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LITHUANIA  
GARGŽDAI “KRANTAS”  
SECONDARY SCHOOL

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# CONTENT



- Forming conditions
  - Places of currency.
  - Types of sinkholes.
  - Famous sinkholes.
  - Geological researches.
  - Sinkholes and ecology.
  - Buildings in the places of sinkholes.
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# Forming conditions



The process of forming sinkholes goes where there are instant chapped rocks(limestone, dolomite, whiting, marble, gypsum, anhydrite, rock-salt) and water circulates. The areas beneficent for sinkholes make 0,15 percent of Lithuanian square.

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# FORMING CONDITIONS



Meltable rocks.

Streaming water.

Thick solid layer.

Deep bunched waterproof coating.

Floods and heavy rains.

Antropological appearances.

Tectonic movements.

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# FORMING CONDITIONS



In Lithuania the intensive sinkhole zone takes the position of good soil which have such districts as Biržai, Pasvalys, Panevežys, and Radviliškis.

It comes to about 400 km<sup>2</sup>.

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# FORMING CONDITIONS



Lithuanian sinkhole appearances go in vitriolic (gypsum) and carbonaceous(dolomite) rocks.

Gypsum melts faster than dolomite.

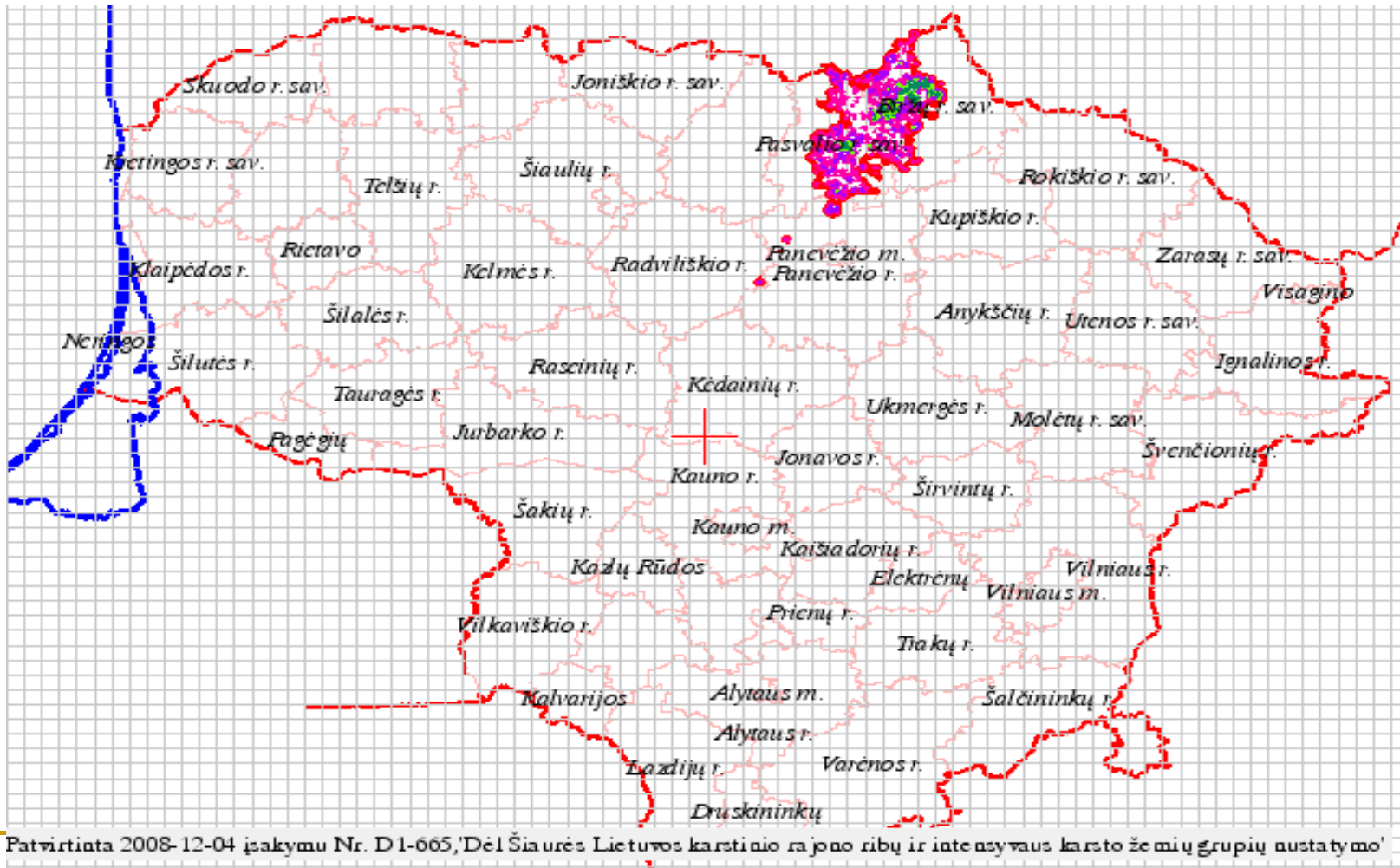
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# Gypsum rocks





