GEOLOGICAL OVERVIEW OF SOUTHERN ALPS & SAVA FAULT

Following text was taken (copy/pasted) from **Celarc et al., 2013 - Field Trip A1: Southern Alps of Slovenia in a nutshell: paleogeography, tectonics, and active deformation (7th IFAA workshop on Alpine Geological Studies)**, with permission from the first author. http://opac.geologie.ac.at/wwwopacx/wwwopac.ashx?command=getcontent&server=images&value=BR0099_135_A.pdf

Introduction

The field-trip area is located in the eastern part of the Southern Alps (NW and central N Slovenia). It is situated between the Periadriatic fault, Labot (Lavanttal) fault and Ljutomer fault which are in the broader sense a part of the Balaton fault zone in the north, and South-Alpine thrust border and Sava fault in the south (PLACER, 2008) (Fig. 1). Julian Alps and Kamnik – Savinja Alps are predominately composed of Mesozoic carbonate rocks. In the Southern Karavanke also Paleozoic rocks are exposed. In the Julian Alps South Alpine and the Dinaric structures now overlap. They consist of two south-verging tectonic units, the Tolmin Nappe and the Julian Nappe. The Tolmin Nappe consists of several thrust sheets. Also Julian Nappe consists of minor thrust sheets, but it has not yet been satisfactorily resolved. The K–S Alps were displaced by approximately 40 km with respect to the Julian Alps along the Neogene dextral strike-slip Sava Fault. The Julian Alps and the K–S Alps exhibit a remarkably similar stratigraphic evolution in the Triassic. North of the Julian Alps and the K–S Alps the South Karavanke Mts. form a strongly elongated strike-slip-related system of sheared tectonic lenses south of the Neogene Periadriatic Line (PLACER, 2008). During the extensional evolution of the Pannonian Basin, connected with the activation of the Periadriatic Line (PAMIĆ & BALEN, 2001), volcanic activity created the Smrekovec Volcanic Complex, part of the small and marginal sub-basin, positioned on the Mesozoic basement of the Southern Alps. In the releasing overstep between major dextral strike–slip Sava and Žužemberk faults, Ljubljana Basin, filled with Quaternary sediments is positioned (VRABEC & FODOR, 2006). Smaller E-W oriented reverse faults that displace Quaternary sediments in the basin may indicate a recent change in the deformational regime from transtensional subsidence to transpression.

