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Ground Geophysical and Geological Mapping in the Central Part of the Moldanubian Pluton

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57 Text-Figures, 5 Tables and 1 Plate (in pocket)

This paper is devoted to the memory of Dr. HERBERT HEINZ

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Tschechische Republik
Moldanubikum
Moldanubischer Pluton
Bodengeophysik
Bodenmagnetik
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Bodengeophysikalische und geologische Kartierung im Zentralbereich des Moldanubischen Plutons

Zusammenfassung

Ein ca. 1110 km² großes Gebiet des Moldanubischen Plutons zwischen Freistadt (OÖ) und Kautzen (NÖ) wurde zwischen 1991 und 1994 mit bodengeophysikalischen Methoden systematisch untersucht. Boden-Magnetik, In-situ-Erfassung der magnetischen Suszeptibilität und Gammastrahlen-Spektrometrie wurden bei einem Beobachtungsraster von 8–10 Punkten/km² simultan durchgeführt. Gleichzeitig wurde auf insgesamt 260 km² großen Teilgebieten zur Erklärung einiger geophysikalischer Phänomene eine detaillierte geologische Kartierung erstellt.

Die Boden-Magnetik erbrachte folgende Ergebnisse:

1) Die große Reingers-Anomalie NE von Kautzen, die auf beiden Seiten der österreichisch-tschechischen Grenze entwickelt ist.
2) Die nordwestliche Fortsetzung der Liebenau-Anomalie, die schon aus der Aerogeophysik bekannt war.
3) Präzisierung der kleinen Sandl-Anomalie.

Durch Modellrechnungen wurden Größe und Position der verursachenden Störkörper interpretiert. Die geologische Kartierung in Verbindung mit In-situ-Erfassung der magnetischen Suszeptibilität erlaubte die Lokalisierung des neu definierten Karlstift-Granits, der als Verursacher der Liebenau-Anomalie und des östlichen Teils der Weitra-Anomalie anzusehen ist. In der weiter nördliche gelegenen Reingers-Anomalie ergab die Kartierung nur kleine gangförmige Granit-Granodioritvorkommen mit anomal hoher magnetischer Suszeptibilität an der Oberfläche. Der Störkörper muß zwischen 300–500 m und 2-3 km Tiefe liegen. Ca. 10.000 In-situ-Messungen der Kalium-, Uran- und Thorium-Konzentrationen erbrachten neue Erkenntnisse über Radioaktivitäts-Verteilungen. Der Magnetitgehalt im Karlstift-Granit geht in beträchtlichem Ausmaß auf sekundäre Veränderungen zurück, die auch die Kalium-, Uran- und Thorium-Verteilungen innerhalb und im Kontaktbereich des Granites umstellten.

Die Kartierung ergab im Gebiet von Litschau auch eine 12 km lange österreichische Fortsetzung der vulkanotektonischen Lásenice-Zone in Form zahlreicher Gänge subvulkanischer Gesteine, deren intrusives Äquivalent ein feinkörniger Muskovit-Granit ist, für den der Name Rubitzko-Granit vorgeschlagen wird.

Abstract

An almost 1100 km² large area pertaining to the Moldanubian Pluton between the towns of Freistadt (OÖ) and Kautzen (NÖ) was systematically studied by ground geophysical methods during 1991–1994. The set of methods included simultaneously applied ground magnetics, in-situ magnetic susceptibility survey and ground gamma-ray spectrometry keeping the observation point density between 8 to 10 points per 1 km². In the same time detailed geological mapping with the view to explain some geophysical phenomena was carried out on 260 km² large partial areas selected within the territory studied by ground geophysics.

The ground magnetics revealed

1) the large Reingers anomaly in the NE Kautzen part of the area developed on both sides of the A/CZ frontier,
2) deliminated the NW continuation of the Liebenau anomaly (primarily disclosed by airborne survey) and
3) gave precision to the small-size Sandl anomaly.

Using magnetic modelling the sizes and the position of the magnetic source-bodies in the geological cross-section were interpreted. The new geological mapping together with in-situ magnetic susceptibility survey supplied this feature of all the granite types presented and, especially, made possible to locate the newly defined Karlstift granite which was found as the source-rock of the Liebenau magnetic anomaly and the eastern part of the Weitra magnetic anomaly. In the northern Reingers anomaly the geological mapping revealed only small dykes of granite-granodiorite porphyries with anomalous high magnetic susceptibility on the surface. The source body has to be hidden at an estimated depth between 300–500 m (its upper part) and 2–3 km (its bottom). New radioactive features of all the rocks presented were obtained by means of a huge collection exceeding ten

thousand in-situ data of potassium, uranium and thorium concentrations in the granites. The magnetite comprised in the Karlstift granite in considerable contents was proved to be a product of secondary alterations. The alteration processes realized in the Karlstift granite also redistributed the potassium, uranium and thorium abundances both in the endo- and exocontact of this granite.

Our geological mapping found also a continuation of the Lásenice volcanotectonic zone from the Czech side. It runs in the length of about 12 km in the Litschau area and it is accompanied by numerous dykes of acid subvolcanic rocks. It was ascertained also their intrusive equivalent – a new type of fine-grained muscovite granite with the proposed name "Rubitzko granite".

1. Introduction

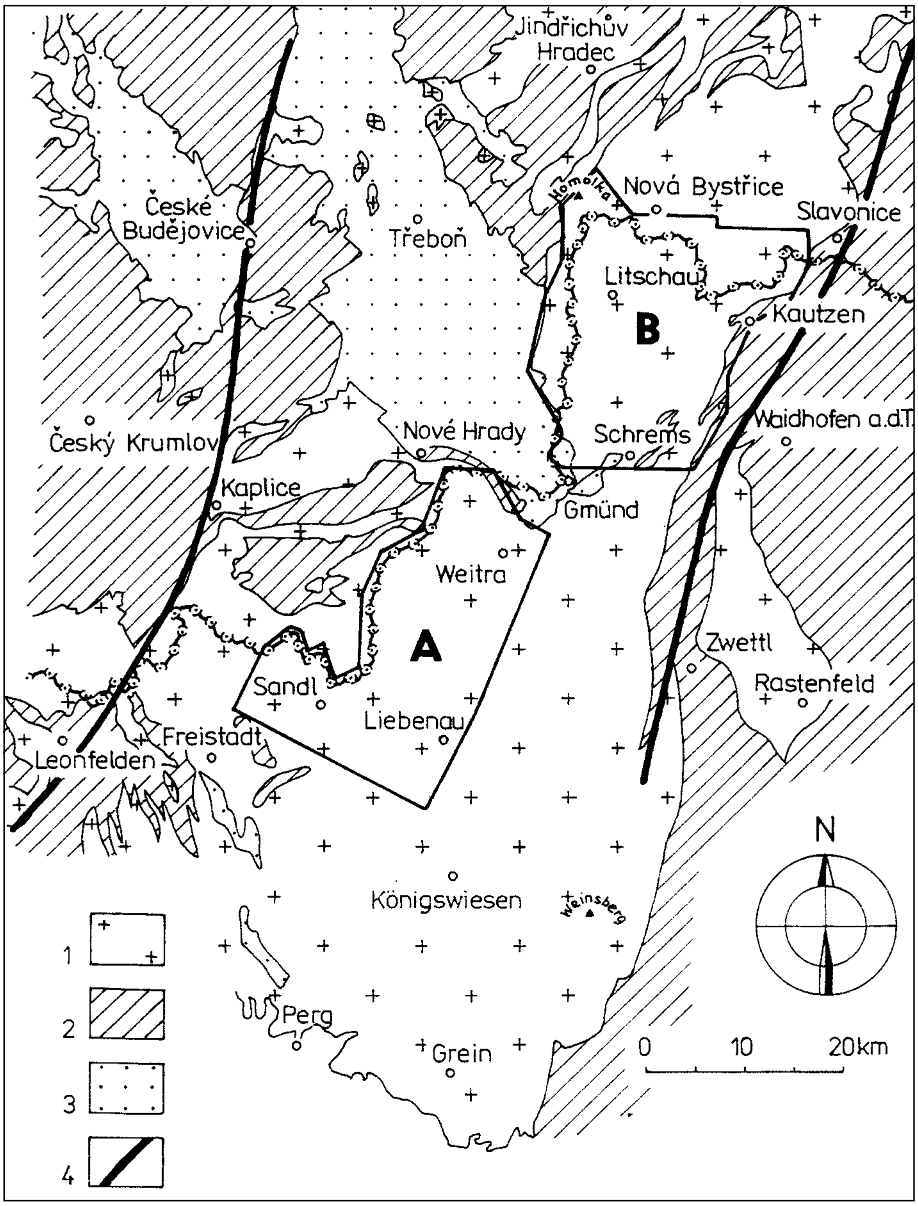
The Moldanubian Pluton (the South Bohemian Pluton in the Austrian geological literature) is the largest igneous body of the Bohemian Massif. About 60 per cent of its area (i.e. 4000 km^2) lies in Austria. The pluton has a horse-shoe shape. The main body trending NNE–SSW is called the Central Massif in the territory of the Czech Republic. Its Šumava branch running WNW–ESE is formed by a number of smaller massifs.

Till the eighties, the Moldanubian Pluton had been believed a rather uninteresting body from the mineral potential point of view. This conception, however, has been radically changed in the last fifteen years. The finds of the Upper Carboniferous greisens with molybdenite mineralizations both in the Czech part (Kozí hora hill near Nová Bystřice) and in the Austrian part (Hirschenschlag near the Austrian/Czech frontier and Nebelstein Mt. SW of Weitra) were very important. Next various mineralizations within the Austrian part of the Moldanubian Pluton were surveyed by GÖD (1989): uranium occurrences at Litschau and near the village of Unterlembach, gold-bearing stream sediments accompanied by scheelite and traces of native bismut within the Mauthausen granite at Liebenau and a pegmatite-bound cassiterite around Neumarkt. On the Czech side near the A/CZ frontier a topas-bearing alkali-feldspar muscovite granite with Sn-(Nb-Ta) mineralization is considered to be the most interesting find in recent time (KLEČKA & ŠREIN, 1992).

The airborne magnetic mapping was realized over the whole territory of Austria in the beginning of 1980's. This basic airborne mapping was followed by detailed helicopter geophysical survey embracing magnetic, gamma-ray spectrometric and electromagnetic methods. This helicopterborne survey was also applied, among others, in two selected areas of the Moldanubian Pluton. One of them was realized between the eastern vicinity of Linz (S) and the southern vicinity of the town of Gmünd (N) in the second half of 1980's (HEINZ et al., 1986; HEINZ et al., 1987; SEIBERL & HEINZ, 1986a,b; SEIBERL & HEINZ, 1988).

The most remarkable subjects revealed by this helicopterborne survey were:

1) a magnetic anomaly between the villages of St. Martin and of St. Wolfgang (let us call it the Weitra anomaly);
2) a complicated magnetic anomaly in the west of the village of Liebenau (the Liebenau anomaly);



Text-Fig. 1.
Location of the detailed ground geophysical activities in the central part of the Moldanubian Pluton during 1991–1994.
A = the Freistadt – Gmünd area of almost 500 km^2; B = the Schrems – Litschau – Kautzen area of approx. 600 km^2.
1 = Moldanubian Pluton, 2 = metamorphic rocks, 3 = Cretaceous and Tertiary sediments of the Třeboň and the České Budějovice Basins, 4 = main fault systems.

3) uranium abundances up to 70 cps on the eastern slope of the Nebelstein Mt. and up to 100 cps in the northern margin of the area flown in detail (W of Gmünd);
4) the NW–SE 6–7 km long belt of relatively low resistivities passing through the northern surroundings of the town of Weitra (HEINZ & SEIBERL, 1990).

The anomalies discovered by this helicopterborne geophysical mapping iniciated the complex follow-up program in an area of almost 500 km² situated between the towns of Freistadt (SW) and of Gmünd (NE) in which ground magnetometry, in-situ study of the magnetic susceptibility of rocks, ground gamma-ray spectrometry and selectively applied detailed geological mapping were involved. Besides that, the NW plutonic corner of Lower Austria and the adjacent part of Southern Bohemia of the total extent reaching up to 600 km² situated between the towns of Schrems (S) and Nová Bystřice (N) were studied using an identical set of ground geophysical methods followed by detailed geological mapping of selected areas.

The results obtained by this four-years mapping program in the two large areas of the Moldanubian Pluton are the subject of this paper.

2. Area Delimination, Survey Objectives

Both areas in which ground geophysical methods and detailed geological mapping were applied are shown in Text-Fig. 1.

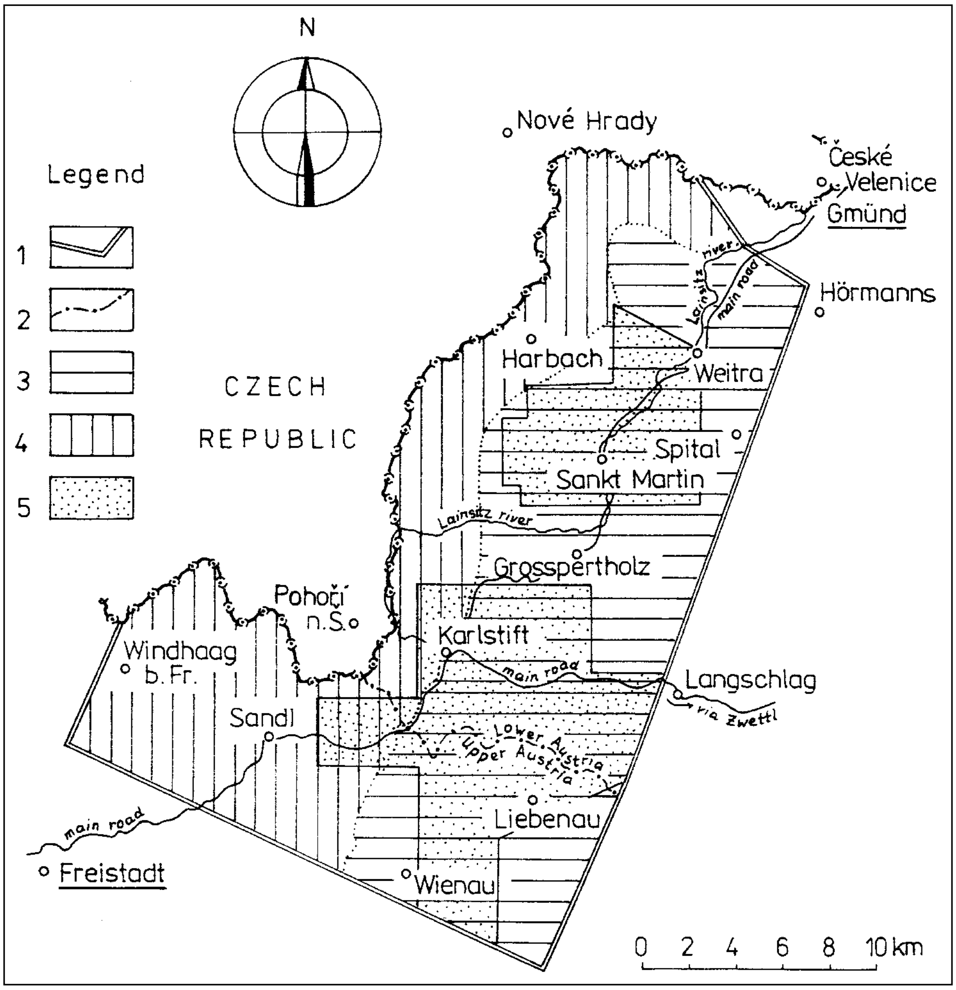
The whole 500 km² of the area A (Freistadt – Gmünd) designed for detailed study is completely situated inside the Moldanubian Pluton. This part of the Pluton is mostly represented by Weinsberg granite, the substantial southern segment is built by fine-grained Mauthausen granite while the northern part is mostly located in medium- to coarse-grained Eisgarn granite. Only the NE part of the area A is bordered by the SE bay of the Třeboň Basin (SW of the town of Gmünd).

Seventy per cent (350 km²) of the whole area under study has been already covered by detailed helicopterborne magnetic, gamma-ray spectrometry (the data of this helicopterborne gamma-ray spectrometry were not converted to the radioelement concentrations) and two-frequency electromagnetic (Dighem II) methods. To obtain the comprehensive magnetic pattern of the whole 500 km² area, ground magnetometry had to be measured in the remaining 150 km² predominantely situated in the near-frontier and in the SW parts of the area (regarding the necessary overlap it was realized in an area of 170 km²). Ground in-situ susceptibility survey and ground gamma-ray spectrometry immediately supplying the potassium, uranium and thorium concentrations as well as total gamma-ray activity of rocks were applied in the whole 500 km² large area. Detailed geological mapping was carried out in two separated partial areas:
1) in the southern vicinity of the town of Weitra (cca 50 km²) and
2) between the villages of Karlstift and of Liebenau (cca 100 km²) – see Text-Fig. 2.

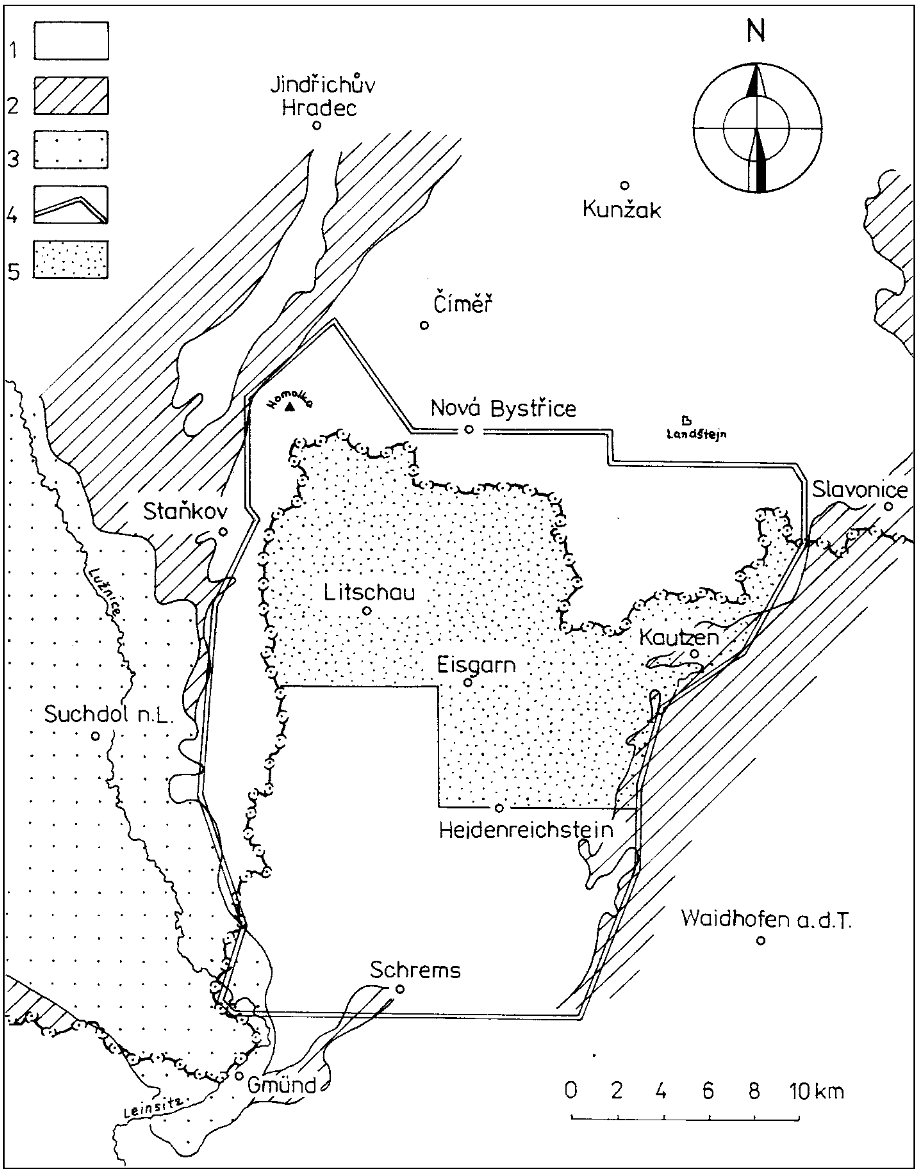
Also the area B – Schrems-Litschau-Kautzen extending to 600 km² is situated in the Moldanubian Pluton. Its NW margin touches the mantle of cordierite gneisses and migmatites, the SW margin follows the boundary of the Třeboň Basin. Only its eastern margin imperceptibly involves Moldanubian paragneisses and allied rocks.