# Map of sinkhole spread





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# Sinkhole phenomenon spread



- In the north of Lithuania there are over 10 thousand sinkholes.
  - Territory is classified as well, medium and less sunk.
  - In a very sunk territory there are more than 200 sinkholes.
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# Kinds of sinkhole phenomenon



- Sinkholes are being formed because of water circulation, melting rocks and lavage. It forms the underground hollows.
  - Sinkhole sources.
  - The result of surface of sinking underground sinkhole. Due to melting rocks forms sinkholes and lakes.
  - Dry sinkholes
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# Subsidence and underground cavities





# Underground caves



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# Karst lakes





# Sinkhole sources

- Green source - unique mineral water source, squirted out in sinkhole.
- It is the biggest source in Pasvalys district, its depth - 16 meters.
- Yield – 8-12 l/s.



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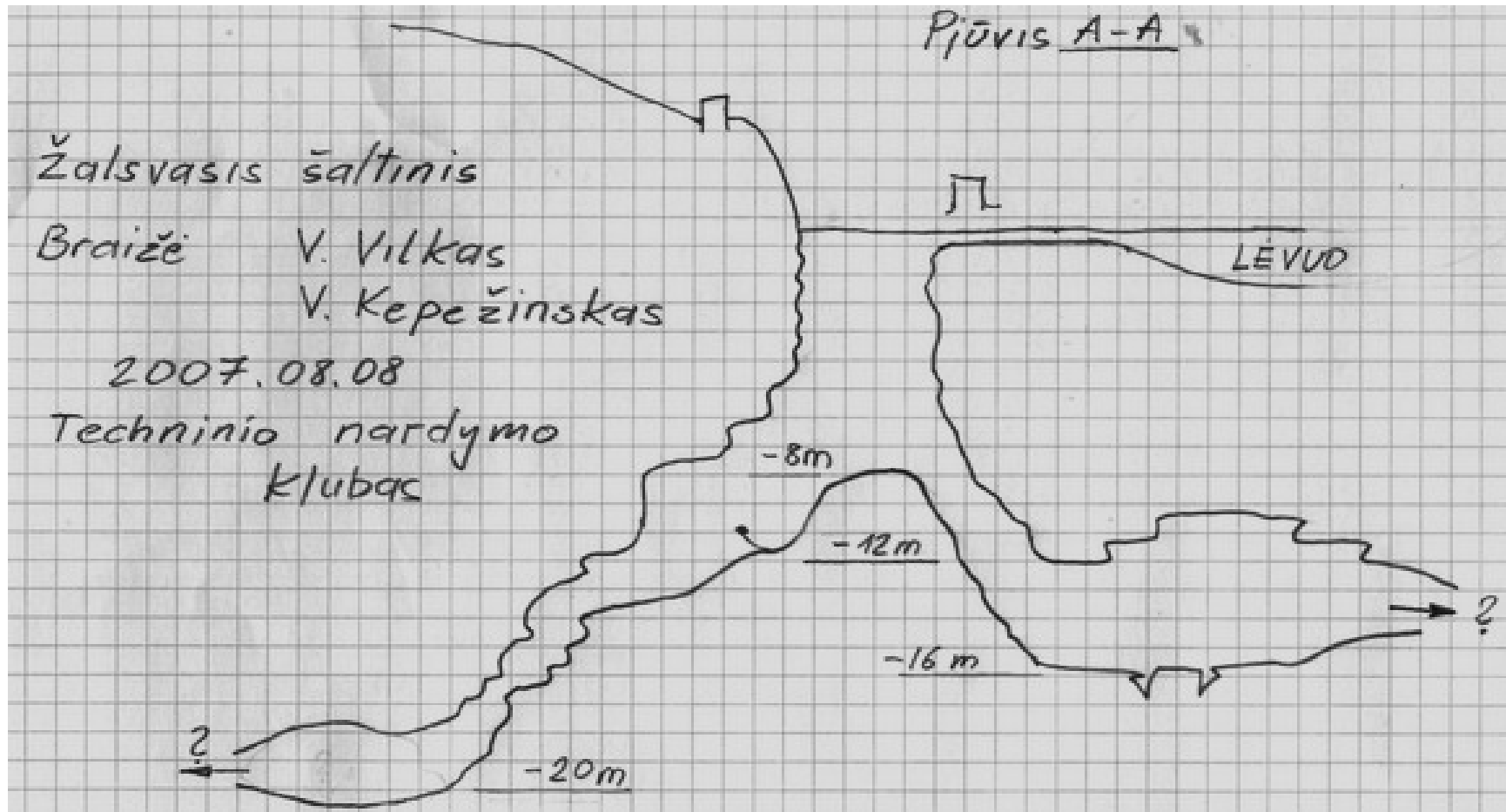
# Green source



