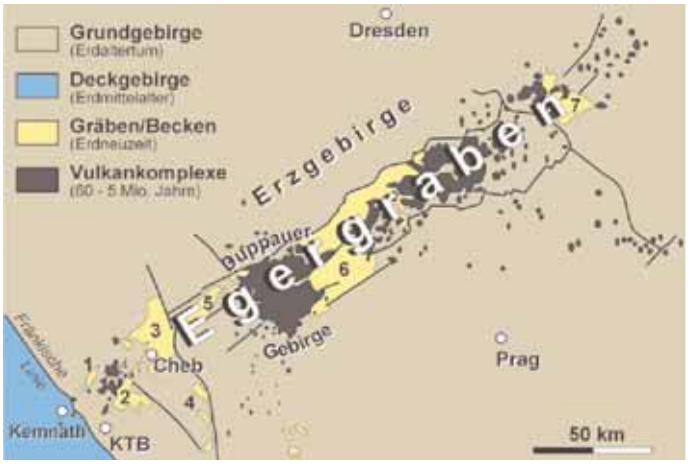
Along the river Eger

OUGS ME field trip to the Bavarian-Bohemian GeoPark, 2010 / Day 3, Oct. 27

Day 3 was to take us into the Tertiary sedimentary Cheb Basin, the yellow coloured region marked 3 on the geological map below. The basin is intracontinental, its sediments were predominately deposited during the Neogene. It is situated at the south-western end of the Eger Rift Valley, or Graben, where it is delineated from the Eger Graben by a major shear fault, known as the 'Mariánské Lázně' or Marienbad fault . A number of small volcanoes are located along the western fringe of the basin. They were described as pocket volcanoes by Dr Andreas Peterek. (Eger is the German name for the Czech town of 'Cheb', the Czech name of the River Eger is 'Ohře'.)



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The map also shows the position of the KTB and Franconian Lineament which we visited on day 1 and the Duppauer Complex which was visited on day 4.

We started day 3 by driving from Windischeschenbach to Neualbenreuth, where we stopped some 50 m from the Czech/Bavarian border, which we crossed by foot in the bright, misty morning light, into a nature reserve. The old border post, about the size of a garden shed, was still standing next to the foot-path. The path took us to a cinder or scoria cone, formed during the middle to late Pleistocene, 300,000 to 500,000 years ago, according to radiometric dating. However, some volcanologists think that it is no older than 100,000 years. Either way, it is the the youngest volcano of North Bohemia: and is known as 'Železná hůrka' or Eisenbühl (Iron Hill).

The study of the porosity of the scoria hints towards a first stage of pyroclastic events, followed by phreato-magmatic or hydroclastic events involving ground water and less gases. As such, less porosity is visible in the phreato-magmatic scoria than that produced during the pyroclastic events. It was followed by explosive events, creating a large crater surrounded by scoria, called a Schlacke in German. The diameter of the volcano is approximately 200 m, and the material that has been thrown out is mantel basalt.

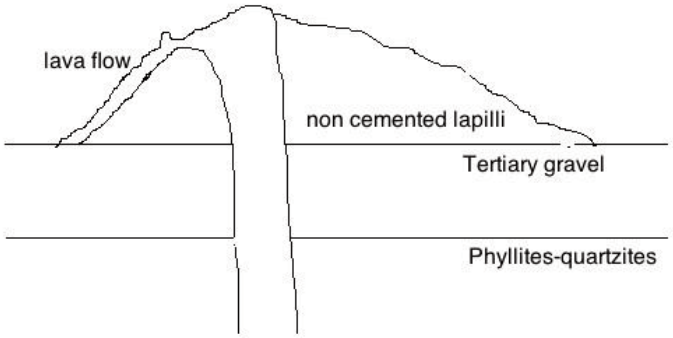
When this area was geologically mapped, more volcanic material was discovered 1 km from the crater and a depression nearby was also identified by using magnetic and gravity anomaly measurement, as a maar. This name relates to the outcome of a phreato-magmatic eruption when the magma on its way up encounters groundwater. The distribution pattern of the volcanic material lead geologists to consider that there are more volcanic pipes aligned in a trend parallel to the Marienbad fault.

Železná hůrka or Iron Hill scoria.