No detail airborne geophysical mapping has been carried-out within the area B before. Therefore, the ground magnetics, the ground in-situ susceptibility survey as well as the ground gamma-ray spectrometry were systematically applied over the whole 600 km² large area.

The detailed geological mapping was realized on 260 km² within the area B. The location of this new geological mapping is shown in Text-Fig. 3.



Text-Fig. 2.
Situation of detailed geological mapping within the area A (Freistadt – Gmünd).
1 = contour of the area under study (the whole area was covered by ground susceptibility survey and by ground gamma-ray spectrometry); 2 = province boundary (Upper Austria/Lower Austria); 3 = area covered by helicopterborne geophysical mapping; 4 = area covered by ground magnetometry; 5 = area of detailed geological mapping.



Text-Fig. 3.
Situation of detailed geological mapping within the area B (Schrems – Litschau – Kautzen).
1 = Moldanubian Pluton; 2 = metamorphic rocks; 3 = Cretaceous and Tertiary sediments of the Třeboň Basin; 4 = contour of the area under study (ground magnetometry; ground gamma-ray spectrometry and in-situ susceptibility survey were applied in the whole area with the exception of the eastern Czech part where areal susceptibility survey fails); 5 = area of detailed geological mapping.

The principal targets of the mentioned ground geophysical survey were the following:

- to map the areal distribution of the magnetic susceptibility of the outcropping rocks;
- to obtain the ΔT magnetic anomalies in the areas not covered by helicopterborne magnetics, to combine them together with the detailed airborne magnetic pattern and, consequently, to present the unified detail magnetic map of the area;
- to study the relationship of the revealed magnetic anomalies to the distribution of the magnetic susceptibility of the outcropping rocks;
- to apply the magnetic modelling for the assessment of the shapes, the sizes and the depths of the magnetic source bodies in the geological cross-section;
- to recognize the areal potassium, uranium and thorium abundances related to both magnetic susceptibility and to the lithological types of the outcropping magmatic rocks;
- to ascertain the values of all three basic radioelement ratios such as Th/K, U/Th and U/K and to evaluate them in reference of the magnetic phenomena as well as in respect of a new geological knowledge obtained.

The detailed geological mapping was carried-out for the following purposes:

- to precise the geological structure of the localities with magnetic anomalies;
- to search for greisens and for other altered rocks which accompany mineralized zones;
- to look for and to explain some relationships between geophysical anomalies and ore-bearing rocks.

The detailed ground geophysical survey together with detailed geological mapping in the Freistadt-Gmünd area A were carried-out during 1991–1992 and finished with the reports by GNOJEK et al. (1992, 1993) and by PŘICHYSTAL (1992b, 1993). The field work in the Schrems – Litschau – Kautzen area B were commenced in 1991 but mostly examined during 1993 and 1994. The partial results were presented by GNOJEK et al. (1991), by GNOJEK & ZABADAL (1994, 1995) and by PŘICHYSTAL (1992a, 1994a,b,c, 1995).

3. Review of Previous Geological Investigations

3.1. Mapped Parts of the Area A (Liebenau – Karlstift, SW Surroundings of Weitra)

The studied area has been covered by an earlier geological mapping of the Austrian Geological Survey in the scale of 1 : 50.000, sheets No. 17 Großpertholz (FUCHS & SCHWAIGHOFER, 1977), No. 18 Weitra (ERICH & SCHWAIGHOFER, 1977) and No. 34 Perg (FUCHS & THIELE, 1982). These older geological investigations are summarized in the explanatory booklets to the sheets (FUCHS & SCHWAIGHOFER, 1978; SCHWAIGHOFER, 1978 and FUCHS & THIELE, 1987).

The succession of the granite intrusions in the Austrian part of the Moldanubian Pluton and their petrology including the tectonomagmatic setting were solved in the papers of LIEW et al. (1989) and FINGER et al.(1992). The study of accessory zircons in the individual types of the granit rocks, i.e. in the Weinsberg granite, the Freistadt granodiorite and the Karlstift granite contributed to the knowledge of intersections among them (FINGER & HAUNSCHMIDT, 1988 and FINGER et al., 1991). The mineral potential of the mapped area was evaluated by GÖD (1989).

In the area of Weitra, molybdenite-bearing greisens on the slope of Nebelstein Mt. represent the most important finds from this point of view. They were mapped in detail by ZIER (1983). GÖD & KOLLER (1989) carried out their petrographical study including determination of some trace elements. They supposed a close genetic relationship between greisens and a special type of peraluminous leucogranite which they described as the Nebelstein granite. SCHARBERT (1987) dated 11 samples of greisen from drill holes NEK 1–12 E of Nebelstein Mt. by the Rb-Sr method (311,6±1,4 Ma). The disseminated mineralization limited to greisens is formed by the paragenesis pyrite – molybdenite – pyrrhotite – chalcopyrite. Greisenization took place at a minimum pressure of 180 MPa and in a temperature between 200° and 400°C (KOLLER et al., 1992).

In the area of Liebenau, gold-bearing stream sediments about 3 km NW of Liebenau are most interesting (GÖD, 1989). In the heavy mineral concentrate the gold is accompanied by scheelite, by traces of native bismuth and by unusual high contents of epidote. According to the mentioned author, the gold mineralization could be connected with significantly altered granites intersected by core drilling. The alteration zones may even exceed 25 m and they obviously form an irregular network. The alteration is characterized by hematitization causing a dark red colour of the granite, by chloritization, by the secondarily formed kaolinite, illite and epidote. There is a general lack of sulfides and no traces of silicification have been observed.

3.2. Northern Part of the Area B (Litschau – Kautzen – Heidenreichstein)

The last geological map of Schrems – Litschau – Kautzen area was made up by WALDMANN (1950) in the scale 1 : 75.000 (sheet 4454 Litschau and Gmünd). The report on the geological mapping he published earlier (WALDMANN, 1930). Since the publication of WALDMANN's map there has not been done a new geological survey of the mentioned area up to 1991. Some of its parts or rock types have been studied. SCHARBERT (1966) introduced a chemical and modal analyses of the Eisgarn granite from the Hohe Stein Hill near Kautzen. The most important investigations were connected with the molybdenite mineralization at Hirschenschlag (GÖD, 1989) which is located just at Austrian-Czech border and its greater part lies on the territory of Czech Republic (the Kozí hora Hill at Nová Bystřice). SCHARBERT (1987) dated by Rb-Sr method nine samples of Eisgarn granite (316±7 Ma) from drill holes near Hirschenschlag.

Very important finds were done in the adjacent Czech part of the Moldanubian Pluton. First of all, the Eisgarn granite has been divided by ZOUBEK (1949) in two varieties:

a) porphyritic medium-grained two-mica granite (the Číměř granite),
b) porphyritic coarse-grained granite rich in muscovite (the Landštejn granite).

The third variety of the Eisgarn granite was introduced by KOUTEK (1925) as a medium- to fine-grained sporadically porphyritic one (the Mrákotín granite). This division to three main varieties was used for the sheet 1 : 200.000 M- 33–XXVIII Jindřichův Hradec (DUDEK et al., 1962).

KLEČKA (1984, 1992) described about 15 dykes of felsitic and vitreous acid rocks subvolcanic in character trending mostly from N to S at the village of Lásenice (8 km N of the Austrian state border). The dyke thickness ranges from 2–20 meters, the length from 100 to 2000 m, their dip is subvertical. The dykes have usually a zoned structure: a zone of felsic microgranite up to 50 cm thick with fluidal textures lies at the contact with country rock. The central part of the dykes is formed by a felsic granite porphyry. The textures and structures indicate a very rapid solidification, in some cases the existence of effusions cannot be excluded. KLEČKA & VAŇKOVÁ (1988) studied the geochemistry of the dyke rocks and their relationship to the Sn-W mineralization. The rocks correspond to acid alkali-feldspar granites with high contents of SiO_2 , Al_2O_3 , P_2O_5 , Na_2O and low contents of CaO and MgO. As the trace elements are concerned, felsitic dykes have high contents of Li, Rb, Cs, Tl, Sn and low Ba, Sr and Zr – these features being typical of strongly differenciated granites. The U content is increased, slightly in granite porphyries and distinctly in microgranites (up to 16 ppm), the Th contents are anomalously low, especially in microgranites (below 2 ppm). These rocks are believed to constitute a N–S trending volcanotectonic zone (KLEČKA, 1992).

A next similar volcanotectonic structure was described by VRÁNA (1990) near Pelhřimov. The circular structure (diameter = 9.6 km) is associated with a dyke swarm of felsitic porphyries which are closely comparable to porphyry and microgranite occurrences at Lásenice (40 km SSW of the town of Pelhřimov). Moreover, planar deformation features (clevages) in apatite are interpreted as indications of dynamic deformation conditions associated probably with an explosive volcanism.

With the Lásenice volcanotectonic zone is linked spatially and perhaps also genetically the granite of Homolka type – the topas-bearing alkali-feldspar muscovite granite (LOCHMAN et al., 1991). The Homolka granite represents an unique rock type within the entire Bohemian Massif. It forms a body elongated in N–S direction, exposed in an area of about 6 km^2, just at the state frontier on the Czech side. The granite contains quartz (32.2–37 %), albite (26.5–30.0 %), K-feldspar (14.6–25.4 %), muscovite (12.8–16 %), chloritized relics of biotite (0.1–0.8 %), topas and apatite (1.6–2.8 %). Columbite, kassiterite, in places fluorite and very rarely ilmenite are accessories. The contents of trace elements are very remarkable: Rb (1060–1560 ppm), Sn (51–314 ppm in unaltered rock) and Nb (47–150 ppm) values are higher than those of any other granite of the Bohemian Massif (KLEČKA, 1992). Occurrences of U (10–19 ppm) and W (10–64 ppm) are also high. On the other hand, Ba (mostly below 50 ppm), Sr (25–57 ppm) and Zr (20–30 ppm) are very low.

Concerning the mineralization, KLEČKA (1992) believes that it exhibits an almost perfect zoning: the highest temperature centre of mineralization in the apex of the body (cassiterite with columbite-tantalite in greisens), further from the centre – quartz dykes with wolframite and arsenopyrite and at still greater distance – quartz dykes with high temperature polymetallic ores (all described on the Czech side). On the Austrian side around the town of Litschau, GÖD (1989) has mentioned an uranium mineralization consisting of minerals of the autunite group.

4. Ground Geophysical Methods Applied

Equipments, field application ways and some evaluation modes are mentioned in this paragraph.

4.1. Magnetic Susceptibility Survey

The in-situ magnetic susceptibility data were measured using the Microkappa (model KT-5) portable magnetic susceptibility meter produced by Geofyzika a.s. Brno. The equipment has the sensitivity of 1×10^{-5} SI units; its range of the applicability is from .01 to 999×10^{-3} SI units. The low 3.5 mA average power consumption of a small 9V batery and its pocket sizes are not negligible advantages of this measuring device.

Rock outcrops and huge boulders quite frequent in the area under study were contacted by the sensor of the Microkappa in several (5–10) different places of their surface and the individual magnetic susceptibility values were detected there. The data span observed and the average value estimated of them were recorded. The measured "points" were often not represented only by one boulder but several nearest objects of this kind were contacted by the susceptibility meter at the local area sized 5×5 m or more representing, thus, one measured "point". The measured "points" comprehended in this way brought fairly representative magnetic susceptibility data.

The total number of susceptibility data collected in the area A was 4089 which means that in the whole 500 km² large area the mean point density of this susceptibility survey reached over 8 points per 1 km². The eastern Czech part of the area B, unfortunately, was not covered by areal magnetic susceptibility survey. But in the Austrian territory and in the adjacent western Czech part of the area B 2547 „susceptibility points" were measured. It means that the remaining 480 km² of the area B were covered with a mean density of susceptibility data of 5.3 points per 1 km². The Text-Figs. 4 and 16 are based on these data.

Moreover, the magnetic susceptibility was also measured on the majority of the documentation points described in course of the geological mapping because it was found that some types of magmatic rocks could be clearly characterized by this parameter. The field investigation even showed that some granites can be distinguished especially on the basis of their magnetic susceptibility.

4.2. Ground Magnetometry

The values of the total vector of the magnetic field intensity (T) were measured using the PM-2 portable proton magnetometer produced by Geofyzika a.s. Brno. This digital equipment can detect the Earth's magnetic field in the range from 40.000 to 58 000 nT with the absolute accuracy 1 nT. Its resolution is 0.1 nT and the tolerance to the field gradient reaches to 2000 nT/m.

Approximately five individual values of the field intensity were sampled on each measured „point" representing a local place up to 10×10 m sized. After the quick evaluation of the differences observed the mean value was recorded as a representative datum for each measured point. The same type of the equipment was simultaneously used as a base station measuring the diurnal variations. Because of the relatively slow progress during the ground magnetic survey (8–10 minutes between individual points) the sampling interval of the diurnals was 5 minutes. The delta T magnetic anomalies were calculated using the reduction to the normal magnetic field published by HEINZ & SEIBERL (1990).

In the area A (Freistadt – Gmünd) 2018 points were measured on a plane of 170 km² which evokes the average density of 11.9 points per 1 km². These ground data together with the helicopterborne map by HEINZ & SEIBERL (1990) – which covers the eastern half of the area A – made possible to compile the magnetic map in Text-Fig. 6. In the area B (Schrems – Litschau – Kautzen) a total number of 5 138 points was measured which evokes a mean point density of 8.6 points per 1 km². The map in Text-Fig. 17 is based on these data.

4.3. Ground Gamma-Ray Spectrometry

The prompt quantitative in-situ analysis of the main three natural radioelements was carried out with the help of the portable GS-256 gamma-ray spectrometers produced by Geofyzika a.s. Brno, as well. This equipment utilizes the cylindric NaI(Tl) scintilation detector 7.5 cm in diameter and 7.5 cm high the resolution of which related to the ^{137}Cs is better than 8.5 per cent. The GS-256 is designed as a 256 channel analyzer with the ability to collect the counts in the time range from 1 to 999 seconds. After calibration on „geometrically infinite" monoelement sources with known abundances (a calibration base having these properties exists near Příbram, Central Bohemia, CR), the GS-256 spectrometer can be adjusted to indicate potassium, uranium and thorium concentrations in per cent K and in ppm U and Th immediately in the end of the pre-set time interval for the accumulation of the counts.

Regarding the relatively high radioelement concentrations in the granite rocks the time interval of 120 seconds was pre-set as the sufficient interval of the counts accumulation required for fairly good in situ gamma-ray spectrometric analysis.

The large outcrops and the huge boulders affording the geometry close to the „infinite" source of the gamma-rays (so called 2π geometry) were the preferential objects for the in-situ determination of the K, U and Th abundances. Only if objects of these sizes and with relatively large and flat outside were not available in the surroundings of the planned measuring point (in which simultaneously ground magnetic and susceptibility data were collected) the eluvium, exceptionally the soil, were accepted as a compensatory object for the ground gamma-ray spectrometry. Fortunately, the favourable geomorphological conditions in the area under study supply the big number of fairly representative objects in 70–80 per cent of the studied area. Therefore, this method realized here can be appreciated as a HIgh-FIdelity gamma-ray spectrometry.

A total number of 4 847 points with a mean density of 9.8 points per 1 km² was measured in the area A (Freistadt – Gmünd) and a total number of 5 230 points with a mean density of almost 9 points per 1 km² was gathered in the area B (Schrems – Litschau – Kautzen). These data collections played the role of the recourses of the Text-Figs. 10–15 and 19–24.

4.4. Brief Data Processing Remarks

The whole data processing procedure was carried out with the help of PC. Both the PM-2 field proton magnetometers and the GS-256 portable gamma-ray spectrometers are able to store several hundreds of measured data in their internal memories and, later on, to transfer them via special interface to PC. Susceptibility data were delivered to PC using the key-board. Coordinates of the measured points were supplied to PC from the topographic maps of the scale of 1 : 25 000 with the help of a digitizer.

After checking all the data and after reducing the measured T magnetic data to the delta T anomalies the regular grid of all final data – such as

1) magnetic susceptibility,
2) delta T magnetic anomalies,
3) potassium concentration,
4) uranium concentration,
5) thorium concentration,
6) Th/K ratio
7) U/Th ratio,
8) U/K ratio and, as an option,
9) gamma-ray total count values

was created.

Consequently, the contour lines were interpolated and plotted in the scale of 1 : 50.000 (Dr. S. ZABADAL is the author of this PC data processing system).

The accuracy of the field survey was taken into account in the map presentation of the measured parameters. Briefly, it can be stated that the standard deviation of the susceptibility data is about 1×10^{-5} SI or 5 % in high values, ΔT mag. anomalies 1.6 nT (less than 2 nT), potassium concentration 0.1 %K (less than 0.2 % K), uranium concentration 0.4 to 0.5 ppm U, thorium concentration 0.7 to 0.8 ppm Th.

Regarding the principle of the three-times standard deviation value for the authenthic data presentation the maps enclosed figure the magnetic field using 5 nT contour interval, the potassium, the uranium and the thorium distributions using the 0.5 % K, 1 ppm U and 2 ppm Th contour intervals. The low susceptibility values are contoured using the interval of 5×10^{-5} SI.

