COULD THE NÄRKE-PLAIN BE AN OLD ASTROBLEME?

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Abstract

The following paper describes part of the unknown geology of the Närke-plain and the adjacent Kilsbergen (mountain chain). This mountain chain rises abruptly out of the Närke-plain; the former is west of the city of Örebro in Central Sweden.
Within the Närke-plain the larger part of the bedrock are sedimentary rocks from Lower Cambrium to Lower Ordovicium; the minor part of the Närke-plain is a window to Precambrian rocks (Örebro-granite).
The Kilsbergen form a semicircle of 28,5 km radius; the semicircle is open to the East, there are no similar mountains like in the West.
This fact gave the first impression that a meteorite could have established the Närke-plain, flying at a very low angle to ground from the East. Of course, this should have occurred before the Cambrian.
In this model Kilsbergen would be the outer (secondary) crater of a complex astrobleme. On the primary crater (if there is any) nothing is known.
The rim of the outer crater (= Kilsbergen) is to a radial depth of about 5 km covered with red gneiss. At the foot of Kilsbergen boulders from the slope and the rim are found, showing a strange mixture of the minerals hedenbergite to augite, in direct contact with red microcline and quarts. This is a mixture that normally does not occur.
Near to Garphyttan extended beds of prepaleozoic carbonate rock emerge and disappear into the Kilsbergen. This material has been hit by the meteorite, too, pulverized and together with other bedrock cast up into the atmosphere as a plume. After back fall this material has on the brink and 5 km further away created the observed red gneisses (the dye is from iron ore in the brink). The mixture of pulverized carbonate and bedrock has formed a rock, similar to Petalas /12/ "calcrete"; in this case with larger grains of quarts than in the Rättvik-occurrence of calcrete.
Other samples of the reconstructed carbonate stone show inclusions of 2 mm large spheres of polished calcite in a very thin cover of some evaporated material that is not soluble in hydrochloric acid. A third type of samples shows residues of a melt, which has intruded the reconstructed carbonate.

In summary: There is so much evidence for exogene processes, which cannot be explained by terrestrial processes that the assumption of an early astrobleme cannot be denied.

Keywords: Meteorite, astrobleme, Närke-plain, Kilsbergen, Örebro, Garphyttan, reconstructed rock, calcrete.

Introduction

Standing in the centre of the Närke-plain (the plain around the Swedish city of Örebro) at e.g. Lake Tysslingen looking to the west a mountain chain is seen from south to north, similar to a crater rim. Of course this rim has nothing to do with a volcanic crater, but it very well could have been shaped by a fall of a meteorite long time ago, before the Cambrian (570 millions of years ago). In the following we shall try to interpret the information nature supplies in the form of rock samples and from the topography of Kilsbergen (name of mountain chain) north of the village of Garphyttan. This author has not yet researched south of Garphyttan.

Topography

To the west, north and also south of Garphyttan the Kilsbergen rise like a wall out of the Närke-plain: The community of Garphyttan is lying at 106 m above Sea, but the nearest top – Garphytte Klack – is at 196 m; the lateral distance between these two points is less than 500 m. Lake Ånnaboda is at 235 m and the highest peak in the proximity is at 298 m, 3 km west of Klockhammar.
Along the path as the crow flies from the steel mill to Garphytte Klack you pass by a steep of 45 degrees, consisting of surge gravel, but also up risen blocks, large as homes, that one has to get round. On the way up one passes the highest coastline (HK) at 165 m /1/; above this the rock is surged by waves during the recede of the Quaternary Sea; it consists of reddish gneiss. Further down this will be treated more in detail.

It is well known that the Närke-plain contains residues from Lower Cambium up to Lower Ordovician. Shale from the Upper Cambrium has during Second World War and later been used to extract crude oil from it or has been used as fuel in burning Ordovician limestone to CaO.

On regarding the topographic map of the Närke-plain first one does not recognizes anything spectacular. Later on one recognizes that e.g. the river Svartån between Kvistbro and Hiddinge flows in the same bowed valley as the Garphytteån, alas in the opposite direction; the sites Logsjön and Vretstorp are lying on the same circle bow. After having drawn this bow into a map one realizes that roads (which normally follow valleys) and communities (which tend to lie along the valley and not across it) like Rönneshyttan follow the bow, too. This circle bow extends from Garphyttan till Rönneshyttan and has its centre at the deviation between the roads RV 51 and RV 52, to the west of Sköllersta, with a radius of 28,5 km; as well in the north as in the south it looks like the tangential circle of a parabola. The tangential point between the parabola and the circle is near Kvistbro. The northern part of the bow follows the Kilsbergen with one to two kilometres distance (Kilsbergen on the outside of the circle), Farther in the north as well in the south the topography of the landscape follows a parabola: In the north this is near Skärmarboda and in the south at Rönneshytta; there the map of the bedrock shows small strips of old granite (in Swedish: Urgranit).