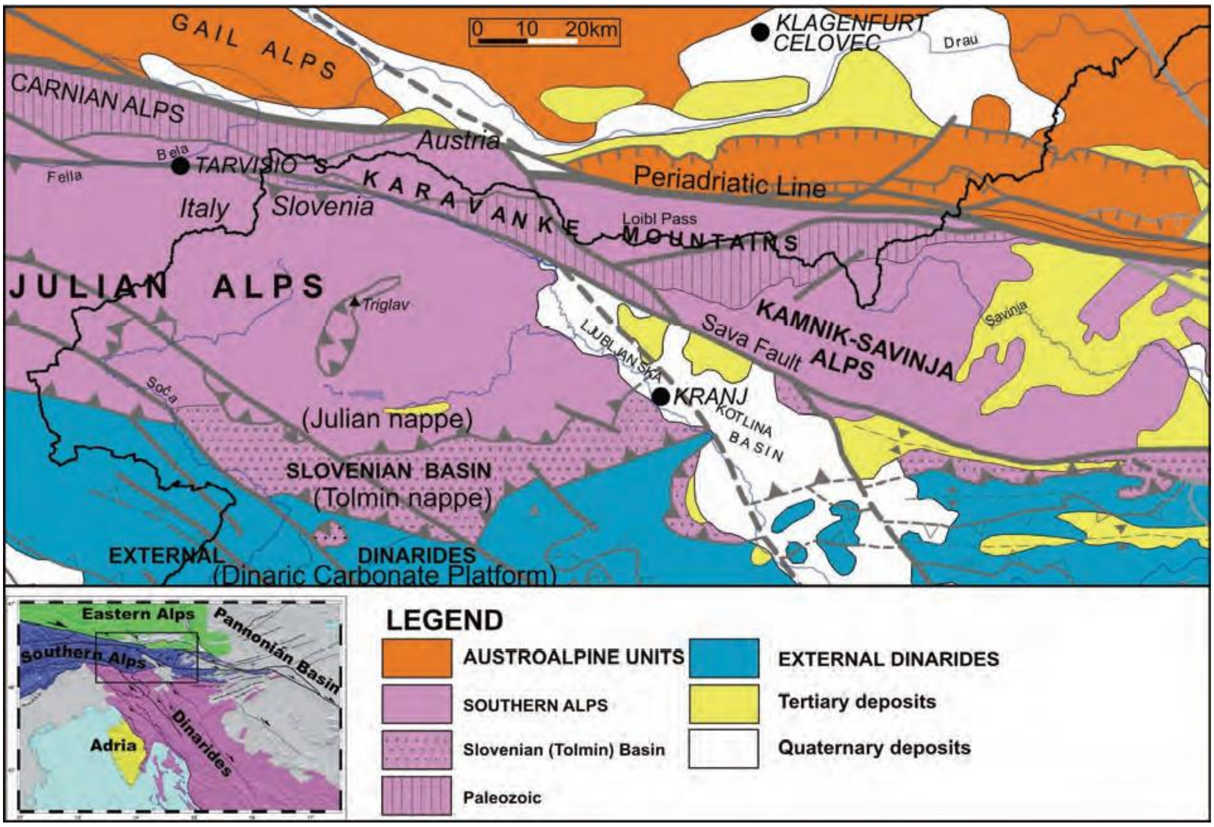


Figure 1: Macrotectonic subdivision of the NW and central N Slovenia (after PLACER, 2008).

Sava fault (by Marko Vrabec)

The dextral strike-slip Sava fault is a major NW-SE-trending regional fault in the easternmost exposed part of the Periadriatic fault system (e.g. VRABEC & FODOR, 2006; Fig. 10). Between the Sava fault and the Periadriatic fault proper a complex transpressional shear lens developed, where complex rotations of fault-bounded blocks were documented with paleomagnetic data (FODOR et al., 1998).

The Sava fault is traditionally interpreted to connect westward with the E-W trending Fella reverse fault of the northeastern Italian Southern Alps, although its direct linkage with the Periadriatic fault accross the Carnic Alps seems more plausible from both geometrical and kinematic considerations (FORKE et al., 2008). Due to incision of the upper Sava river valley along the fault trace, the fault has a marked topographic expression, which continues into central Slovenia where the fault separates the Quaternary Ljubljana basin from the northbounding mountain ranges (Fig. 11). Further to the east, the fault is interpreted to bend in the E-W orientation and to eventually connect with other faults of the Periadriatic fault system, like the Šoštanj fault and the Labot (Lavanttal) fault (KAZMER et al., 1996; PLACER, 1996; FODOR et al., 1998).

The amount of displacement on the fault was estimated from dextral separation of various Oligocene formations that crop out on both sides of the fault. Estimates range from 25 km (HINTERLECHNER–RAVNIK & PLENIČAR, 1967), 40 km (KAZMER et al., 1996) to 65–70 km (PLACER, 1996), though we find the lower estimates more realistic. The time span of the activity of the fault is also not very well constrained by geological criteria. Folding and reverse faulting of mid-Miocene sediments in the restraining bend of the fault north of Ljubljana limit the main slip phase to post 12 Ma (VRABEC, 2001).

Several indications exist for the recent activity of the fault. The rectangular Ljubljana basin, filled with Quaternary sediments, is interpreted as a pull-apart depression in a releasing overstep between the Sava fault and the Žužemberk fault (e.g. VRABEC, 2001). A GPS study of active displacements in the eastern part of the Peraidriatic system implies a slip rate of around 1 mm/yr on the Sava fault (VRABEC et al., 2006). More recently, a line of supporting geomorphological evidence, like dextral shifts of the drainage network and displacements of Quaternary-Holocene alluvial fans was documented along the fault (JAMŠEK-RUPNIK et al., 2012, 2013a; JAMŠEK-RUPNIK in preparation).