A specially designed software for the black/white plot utilizes different line-types for various value intervals of the geophysical field presented. Negative magnetic anomalies are shown in dashed lines, the normal magnetic field ("zero" anomaly) is shown as a dashed- and -dot line, positive magnetic anomalies are drawn in full lines. The distribution of the magnetic susceptibilities, the potassium, uranium and thorium concentrations as well as the ratio maps are presented in the following style: the very low and the low values are contoured with short dashed lines, the medium values (close to the mean value) are contoured with medium-long dashed lines and the high values are drawn in full-line contours.

4.5. Staff

The partial stages of the project were performed by the following specialists:

Field observations and geophysical data collection were carried out by Dr. Karel ŠALANSKÝ, Dr. Ivan GNOJEK, Dr. Karel DĚDÁČEK, Dr. Stanislav ZABADAL, Dr. Igor POLEDŇÁK, Dr. František JANÁK and Ing. Petr OBOŘIL with the help of Pavel OBOŘIL, Libor BUČEK and Stanislav VRBA. The data processing was performed by Dr. Stanislav ZABADAL and the interpretation was done by Dr. Ivan GNOJEK with the assistence of Dr. František JANÁK.

The detailed geological mapping was performed by assoc. prof. Dr. Antonín PŘICHY-

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Text-Fig. 4.
Area A: Magnetic susceptibility contour map.

STAL. The study of ore minerals was carried out in cooperation with Dr. Zdeněk LOSOS and Dr. Marek SLOBODNÍK. The microprobe analyses were done by Dr. Petr SULOFSKÝ, Dept. of Mineralogy, Petrology and Geochemistry, Masaryk University, Brno.

5. Results of Ground Geophysics

5.1. Area A (Freistadt – Gmünd)

5.1.1. Magnetic Susceptibility

Great variability of susceptibility data is a normal and natural feature of rocks. Contacting various parts of an outcrop or of a boulder by the Microkappa susceptibility meter the observer gathers different susceptibility values of the object investigated from, approximately, a half liter of its volume close to the sensor of the Microkappa. Before the evaluation of the gathered data it is necessary to point out that the method is not able to supply susceptibility data of deep seated (not outcropping) objects. The presented maps of magnetic susceptibility (Text-Figs. 4 and 16) demonstrate the contours of the mean susceptibility values; it means that the maps do not figure the rare extreme point values.

The majority of granite rocks in the area A is typical with susceptibility values ranging from (0.01) 0.05 to 0.15×10^{-3} SI unit. The slightly increased values from 0.2 to 0.5×10^{-3} (SI) draw our attention to the feasibility that rock type differences may occur in the area. The highly increased values exceeding 1×10^{-3} (SI) show rocks significantly different in their composition which could be – besides the primary differentiation – also affected by secondary alteration processes resulting, among others, in increased accumulation of magnetic minerals. These rocks with susceptibilities higher than 1×10^{-3} (SI) have to evoke distinct delta T magnetic anomalies, as well.

Examining the magnetic susceptibility contour map (Text-Fig. 4) the observer can note that the area typical with susceptibilities exceeding 0.2×10^{-3} (SI) is continuously developed in the NE corner of the area under study among the villages of Eichberg, Altweitra and Hörmanns where the geological map by ERICH & SCHWAIGHOFER (1977) shows Weinsberg granite. The values higher then 0.2×10^{-3} (SI), however, do not accompany the Weinsberg granite continuously in its large territorial extension. Other areas of similar increased susceptibility values – but of less extent – were found within the Weinsberg granite between the villages Sankt Wolfgang and Spital and in the northern surroundings of Harbach; generally – in the vicinity of the Eisgarn type of granite mapped by the cited authors in the W and NW environs of the town of Weitra.

The anomalous spots with susceptibilities exceeding 0.5–up to 5×10^{-3} (SI) in the vicinity of the villages of Reinprechts, Wultschau and Harbach (anomaly „A" in Text-Fig. 4) partly correspond with small known bodies of "diorite" rocks described in this area by ERICH & SCHWAIGHOFER (1977). Moreover, the extent of increased susceptibility data may advice larger distribution of these intermediate to basic bodies, there.

Further to the south of Wultschau (Maissen) the narrow sagged 3.5 km long belt with susceptibilities growing to the tens of the order of 10^{-3} (SI) – the extreme value found there was 58×10^{-3} (SI) – was traced along the eastern slope of the Nebelstein Mt. (anomaly „B" in Text-Fig. 4). This belt of anomalous susceptibilities is closely bound with high abundances of uranium accompanied by very low thorium concentrations in this partial area.

Other significantly increased susceptibility values reaching up to 7×10^{-3} (SI) were detected between the villages of Sankt Martin and Sankt Wolfgang (anomaly „C" in Text-Fig. 4). This local area of high susceptibilities unambiguously corresponds with the uppermost near-surface block of the magnetic bodies which evoke the large magnetic anomaly deliminated by the detailed GBA-helicopterborne geophysical survey in the SW vicinity of the town of Weitra (see the interpretation profile V–W, the location of which is shown in Text-Fig. 6). From the comparison of the delta T magnetic anomalies with the magnetic susceptibility contour map (Text-Figs. 4 and 6) clearly follows that the deep-seated blocks of the magnetic source body cannot evoke anomalous susceptibilities detectable on the ground.

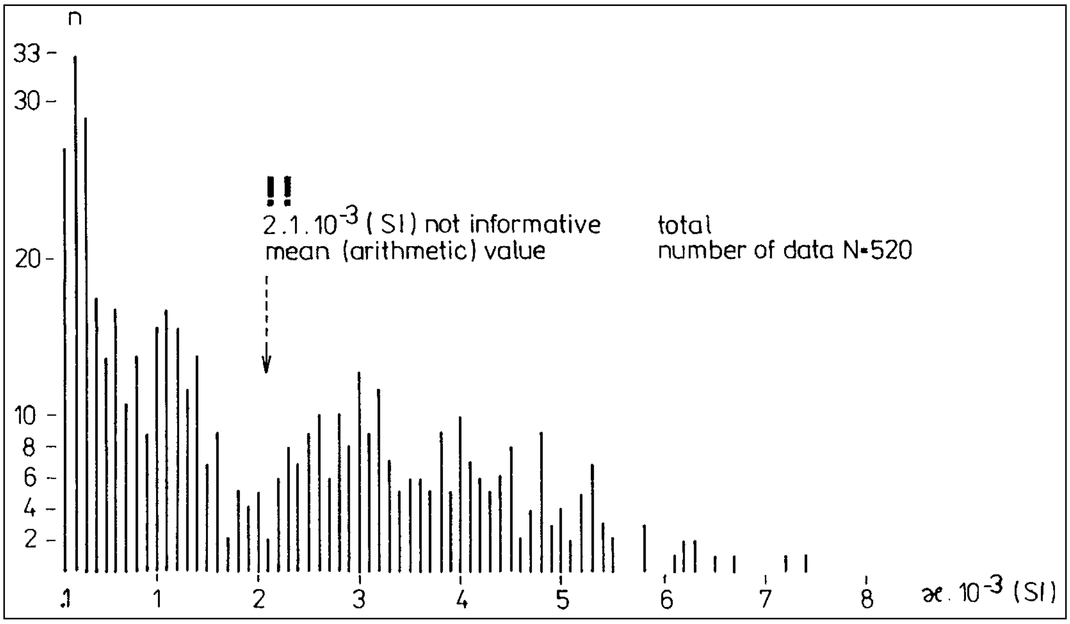
In the top part of the Weitra magnetic anomaly caused by the near-surface block of its source the detailed study of magnetic susceptibility was done between the villages of St. Martin and St. Wolfgang. Its location is shown in Text-Fig. 4. The area sized 250 m×230 m was chosen for this study and an approximate observation grid 10 m×10 m was used. Rock outcrops and boulders, naturally, were preferred but in the case of lack of them the detritus and even coarse-grained eluvium was detected.

The areal distribution of susceptibility data obtained in this detail area with 520 "point data" based on cca 2500 individual measurements clearly demonstrates the irregular and mosaic-type distribution of the susceptibility values in the plane. The frequency distribution of these susceptibility data presented in Text-Fig. 5 is also very informative. The high variance of the susceptibility values in rocks is proved by the existence of (at least) two groups of data, the first of them ranging from 0.1 to 1.6×10^{-3} (SI) and the second one from 2.2 to 5.5×10^{-3} (SI). As the frequency distribution of the susceptibility values is too far from the normal Gauss distribution the calculated arithmetic mean value is situated in the domain of the lowest frequency of data.

One of the most striking pieces of knowledge obtained during the detailed susceptibility study seems to be the fact that even eluvial soil can be a carrier of high magnetic susceptibilities. In 137 points, in which no solid rocks could be found within the area of the detail study, the increased susceptibilities reaching usually up to 1.5×10^{-3} (SI), exceptionaly up to 2.5×10^{-3} (SI) were observed. It means that the magnetic minerals involved in granite rocks are able to "survive" some weathering processes and can stay as an ingredient of the eluvial soils.

The most remarkable susceptibility anomalies both in the areal extent and in the magnitude were found in the southern part of the area under study. This largest anomaly has a horse-shoe shape and is almost continuously developed from the Czech/Austrian border (south of the village Pohoří na Šumavě), in the southern vicinity of the village of Karlstift, in the northern and the western vicinities of the villages of Liebenau and Liebenstein. It is terminated in the northern vicinity of the village of Harrachstal (the anomaly "D" in Text-Fig. 4). The highest susceptibility values exceeding 10×10^{-3} (SI) were found in its southern branch, SW of Liebenstein.

Smaller spots with anomalous susceptibilities were also found in the western part of the area under study between Windhaag bei Freistadt and Sandl (the anomaly "E" in Text-Fig. 4). The largest and simultaneously the highest of them reaching up to 11×10^{-3} (SI) was taken 3 km NW of Sandl (let us call it the Sandl anomaly), smaller and iso-



Text-Fig. 5.
Frequency distribution of susceptibility data in the outcropping block of the source-body of the Weitra magnetic anomaly.

lated susceptibility anomalies were also detected in the NW vicinity of Windhaag b.F. (about 0.5×10^{-3} SI) and between the villages of Grünbach and of Spörbichl (up to 1×10^{-3} SI).

Almost all mentioned susceptibility anomalies in the southern part of the area under study correspond to the extent of the delta T magnetic anomalies (confront Text-Figs. 4 and 6) which means that almost all magnetic anomalies in this part of the area investigated have their sources in the position of the near-surface and/or outcropping bodies. As the location of the anomalous susceptibilities often corresponds to the anomalous distribution of radioactive elements, thus, the concentration of magnetic minerals seems to be closely bound with alteration processes which redistributed the radioactive elements in the affected rocks.

5.1.2. Geomagnetic Field Anomalies

The map of the delta T magnetic anomalies (Text-Fig. 6) is a compiled map which was composed from the airborne data (HEINZ & SEIBERL, 1990) covering the eastern part of the area and from the ground data obtained in the near-frontier part, as well as in the western section of the area under study during 1991 and 1992.

As the whole Moldanubian Pluton territory is situated in the vast North-Austrian magnetic minimum, both the Weitra and the Liebenau anomalies are superimposed on the deep negative field of about –50 to –60 nT in the map of the cited authors. Consequently, the top part of the Weitra anomaly is developed in the interval from –100 to 140 nT and its western (Nebelstein) part does not even reach the positive values; its maximum has the value of –25 nT. Analogically, the amplitude span of the Liebenau anomaly is in the interval from –120 to 100 nT (HEINZ & SEIBERL, 1990). These facts got us better to use a regional normal magnetic field for the interpretation purposes in the Freistadt – Gmünd area A which was obtained by shifting the zero level 50 nT down. The resultant magnetic anomalous field acquired after this shift is presented in Text-Fig. 6.

The Weitra magnetic anomaly "W" representing the most striking magnetic object in the northern part of the area was studied in detail along the profile V–W shown in Text-Fig. 6. Both the airborne and the ground data were used for its interpretation utilizing the TALWANI & HEIRTZLER (1964) two dimensional method of magnetic modelling (GNOJEK et al., 1992).

A slightly vaulted dome structure which is regarded to be quite frequent in granitic bodies was accepted as a starting model for the interpretation of the eastern shallower part of the Weitra anomaly. Qualitative analysis of its anomalous field enabled us to predict the existence of at least one to two local faults of WSW–ENE direction which might disturb the primarily entire source of the anomaly. Later on, two almost parallel faults of this direction were really identified by detailed mapping in this field (PŘICHYSTAL, 1992b).

The resultant model of the Weitra anomaly source body (Text-Fig. 7) indicates it (in the NNW–SSE cross-section) as a five kilometers wide dome structure broken by two faults into three individual blocks situated in different vertical positions. The central block causing the top of the anomaly is regarded to be a tectonically uplifted part of the source reaching almost the surface. The outside blocks are expected to be deeper-seated bodies with their upper margins in the depth of 500 to 800 m. The northern outside block is supposed to be more significant both in its volume and in its magnetic properties.

The source body of the western (Nebelstein) part of the Weitra anomaly is interpreted as a tectonically cut off, and substantially deeper seated body situated in a depth of about 1 km. A tens of kilometers long silicificated mylonite zone of SSW–NNE direction running through the whole area under study (Harrachstal – Karlstift – Wultschau) having the function of a left lateral strike-slip fault played an important tectonic role in this area. It also significantly influenced the position of magnetic anomalous facies of the pluton.

Local anomalies situated to the north of the Weitra anomaly in the vicinity of the villages of Wultschau and of Reinprechts are interpreted as a response of "diorite" bodies found there. It is remarkable that these more basic bodies occur in the northern continuation of the mylonite zone mentioned above.

Even more variable magnetic data were found in the southern and western parts of the area. First of all, it is the Liebenau magnetic anomaly "L" which was located between the villages Karlstift – Liebenau – Wienau by the GBA detailed airborne mapping. Besides the continuous part of the Liebenau anomaly a separate branch of it was deliminated SW of Karlstift. Another high amplitude Sandl anomaly "S" (170 nT) was identified between the villages of Sandl and Windhaag bei Freistadt. Moreover, small-sized magnetic anomalies were localized in the vicinity of the village of Rindlberg near the southern margin and in the SW corner of the area under study – S and SW of Windhaag bei Freistadt.

The systematic magnetic susceptibility survey applied in the whole area proved that practically all magnetic anomalies found in the southern part of it are accompanied by anomalous susceptibility values on the ground. It means that almost all source bodies of the Liebenau, of the Sandl, as well as of the small anomalies near Rindlberg and Windhaag b.F. reach to or are exposed at the surface. Consequently, the problem of their quantitative interpretation can be reduced to the question of the thickness of their source bodies, i.e. in which depth the anomalous sources are terminated.

Utilizing the large collection of susceptibility data and taking into account the fact that the susceptibilities detected on the ground could be rather decreased by weathering processes the magnetic modelling of the anomalous sources was done along two profiles across the Sandl anomaly and along three profiles across the Liebenau anomaly; (GNOJEK et al., 1993). Location of the chosen interpretation profiles presented here, i.e. profile K-L across the Liebenau anomaly and Y-X across the Sandl anomaly (Text-Figs. 8 and 9) are located in Text-Fig. 6.

Applying the susceptibilities from 8 to 13×10^{-3} (SI) the magnetic modelling showed that the source bodies could reach a depth ranging from 600 m to 800 m in both anomalies. If higher susceptibilities were accepted the resulting thickness of the source bodies would be even lower. From both the delta T magnetic and the susceptibility surveys it follows that the whole complex Liebenau magnetic structure as well as the Sandl magnetic structure can be understood as root (bottom) remnants of previously thicker magnetic bodies. The irregular and complicated horse-shoe shape of the Liebenau anomaly seems to be a result of complex tectonic influences, predominantely by the faults of WNW–ESE and SW–NNE directions.

The small 10 nT anomaly found at the Czech/Austrian border in the northern margin of the area to the E of the village of Pyhrabruck may be caused by a rest of the crystalline mantle (migmatites) mapped in a narrow belt, there.

5.1.3. Distribution of Natural Radioactive Elements

As the new detailed geological maps by PŘICHYSTAL (1992b, 1993) are focused only to the localities in which the magnetic anomalies are developed and which, thus, could be considered to be prospective localities regarding mineralizations, the areal evaluation of the natural radioelement distribution