This strange topography – together with fids of particular rocks, which can be created by catastrophic events, only (to be described farther down) lets this author suppose, that a meteorite-fall before the Cambrian has been this event.
A meteorite hitting the Earth vertically makes an astrobleme that in most cases is a closed circle, like the Siljan impact. However, if a meteorite hits the surface at a very low angle like here, an asymmetric astrobleme is formed, like a parabola; this supposed meteorite must have come from the east (to days direction). Since the continental plates have moved and rotated at all time in relation to the stable Earth rotation axis, the real in-flight direction at the instant of the fall can have been another.
The diameter of the tangential circle – 57 km – is so large, that the impact must have created a complex crater. Some of such craters are seen on the Moon. These are characterized by a primary crater, which is few times larger in diameter than the falling object, further outwards by a ring-dyke and finally by the outer crater rim; see Fig. 8.14 in /3/. The dyke is the boundary between shocked material inside and unshocked rock outside. In shocked material the Hugoniot elastic limit HEL has been exceeded, the rock in question is during few seconds' super-plastic.
To day the ring-dyke is certainly filled up with younger sediments, but it is still so much present to form the valleys for the rivers Svartälven and Garphytteån. Seismic measurements along a radial line near the outer crater rim will quite certainly disclose the position of the ring-dyke.
On the east side (east of Örebro) there is no indication of a similar outer crater, like the Kilsbergen are on the west side.

Landslides on the slope of the Kilsbergen

The brink of an astrobleme is poorly defined: It is not directly created by the astrobleme, but only indirectly: Inside the ring dyke much of the rock at the previous surface has been cast up as 'spalls' and blown away in radial direction. Some of this material has fallen on the later 'outer crater wall', which increased its height, while the area inside the ring-dyke was lowered by the loss of the 'spalls'.
In addition to the 'spalls', in large astroblemes the meteorite and the local rock below it has been pulverised melted or evaporated and cast up into the atmosphere. This cloud rises during several seconds to several kilometres height and precipitates later during many hours to the ground again, forming a ring round the impact site.

During this authors first visit to the slope he reacted on the large blocks of rock, which had sharp edges, looked undamaged and stood upright, often with a minor tilt toward the slope: These blocks never have rolled down the slope, otherwise they should have been more round. The mass of these blocks suggested that they had sledded down like in a mudflow. In such a flow several blocks may pile up on top of one another, forming cavities in between. An example near Garphyttan is a place named "Gulhålet" (Pos A). There one can crawl below the blocks and look on these from their downside. The suburb of Garphyttan 'Upper Garphyttan' is built on a 20 m thick shelf of sledded boulders: This is known from the construction of drilled holes for 'heat from the Earth'. There the bedrock is so porous that steel tubes have to line the drill holes down to 20 m depth.

Certainly rock fall has happened during all time, but the last slide has taken place during the last phase of melting of the continental ice-cover, the retreating front passing Garphyttan at about 10400 BP /2/; at that time the ice at that place had direct contact with the Yoldia Sea. Near the border of the ice the higher regions of the bedrock had been ice-free and frozen-in blocks had lost their contact with the ground. They sledded down towards the tongue of the land-ice. This tongue retreated by 200 m per annum, which meant that the blocks could sink some meters every year. When these were halfway down, they dipped towards the steep rock. The recession speed is seen in map /4/, where in its lower part of the map several terminal moraines are shown.

Tectonics

In recent maps of the bedrock of the Kilsbergen area /5/ two faults are shown. It is possible that these faults have happened later than the impact and followed the border between shocked and un-shocked rock. Normally dip-slip faults are straight; here the border is curved. Against the assumption of faults speak the find of rock-samples in the slope of Kilsbergen, which are of such shape and composition that an astrobleme, only, can bring about. Concerning this statement see later down in this paper.

The red gneisses

In modern maps of the bedrock in the Kilsbergen area almost all rock types are shown as "leptite". In the oldest geological map from 1875 /6/ and also in the newer sheet /4/ from 1970 there is a 5 to 8 km vide belt of 'red gneisses' shown, following the brink of Kilsbergen. The area outside this belt is mapped as 'leptite'. In the comments to sheet /6/ the following text is given:

"The red gneisses form a belt over the central regions of the map. From the region between Ramshyttan and the lake Ämten at the northern boarder of the map this belt stretches to the south and southwest across Boxboda, the Gålsjö lakes, Sonnaboda, Garphyttan and Svenshyttan and further sites to the southern border of the map sheet between Hällshyttan and Mårtenstorp. In the north the red gneiss is the dominating part of the

visible rock; further to the south it is limited to the proximal area at the brink and to slidden rock near the foot of the brink, but also to isolated hillocks south of Garphyttan."
Several pictures of the red gneiss are shown in this paper. In it microcline and quarts form layers of varying thickness; both minerals are more red than normal. In addition there exist layers of dominating biotite and other layers, where microcline, quarts and biotite are mixed. Also in the Siljan astrobleme the microcline is much more red to red-brown than is normal: Certainly the heat treatment during and after the impact affects this.