- The source squirted out in the sinkhole in about the year of 1960. From the bottom of the sinkhole erupting water made a few meters long channel which has a bottom with pale grey, green color sediments, coloring the water with green. Sinkholes, from which flows the water, in the sides there are peaces of gypsum and dolomite. Water is cold and clear and it has a smell of sulphuretted hydrogen.
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# Scheme of Žalsvasis underground source



# Dry sinkholes



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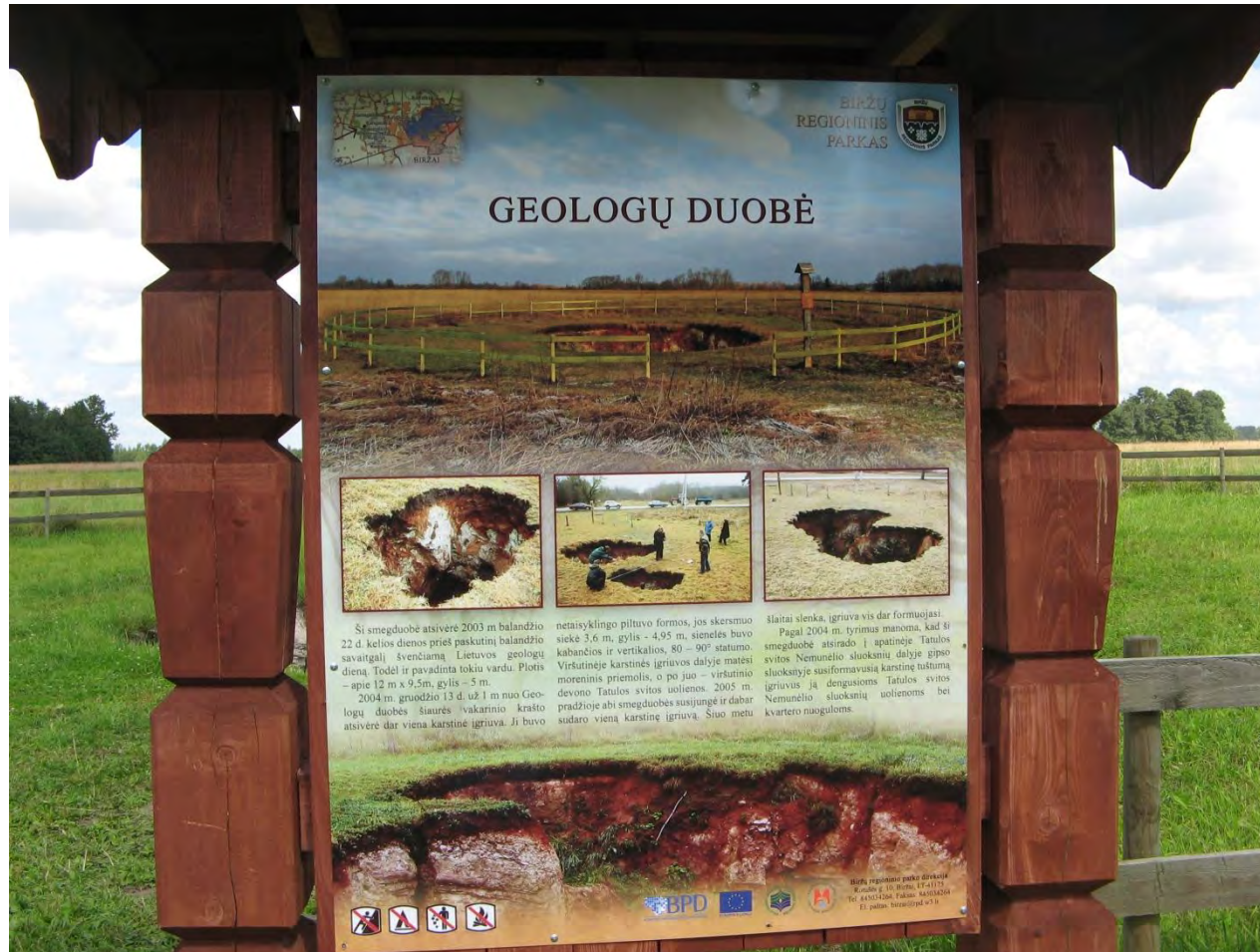
# The famous sinkholes