We drove past Cheb and stopped next at a small, but very famous volcano, the 'Komorní hůrka' or Kammerbühl. It forms a gentle hill, some 50 m high, on the Cheb basin which has an altitude of around 450 m. 'Komorní hůrka' is a cinder cone of lapilli, which are lava fragments of a few millimetres to a few centimetres in size, depending on the classification. When they are larger they are called scoria.

The eruption started at the end of the Tertiary to the beginning of the Quaternary, with strombolian activity and lasted into Pleistocene 115,000 to 15,000 years ago. The local wind pattern blew most of the pyroclastics to the east. At the final stage, lava filled

in the chimney and the crater, eventually flowing over the cone towards the south-west.



Some of the last outbreaks happened during Holocene, that is less than 10,000 years ago. The lava is a nephelinite, quite a rare basalt in Europe. The lapilli and the basaltic lava flow were quarried since the Middle Ages; the black tower of the castle of Eger is made of it.

Komorní hůrka or Kammerbühl.

The importance of this site is historical. It was at the heart of a controversy in the nineteenth century, when naturalists started to question the origin of this hill: The Neptunists (Neptune is the Roman god of the sea) thought that the basalt precipitated from the water as a sedimentary process. The Plutonists (Pluton is the Roman god on the interior of the Earth) defended the theory that basalt is the product of melting of brown coal, which erupted on the surface.

Johann Wolfgang von Goethe was not only a romantic poet, but also a passionate naturalist, and as such visited the site in 1808. He first felt that the Plutonists had a point, but later he changed his mind. He persuaded Kašpar Šternberk, one of the founders of the National Museum in Prague, to take part in a research project, digging a gallery through the hill to prove that it is a volcano. They started in 1826, excavated 300 m of galleries and found the chimney, but by that time Goethe had died. The galleries have since collapsed, but the portal of the old tunnel with its epigraphs can still be seen.

From 'Komorní hůrka' we drove to 'Františkovy Lázně' or Franzensbad, a spa town some 10 km north of Cheb, still at the western margin of the Cheb sedimentary basin. Mike gave us the altitude in front of the main pump hall 'Glauberový pramenú' : 449 m. We tasted the waters from different wells: 'Nový Kostelni', 'Glauber III' and 'Glauber IV'. 'Glauber IV' is the most mineralised water in the Cheb Basin (ca. 21g/l), it has a carbon dioxide content of 1,5g/l and flows at a rate of 0,9 l/min from a depth of 93 m. Extremely healthy if not the tastiest of waters!

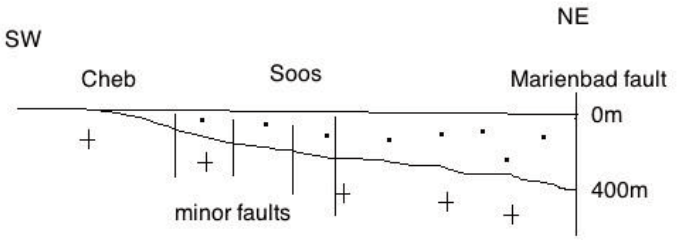
We visited some other mineral springs in the park; there are more than 20 listed wells in Franzensbad, and on our way back, Gillian voiced this thought:

“If this was the only drinking water available in a third world country, Oxfam would quickly step in and build a purification plant.”

Why is there so much healthy water? The answer to that question is related to the tectonic structure of the sedimentary basin. An active magma reservoir in the upper mantel, at a depth of about 30 km, releases carbon dioxide and mantle fluids which get trapped in the crust at a depth of 5 km to 10 km. Above this, in the upper crust, water-rock interaction releases minerals into the water, and eventually peat adds the extra taste.

Františkovy Lázně

After having taken the waters and had a walk through the town, we made our way to Soos, 5 km to the north east of Franzensbad. Soos is a nature reserve in the central part of the basin. The basin is asymetrical in depth, which increases eastwards, to around 350 to 400 m at its eastern margin along the Marienbad fault



It was lunchtime and the sun was warm enough for us to sit in the park-like entrance area to eat our packed lunches. We then took a pleasant stroll on a boardwalk, through the nature protected area of 'Soos'. This consists of a partly drained swamp, displaying up to 8 m thick diatomites* from the early Holocene and spectacular mofettes with intense CO_2 emanation, deriving from the upper mantle (30 km). A mofette or mofet is a gas emitting hole.