Quite generally gneisses are formed by the methamorphosis of (in water deposited) sediments or by differentiation (segregation) of quarts or feldspar to layers, vertical to the main pressure /7/. Let us play with the supposition that the material for these gneisses originates from the dust, created by the volatilized meteorite and the bedrock at the site of the impact. Depending on the size of the meteorite the 'touch-down' phase is over in some few seconds: The cloud created by this may hang in the air for hours. It contains particles of very varying size, from vapour (from the meteorite and the local bedrock), melted and now solidified particles, mechanical particles and small stones. The evaporated material condenses on its surroundings and coats these particles with a thin layer. If the evaporated material is iron (minor quantities are often present in meteorites), these particles will be coated red from hematite, which forms on oxidation of the iron coating. This has happened in the Lake Siljan astrobleme: There distinct parts of the fall-out have been dyed read, other are still white. The sediment-powder was very unstable on the slopes of the primary and secondary crater, slid down and mixed like a snow avalanche. Therefore we find very sharp and uneven boundaries between white and red Orsa sandstone /11/.
Similar as in volcanic eruptions stones will fall back quite immediately, the dust will stay longer and will be mixed by the wind. Therefore it is quite imaginable that the final sediment on Earth is more or less layered. In fact we find completely even (no layers) and layered red gneisses. See Fig. 1 and Fig. 2 from Lockhytta (Pos D) and Fig 3 from Garphytte Klack (Pos E).

The part of the dust cloud that falls back to the slope (outer crater) does not stay there for a longer time. In half-consolidated shape it slides down like a snow avalanche, different part of it mix with one another. Pictures Fig. 4, Fig. 6 and Fig. 7 show samples from the foot of the slope at Garphyttan (Pos B). The figures show a mixture of different layers; the wider layer in Fig. 5, Fig. 6 and Fig. 7 are much darker, finer in grain and hold more mica. The lighter layers consist only of quarts and feldspar; grain size 5 mm.
From the same site other samples are shown: Fig. 8, Fig. 9 and Fig. 10. The first picture shows the sawed and dyed with lacquer part; Fig. 9 shows the rough rear side and Fig. 10 shows a cut through this sample. We see crystalline quarts, red microcline and balls and fragments of a black mineral. This mineral is seen in Fig. 9 as fragment, too. Due to a

series of parallel cleavage surfaces this mineral is recognized as diopside, hedenbergite or augite. How can these minerals occur in the same specimen together with microcline, when they normally do not occur together? The answer is: By a catastrophic event. A dark diopside occurs in the small iron-mines near the top of Klacken.

Not the whole gneiss area is layered: Near (Pos C) there are extended slabs of stone, which have the same colour and the same grain size, but no layering, see Fig. 11; they could have been called aplite. May be this area has been covered by a homogeneous mixture of the powder.
Gneiss lying on leptite or granite cannot be particularly thick. Core drilling would disclose the thickness of the layer and so the mechanism, how that raw material has reached its present position.

Windows through the cover of paleocoic sediments within the area of the supposed astrobleme

On the map of the bedrock named Örebro SV there is south of Örebro a large window right through the Cambrian sediment to the underlying bedrock. Along its southern side limited by a fault the base rock consists of younger granite and leptite. The granite has invaded the leptite: Thus the supposed impact has to be older than the granite and younger than the Lower Cambrian. The nearest age-determined granite is that from Fellingsbro (by I.S. Oen /8/), the result is 1715±50 million years. Thus the age of the astrobleme has to be between 1715 and 570 million years. This author knows nothing on the age of the Örebro-granite.

One could ask the question if it is possible to find PDF (Planar Deformation Features) in samples from this granite; these are formed at very high pressure, only, are a safe proof for an astrobleme. However, there are some problems:

- May be, PDF-structures have in this case not been formed due to the very flat flight of the meteorite; with necessity the vertical force has to be low under these conditions
- How long does PDF exist, if they ever have existed? They are a disruption of the lattice which in time may heal
- PDF can hardly be formed at the outer crater ring, because this is outside the shocked volume.

Therefore lack of PDF is no proof for that the Närke-depression is *not* an astrobleme. This is similar to Criminology: One knows that a murder has happened but one has not the body!