- The sinkhole of Geologists
  - Cow's pit
  - The source of Smardona
  - Lake of Kirkliai
  - Jaronis pit
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# The Geologists' Pit



# Geologists' Pit





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## The sinkhole of Geologists



- **It is a karst sinkhole** in Karajimiškis village, only one kilometre from the well-known sinkhole– Cow’s pit. It was opened in 2003 April 22, right before Lithuanian geologists day, therefore named the same name. Width – about 12 m x 9,5 m, depth – 5 m.
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# Cow's pit

- Sinkhole „Cow's pit“, 3,5 km. from Birzai (Karajimiškio k.) The largest pit called „Cow's pit“, in which, according to locals, a cow has gone in it. Its depth - 12 meters.



# Cow's pit



- Cows pit – shaped of a well, almost round sinkhole. At the top it is about 12 m, its depth is about 12.6 m. Going to the bottom the pit gets narrower, at 8.5 m depth it has 2 m diameter. At this side vertically tumbled walls that are made from a very thick lump of dolomite with thin streak of gypsum and margel. At the bottom of the pit, from 9.5 m depth, opens a wide cavity at the gypsum site from which ramificates 5 manholes that are 46 m. long.



# Cow's Cave



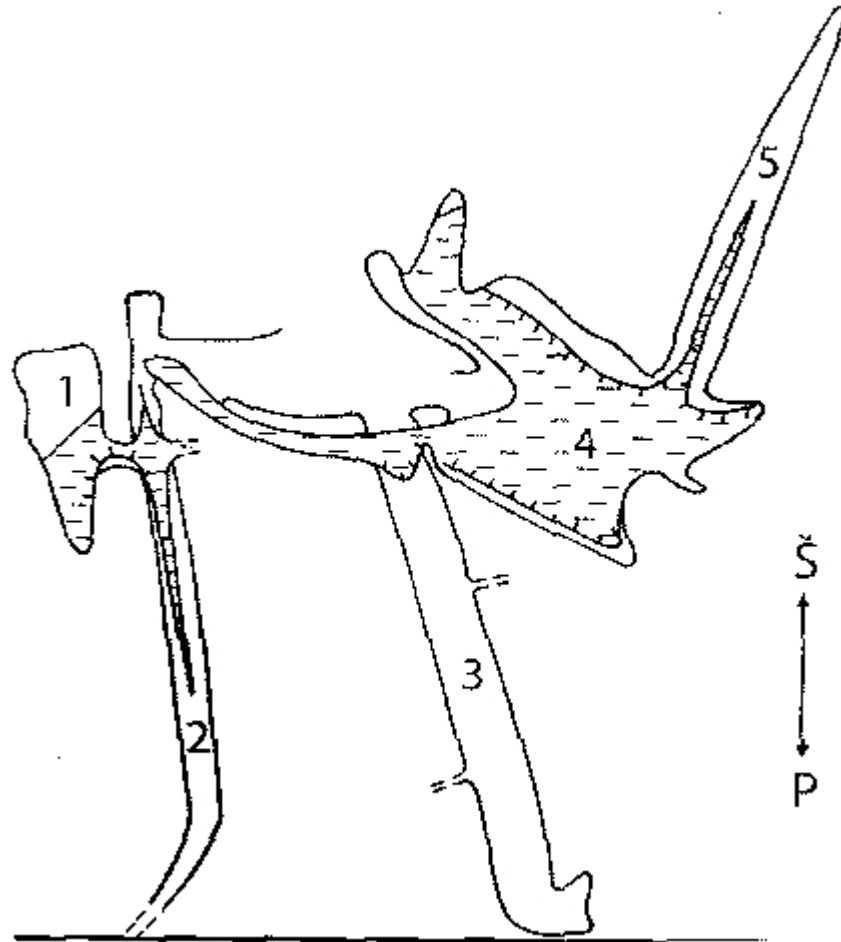
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## Cow's pit scheme