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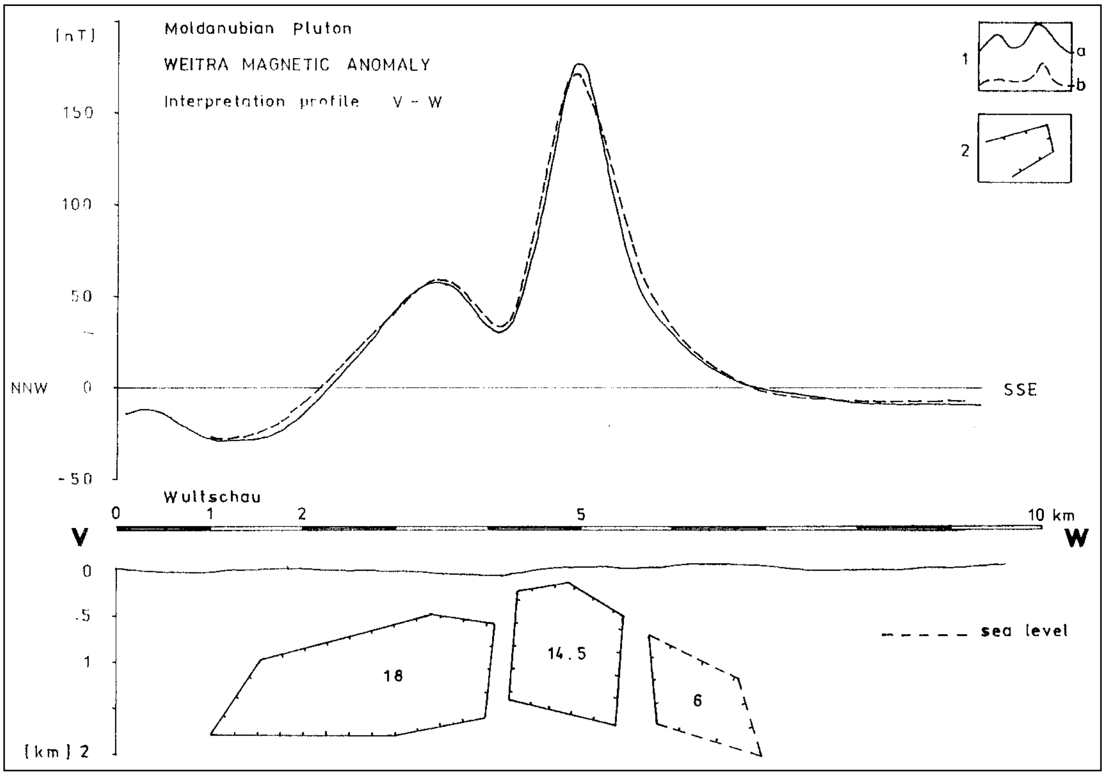
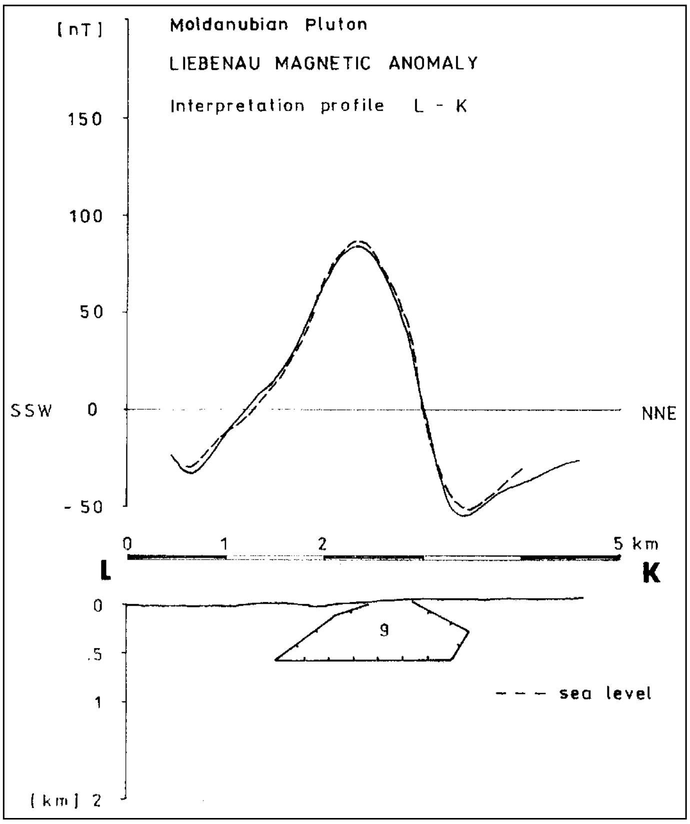
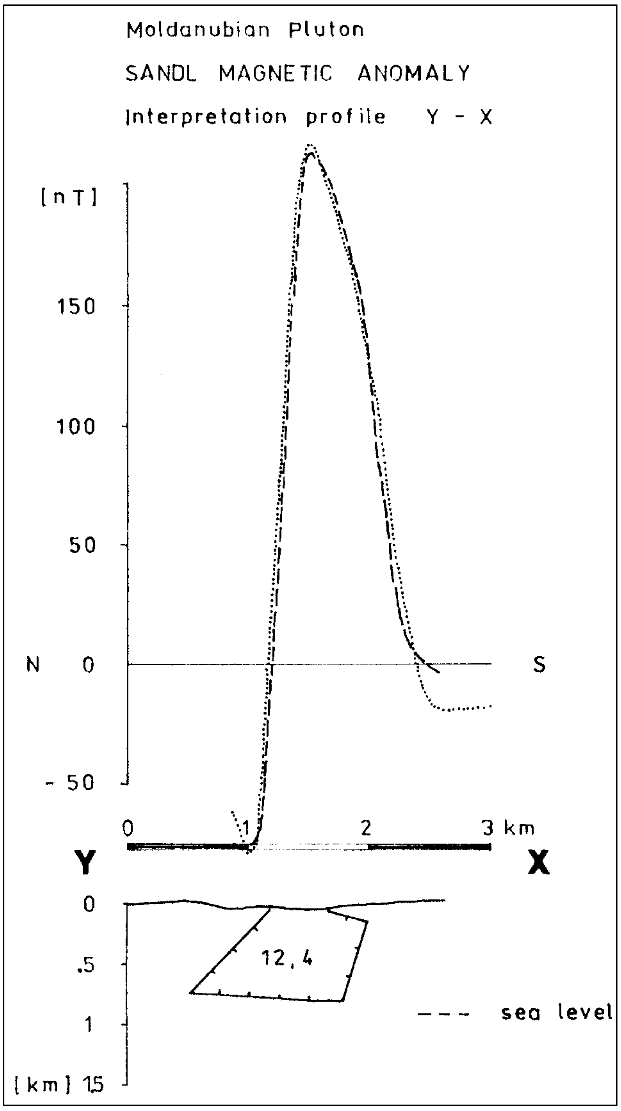
Text-Fig. 6.
Area A: Magnetic anomalies ΔT.

Text-Fig. 7.
Weitra magnetic anomaly; interpretation profile V-W.
1 = magnetic data: a) measured (airborne); b) computed effect of the model source-body.
2 = contour of the source-body; numbers inside the bodies are the mean magnetic susceptibilities used for the model ($n \times 10^{-3}$ SI).





Text-Fig. 8. ▲△▲
Liebenau magnetic anomaly; interpretation profile L-K.
(The meaning of different lines is the same as in Text-Fig. 7).



Text-Fig. 9. ►▷►
Sandl magnetic anomaly; interpretation profile Y-X.
(The dotted line means the measured ground data; the meaning of the other symbols is the same as in Text-Fig. 7).

Table 1.
Distribution of radioactive elements in the rock types of the Moldanubian Pluton, Freistadt – Gmünd partial area.

Eisgarn granite				
	potassium [% K]	general:	3.5-4.5(5)	
	uranium [ppm U]	general:	6 - 12(14)	
		exceptional:	20 - 38	north section of the A/CZ border
	thorium [ppm Th]	no general values		
		exceptional:	4 - 14	"northern subtype"
			16 - 24	"central subtype"
			26 - 46	"southern subtype"
Weinsberg granite				
	potassium [% K]	general:	3.5-4.5(5)	
		exceptional:	5 - 6.5	N- and S- rims of Liebenau mag.struc.
			5 - 6.5	N-vicinity of Sandl mag.struc.
	uranium [ppm U]	general:	3 - 5	
	thorium [ppm Th]	general:	16 - 26	
		exceptional:	28 - 40	S-vicinity of Weitra mag.struc.
			28 - 40	E-vicinity of Liebenau mag.struc.
			28 - 40	N-vicinity of Sandl mag.struc.
Fine-grained biotite granite				
	potassium [% K]	general:	3 - 4	
		exceptional:	4 - 6	SW of Lauterbach
			5 - 6	locally on Sandl mag.struc.
			5 - 6	locally near Liebenau mag.struc.
	uranium [ppm U]	general:	4 - 6	
		exceptional:	6 - 10	SW of Lauterbach
			6 - 14	E-slope of Nebelstein Mt.
			6 - 10	Sandl mag.struc.
			6 - 12	E- and S- parts of Liebenau mag.struc.
	thorium [ppm Th]	general:	16 - 26	
		exceptional:	4 - 6	E-slope of Nebelstein Mt.
			28 - 50	Sandl mag.struc.
			26 - 36	S-part of Liebenau mag.struc.

is presented here on the background of geological maps by ERICH et al. (1977), by FUCHS & SCHWAIGHOFER (1977) and by FUCHS & THIELE (1982), because these maps continuously cover the whole area under study.

5.1.3.1. Potassium Distribution
(Text-Fig. 10)

The lowest potassium concentrations from 3 to 4 per cent K were ascertained within the fine-grained type of biotite granite (prevalently the Mauthausen granite) in which, simultaneously, the most monotonous potassium abundances were found. Even in the facies defined by FUCHS & SCHWAIGHOFER (1977), as those carrying the big porphyric grains of K-feldspar, mostly mapped in the large west and northwest vicinity of Liebenau, the monotonous potassium distribution is not changed. Some exceptions of this general scheme were found in the small spot of fine-grained granite near the Czech/Austrian frontier (NW of Nebelstein Mt.) where the local abundances reaching up to 6 per cent K were detected.

The Eisgarn granite building the northern part of the area between the village of Sankt Martin and the southern margin of the Třeboň Basin mostly displays a potassium abundance about 4 per cent K (from 3.5 to 4.5 per cent K). Only at localities where aplite and pegmatite bodies are developed within the Eisgarn granite – near the villages of Wetzles and of Altweitra – potassium abundances reaching up to 6 (6.5) per cent K were found.

The Weinsberg granite is, generally, in its potassium concentrations very similar to the Eisgarn granite mostly showing abundances about 4 (from 3.5 to 4.5) per cent K. This fact is clearly seen in the central part of the area studied, i.e. in the vicinity of the Bärenstein Mt. and the Wachberg Mt. and around the villages of Harmanschlag, Mühlbach and Watzmanns.

On the contrary, the areas of Weinsberg granite situated close to the outcropping magnetic bodies demonstrate rather increased potassium abundances exceeding 5 and locally reaching up to 6.5 per cent K. A distinct example of this fenomenon is the horse-shoe shaped rim of the increased potassium values which can be clearly seen as a parallel belt around the whole Liebenau magnetic structure, i.e. in the large surroundings of Karlstift and in the vicinities of the villages of Brudernhof, Langschlag, Liebenau and Liebenstein. An analogous potassium distribution was also found in the northern vicinity of the Sandl outcropping magnetic body where the potassium abundances also reach to the values of 6.5 per cent K within the Weinsberg granite mapped in the northern contact of the magnetic rocks of the Sandl anomaly. This specific spreading of the potassium insinuates a secondary redistribution of this element outside the bodies enriched in magnetic minerals.

5.1.3.2 Uranium Distribution
(Text-Fig. 11)

The lowest uranium concentrations are, generally, distributed within the Weinsberg granite in which the most frequent values are those from 3 to 5 ppm U. However, in these relatively monotonous values, several small-sized spots with U-concentrations up to 10 ppm U were found especially in the central part of the area between the villages of Grosspertholz and of Bruderndorf. These local uranium anomalies, moreover, coincide with local thorium minima disclosing, thus, a presence of a different rock in the realm of the Weinsberg granite. If the Weinsberg granite is considered to be a representative of the deepest part of the Moldanubian Pluton, then, the small spots rich in uranium and poor in thorium may reveal (and they are interpreted here as) a denudation remnants of a different (younger) type of the pluton.

The fine-grained type of biotite granite mostly mapped in the southern and the western parts of the area under study is predominantely characterized by the U-abundances from 4 to 6 ppm U which means that the boundary between the fine-grained and the Weinsberg types cannot be obvious in the U-concentration contour map in some parts of their contact. Several exceptional partial areas with expresively increased U-concentrations were found within the fine-grained type of biotite granite. The most remarkable of them are the following:

- near-frontier area SW of the village of Lauterbach (6–10 ppm U),
- eastern slope of the Nebelstein Mt. (6–14 ppm U),
- the area of the Sandl magnetic anomaly (6–10 ppm U),
- the eastern and the southern parts of the Liebenau magnetic anomaly (6–12 ppm U).

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Text-Fig. 10.
Area A: Potassium concentration contour map.

With the exception of the first mentioned partial area SW of Lauterbach, all three other areas listed above coincide with localities in which anomalous magnetic susceptibilities were detected.

Very high concentrations of uranium from 6 to 12 (14) ppm U were found within the whole territory in which the two-mica granite was mapped, i.e. in the northern part of the area under study.

The highest uranium concentrations were detected in the northern margin of the area A just on the A/CZ frontier, approx. 2 km ENE of the village of Pyhrabruck in the NW vicinity of the Lagerberg Mt. (Holý vrch Mt. in the Czech maps). The uranium concentrations from 20 to 38 ppm U were found there in the granite rich in muscovite especially on the Czech side of the frontier line. Extremely low thorium concentrations between 1.5 and 4 ppm Th follow these high uranium abundances. The muscovite granite occuring here is considerably similar in its gamma-ray spectrometric features to the Homolka granite outcropping in the NW corner of the area B.

5.1.3.3. Thorium Distribution
(Text-Fig. 12)

According to the authors' long-time experience the thorium distribution usually reflects the rock-type petrography very well; but this is not quite true in the Moldanubian Pluton.

In the granite of the Eisgarn type which occupies almost the whole northern part of the area A three “thorium subtypes” can be distinguished:

- The first subtype – very rich in thorium – displaying concentrations from 26 to 40 (46) ppm Th was detected in the southern partial area between the villages of Sankt Martin, Wultschau and the town of Weitra, and around the villages of Wetzles and of Altweitra.
- The second subtype with medium thorium concentrations from 16 to 24 ppm Th is wide-spread in the partial area limited by the line connecting the Mandelstein Mt. and the inhabited places of Heinrichs bei Weitra, Eichberg and Weitra.
- The third subtype with very low concentrations from 4 to 14 ppm Th covers the northern part of the area under study situated near the southern margin of the Třeboň Basin.

The Weinsberg granite which prevails in the central part of the area A is, generally, typical with medium thorium concentrations ranging from 16 to 26 ppm Th. However, there are also several exceptions within the area built by this type of granite. In the southern vicinity of the Weitra magnetic anomaly the thorium concentrations from 28 to 36 (40) ppm Th were found in the surroundings of the villages of Grosspertholz, Mühlbach and Oberwindhag. Moreover, in the

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Text-Fig. 11.
Area A: Uranium concentration contour map.

eastern vicinity of the Liebenau magnetic structure as well as in the northern neighbourhood of the Sandl magnetic anomaly the Th-concentrations from 28 to 40 ppm Th were also detected within the Weinsberg granite.

The fine-grained type of biotite granite was also found to be inhomogenous in the thorium concentration. The expressive minima about 4–6 ppm Th were found in the eastern slopes of the Nebelstein Mt. (where the Th-low is accompanied by very high U-concentrations) and in the vicinity of the Viehberg Mt. (with rather normal U-concentrations). Remarkably high thorium abundances were detected in magnetically anomalous parts of biotite granite (the Karlstift granite), i.e. in its southern part between the villages of Liebenstein and of Wienau (from 24 to 36 ppm Th) and in the Sandl magnetic structure where the Th-concentrations were increased up to 50 ppm Th. The remaining part of the fine-grained granite is typical with abundances of 16–26 ppm Th i.e. similarly as it was stated in the Weinsberg granite.

The knowledge mentioned above suggests the idea that even the distribution of such relatively stable element as the thorium is could be secondarily removed during some mineralization processes.

The distribution of the radioactive elements in the area A explained above can be summarized in Tab. 1.

The Karlstift granite deliminated during the recent PŘICHYSTAL's mapping as a new separate type of granite (the outcrops of which almost completely coincide with the anomalous areas in the magnetic susceptibility contours maps – Text-Figs. 4 and 16) has no specific and uniform contents of radioactive elements. The alteration origin of this granite is responsible for the variable distribution of these elements.

5.1.3.4. Derived Ratio Parameters

The radiogeochemical features presented in the contour maps of potassium, uranium and thorium concentrations are emphasized and strengthened in the three kinds of the ratio maps enclosed.

The thorium/potassium ratio map (Text-Fig. 13) perfectly shows, at least,

1) outcropping anomalous rocks of the Liebenau and the Sandl magnetic structures rich in thorium,
2) specific areas of the fine-grained biotite granite extremely poor in thorium in the E-slope of the Nebelstein Mt. and around the Viehberg Mt. and
3) the three radiogeochemical subtypes of the Eisgarn granite, as well.

The uranium/thorium ratio map (Text-Fig. 14) clearly but in the opposite positive way emphasizes the items (2) and (3) mentioned in the previous paragraph and, moreover, accents the interpreted "rem-

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Text-Fig. 12.
Area A: Thorium concentration contour map.

nants of different rock type" in the realm of the Weinsberg granite in the central part of the area (Grosspertholz – Bruderndorf).

Another view on the uranium rich rocks is presented in the uranium/potassium ratio map (Text-Fig. 15).

5.2. Area B (Schrems – Litschau – Kautzen)

As some of the most interesting objects (Reingers magnetic anomaly, Homolka granite stock and others) are situated just at the A/CZ frontier the authors decided to present the maps of the area B (Text-Figs. 16, 17 and 19–24) including the needful Czech territories which were studied by similar methods like the Schrems – Litschau – Kautzen area itself. The informative value of the maps was increased substantially in this way. The areal interpretation was carried out on the base of the geological map by WALDMANN (1950) of the scale of 1 : 75.000 which is the only map covering the whole area B.

5.2.1. Magnetic Susceptibility (Text-Fig. 16)

The overwhelming majority of the area B being built by the Eisgarn granite demonstrates monotonous magnetic susceptibility data. The lowest values of about 0.05×10^{-3} (SI) were found in the SW and W margin of the Pluton around the villages of Neunagelberg, Altnagelberg, Steinbach and E of the village of Rapšach (CZ). The remaining majority of the Eisgarn granite territory is typical with low susceptibilities from 0.06 to 0.08×10^{-3} (SI) – see the contour line of 0.07×10^{-3} (SI) in Text-Fig. 16. Only three small different places were found in the northern part of the Eisgarn granite realm i.e.

1) N and NNE of the town of Litschau,
2) between the village of Haughschlag and the customs in Grametten and
3) E of the Homolka Hill (CZ) where susceptibilities reach to 0.12 or 0.15×10^{-3} (SI).

A completely different pattern of variegated susceptibility data generally exceeding 0.1×10^{-3} (SI) was found in the SE and E parts of the area B. The boundary between the monotonous and the variegated areas follows the line connecting the villages Köttinghörmanns – Amaliendorf – Eggern (East). To the SW of Kautzen in the vicinity of the village of Weissenbach there is a body of Weinsberg granite which presents susceptibilities from 0.12 to 0.25×10^{-3} (SI). Among the villages of Seyfrieds (SE), Haslau and Artolz the values exceeding 0.2×10^{-3} (SI) correspond to the Wolfsegg granite outcropping there. The susceptibility anomalies reaching to 0.3×10^{-3} (SI) measured in the vicinity of the villages of Gebharts and of Seyfrieds coincide with the occurrences of the diorite bodies (compare to WALDMANN, 1950).

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Text-Fig. 13.
Area A: Thorium/potassium ratio.

Intermediate to basic dyke rocks create remarkable susceptibility anomalies both in the monotonous and in the variegated susceptibility patterns (marked as “dy” in Text-Fig. 16). They are mostly situated in the outside rim of the Reingers magnetic structure which fills the NE part of the area B. These anomalous dyke-rocks with susceptibility values from 0.5 to 3×10^{-3} (SI) were found to the W of the village of Gross Radischen, between Eggern and Reinberg-Dobersberg, SW of Weissenbach and especially N of Brunn where several swarms of dykes demonstrating the values even from 6 to 17×10^{-3} (SI) were identified. A small anomalous dyke rock occurrence was also found in the northern vicinity of the village of Rohrbach near the eastern margin of the area B.

The most striking susceptibilities were found in the E and SE vicinity of the village of Hirschenschlag i.e. in the direction to the Kozí hora (CZ) ore occurrence. The very high values from 1 to 10 (exceptionally to 50)$\times10^{-3}$ (SI) were disclosed there (anomaly “a” in Text-Fig. 16). These anomalous values reveal the secondary alteration processes during which an enrichment of rocks in magnetite took place.

Finally, the magnetic susceptibility pattern of the Schrems – Litschau – Kautzen area is partly framed with the response of several remnants of the metamorphic mantle in which medium susceptibility data from 0.15 to 0.7×10^{-3} (SI) were found. These remnant occurrences were detected both in the western margin of the Pluton between the villages of Chlum u Třeboně and of Rapšach, as well as along the eastern margin near the villages of Tiefenbach, SE of Rohrbach and SW of the town of Schrems (they are marked as “cr” in Text-Fig. 16).