Prepaleozoic carbonate rock in Kilsbergen

Prepaleozoic carbonate rocks are part of the ‘leptite series’ of rocks, age around 1800 millions of years; they are relatively common in Central Sweden. They have nothing to do with the carbonate rocks from Ordovicium.
From the villages Axberg and Dylta there is a steep dipping horizon of calcium carbonate toward Garphyttan. Near Garphyttan there are minor

outcrops of that stone. A large outcrop – now emptied of carbonate is about 2 km South of Garphyttan. In the forest touching upon Upper Garphyttan blocks of this primary carbonate are found, containing irregular inclusions of a dark diopside (Pos F).
In the same area (Pos G) irregular large dark-brown blocks are found, which evidently have come down from the steep above. These blocks would never been recognized as carbonate rock if they were not surrounded by a sea of *hepatica. Hepatica* is an extremely sensitive indicator for carbonate rock. Within a granite area one never would find *Hepatica* unless a carbonate rock has been transported to there by one or anther means.
The carbonate blocks in Upper Garphyttan are full of cracks, which are filled with limonite. Also after sawing the exposed surface looks dark. Inspected by a stereomicroscope things look different: One sees clear 2 mm large crystals that allow looking deep into the sawed surface. Everywhere very thin and spherically bent lamellae are seen, which makes the dark impression. To understand this written text a similarity may be used: When roasted peanuts are opened one sees the 'nut' covered with a very thin red-brown skin. The relation of the thickness of this 'skin' to the nut itself is about the same as the relation of our spherically bent lamellae to the crystallites in our sample. After dissolving the sample in hydrochloric acid the calcite grains disappear; concerning their mass the residue is a totally insignificant heap of lamellae.
The explanation is the following: During the impact of a meteorite this and the bedrock beneath the impact site is pulverized, partly to vapour, partly to rock powder. During the upward flight the vapour condenses on the tiny particles. The tiny calcite particles with their coating fall down later, sinter together and burst their coating, which now lies like rubbish in between these. This carbonate stone has no similarity at all with the original primary carbonate. Here it is called '*reconstructed*' carbonate.

There is a second particularity in these '*reconstructed*' carbonate stones: On a sawed surface – but even on a broken surface – up to 5 mm large balls of a red-brown iron oxide are seen. It is assumed that these balls are fragment of an oxide (not magnetite) that have been thrown up and during their way up and down grinded to a spherical form.

There is a third particularity: Some parts of this sample in polished shape show red flaws (like turbidities in water), without distinct limits. At high magnification one sees that the flaws consist of thousands of red needles, oriented in all directions. These are exsolutions from the reconstructing carbonate rock; because of colour and form colloidal hematite seems to be plausible:

$$4\ Fe_3O_4 + O_2 = 6\ Fe_2O_3$$

Here below samples from original primary calcite are shown as Fig. 12 and two samples of reconstructed calcite as Fig. 13 and Fig. 14. The first sample is a non-polished sawed surface; the other sample is a broken surface (note the accumulation of iron-oxide in the upper right corner). The samples are from Upper Garphyttan and were near one another (Pos G).

Other rocks from the brink of Kilsbergen

On Garphytte Klack there are several minor iron-ore mines (Pos E) on a course. The ore mineral is magnetite that is located in a dark diopside; no other skarn-minerals exist there. The ore is a steep layer. Since diopside/hedenbergite has been found at the base of the slope (Fig. 9) it seems to be abundant. This gives the impression that this ore is not a normal skarn-ore, which originates from exhalations on the Sea floor, but is an impregnation ore, with a feeder in a radial fissure in the rim of the outer crater of the astrobleme, see Fig. 15. The magnetite is hardly seen in the photograph.

In the mining area another rock as boulders is seen too; this type I up to date have not seen as solid rock. It may have been a cover on the read gneiss that had mainly eroded. The rock may be described as a fine aplite and consists of quarts and feldspar, only. The grain size is below 0,5 mm, a diffuse layering can be suspected, see Fig 16.

A further dark-brown rock is found at the base of the slope to Garphytte Klack. The rock has a visible layering, but there is no system in it. The mineral grains are round, without sharp edges like in granite, merge in one another. As a guess this is an early fraction of the downfall from the plume of powdered rock. The banding one can infer goes across the whole sample and indicates that in the sample is an 'up' and a 'down'. The colour could be that from goethite (Pos H); see Fig. 17.

Outside the northern wing of the supposed impact parabola there is at Skärmarboda (Pos I) a wide area of caves established by piled up granite boulders, large as homes. During the retreat of the Quaternary Ice sheet 10 000 years ago the surges of the retreating Yoldia Sea have washed off the detritus below the boulders and thus created the caves. The following is just a speculation: Probably a fault younger than the supposed astrobleme has created a cliff, from which later these blocks broke off. However, it is the granite as such, which demands attention. The microcline in it is not as usually dyed pale rose, but it is brick red. The rare occurring plagioklas are crystals are located within the microcline crystals. The latter are about a centimetre wide, have grown at the expense of the previous minor crystals by cannibalism. The quarts grains, too, are dyed antique-rose, red-brown or lilac.
The most obvious fact is the weathering of this granite. Other granite, lying on the ground for millions of years, gets a rounded and smooth shape; here samples of the local Örebro-granite are rough on its surface, consist of loosely 'glued' crystals, which are full of edges and corners. The granite is in consistency comparable with a Rappakivi-granite, but no cover of the microcline-crystals by plagioklas exists.

Similar samples are found at Budberget on the northern end of Lake Flosjön in Dalecarlia/9/. The granite at Skärmarboda can very well have been affected by an astrobleme, probably by 'our' astrobleme. Under these conditions – long exposure to high temperature - the brick-red and large microcline crystals are created. See Fig. 18.