- Scheme of Cow's pit's holes:
  - 1 –the wet cave;
  - 2 – narrow hole;
  - 3 – bat hole;
  - 4 – toad's cave with an underground lake;
  - 5 – shining hole.
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# The scheme of Cow's Pit





# Sardonis source



# The source of Smardona



- It is found in **Likènai**.
- The place is rich of vitriolic mineralic waters and sulphuric mud. Supposedly, the water of The source of Smardona was used as a medicine in XVI a. Now in Likènai there is a rehabilitation hospital, where treatment of the heart, joints and nervous diseases.



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## Lake of Kirkliai



- Lake of Kirkliai, (Kirkiliai village, Biržai district) Kirkiliai village is known for its sinkhole lakes. Here sinkholes are being protected, mostly called pits by the locals. Most of the pits became connected to lakes and swamps.
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HIRŽŲ  
REGIONINIS  
PARKAS

## KIRKILŲ KARSTINIAI EŽERĖLIAI

Karstiniai ežerėliai yra jauniausi Europoje, susiformavę karstinių procesų metu. Daugiausia jų yra Kirkilų ir Draseikių kaimuose ir jų apylinkėse. Tai nuo 30 iki 100 m<sup>2</sup> ploto vandens telkiniai. Vidutinis jų gylis – nuo 0,8 iki 4,5 m. Karstiniai ežerėliai telkiasi nebūtinai vienoje smėgdubėje, o dažnai apjungia kelias smėgdubes ar net jų grupes. Vieną smėgdubę gali pakartotinai įgrūsti net keliis kartus, o įgriuvus gretimų smėgdubių pertvaroms, susidaro sudėtingo kontūro karstiniai ežerai.

Kirkilų kaimo šiaurvakariname pakraštyje telkto labiausiai išsiskiriantis visame karstiniame ežerose Kirkilų (ilgasis arba Upegalis) ežeras, susidarys iš vandens pripildytųjų ir apjungusių ne mažiau kaip 30 skirtingo amžiaus ir dydžio smėgdubių (ežero priegose taip pat gausu pavienių apvandenintų, užpelkėjusių ir sausų smėgdubių). Tai maždaug nuo 3,9 iki 6,0 ha ploto ežerogas labirintas, kurio labai vingiuota, su kyšuliais daugiau kaip 2,5 km ilgio kranto linija. Pavasario polaidžių metu ir po liūčių vanduo žymiai pakyla ir apsemia puslėsnius, taip susidaro daugiau salų.



Šio labai sudėtingos formos ežero didžiausias ilgis apie 600 m, plotis 300 m, didžiausias gylis siekia 6-7 m. Nuo Kirkilų ežero piečiausios atšakos 1926 m. iškastas melioracijos griovys (iškojęs naują smėgdubių susidarymą šio kanalo traseje) jungia jį su PV už trijų kilometrų plytinėiu Ušabalų durpynu. Iš Kirkilų ežero šiaurinio galo išteka melioruotas upelis Šilnelis, kuris už 1 kilometro pritekė per Jonavos (Šilnio) 3,5 ha ploto ežerėlį ir dar už 1,2 km pasiekia Apakščos upę. Šilnelio upelis iš Kirkilų ežero nuteka vandens perteklius, o esant aukštesnei patvankai Apakščos, potvynio vanduo paplūsta upeliu aukštesnio link ir per tą patį Šilnio ežerą pasiekia Kirkilų ežerą, pakelia jame vandens lygį, kuris paprastai laikosi 46,7 m absoliutiname aukštyje (vandens lygio svyravimo amplitudė siekia 2,4 m).