5.2.2. Geomagnetic Field Anomalies
(Text-Fig. 17)

Three different patterns of delta T magnetic anomalies can be distinguished in Text-Fig. 17 presenting the magnetic anomalies of the area B. They are:

1) monotonous field in the W and NW,
2) varied field in the SE and
3) extensive Reingers anomaly filling the NE part of the area under study.

The quiet and monotonous field with negative anomalies ranging from –10 to –50 nT belongs to the area almost completely built by the Eisgarn granite. This type of field reveals that no magnetic bodies can be expected inside or beneath the plutonic rocks in this “Litschau part” of the Moldanubian Pluton.

The SE part of the area B displays, on the contrary, a more varied and mostly mosaic-shaped magnetic field. The boundary line between the monotonous and the varied fields can be drawn in the direction SW -NE along the line connecting the resident

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Text-Fig. 14.
Area A: Uranium/thorium ratio.

places of Gmünd – Langegg – Heidenreichstein – Dietweis – eastern vicinity of Eggern. Some short-wave anomalies with amplitudes reaching up to 40 nT which were found in the northern surroundings of the village of Rohrbach and to the ESE of Eggern are connected with swarms of magnetic dyke rocks (marked as “dy” in Text-Fig. 17). Similar small anomalies detected in the vicinity of the villages of Seyfrieds, Artolz, Haslau and Gebharts pertain partly to small diorite and gabbro-diorite bodies (signed as “di“), partly to some isolated remnants of metamorphic rocks (compare with Waldmann, 1950).

The positive magnetic field shown in the SE margin of the area reveals the proximity of the metamorphic mantle of the pluton. Several small-sized anomalies were detected there identifying the varied moldanubian paragneiss series. They are marked as “cr” in Text-Fig. 17. The most striking of them is the anomaly with the amplitude of 200 nT found in the SSE vicinity of the village of Rohrbach which is caused by amphibolites and amphibolite gneisses displaying a susceptibility of 0.7×10^{-3} (SI). Similar anomalies but of lower amplitudes connected with the mantle of metamorphites were found near the village of Heinreichs (SE corner of the area), WSW of the town of Schrems and also in the NW margin of the area – to the NE of the village of Staňkov (CZ).

The most significant object disclosed by the ground magnetometry is the Reingers circle-shaped anomaly filling the substantial NE part of the area B (anomaly R in Text-Fig. 17). It arises from the minima of about –30 (–40) nT in the S and in the W and even from –70 nT minima developed in the N on the Czech territory. The size of this anomaly is also remarkable – exceeding 15 km in its diamater. The eastern margin of the anomaly is not defined simply because of complications caused by two main reasons:

1) the large number of local anomalies evoked both by metamorphites of the Monotonous Group and by magnetic dyke rocks and
2) due to the tectonic influence of the expressive Vitis – Přibyslav fault system passing there.

Taking into account the most frequent structural forms developed in granite masses the source body of the Reingers anomaly was interpreted applying the model of a vault-shaped dome structure pertaining to a light and acid granite rocks. The acid granite milieu is supposed in the space in which the source body has to be developed because the detail gravity map does not show any response of a heavy basic rocks. As our collection of the susceptibility data gathered from the Hirschenschlag locality – which is in a good harmony with the results by Chlupáčová (1985) from the Kozí hora (CZ) locali-

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Text-Fig. 15.
Area A: Uranium/potassium ratio.

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Text-Fig. 16.
Area B: Magnetic susceptibility contour map.

ty – fill the broad interval from 0.5 to 50×10^{-3} (SI) the susceptibility values about 20×10^{-3} (SI) used for our modelling of the Reingers anomaly source body cannot be regarded as merely hypothetical.

The results of magnetic modelling along the 18 km long interpretation profile (shown as "R-P" in Text-Fig. 17) are presented in Text-Fig. 18. The source body is estimated to be about 14 km large in N–S direction and almost 13 km long in W–E direction. Its thickness can reach some 1.5 km in the central part of the body. The top part of the source vault-structure is supposed to be in a depth from 300 to 500 m below the ground dipping to a depth of about 1.6 km in the S and about 3 km in the N. The qualitative evaluation of the anomalous field enabled to deliminate the uppermost block of the source among the villages of Hirschenschlag, Reingers and the hill of Větrov (CZ).

Besides the outcropping magnetic dyke rocks mentioned in the previous paragraph dealing with the magnetic susceptibility some buried magnetic dyke rocks can be predicted – on the base of the magnetic anomalies – between the villages of Reinberg-Dobersberg and Engelbrechts and in the surroundings of the village of Gross Taxen on the S and SE margin of the Reingers magnetic anomaly (marked as "d" in Text-Fig. 17).

5.2.3. Distribution of Natural Radioactive Elements

If the radiogeochemical features of the Freistadt – Gmünd area A are compared with these of the Schrems – Litschau – Kautzen area B then the general statistics demonstrates that the area B in which the Eisgarn granite prevails is poorer both in potassium and thorium concentrations and, on the contrary, more rich in uranium abundance. This general trend is evident from Table 2.

Table 2.
General statistics of gamma-ray spectrometry data of the two comprehensive areas of the Moldanubian Pluton (mean values ± standard deviations).

Element concentration and ratio-value	Freistadt-Gmünd area A	Schrems-Litschau-Kautzen area B
potassium	4.01 ± .86	3.62 ± .95
uranium	4.77 ± 2.03	6.25 ± 2.69
thorium	22.91 ± 8.08	16.65 ± 8.57
Th/K	5.77 ± 1.82	4.65 ± 2.2
U/Th	.25 ± .3	.6 ± 1.1
U/K	1.22 ± .55	1.79 ± 1.04
number of points (incl.the Czech data)	5 201	5 230

Note: Both areas are refered to the unified Czech and Austrian calibration bases (unification in 1990)

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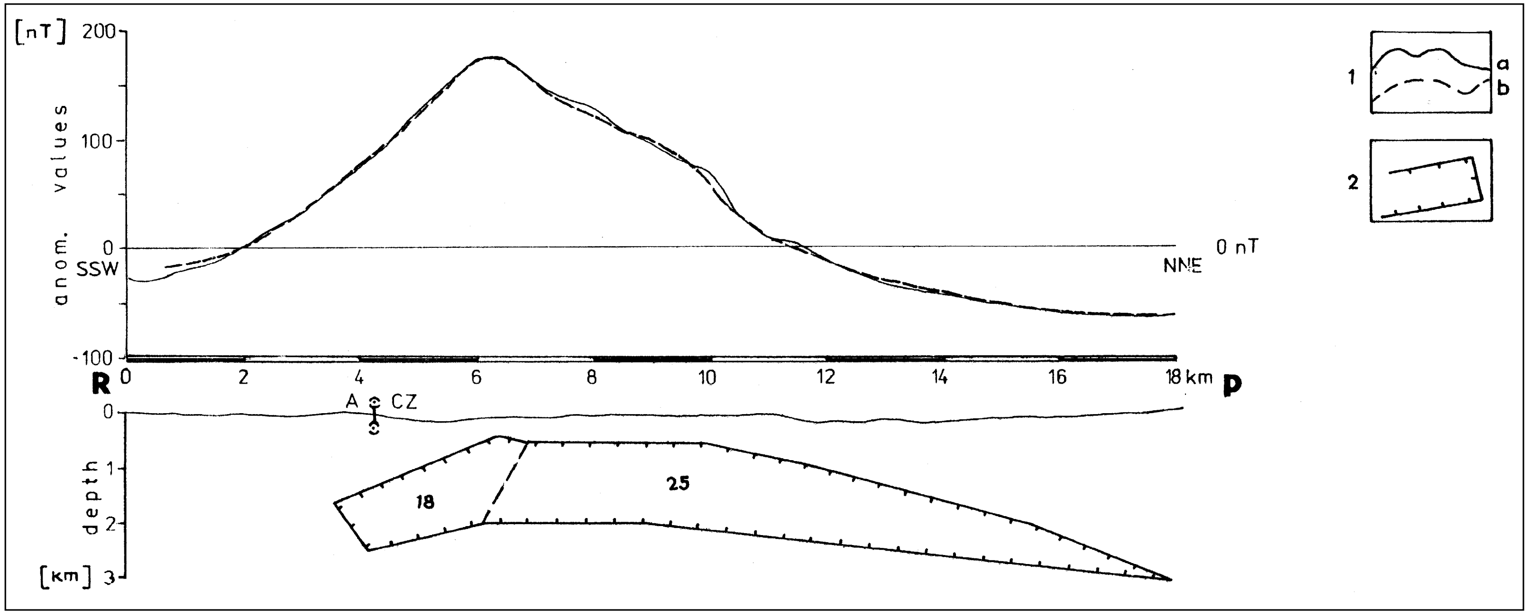
Text-Fig. 17. ▲△▲
Area B: Magnetic anomalies ΔT.



Text-Fig. 18 ◀◁◀
Reingers magnetic anomaly; interpretation profile R – P.
1a = measured ground magnetic data.
The meaning of the other symbols is identical with those of Text-Fig. 7.

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Text-Fig. 19.
Area B: Potassium concentration contour map.

5.2.3.1. Potassium Distribution
(Text-Fig. 19)

The enclosed map of the potassium concentration in the area B shows a mosaic-shaped pattern of this element distribution.

The largest spots of high concentrations reaching from 4.5 to 6.5 per cent K seem to be situated in the outside margin of the Reingers magnetic structure. They are uncontinuously developed between the villages of Illmanns and Groß Radischen (W), then between Eggern and Kautzen (S) and between Reinolz and Staré Město pod Landštejnem on the eastern margin of the Reingers structure.

Other almost continuously developed potassium concentrations exceeding 4.5 per cent K were found in the NW corner of the Austrian territory between the villages of Schlag and of Haugschlag (NW of Litschau) and in the surroundings of the village of Gopprechts (in the central part of the area B).

In the SE part of the area B high potassium concentrations occur only in very small spots.

5.2.3.2. Uranium Distribution
(Text-Fig. 20)

A distinct areal trend in the direction NW–SE can be watched in the map of uranium concentration. The W and NW parts in which the Eisgarn granite prevails are very rich in uranium while the E part of the area B is relatively poor in this element. High uranium concentrations reaching exceptionally up to 27 ppm U were found on both the Czech and Austrian parts within the western half of the Pluton from the customs of Neunagelberg on the S to the village of Haugschlag on the N.

In this western uranium rich half of the pluton some 60 km^2 large Litschau's subarea can be defined in which concentrations from 8 to 16 ppm U are almost continuously detectable.

The extreme places with uranium concentrations systematically exceeding 10 ppm U were found around the Homolka Hill (CZ) in the NW corner of the area B and approx. 5–8 km to the SW of Litschau on both sides of the state frontier between the village of Rapšach (CZ) and the hill of Hoher Berg (A). Besides the anomalous uranium abundances these two localities are conspiciously remarkable with extremely low concentrations of thorium.

The uranium concentrations successively decrease from the W and NW parts of the area to the east. Hence, in its central part the concentrations from 5 to 7 ppm U are quite common while in the eastern margin of the area B such low values as 3 and 4 ppm U dominate.

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Text-Fig. 20.
Area B: Uranium concentration contour map.

5.2.3.3. Thorium Distribution
(Text-Fig. 21)

The total span of thorium concentration in the area B is very broad ranging from 2 to 74 ppm Th. This mentioned span is 25 ppm broader than that of the area A in which the highest thorium concentrations do not exceed 50 ppm Th. A reverse areal trend can be observed in the map of thorium concentration – as compared to the uranium distribution. The NW part of the area B is relatively poor in thorium while the highest thorium abundances are situated in the SE.

Medium thorium concentrations ranging from 14 to 22 ppm Th (with only locally increased ones to 30 ppm Th) are the common values in the NW part of Text-Fig. 21. The large minima near the town of Litschau (6–12 ppm Th) and between the villages of Leopoldsdorf – Groß Radischen – Dietweis (8–12 ppm Th) caused mostly by a fine-grained variety of the Eisgarn granite and, especially, the deep minima ranging from 2 to 6 ppm Th between Rapšach (CZ) and the Hoher Berg Hill (A) and around the Homolka Hill (CZ) emphasize the shortage of thorium in this part of the Pluton. The only exception consisting in the continuously developed spot of the thorium concentrations about 30 ppm Th was found near the villages of Rottal and of Haugschlag in the NW corner of the area which belongs to the Číměř subtype of the Eisgarn granite.

The highest abundances of thorium are concentrated in the SE part of the area B in the surroundings of the town of Schrems, around the hill of Hartberg and between the villages of Gebharts – Haslau – Seyfrieds – Artolz where concentrations from 30 to 70 ppm Th were detected. The highest values reaching up to 74 ppm Th were found to the E of the Hartberg Hill, the largest continuously developed area with abundances exceeding 40 ppm Th is situated between the villages of Haslau and of Artolz which corresponds to the Wolfsegg granite (Waldmann, 1950). To the N of the village of Rohrbach (in the vicinities of the villages of Weissenbach, Engelbrechts and Kautzen) thorium concentrations exceeding 24 ppm Th are mostly connected with the Weinsberg granite.

Low thorium concentrations ranging from 8 to 12 ppm Th found along the eastern margin of the area B belong to the metamorphites playing the role of the mantle of the Pluton.

5.2.3.4. Derived Ratio-Parameters
(Text-Figs. 22, 23, 24)

The specific features of the area B described in the previous paragraphs concerning the potassium, uranium and

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Text-Fig. 21.
Area B: Thorium concentration contour map.

thorium distributions are distinctly illustrated in the maps presenting the ratio-values of Th/K (Text-Fig. 22), of U/Th (Text-Fig. 23) and of U/K (Text-Fig. 24).

All three maps of this ratio-parameters perfectly deliminate the geochemically exceptional stock of the medium to coarse grained young granite of Homolka which is, besides the uranium, also rich in phosphorus and rare metals (Breiter & Scharbert, 1995; Breiter & Gnojek, 1996). As the radiogeochemical features of the surroundings of the Hoher Berg Hill (SW of Litschau) and NE of Rapšach are very similar to those of the Homolka Hill some relative rocks could be expected there, too.

The bodies of the fine-grained variety of the Eisgarn granite with relatively low thorium concentrations are clearly emphasized in the ratio-maps of Th/K and of U/Th. The general feature of the area consisting in the great abundance of uranium followed with the lack of thorium in the NW and, on the contrary, the reverse relation of these two radioactive elements in the SE are also distinctly presented in the ratio-maps. Certainly, the Wolfsegg granite and allied rocks rich in thorium are deliminated well especially in the Th/K and the U/Th ratio-maps (Text-Figs. 22 and 23).

An implication of some redistribution of potassium outside the Reingers magnetic structure followed also with a removal of thorium is outlined namely in the Th/K ratio-map.

6. Results of Geological Mapping

6.1. Mapped Parts of the Area A (Liebenau – Karlstift, SW Surroundings of Weitra)

The most important geologic phenomenon connecting both mapped sectors in the area Weitra – Liebenau is a sinistral (left lateral) strike-slip fault system running from the western surroundings of the village of Reinprechts in the north via Harmanschlag, Angelbach and Karlstift up to the southern limitation of the studied area. We suggest to call it the Karlstift strike-slip fault. Similar sinistral strike-slip faults with NNE–SSW up to NE–SW direction (i.e. the Rodl, Vitis and Diendorf ones) are typical for the southern part of the Bohemian Massif. They are interpreted as shear zones of late Variscan age with partial Alpine rejuvenation. Brittle deformation within the zones likely represents foreland deformation during the Alpine orogeny (Wallbrecher et al., 1991). According to these authors, the $^{40}Ar/^{39}Ar$ dating of various muscovite size fractions formed during associated mylonitization

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Text-Fig. 22.
Area B: Thorium/potassium ratio.

yielded ages of 294.5 ± 0.8 up to 260.3 ± 1.1 Ma. The Rb-Sr dating of muscovites showed an age of approx. 190 Ma what is interpreted as an influence of the Alpine rejuvenation.

6.1.1. Quartz dykes

The Karlstift strike-slip fault is accompanied by intensive mylonitization and huge quartz dykes. The biggest one lies in the western part of the village of the same name and has following dimensions: length – 300 m, width – 15 m and height – 8 m. The dyke contains two generations of quartz. The prevalent older brownish quartz is cut by younger white quartz veinlets and moreover cubes of limonitized pyrite are to be found around enclosures of mylonite in quartz. The quartz dykes close up the Karlstift strike-slip fault and they have the same course (about 20°). The veinlets of younger white quartz follow fracturing 88°–98°/80°–85°.

6.1.2. Mylonites, Ultramylonites and Mylonitized Granites

They display usually a green shadow of their colour what is caused by chloritization of biotite and by a net of quartz veinlets. Feldspar phenocrysts are intensively broken up and, generally, the mylonitized rocks have a much finer grain size (up to aphanitic fabric) than their precursors. In thin sections, quartz has a very intensive undulose extinction and veinlets with calcite and epidote penetrate plagioclases and microclines. Magnetic susceptibility usually gently falls down ($0.05–0.08 \times 10^{-3}$ SI) comparing the typical non-mylonitized Weinsberg granite.

6.1.3. The Weinsberg Granite

It forms the prevalent rock type besides the mentioned magnetic anomalies. It is a significantly porphyritic coarse-grained granite with colour between dark grey up to light grey in dependence on content of biotite and K-feldspar phenocrysts. The phenocrysts can reach dimensions from 2×1 cm up to 10×3 cm and their number changes from 6–15 crystals/dm^2, in some places their nearly parallel arrangement is visible (e.g. the top of Nebelstein, see Text-Fig. 25). Mineral particles of groundmass have a diameter of over 4 mm. The mineral composition of the Weinsberg granite has published KURAT (1965): microcline 35–37 %, plagioclase 33–35 %, quartz 19–22 % and biotite 9–13 %. Apatite, zircon and magnetite form accessories. Xenoliths of biotite gneisses (up to 10–15 cm) have been found in some places. According to the field observations, the Weinsberg granite had to be the oldest member of the magmatic sequence

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Text-Fig. 23.
Area B: Uranium/Thorium ratio.

in the studied area because it is cut by younger dykes and bodies of two-mica granites and there have been found its xenolithes in the fine-grained biotite granite (e.g. documentation points NE of Monegg – Steinmühle, W of Liebenau, Text-Fig. 26). The Rb-Sr age published by SCHARBERT (1987) is 349±4 Ma, but new data based on U/Pb isotope investigation of monazite, xenotime and zirkone (VON QUADT & FINGER, 1991) show an age about 20 Ma younger (318±4 Ma, 314±4 Ma and 317±19 Ma).