The investigations by P. J. Holmquist

During the course of this investigation this author has from SGU/Libraray received a paper by P. J. Holmquist from 1935 /10/. Holmquist has investigated the granite – particularly the Örebro-granite – between Örebro and Kilsbergen. At that time this granite still was exposed near the suburb Hageby, to the North of the centre. At Hageby there was a minor quarry for granite; there he recognized that the granite was heavily affected by pressure. Large sheets – only 0,25 m thick – could be lifted off the bedrock. The extreme pressure within this complex astrobleme can very well have created these sheets.

Holmquist also has studied all available exposures between Örebro and Garphyttan and has found one at the northern end of Lake Tysslingen at Älgesta (Pos J), where the bedrock is neither granite nor leptite. The hillock consists of two different melts that are intercalated in one another, see Fig. 19.
Holmquist suggests that an "exogene" process has affected the local bedrock, but without any suggestion what this could have been.

Later investigations

During this authors recent visit in June 2014 to Garphyttan he has found other samples of *reconstructed* carbonate rock that deviate much from samples show in Fig. 13 and 14. These samples are so typical and unique that he anticipates the final result of this investigation: These samples have been formed by sedimentation out of a dust cloud from the impact of a meteorite.
The cast-up material consist i.a. of quarts from the local granite, now rounded and polished in the dust cloud. These quarts grains have sedimented together with the carbonate dust and have been 'baked in', forming a *reconstructed* carbonate stone. Due to weathering of the carbonate, the grains (1 to 3 mm large) are now uplifted and clearly visible. Sedimentation from a water stream never can establish this disparate mixture.
In Rättvik, near the graveyard, at the beach at low water level, there is a similar mixture of fine-grained carbonate and sand. This has been created by the impact of the Siljan meteorite, which formed a large plume of debris. Here the 'sand' is very fine grained, consisting of 'sand' particles of some few tens of a millimetre. The sand fraction has formed the s.c. Orsa-sandstone. Three years ago the graveyard in Rättvik has been increased; the existing stony ground had to be removed and replaced by soil. The stones have been of the type *reconstructed* calcite, with plenty of fine quarts grains baked in. These balls of conglomerate of about half a metre

size are now spread around the town in curves as ‘fenders’. All mixtures of sand and carbonate are present; outside the public library there is a bolder of about $2m^3$ size to be seen.
The difference between this *reconstructed carbonate (called “calcrete”)* and the original Ordovician carbonate is

- Freedom from macrofossils
- Touched by hand one senses all the sand grains like on a sanding paper
- By a magnifier or by eye the sand grains are seen

Back to Garphyttan: Starting from a large boulder at coordinate 145060E/ 657686N (a large block in the forest East of Upper Garphytta) and following the bearing 35° west up the hill, one notes here and there overgrown holes in the ground, up to 5 m wide. These have a collar of *Hepatica* round it; have contained carbonate stone (Pos K). Since the nearest smelting furnace is not further than 200 m away, the assumption that the carbonate had been fetched for the smelting of ore, is not wrong. These particular stones were original calcium carbonate like in Fig. 12. or were *reconstructed* carbonate like in Fig. 13 and 14.
This time our author at (Pos K) has found samples of *reconstructed* carbonate, similar to those from Rättvik. See Fig.20, Fig. 21 and Fig. 22. All figures belong to the same sample. It is 16 cm long; the ‘baked in’ quarts grains are easily seen.

However, there is another phenomenon, which is harder to understand. In the sample there are several cracks, filled with the former melt. This melt contains grains of quarts, too, absorbed under its way through the sample. According to our picture of Kilsbergens creation the rim of Kilsbergen is identical with the outer crater of the astrobleme. In a round astrobleme (nearly vertical impact) we do expect the melt in the centre, but not in the periphery. Here in Garphyttan the unconsolidated sediment has been created within few hours after the impact; however, it has to have some rigidity – which is achieved first after some years – to accept a melt without other damage.
It may be that in case of a very low flight angle the centre of all what is happening is much nearer the outer crater rim than at vertical impact? May be seismic measurement along a radial line inwards could give some information.

Another sample, taken some few meters from (Pos K), holds another mystery: Fig. 23 shows this sample; the picture is in reality 6 cm wide. We see black dots, sitting in depressions, about some tens of a millimetre wide. By the stereomicroscope one recognizes these dots to be hollow semi-spheres, consisting of some glass. The dots sit in *reconstructed* carbonate stone. We can imagine, that during blowout a very high speed of many km/s prevails and the melt rock forms spheres. These spheres certainly contain residues of air or water vapour. The high blowout velocity transports rapidly the plume to high altitude; there the outer pressure is low, the spheres burst by the large pressure difference. These spheres or their coating may be the dark background material we have commented upon in description of the *reconstructed* carbonate stone of Fig. 13.