In the whole of the Cheb Basin, there is a high concentration of degassing, aligned with the trend of the Marienbad fault; the gases find their way up along minor faults cutting through the sedimentary layers. How do we know the source of the gases? Measurements of the abundance of helium isotopes are made, helium-3 has its origin in the mantel whereas the crust is richer in helium-4. Although the helium content of the gases is very small, the ratio of He-3 to He-4 is a good indicator of the source. When the He-3/He-4 increases, strong mantel degassing is indicated. The Cheb basin has the highest He-3/He-4 ratio in Central Europe, similar to what is found in the region of Etna. The question of continued subsidence of the basin is still under discussion; there might be some, but it is insufficient for further deposition, hence some erosion is taking place.

* The Oxford Dictionary of Earth Sciences defines a diatomite as: 'A diatom- or bacillariophyceae-algae-rich sediment which has been laid down in a lacustrine or deep-sea environment. The diatom cell wall is made of silica, therefore, the sediment is siliceous.'

Mofettes in the Soos nature reserve

Our next stop was to 'Nový Kostel', the epicentral area of the Northwest Bohemian swarm earthquakes, related to the Marienbad fault. Records of seismic activity go back to the fourteenth century, although not a lot of damage is associated with theses earthquakes. After the tremors up to 4.6 on the Richter scale during winter 1985-86, intensive investigation of the area was launched.

Amongst other techniques, paleoseismology is used, which consists in digging trenches to study soil disturbances. In 2008, 40,000 events were recorded over a period of two months. 3D plotting of the centre of the earthquakes shows a curved fault plane. As the stresses in the crust are not released in a major event, but through thousands of minor quakes over several weeks, the phenomenon is called an earthquake swarm. Usually earthquake swarms occur next to a boundary where two tectonic plates meet, but here, that is not the case. It is more likely to be continuing magma injections into the crust, due to continuing rifting, that increases the pressure of the carbon dioxide trapped in the rocks, which triggers the earthquakes at a depth of 6 to 14 km.

The highlight of the day was the Big Mofette south of 'Milhostov'. This is the most beautiful and largest mofette of the Cheb Basin, it is called 'Bublak' (the bubbling spring). It is located in a swampy area in the valley of the 'Plesna River', which, according to Dr. Peterek flows along an active fault, oriented NW-SE.

A related fault scarp is indicated by the difference in the height of the flanks of the valley and asymmetry of the valley cross section.

Bublak, the bubbling spring

Twice a month the gasses are sampled and the isotopes checked. The idea is to get data that relates the variations of the isotopic ratio with the seismic activity, implying sampling before and after the tremors. Since direct measurements can only be done in wellington boots and wading through the swamp it is difficult to carry out. Remote measurements are now made, but the results to date are not very satisfactory. Around this area, dry mofettes also exist. They can be located where the carcasses of dead animals are found. A dangerous place to hang about.

To finish the day, we took a walk on the 'Litov' mine tip close to 'Chlum Svaté Maří' or Maria Kulm, with samples of brown-coal and tempered shales (Porzellanite, Porcellanite) resulting from subsurface fires. The trip also provided a good view across the Eger Graben with the 'Krušné hory' or Erzgebirge to the north and the 'Slavkovský les' or Kaiserwald to the south. There was a church close by, but I can't remember the story... Mike can you?

Yes, Mike can. The church is Maria Kulm and it was where Lady Bracknell, alias Frau Molloy, was christened 'Dorothea Waltraud Hammerschmidt' in the late Holocene.

During the day, our trip had taken us broadly in a north-easterly direction, basically following the route of the river Eger through the Cheb Basin, towards 'Loket' in the Eger Graben, where we spent the next two nights in the Kaiser Ferdinand hotel. Both Loket and the Kaiser Ferdinand hotel can be recommended, the latter not least for having their own brewery in the basement. Their beer was excellent, it was very different from the famous Czech beers Pilsner Urquelle and genuine Budweiser, it was rather similar to the speciality around Windischeschenbach, the 'Zoiglbier'.

Chlum Svaté Maří or Maria Kulm.

Text by Elisabeth d'Eyrames,
photos by Dave Kopsch
and 'flower arrangements' by Mike Molloy.