Magnetic susceptibility of the Weinsberg granite usually ranges between 0.12–0.22×10^{-3} (SI) as it follows from measurements at a few hundred documentation points. Lower data than 0.1×10^{-3} (SI) signalize cataclasis or mylonitization accompanied by quartz veinlets. Higher values (up to 0.3×10^{-3} SI) are usually connected with anomalous content of biotite or occurrences of gneiss xenoliths, for example gneiss xenoliths in the Weinsberg granite near Mitterschlag yield a magnetic susceptibility of 0.24–0.34×10^{-3} (SI). In the whole area there was found only one exception where the Weinsberg granite gave a surprising magnetic susceptibility of 7–11×10^{-3} (SI). The documentation point L-152 lies 500 m WNW of Gotthardl and this occurrence can be probably explained as a denudation relic that has been exceptionaly striked by secondary magnetitization as well. The chemical composition of the Weinsberg granite from the area A is shown in Table 3.

6.1.4. The Mauthausen Granite

Another biotite granite in the studied area represents the aphyric or sporadically porphyritic fine- to medium-grained biotite granite also with a standard magnetic susceptibility ranging from 0.08 to 0.14×10^{-3} (SI). This type has been usually compared with the Mauthausen granite (GÖD & KOLLER, 1987; SCHARBERT, 1987) because of the same qualities, i.e. finer-grained fabric and absence or only sporadical occurrence of feldspar phenocrysts. Mica is represented by biotite which has many pleochroitic halos around enclosed small zircons (Text-Fig. 27), apatite and opaque minerals form also inclusions. The biotite seems to be less chloritized comparing the Karlstift granite. Small amounts of muscovite can occur. Quartz and K-feldspars are allotriomorphic, plagioclasses have hypidiomorhic shapes. As its age is concerned, at some outcrops we found geological evidence that the Mauthausen granite is younger than the Weinsberg granite: dykes of the Mauthausen granite cutting the Weinsberg granite, xenoliths and feldspar xenocrys-

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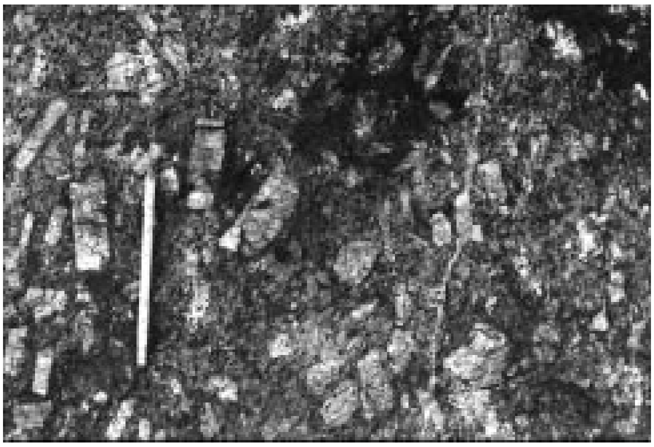
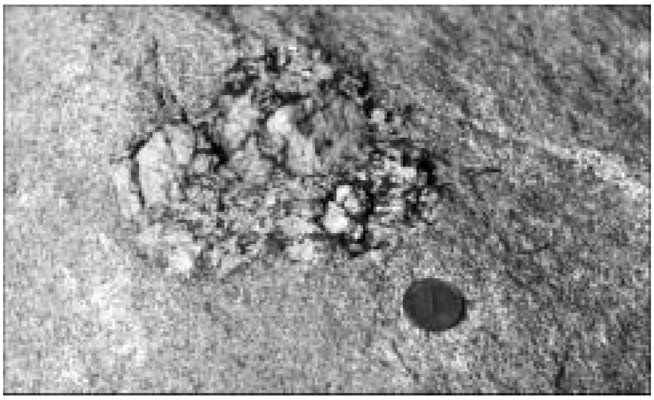
Text-Fig. 24. ▲△▲
Area B: Uranium/Potassium ratio.

d.p.	SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	MgO	CaO	Na_2O	K_2O	P_2O_5	S	F^-	H_2O^+	H_2O^-	CO_2	total
G 223/gab	48,83	0,47	15,87	1,30	6,86	0,09	12,99	8,14	1,63	0,47	0,34	0,12	0,03	1,75	0,33	0,17	99,39
G 170/W	65,98	0,86	16,04	1,16	2,86	0,04	1,04	1,57	2,91	5,91	0,31	0,03	0,09	0,65	0,15	0,10	99,70
L 179b/W	70,18	0,42	14,83	0,29	2,22	0,04	0,74	1,54	2,85	5,35	0,25	0,00	nd.	0,58	0,10	0,25	99,64
L 171/xt	40,51	1,65	24,75	4,06	11,40	0,14	3,86	0,64	0,39	7,80	0,06	0,00	nd.	4,03	0,39	tr.	99,68
L 192/xt	47,11	0,99	16,08	8,09	16,10	0,74	3,50	1,18	0,67	3,26	0,36	0,00	nd.	1,70	0,41	0,20	100,39
L 179/M	64,76	0,68	16,27	0,68	3,34	0,08	1,71	3,29	3,48	3,88	0,48	tr.	nd.	0,44	0,12	0,53	99,74
G 380/M	69,66	0,56	15,09	1,04	1,86	0,04	0,93	1,52	3,36	4,31	0,28	0,10	0,10	0,52	0,24	0,10	99,71
G 55/M	70,64	0,48	14,58	1,22	1,29	0,04	0,68	1,31	3,21	4,33	0,22	0,04	0,07	0,96	0,38	0,22	99,67
L 153/K	67,08	0,55	15,23	1,42	2,31	0,07	1,38	2,91	3,36	4,47	0,28	0,00	nd.	0,58	0,12	0,20	99,96
G 73/K	67,20	0,60	15,26	1,53	1,86	0,05	1,13	1,96	3,34	4,38	0,33	0,02	0,11	1,04	0,28	0,24	99,33
L 114/K	59,01	0,87	15,92	2,67	3,98	0,14	2,55	5,01	3,16	4,18	1,05	tr.	nd.	0,73	0,19	0,39	99,85
G 145/K	72,46	0,44	12,66	0,75	2,43	0,04	0,58	0,35	2,04	6,14	0,20	0,01	0,06	0,75	0,37	0,09	99,37
L 80/xt	67,31	0,64	15,62	1,17	2,32	0,06	1,28	3,17	3,33	3,87	0,23	0,00	nd.	0,55	0,18	0,35	100,08
G 482/bmg	72,94	0,32	14,15	1,17	0,43	0,02	0,33	0,42	2,73	5,35	0,28	0,02	0,06	0,76	0,46	0,12	95,56
L 239/bmg	73,82	0,14	13,80	0,92	0,25	0,01	0,19	0,79	2,94	5,50	0,26	0,00	nd.	0,75	0,16	0,31	99,84
G 131/bmg	71,43	0,52	14,12	1,07	1,58	0,04	0,72	0,84	2,78	4,84	0,34	0,02	0,11	0,57	0,27	0,37	99,62
G 323/bmg	72,90	0,30	14,17	1,18	0,57	0,02	0,40	0,40	2,22	6,44	0,35	0,01	0,06	0,53	0,43	0,04	100,02
L 204/dp	61,22	0,76	17,22	2,31	2,90	0,11	2,11	5,24	4,24	1,28	0,32	0,00	nd.	1,48	0,25	0,24	99,68
L 143/gdp	66,73	0,48	16,48	1,21	1,99	0,05	1,32	2,72	3,59	2,28	0,19	0,00	nd.	1,70	0,54	0,38	99,66

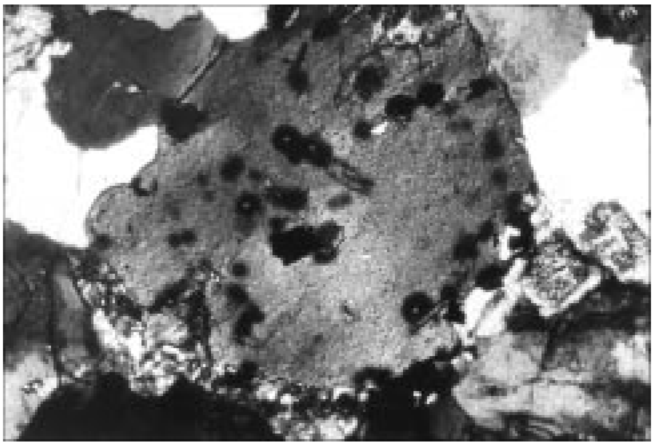
Table 3. ◀◁◀
Major element analyses of igneous rocks and their xenoliths from the Freistadt – Gmünd area.
List of samples see Appendix.
Samples indicated by letter G were analysed in the chemical laboratory of Unigeo Brno (analysts: Edita STUCHLÍKOVÁ et al., 1992).
Analyses with letter L come fom the chemical laboratory at the Dept. of Mineralogy, Petrology and Geochemistry, Faculty of Science, Masaryk University, Brno (analyst: Pavel KADLEC, 1993).
d.p. = documentation point; tr. = traces; n.d. = not determined.



Text-Fig. 25.
Weinsberg granite with subparallel pattern of feldspar phenocrysts.
Top of Nebelstein Mt.



Text-Fig. 26.
Xenoliths of Weinsberg granite in fine-grained biotite (Mauthausen) granite.
d.p. L 269; 300 m NE of Monegg – Steinmühle.



Text-Fig. 27.
Mauthausen granite.
Biotite with many pleochroic halos around small zircons.
d.p. G 55; magnification ×43; ordinary light.

tals of the Weinsberg granite in the Mauthausen granite (Text-Fig. 26).

The most interesting ascertainment follows from geological mapping of the area between Hintereibenberg and Vordereibenberg (WNW of Liebenstein) where is horizontal finger-like alternation of the Mauthausen granite with the Weinsberg granite.

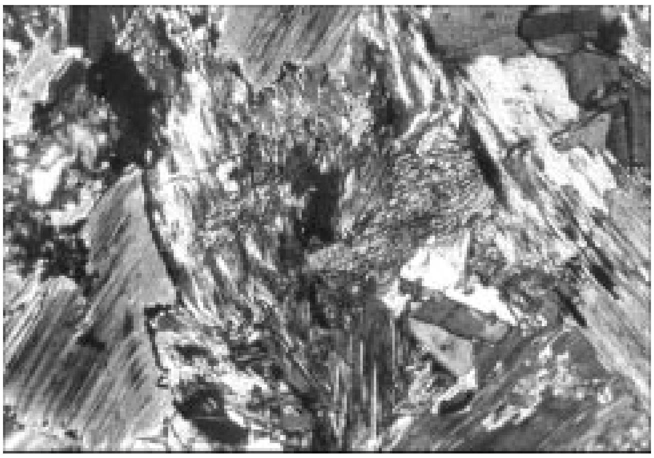
6.1.5. The Karlstift Granite

It is the third type of biotite granite in the investigated area. KLOB (1970) used this term for the first time to describe a porphyritic biotite granite forming an independent geological body in the Sandl – Karlstift – Liebenau area. Later geological survey by FUCHS & SCHWAIGHOFER (1977) showed that only a part of the body is porphyritic, i.e. the part near the contact with the Weinsberg granite. Our new mapping confirmed this fact. In addition to it, only this prevalently porphyritic part has simultaneously an increased magnetic susceptibility (0.5–28$\times 10^{-3}$ SI). It can be concluded that this increased susceptibility is a typical feature of the Karlstift granite and this one has to be defined as aporphyritic medium-grained biotite granite with an anomalous magnetic susceptibility (higher than 0.5$\times 10^{-3}$ SI). The new mapping also revealed a body of Karlstift granite in the area of the Weitra magnetic anomaly, just in the centre of the anomaly between the villages of St. Martin and of St. Wolfgang.

6.1.6. Gabbro

Two large bodies and five small occurrences of diorites were described by FUCHS & SCHWAIGHOFER (1977) at the northern margin of the area investigated. During our new mapping it was possible to verify only the large bodies. The first one lies between the villages of Wultschau and Harbach, the second one is to the northwest of the village of Reinprechts. The both “diorite” bodies are situated at the Karlstift shear zone and they are also intensively mylonitized in some of their parts. The rocks are significantly different from the granitic rocks within the whole mapped area. They have brownish dark-grey colour, massive structure and medium- to coarse-grained texture with no feldspar phenocrysts. Microscopic study of thin sections showes textures which could be partly compared with the ophitic one: lath-shaped plagioclases (57–79 % An, labradorite–bytownite) are surrounded by brown mica (Mg-rich biotite with 16,6–20,5 % MgO), pyroxene, fibrous uralite and small relics of olivine (Text-Fig. 28).

From the chemical point of view (sample G 223), the rock has a very high content of MgO (12,99 %). Comparing the average diorite (NOCKOLD, 1954; MUELLER & SAXENA, 1977), the content of MgO is two times higher than that of the average diorite (6,12 %). Calculations of CIPW normative



Text-Fig. 28.
Gabbro (Mg rich biotite; amphibole; uralite; plagioclase).
d.p. G 236; boulders at the W margin of the gabbro body of Reinprechts.
Magnification ×43; crossed polars.

Table 4.
Major element analyses of igneous rocks from the Litschau – Kautzen area (for list of samples see Appendix).
Samples indicated by letters Ka were analysed in the chemical laboratory of Unigeo Brno (analysts: Edita STUCHLÍKOVÁ et al., 1992).
Analyses with letters LT come fom the chemical laboratory at the Dept. of Mineralogy, Petrology and Geochemistry, Faculty of Science, Masaryk University, Brno (analyst: Pavel KADLEC, 1993).
Abbreviations see Table 3.

d.p. %	SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	MgO	CaO	Na_2O	K_2O	P_2O_5	S cel.	F^-	H_2O^+	H_2O^-	CO_2	total
Ka 101/W	63,35	0,85	17,41	1,44	3,00	0,05	1,22	2,85	3,26	5,28	0,30	0,01	0,12	0,65	0,25	0,12	100,16
Ka 13/Em	74,23	0,18	14,03	0,62	0,72	0,04	0,28	0,76	3,23	4,69	0,21	0,02	0,09	0,55	0,23	0,10	99,98
Ka 240/Em	73,57	0,16	13,96	0,87	0,43	0,02	0,35	0,70	2,85	4,89	0,25	0,01	0,06	0,96	0,40	0,20	99,68
Ka 69/Č	72,76	0,23	14,38	1,09	0,43	0,02	0,45	0,69	2,98	5,08	0,29	0,01	0,08	0,84	0,38	0,15	99,86
Ka 129/L	73,06	0,20	14,76	0,65	0,72	0,02	0,33	0,57	2,72	5,72	0,22	0,01	0,10	0,71	0,15	0,05	99,99
LT 385/L	73,33	0,23	13,82	0,37	1,35	0,02	0,34	0,74	2,88	5,57	0,24	tr.	nd.	0,27	0,13	0,53	99,82
Ka 334/ag	74,63	0,15	12,49	1,32	2,57	0,10	0,33	0,19	0,15	5,11	0,27	0,01	0,11	1,62	0,38	0,22	99,65
LT 369/ag	74,72	0,14	14,50	0,41	0,12	tr.	0,25	0,21	2,38	5,68	0,06	0,00	nd.	0,94	0,37	0,43	100,21
Ka 156/gre	77,31	0,15	12,29	2,76	0,07	0,03	0,40	0,39	0,35	3,75	0,33	0,01	0,40	1,05	0,29	0,10	99,68
LT 31/R	74,19	0,07	14,47	0,37	0,61	0,04	0,06	0,66	3,88	4,02	0,32	0,00	nd.	0,56	0,10	0,46	99,81
LT 44/R	74,81	0,07	14,00	0,54	0,44	0,03	0,04	0,51	3,74	3,96	0,37	tr.	nd.	0,71	0,13	0,38	99,73
LT 195/R	74,57	0,07	14,25	0,56	0,51	0,03	0,11	0,49	3,81	3,98	0,33	0,00	nd.	0,49	0,12	0,48	99,80
LT 46/fgp	73,83	0,11	14,60	0,48	0,43	0,04	0,16	0,60	3,88	4,25	0,43	0,00	nd.	0,64	0,12	0,32	99,89
LT 121/fgp	74,15	0,09	14,36	0,36	0,58	0,04	0,19	0,55	3,69	4,23	0,36	0,00	nd.	0,53	0,11	0,53	99,77
LT 363/fgp	74,90	0,13	13,74	0,71	0,44	0,02	0,24	0,52	2,94	4,93	0,27	0,00	nd.	0,65	0,18	0,44	100,11
Ka 212/fgp	78,50	0,10	12,08	0,65	0,07	0,02	0,29	0,12	0,67	5,91	0,02	0,02	0,12	1,03	0,20	0,09	99,89
Ka 268/fgp	77,71	0,11	12,56	1,34	0,07	0,02	0,26	0,05	2,62	3,54	0,04	0,01	0,04	1,09	0,23	0,10	99,79
Ka 1/anp	62,88	0,84	15,77	3,10	2,15	0,05	2,00	2,89	3,12	4,48	0,46	0,03	0,15	1,11	0,33	0,22	99,58
LT 507/anp	67,14	0,55	15,86	2,01	1,51	0,07	1,39	1,70	4,37	2,94	0,21	0,00	nd.	1,54	0,58	0,22	100,09
Ka 16/m	50,68	1,53	13,43	3,32	3,58	0,09	8,44	7,53	2,19	4,69	1,48	0,08	0,37	1,43	0,78	0,31	99,93
LT 42/dp	50,25	1,75	15,51	4,26	4,21	0,13	5,35	7,09	2,84	2,71	0,56	0,14	nd.	2,15	0,20	2,98	100,13

mineralogy showed about 11 % of olivine. From the above described arguments including the mineralogical composition it is evident that the rock represents a gabbro.

6.1.7. Aphyric Variety of the Eisgarn Granite (Fine- to Medium-Grained two Mica Granites)

The flat area among Weitra, Reinprechts and Rossbruck is built of biotite-muscovite and muscovite-biotite granites which have been compared with the Eisgarn granite in all previous geological maps and papers. Another body of two-mica granite is situated along the supposed NW–SE running fault NE of Karlstift.

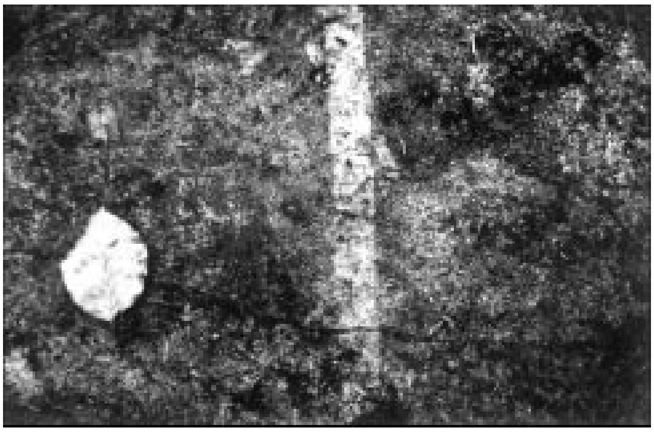
The rocks are represented by light-grey fine- to medium-grained prevalently aphyric or only sporadically porphyritic granites. Allotriomorphic quartz is usually younger than pleochroic biotite and muscovite, cross-hatched microcline shows a trend to form phenocrysts and can enclose partly altered hypidiomorphic plagioclases. Magnetic susceptibility ranges between $0.03–0.12\times10^{-3}$ (SI). According to their major chemical composition (Table 3), calculated CIPW normative mineralogy (normative corundum is higher than 3) and a molar ratio of Al/(Na + K + Ca), these two-mica granites are indicated as peraluminous S-type granites. The Rb-Sr age of the Eisgarn granite is 316±7 Ma (SCHARBERT, 1987).