Conclusions

The mountain chain Kilsbergen – West of Örebro – encloses the Närke-plain by a semicircle. Starting with this topography this author put forward the hypothesis that a meteorite, coming from the East under a very flat angle, might have created the Närke-plain. Since the probability to find other evidence is much larger at the brink of the Kilsbergen than within the plain, he has investigated the rim of Kilsbergen at Garphyttan and north of it. The rocks upon to the tens of kilometres long rim are in literature interpreted as red leptite gneisses. Another interpretation could be, that they have started as sediments from the dust cloud, created by the impact of a meteorite. At this occasion local Precambrian carbonate stone has been pulverised, too, cast up in the atmosphere and then fallen back to ground. The powder has sintered to a new *reconstructed* carbonate stone. This contains up to 5 mm large balls of a reddish iron oxide and flaws of tiny hematite needles.
Also other 'impossible' rocks are found at the foot of the Kilsbergen like a mixture of red-brown microcline, quarts and augite.
Also during a later visit to the brink of Kilsbergen at Garphyttan further two rocks have been found, which are generated from the powder in the eruptive cloud, formed by a meteorite impact:

a) *Reconstructed* calcite with many baked-in round grains of quarts Rounded and polished within the turbulent gas-stream
b) *Reconstructed* calcite with many tiny (1 mm) black hollow spheres. This seems to be a solidified melt.
c) *Reconstructed* granite at Skärmarboda, very similar to such granite from many sites within the Siljan-astrobleme.

The multitude of finds, previous publications from 1935 where the author Holmquist states, that the Precambrian bedrock within the Närke-plain must have been affected by exogene processes, makes this author believe, that the Närke-plain is a very old complex astrobleme, with Kilsbergen forming the outer crater rim.
There does not exist any previous publication, which might indicate, that the Närke-plain could be an astrobleme.

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About the author

The author is physicist (PhD) from the university at Stuttgart and geologist (fil cand) from Uppsala University. He has studied the Siljan astrobleme and the other astroblemes, belonging to this fall, during the recent ten years and of course also the waste literature on astroblemes. A small part of all collected samples are to be seen at the Museum belonging to the local Geological Society at Ludvika with address Ludvika, Gammelgården.

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Positions

(Pos A)	145103E/657721N	Gulhålet in Garphyttan
(Pos B)	145091E/657706N	At the fot of the brink in Garphyttan
(Pos C)	145830E/658675N	Stenars stuga, south of Lockhyttan
(Pos D)	145730E/658845N	Lockhytta
(Pos E)	145063E/657730N	Mines on Garphytte Klack
(Pos F)	Not found again	Upper Garphyttan
(Pos G)	Not found again	Upper Garphyttan
(Pos H)	Not found again	Upper Garphyttan
(Pos I)	146185E/659285N	Skärmarboda
(Pos J)	145645E/657970N	Älgesta

(Pos K) 145060E/657691N Upper Garphyttan

Pictures

Fig. 1: Red gneiss north of Lockhyttan, 145730E/658845N, (2497)

Fig. 2: Red gneiss north of Lockhyttan, 145730E/658884N, (2516)

Fig. 3: Red gneiss at Garphytte mines, 145063E/657730N, (2525)

Fig. 4: Slide-material of red gneiss at the foot of the cliff at Garphyttan. 145191E/657706N(2485)