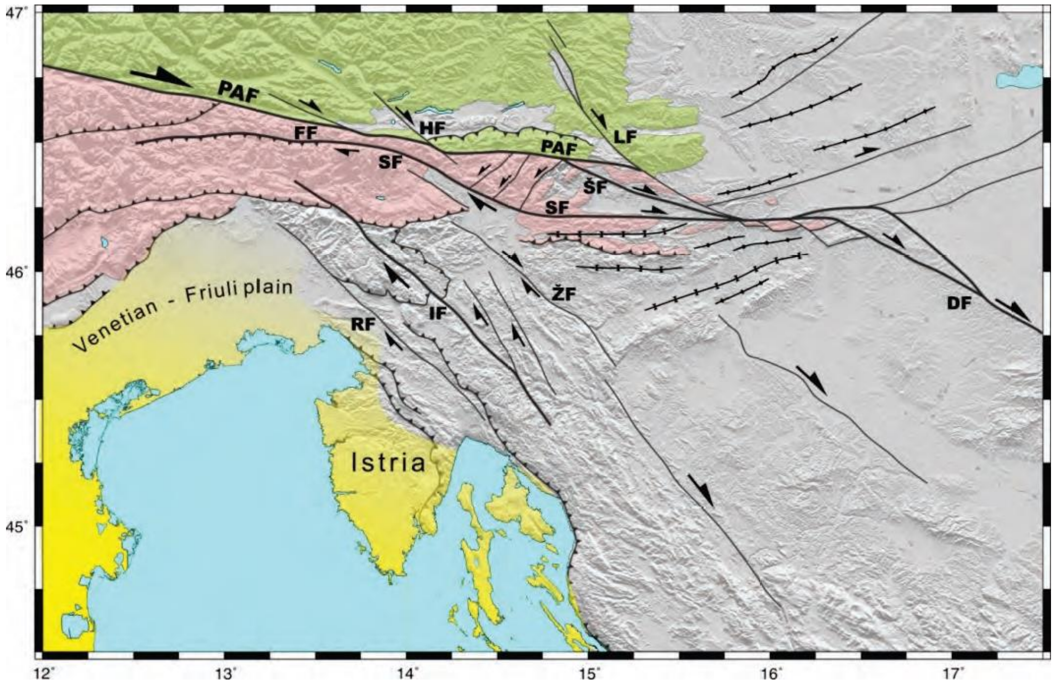


Figure 10: Trace of the Sava fault on the simplified tectonic map of the region (modified after VRABEC & FODOR, 2006). DF – Drava fault, FF – Fella fault, HF – Hochstuhl fault, IF – Idrija fault, LF – Labot (Lavanttal) fault, PAF – Periadriatic fault, RF – Raša fault, SF – Sava fault, ŠF – Šoštanj fault, ŽF – Žužemberk fault.

Figure 11: Spectacular topographic expression of the Sava fault in northwestern Slovenia. View is towards the east from the exit of the upper Sava river valley towards the Ljubljana basin. In front of the image the linear Završnica valley and its parallel ridge run along the Sava fault. Further towards the southeast, a prominent break in hillslope and faceted mountain faces, both indicating the location of the fault, are clearly visible. Image source: Google Earth.