6.1.8. Leucocratic Fine-Grained Muscovite (±Biotite) Granites and Aplitic Granites

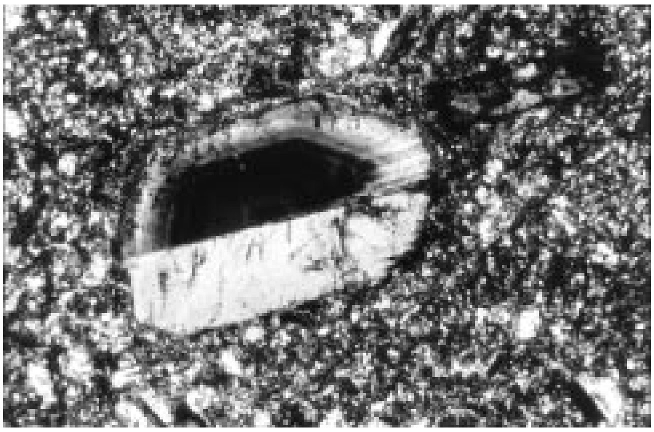
They were found besides the Eisgarn granite as dykes and small bodies. They form thin vertical dykes with a thickness from centimetres to several metres and occur especially within the Weinsberg granite including its small denudation relics (e.g. around the village of Stumberg W of Liebenstein), in the Mauthausen granite (Text-Fig. 29) or numerous occurrences are within the body of the Karlstift granite between St. Martin and St. Wolfgang and the adjacent part of the Weinsberg granite. Several small bodies were found at the contact between the Mauthausen granite and the Karlstift granite N and W of Gotthardl, just at the Liebenau gold anomaly described by GÖD (1989). The leucocratic granites have white-grey (rose-grey) colour with variable grain-size fabric (aplitic, fine-grained,

Table 5.
Trace element analyses of igneous rocks from the Litschau area (for list of samples see Appendix).
Analyst: Jana STRUBLOVÁ, Gematest Praha; RTG Spectrometer Philips PW 1404.

d.p. ppm	Ag	As	Ba	Bi	Cd	Co	Cr	Cu	Ga	Mo	Nb	Ni	Pb	Rb	Sb	Sn	Sr	U	V	W	Y	Zn	Zr
LT 29	<15	16	175	<15	<15	<10	<5	<5	17	<10	16	<5	28	359	<15	11	36	<15	<20	<15	18	25	59
LT 31	<15	<5	<50	<15	<15	<10	<5	<5	26	<10	25	<5	<10	618	<15	22	<5	<15	<20	<15	15	45	13
LT 42	<15	<5	3143	<15	<15	32	48	61	14	13	16	42	17	174	<15	<10	1240	<15	158	<15	26	88	226
LT 47	<15	1381	<50	<15	<15	<10	<5	<5	26	<10	45	<5	<10	546	<15	23	<5	<15	<20	<15	9	35	24
LT 121	<15	<5	<50	<15	<15	<10	<5	<5	27	<10	28	<5	16	644	<15	29	10	<15	<20	<15	16	98	15
LT 222	<15	<5	177	<15	<15	<10	18	<5	21	<10	20	<5	24	465	<15	<10	35	<15	<20	<15	20	23	54
LT 307	<15	<5	201	<15	<15	<10	28	<5	17	<10	14	<5	28	391	<15	13	37	<15	<20	<15	21	50	46
LT 369	<15	<5	411	<15	<15	<10	11	<5	17	<10	12	<5	33	369	<15	<10	55	<15	<20	<15	12	12	91
LT 507	<15	<5	530	<15	<15	<10	12	<5	15	<10	12	<5	17	68	<15	<10	620	<15	47	<15	15	54	192
LT 18/25	<15	<5	77	<15	<15	<10	<5	<5	21	<10	16	<5	22	498	<15	20	19	<15	<20	<15	15	14	11



Text-Fig. 29.
Two cm thick vertical dyke of aplitic muscovite granite within fine-grained biotite granite (Mauthausen granite).
d.p. L 284; 500 m SW of Monegg – Steinmühle.



Text-Fig. 30.
Diorite porphyry with a phenocryst of zonal plagioclase feldspar.
d.p. G 199; 1 km SE of the main crossroad in Karlstift.
Magnification ×43; crossed polars.

rarely pegmatitic). Muscovite is the prevalent mica but biotite can occur in places, too. At several documentation points these sugar-like muscovite granites contain megascopically visible garnets. The magnetic susceptibility of the rocks is very low (about 0.01–0.05×10^{-3} SI).

6.1.9. The Nebelstein Granitic Complex

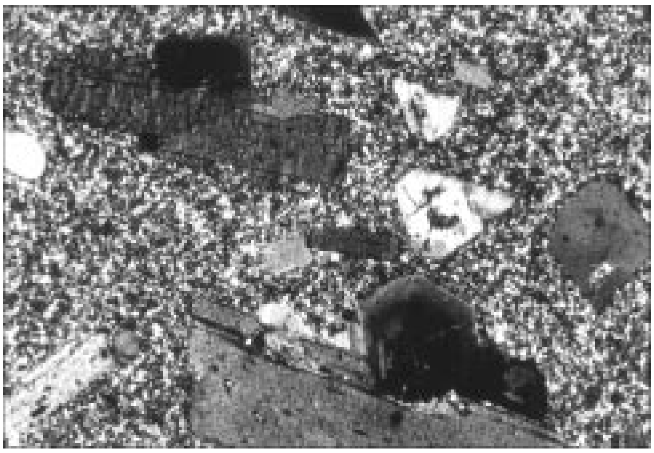
A conspicuous fault-slope about 1.8 km E of Nebelstein with the geographical name "Zeiler Berge" is prevalently built of aphyric fine- to medium-grained muscovite granite with small districts of two-mica granite on the one hand and with occurrences of greisens on the other hand. The muscovite granites have in places a very high magnetic susceptibility (13–58×10^{-3} SI) and their colour has rose or red shade because of hematitization as one of the main alteration phenomena. Muscovite is the prevalent mica and forms leaves with diameters up to 0.5 cm, biotite relics can be found rarely. Investigation of thin sections shows perthitic K-feldspars which enclose small relics of plagioclases which are clouded by products of hydrothermal alteration. KOLLER et al. (1994) have believed that the different granitic rocks of the Nebelstein complex (i.e. two-mica granite, muscovite granite and quartz-muscovite greisens) originated from a special type of biotite granite by progressive alteration. This special biotite granite is not exposed in the area of Zeiler Berge and it was detected only in drill cores at a depth of about 140 m (GÖD & KOLLER, 1987). These authors described two different mineralizations in the area of Nebelstein:

a) a disseminated one, which is limited to the greisens and consists of pyrite, pyrhotite, molybdenite and accessory chalcopyrite and
b) an oxidic mineralization represented by magnetite. The magnetite is cogenetic with the greisenization.

The two-mica granites of the Nebelstein complex have been dated by Rb-Sr method. According to Scharbert (pers. com.) biotite yielded 312.3±1.9, 310.9±2.0 Ma and muscovite 307.8±1.9, 306.1±1.7 Ma.

6.1.10. Lamprophyres, Diorite and Granodiorite Porphyries

They represent probably the youngest magmatic rocks in the surveyed area. Two of them were already marked as lamprophyres in the map 1 : 50.000 of FUCHS & SCHWAIGHOFER (1977). The first dyke lies within the Mauthausen granite and is found as blocks up to 30 cm in the field near the village of Gugu (d.p. L 290). It is not possible to determine its course. This dark-grey rock has a high magnetic susceptibility (12–18×10^{-3} SI) and almost no feldspar phenocrysts. Well preserved hornblendes form phenocrysts, the rock can be classified as a hornblende lamprophyre. The second dyke (d.p. L 143, 400 m SE of Bum) with the probable course of 320–330° is situated within the Weinsberg granite. The green-gray rock with phenocrysts of feldspar and altered hornblende has a relatively low magnetic susceptibility (0.21–0.23×10^{-3} SI) probably because of hydrothermal alteration (chloritization and epidotization of hornblendes, sericitization of feldspars). The rock represents a granodiorite porphyry. The third occurrence was found S of Durschnittsau (d.p. L 204). The dyke can be followed about 100 m with a course of 340–350° within the Mauthausen granite. Its magnetic susceptibility is high: 23–30×10^{-3} (SI) and the rock is partly hydrothermally altered as well (chloritization, epidotization, carbonatization). The hydrothermal alteration is confirmed by chemical analysis (Tab. 3, high content of CO_2, H_2O). The both last rocks have a higher content of TiO_2 and the prevalence of Na_2O above K_2O. A next diorite porphyry forms dykes with a thickness of 5–10 m E of Karlstift where they cut both the Weinsberg granite and the Karlstift granite. The phenocrysts are represented by



Text-Fig. 31.
Granodiorite porphyry.
Phenocrysts of biotite; plagioclase and quartz in very fine-grained groundmass.
d.p. G 439; Hausschacherforst S of Weitra.
Magnification ×43; crossed polars.

gioclases and relics of a mafic mineral (probably hornblende) which is replaced by chlorite and epidote (Text-Fig. 30). Very fine-grained groundmass contains allotriomorphic plagioclases, chlorite and leucoxene. The magnetic susceptibility is only about 0.12×10^{-3} (SI). The last dyke rock was ascertained in the area of Hausschacherforst, S of Weitra. The granodiorite porphyry has phenocrysts of biotite, plagioclase and quartz in a very fine-grained groundmass (Text-Fig. 31). The magnetic susceptibility reaches 0.06×10^{-3} (SI).

As Post-Paleozoic rocks are concerned, it is necessary to mention a small relict of quartz gravel 0.75 km W of the Schützenberg bridge (2.5 km SW of Weitra). The gravel lies at the altitude 600 m above sea level. The diameter of pebbles is about 5–8 cm and they are well rounded. It can be supposed its Pleistocene–Pliocene age.

6.2. Mapped Part of the Area B (between Litschau – Kautzen and Heidenreichstein)

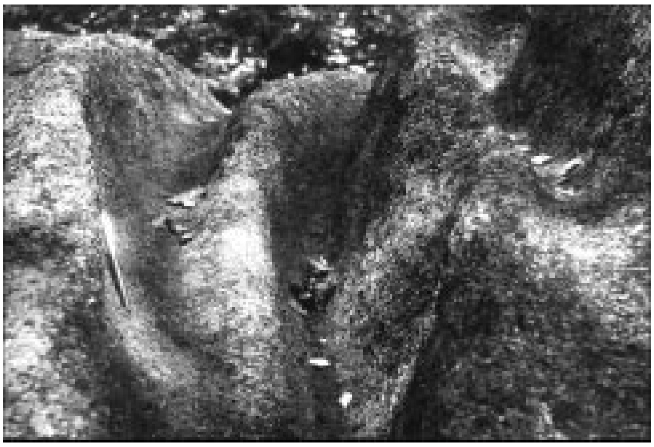
6.2.1. The Eisgarn Granite

From the geological point of view, the mapped area covers the Moldanubian Pluton in the E–W section including its eastern contact with migmatites or migmatitic biotite gneisses of the Monotonous Group. The absolute majority of the mapped territory is built of the Eisgarn granite. During the presented mapping, we applied its division in two varieties used by ZOUBEK (1949) and DUDEK et al. (1962) on the Czech side of the Moldanubian Pluton. Our mapping revealed the third variety which is typical for the endocontact of the Pluton and we have called it the marginal variety.

6.2.1.1. The Landštejn Variety of the Eisgarn Granite

The prevalent part of the Eisgarn granite, i.e. the area between the Czech/Austrian border in the west and the road connecting the custom-house at Grametten with the village of Eisgarn in the east, is formed by the Landštejn variety of the Eisgarn granite. It is a porphyritic coarse-grained two-mica granite with a usually higher content of muscovite. ZOUBEK (1949) supposed the Landštejn granite to be a relatively young member rich in volatiles, especially in water. According to modal analyses (DUDEK et al., 1962), there are not any important differences in the content of minerals but only in the particle size. The granite is usually only slightly porphyritic because of the coarse-grained groundmass. The major element composition is very similar to the composition of both the further varieties. The magnetic susceptibility of the Landštejn variety varies between 0.03 and 0.05×10^{-3} (SI).

Text-Fig. 32.
The Landštejn variety of the Eisgarn granite.
d.p. Ka 142; 1500 m NNE of Eisgarn.
The diameter of the rock basins is about 2 m.



Text-Fig. 33.
Fluting karrens in the Landštejn variety of the Eisgarn granite.
d.p. Lt 598; Teufelstein near Schandachen.

Text-Fig. 34.
Fluting karrens in the Landštejn variety of the Eisgarn granite.
d.p. Lt 598; Teufelstein near Schandachen.

The best accessible outcrops of the Landštejn granite are in the area around the road Eisgarn – Grametten (Kolomanistein NNE of Eisgarn, natural monument 1.5 km NNE of Eisgarn – Text-Fig. 32, Teufelstein near Schandachen – Text-Figs. 33 and 34).

6.2.1.2. The Čímĕř Variety of the Eisgarn Granite

It is a porphyritic medium-grained two-mica granite with a light-grey colour, usually massive structure and porphyritic texture. Microcline phenocrysts can have a parallel pattern in some places. Small xenoliths of biotite gneiss are common. The Čímĕř variety is spread in the eastern part of the mapped area.

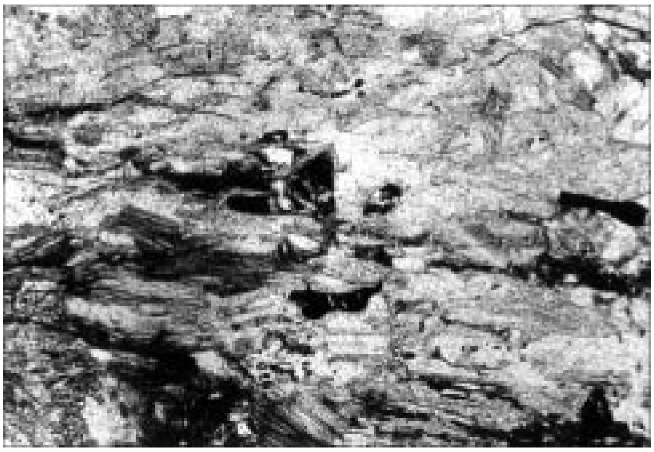
Examination of thin sections revealed a typical granitic (hypidiomorphic granular) texture, perthitic microcline phenocrysts enclosing crystals of plagioclases, both micas and characteristic garland quartz in microcline which was described already by SCHARBERT (1966). Pseudomorphoses after probably cordierite can be found rarely, ilmenite is the main representative from the opaque minerals.

6.2.1.3. The Aphyric Fine- to Medium-Grained Variety of the Eisgarn Granite

The new mapping has shown that this variety is spread especially at the contact of the Moldanubian Pluton with the Monotonous Group. On the other hand, the same rock type was found also as isolated bodies within the Číměř and Landštejn varieties; the largest one occurs at the boundary between the both varieties trending north–south around the village of Gross Radischen. Some of the bodies were already mapped by WALDMANN (1950) but as Mauthausen granite. Alternation of the aphyric fine-grained variety with the Číměř one was ascertained in the eastern vicinity of the mentioned body around Gross Radischen. At most documentation points only stone chips of the two varieties occur together but some outcrops near Leopoldsdorf gave an evidence about alternation of approximately 5–10 m thick granite "layers".

6.2.2. Biotite Gneiss

The Moldanubian Pluton intruded into rocks of the Monotonous Group which are represented by biotite gneiss in the easternmost part of the mapped area between the villages of Tiefenbach and Reinolz. The dark rock has conspicuous schistosity with a relatively uniform strike (NNE–SSW) and a dip of about 30–45°. In places, the biotite gneiss is migmatitized. Comparing granites, the gneiss has a higher content of opaque minerals (Text-Fig. 35) which causes a gently higher magnetic susceptibility (0.15–0.2×10^{-3} SI).



Text-Fig. 35.
Biotite gneiss with opaque minerals.
Roadcut at the eastern margin of Illmau.
Magnification ×43; ordinary light.

6.2.3. The Weinsberg Granite

It was found in the southeastern part of the mapped area. It is a coarsely porphyritic and coarse-grained biotite granite with conspicuous dark colour (comparing all three varieties of the Eisgarn granite) and by large K-feldspar phenocrysts (up to 10×1.5 cm). Number of phenocrysts can reach 12–15 dm^2. Magnetic susceptibility is generally higher than that of the Eisgarn granite and it can extend over 0.1×10^{-3} SI.

6.2.4. Dykes of Pegmatites and Aplites

They were found at several documentation points near the eastern margin of the Moldanubian Pluton. Pegmatites are situated prevalently within the aphyric marginal variety of the Eisgarn granite (N and W of Reinolz, N of Groß-Taxen). The best outcrop N of Reinolz shows an E–W-trending pegmatite dyke with graphic texture of its marginal parts and crystals of smoky quartz, feldspars and leaves of muscovite in the middle. The length of the dykes can reach several tens of metres, their thickness is up 2–3 m.

6.2.5. Greisens and Hydrotermally Altered Granites

They occur in the Hirschenschlag area where their detailed investigation was already done (GÖD, 1989; KOLLER et al., 1994). Our mapping found a new small occurrence 300 m south of Reinberg – Dobersberg.

KOLLER et al. (1994) described two different types of greisens in the Hirschenschlag area:

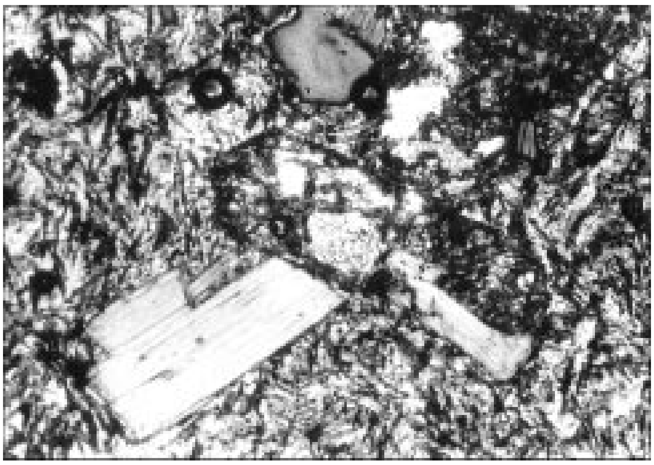
1) isolated irregularly shaped 10–20 m thick bodies of barren quartz-muscovite rocks;
2) mineralized chlorite-rich greisen bodies a few meters in thickness surrounded by an alteration halo of 1–2 m.