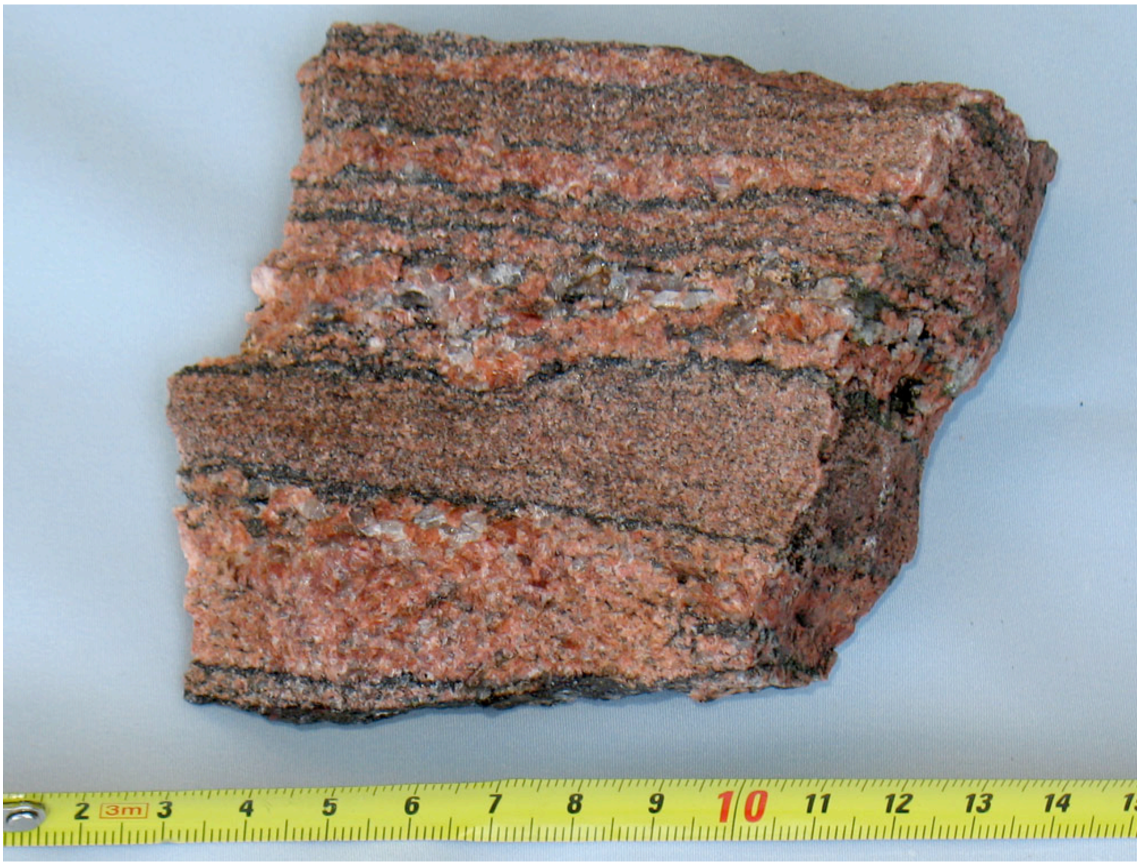

Fig. 5: Slide-material of red gneiss at the foot of the cliff at Garphyttan 145091E/657706N (2486)

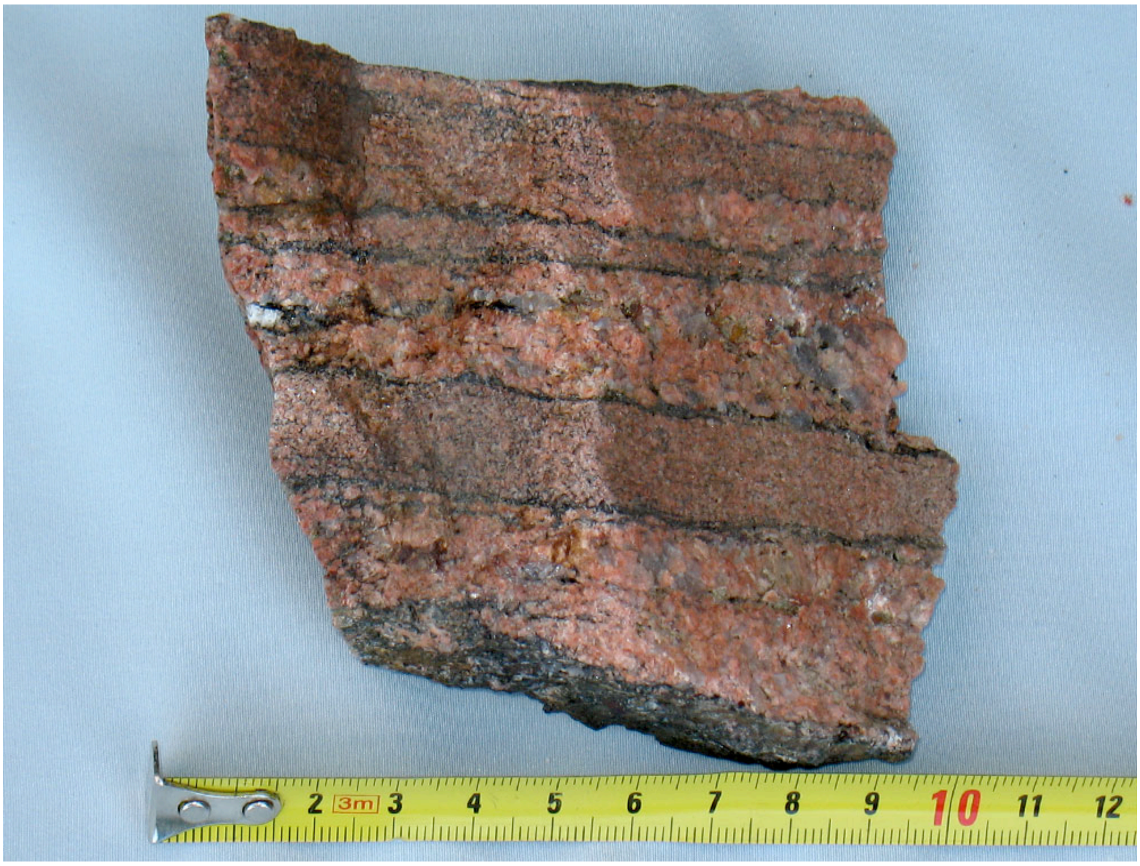

Fig. 6: Slide-material of red gneiss at the foot of the cliff at Garphyttan 145091E/657706N (2488)