Point 5 - Zelenci Spring

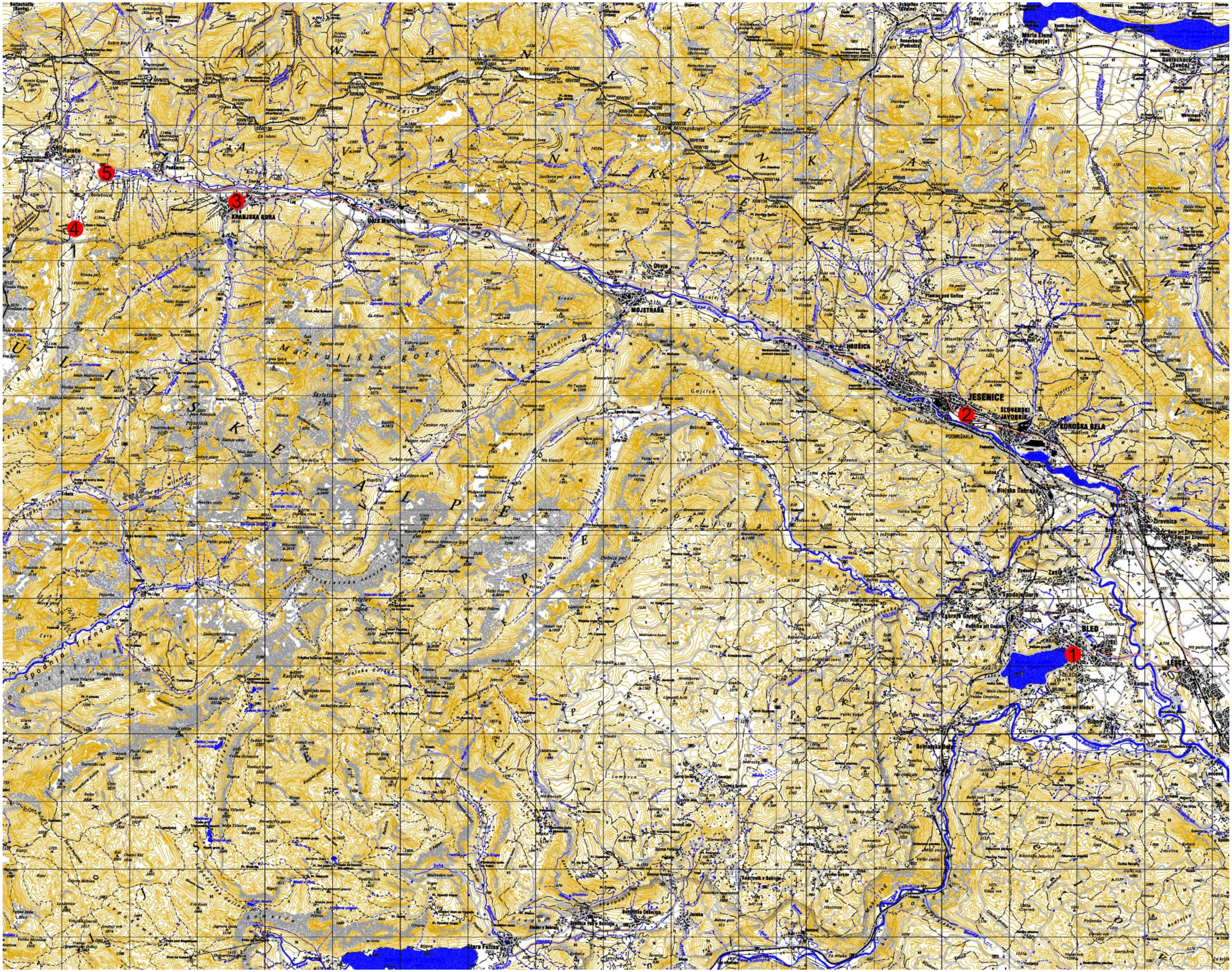
Text from Wikipedia

Zelenci is a spring and eponymous nature reserve near the town of Kranjska Gora, in the far northwestern corner of Slovenia. It is the source of the river Sava Dolinka, a tributary of the Danube. At Zelenci, water from the underground stream Nadiža (originating in the Planica valley) re-emerges through the porous bottom of a two-m deep lake, whose waters are noted for their deep, brilliant green. The spring and its surrounding area are named after this colour, zelen meaning "green" in Slovene and "Zelenci" being its possessive plural).

The Upper Sava Valley is the result of action by the Planica glacier, creeping from beneath Jalovec, Ponce and Mojstrovka. The area contains many lake sediments, suggesting that Zelenci is a remnant of a once much larger Lake Koren, created by the retreat of the glacier, which carried along much debris. In retreat, the bulk of it was deposited at what is now Podkoren, damming the Sava with the Koren Pass, which hemmed in glacial melt and formed an extensive lake. The Sava then tunneled through this natural dam, lowering the water level of lake Koren until only Zelenci and its surrounding wetlands were left.

Zelenci is considered the beginning of the longer of the two sources of the Sava, the longest Slovenian river at 221 km. The spring is actually the re-emergence of an underground creek called Nadiža, whose first source is near the mountain hut at Tamar, but which spends most of its course underground after disappearing at the Ledine gravel basin near Rateče. The porous chalk of the Zelenci lakebed permits a constant upwelling of groundwater in the form of tiny jets, a phenomenon unique in Slovenia. The lake formed by the springs has a constant year-round temperature of 5–6 °C. From the lake, the water flows into a stream, which empties eastward into the "Blata" ("Muds"), a 200 m wide and one km long shallow marshland. The actual riverbed of the Sava Dolinka does not begin until after this, at Podkoren beside the slopes of Mount Vitranc.

Zelenci was declared a nature reserve in 1992, both for its geological interest and as home to numerous endangered animal and plant species. The area of the nature reserve is 47 ha. The maintained paths feature informational signage, as well as viewing bridges and an observation tower. The unspoiled natural beauty of the multiple springs and emerald-green lake had also drawn the attention of the painter Ladislau Benesch.



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2
3
4
5
JESENICE
MOJSTRANA
KRANJSKA GORA
BLED