Karstiniuose ežerėliuose vyksta įvairūs biologiniai procesai. Tik šiuose ežerėliuose randama plika akimi matomos įvairių sierių bakterijų kolonijos. Juose taip pat auga įvairūs vandens augalai: musurabragiai (Chara), nerys (Ceratophyllum demersum), pildėnos (Lemna), mėlidai (Scheuchzeria). Senesnių karstinių ežerėlių pakrantes apaugusios medžiais. Vasaros metu, nukritus vandens lygiui, jų pakrasteuose formuojasi smilgų bendrijos.



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# Kirkilai lakes





# Jaronis pit



# Jaronis pit



- After a few years since the soil collapsed, underground channels crammed and water started to accumulate until the pit formed a lake.
  - The water of Jaronis pit maximum depth is about 6 m, medium - 3 m, surface area - 570 m<sup>2</sup>.
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# The newly emerging sinkhole



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# Geological researches



- Forming conservation areas
  - Performing ground depth engineering and geological researches
  - Supervising underground water level and quality
  - The map of North Lithuania sinkhole
  - Attempting to educate and inform the society
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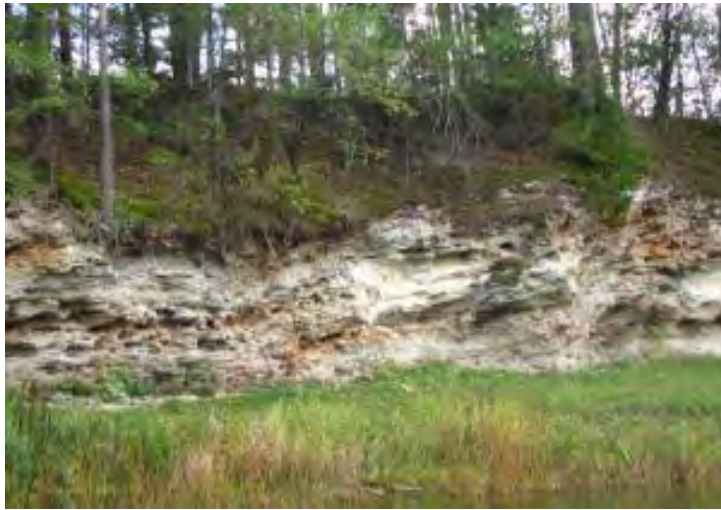
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# Territories in captivity



- Nemunėlis- the bottom park. There are exposures with devon period rocks
  - Kirkliai park. Active surface park area
  - Karajimiškis park. Active sinkhole area.
  - Kirdoniai- Tatula park. The most sinkholes are dry, some of them became lakes.
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# Nemunėlis-Apasčia outcrops



# Kirdoniai- Tatula park



- Tatula - the river in the north of Lithuania, that belongs to Mūša reservoir.
- Tatula's water is cold because of double channels – superstructure and underground. In the valley of the river, there are a lot of sinkholes of complicated configuration.
- There are a lot of sources in Tatula's lower slopes and this channels length is 3 km, going to Kirdoniai–Tatula geological park.

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# Biržai regional park



- The largest distinction of this park – the view of pits with a lot of sinkholes, that formed when water swilled layers of gypsum. Most of them are in surroundings of Karajimiškiai ir Kirkilai, in Tatula valley. Sinkholes are very various – simple and complex structure, ones have lakes and others are dry. Flat landscape with numerous sinkholes are unique at European level. In recent years, sinkhole phenomenon became very active. The new sinkholes open not only taking the trees but animals and buildings.
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# The map of Biržai regional park





# Walking trail in Kirkilai Reserve



# Buildings at sinkhole zones



- Engineering geological surveys are required.
- The studies necessary to establish the boundaries of the karst region.
- Limit the amount of constructs.
- It is forbidden to release wastewater into the ground and develop underground oil tanks.
- Treatment of the soil only in accordance with the Environmental requirements.



# Wall cracks due karst process







# Generalization



- Good use of sinkholes is a beautiful part of landscape.
- Overflowing with garbage and dirty sewage threatens to become hotbeds of disease.
- Karst relief creates an interesting landscape.
- Karst research provides a rich knowledge of the depths of the earth.