Fig. 7: Slide-material of red gneiss at the foot of the cliff at Garphyttan
145091E/657706N (2489)

Fig. 8: Slide-material of red gneiss at the foot of the cliff at Garphyttan
145091E/657706N (2540)

Fig. 9: Slide-material of red gneiss at the foot of the cliff at Garphyttan
145091E/657706N (2542)

Fig. 10: Slide-material of red gneiss at the foot of the cliff at Garphyttan
145091E/657706N (2544)

Fig. 11: Aplitic texture in a ‘red gneiss’-area, Stenarstugan, 145830E/658675N (2518)

Fig. 12: Old (original) carbonate stone, Garphyttan (2506)

Fig. 13: Reconstructed carbonate stone, sawed surface (2551)

Fig. 14: Reconstructed carbonate stone, natural surface (2552)

Fig. 15: Magnetite ore (the main part is diopside), Garphytte mines 145063E/657730N (2533)

Fig. 16: Aplite in boulder at Garphytte mines, 145063E/657730N, (2531)

Fig. 17: Dark, quarts-rich rock, probably deposit from the impacts dust-cloud, Garphyttan, (2521)

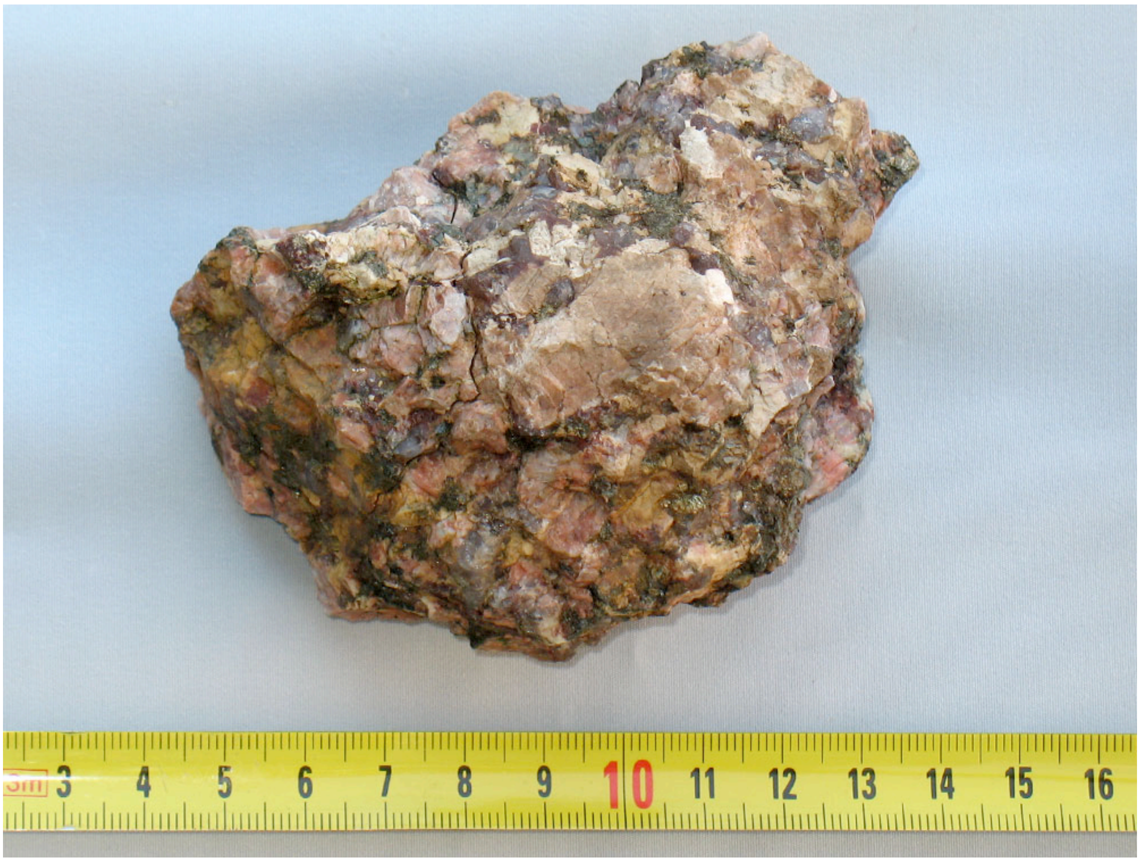

Fig. 18: Granite from Skärmarboda, 146190E/659295N (2511)

Fig. 19: Two melts intermixed, Älgesta, 145645E/657970N (2519)

Fig. 20: Reconstructed, from air sedimented carbonate stone, with quarts-grains (2582)

Fig. 21: Same sample as Fig.20. The brown band in the right part is a melt, containing quarts-grains, too (2586)

Fig. 22: Backside of Fig.20. A brown melt is clearly visible in the right part, (2589)

Fig. 23: The white stuff is recrystallized carbonate stone (recrystallized from the astroblemes’ dust cloud). The black dots are often hollow drops of a former melt (2593)