Both types are situated in the Číměř variety of the Eisgarn granite. Magnetic susceptibility can reach up to 25–50×10^{-3} (SI) in mineralized greisens with high content of magnetite.

Altered granites have unusual grey-red colour with conspicuous leaves of muscovite. Texture of granitic rock is partly preserved, in some samples including the presence of biotite. Generally, the content of muscovite and quartz becomes higher, biotite is altered to chlorite and feldspars are clouded by opaque pigment. In some cases, magnetic susceptibility is gently higher comparing the Eisgarn granite.

6.2.6. Minette and Granodiorite-Diorite Porphyries

In addition to pegmatites and aplites there were found also mafic dyke rocks: quartz-diorite and diorite porphyries and minette. The occurrence of minette is situated within the aphyric marginal variety at the eastern contact of the Moldanubian Pluton with the Monotonous Group. Because of easy weathering, only stone chips indicate one or two minette dykes of probably NW–SE direction. The dark brown-green rock has conspicuous shiny phenocrysts of euhedral biotite (up to 5 mm). The examination of thin sections showed biotite and rarely pyroxene as phenocrysts (Text-Fig. 36). The groundmas is built of small K-feldspars, biotite and opaque minerals. The magnetic susceptibilty is relatively high: about 5×10^{-3} (SI).



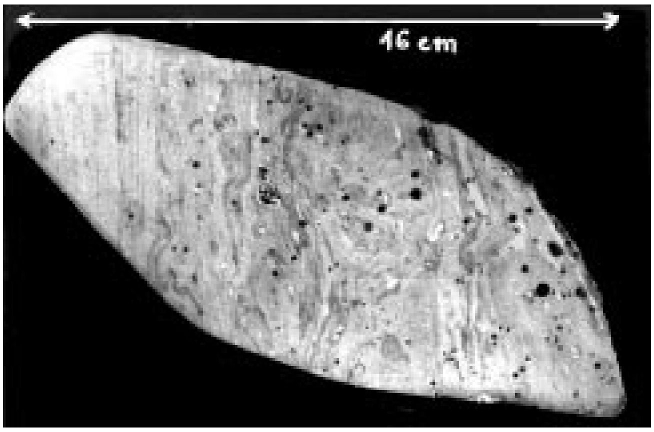
Text-Fig. 36.
Minette; Phenocrysts of biotite and pyroxene which is partly replaced.
Stone chips 200 m W of Hoher Stein; 3 km NW of Reinolz.
Magnification ×43; ordinary light.

6.2.7. Granite-Granodiorite Porphyries with Anomalously High Magnetic Susceptibility

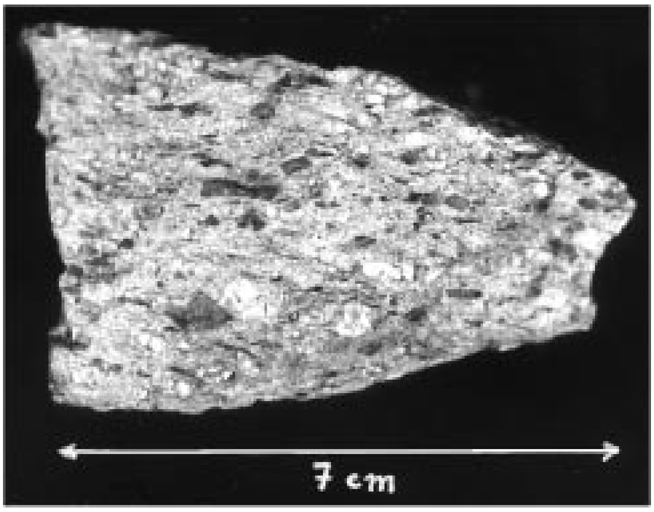
These rocks follow the southern margin of the oval magnetic anomaly between Reingers and Staré Město pod Landštejnem. Similar rocks were described from the Czech territory as syenites (CHLUPÁČOVÁ, 1985). Both have high magnetic susceptibility up to 10×10^{-3} SI. They have unusual red-grey colour with many phenocrysts of plagioclase feldspar and biotite (nevaditic texture). The rocks are intensively hydrotermally altered. Quartz phenocrysts or xenocrysts (?) with intensive magmatic corrosion can occur.

6.2.8. Felsitic Granite Porphyry, Felsitic Microgranite, Vitreous Microgranite

An important tectonic zone trending NNW–SSE runs across the whole mapped area B. In north it links up the body of Homolka granite and than it continues via Rubitzkoteich – E of Josefsthal – Schneiderbühel – Kashof – Sportplatz W of Litschau – the dam of Schönauer Teich – SW margin of Schönau to the Schmidbrunner Bach. Its length is about 12 km.The zone is accompanied by many dykes of felsitic granite porphyry which form usually the central parts of thick dykes, their marginal parts are built of felsitic or vitreous microgranite. The last one has an interesting fluidal texture (see Text-Fig. 37). The felsitic granite porphyries are composed of automorphic pink phenocrysts of K-feldspar (up to 3 cm), quartz (up to 5 mm), chloritized biotite and acid plagioclase. The groundmass is built of allotriomorphic quartz, feldspars and abundant muscovite. The felsitic microgranites are composed of alkali feldspar (often forming radial spherolites), quartz and radial aggregates of sericite. These dyke rocks are distributed especially in the northern part of the zone, i.e. between Sportplatz near Litschau and the Staňkovský rybník pond. In a few places they were found intensively deformed (Text-Figs. 38 and 39).



Text-Fig. 37.
Marginal part of a vitreous microgranite-felsitic granite porphyry.
It shows an impressive fluidal texture and an enlargement of crystals towards the centre of dyke.
d.p. LT 49; 400 m NE of Rubitzkoteich.



Text-Fig. 38.
Deformed felsitic granite porphyry.
d.p. LT 363; 1.5 km W of Rottal.

Text-Fig. 39.
Splinters of deformed quartz crystal in felsitic granite porphyry.
d.p. LT 363; 1.5 km W of Rottal.
Magnification ×40; crossed polars.

6.2.9. The Rubitzko Granite

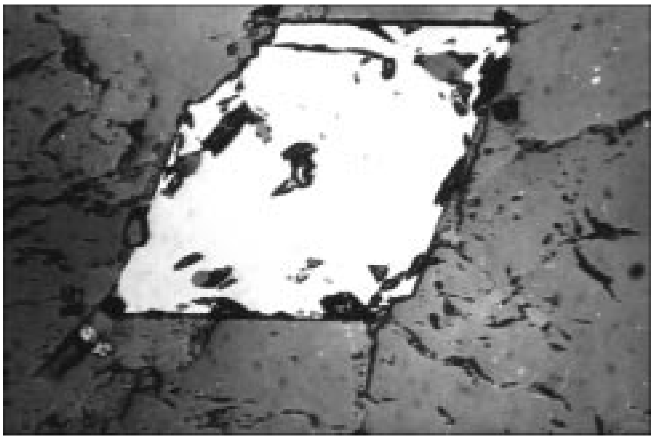
The rock represents the granite intrusive equivalent of the felsitic granite porphyries mentioned above. It is a new type of granite within the Moldanubian Pluton which was described by PŘICHYSTAL (1994a,b). BREITER & SCHARBERT (1995) called it as “Josefsthal” type but the lonely house Josefsthal is situated within the Eisgarn granite and relatively far from a good outcrop of the mentioned granite. The Rubitzko granite has the largest and best outcrops at the Rubitzkoteich Pond. It is a fine-grained aphyric muscovite granite, in places with microphenocrysts of pink K-feldspar and of grey quartz. Muscovite often forms radial aggregates. Microphenocrysts of K-feldspar are surrounded by myrmekites. Field observations proved the close relationship between the Rubitzko granite and felsitic and vitreous granite porphyries. The outcrop at the dam of Schönauer Teich shows a dyke of felsitic granite porphyry immediately connected with the body of Rubitzko granite.

The magnetic susceptibility of the Rubitzko granite is very low ($0.03–0.05\times10^{-3}$ SI), in fact the same as that of the Landštejn variety of the Eisgarn granite.

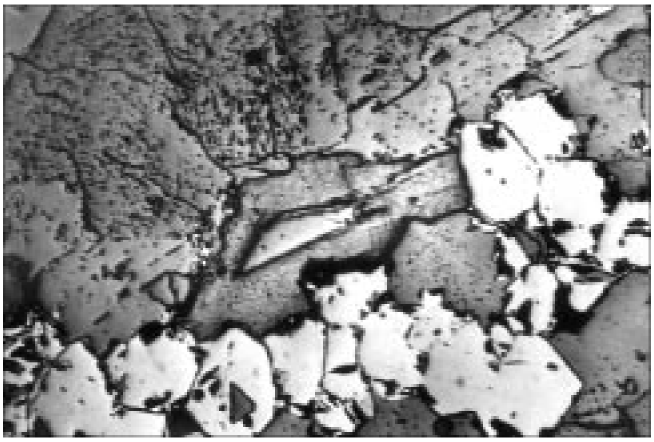
7. Study of Opaque Minerals

(With Z. LOSOS & M. SLOBODNÍK)

The study was focused to reveal bearers of magnetic properties of the mapped rocks. The most interesting rock represents the Karlstift granite with its high magnetic susceptibility ($0.5–28\times10^{-3}$ SI). It can be characterized by the association magnetite – ilmenite with a very change-

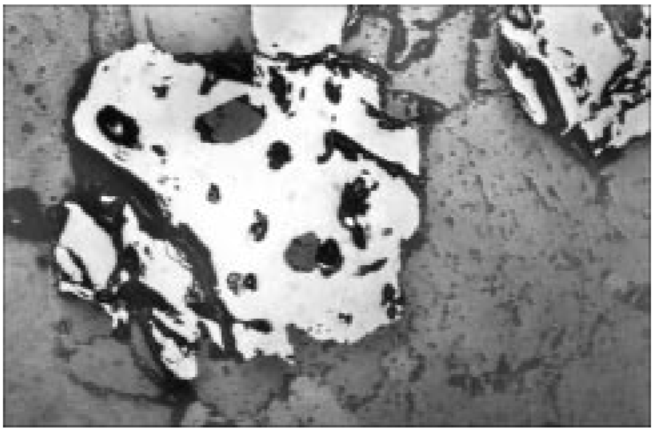


Text-Fig. 40.
Automorphic metacrystal of magnetite (0.05 mm) in Karlstift granite.
d.p. L 17; 1200 m NE of Schönberg.
Polished section.



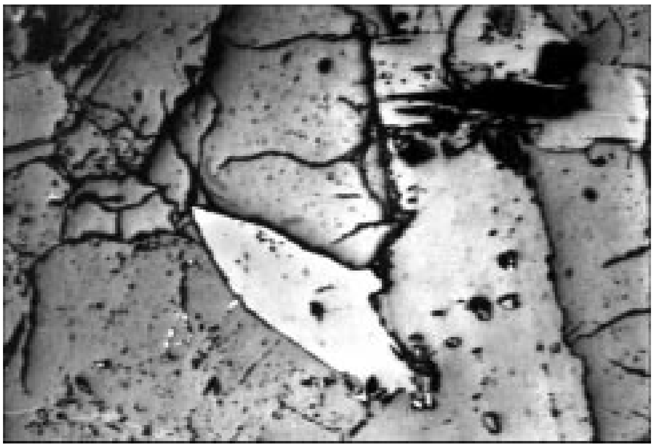
Text-Fig. 41.
Chain-like accumulation of magnetite crystals (size of grains about 0.3 mm), a typical feature for metacrystals.
Karlstift granite; d.p. L 272; 700 m N of Stumberg.
Polished section.

able ratio. Magnetite forms automorphic (Text-Fig. 40), hypautomorphic and allotriomorphic grains, in places magnetite crystals create chain-like accumulations (Text-Fig. 41). Automorphic magnetite is usually less (0.04–0.08 mm) comparing the hypautomorphic one

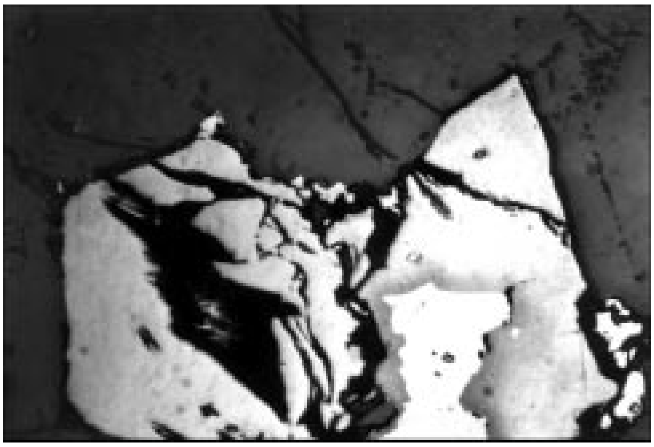


Text-Fig. 42.
Magnetite grain (0.1 mm) with many inclusions of rock-forming minerals; typical feature of metacrystals.
Karlstift granite of extreme high magnetic susceptibility d.p. L 113; SW of Wörnhör.
Polished section.

(0.09–0.26 mm). Some magnetite grains are martitized (changed to hematite along cleavage planes). Ilmenite is often changed to rutile or leucoxene. As a typical feature, ilmenite contains small inclusions of hematite and it has a close relationship to clusters of mafic minerals especially of biotites. Pseudomorphs of limonite after pyrite have been also found. In the nearly non-porphyritic variety with extreme high magnetic susceptibility (around the hill of Grossleitner) and in a dark inclusion only magnetite has occured without presence of ilmenite. In many cases magnetite crystals can be designated as metacrystals with inclusions of older rock-forming minerals (Text-Fig. 42). Magnetite is often accompanied by titanite with the long axis of crystals up to 12 mm (Text-Fig. 43). Pseudomorphs of limonite after pyrite with relics of pyrite in central part of the grains was observed (Text-Fig. 44).



Text-Fig. 43.
Spindle-like crystal of titanite (the long axis is 0.6 mm) which accompanies magnetite in Karlstift granite.
d.p. L 113 SW of Wörnhör.
Polished section.



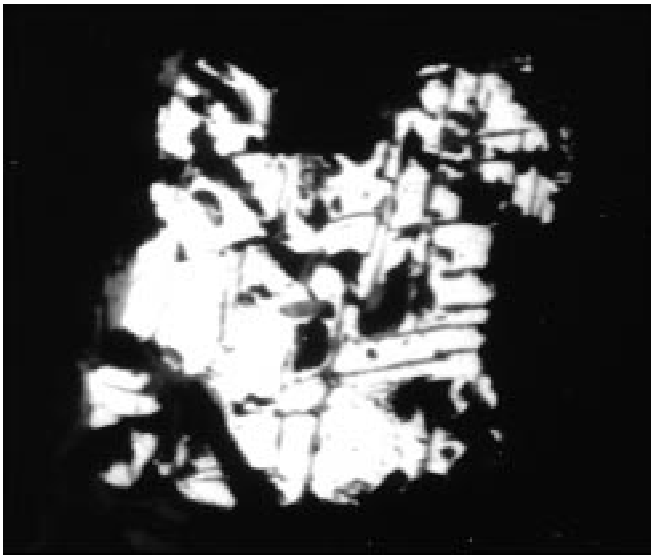
Text-Fig. 44.
Pseudomorph of limonite after pyrite (preserved in the central part).
Left grain is formed by magnetite (0.2 mm).
Karlstift granite; d.p. L 272; 700 m of Stumberg.
Polished section.

Another anomalous rock from the point of its magnetic susceptibility is a granite-granodiorite porphyry with a high magnetic susceptibility. Dykes of this rock were found solely in the eastern part of the mapped territory B, i.e. the westernmost occurrence lies at the road from Grametten to Eisgarn (d.p. LT 507, 2.5 km N of Eisgarn). They are distributed in the southeastern surroundings of the Reingers magnetic anomaly.

7.1. Mafic Dyke Rocks (Diorite Porphyries, Lamprophyres)

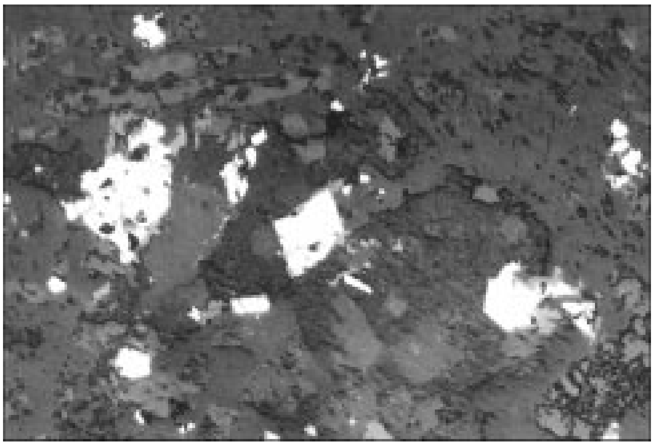
They contain ilmenite and magnetite, usually with skeletal development (Text-Fig. 45) which is an evidence of quick cooling. Ilmenite can be changed to rutile and leucoxene.

An amphibole diorite porphyry situated 1100 m SE of the Rubitzkoteich has a very high magnetic susceptibility ($66–73 \times 10^{-3}$ SI). The rock is filled by many small crystals of magnetite, usually with diameter 0.01–0.07 mm, exceptionally up to 0.1 mm. About 50 % of magnetite crystals are automorphic (Text-Fig. 46, 47). The magnetite has a fresh appearance, with only little inclusions of rock-forming minerals. The skeletal development of magnetite argues for a very rapid solidification under shallow subsurface conditions. Another mafic dyke rock from the southern margin of Schönau has both automorphic and skeletal magnetite with many inclusions of rock-forming minerals (Text-Fig. 48). In addition to magnetite, the rock contains small agregates of Ti-oxides, probably rutile and titanite (Text-Fig. 49).

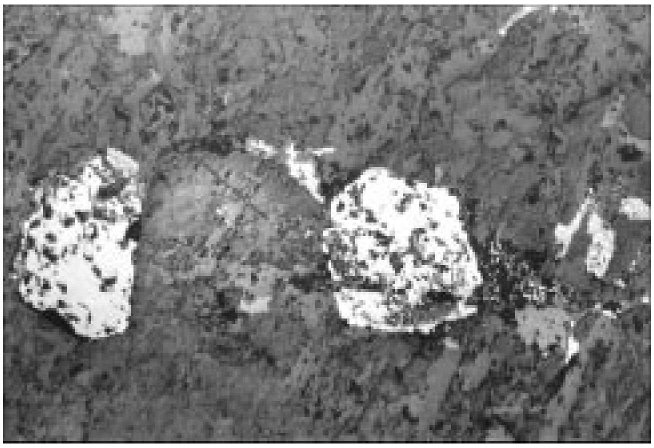


Text-Fig. 45.
Skeleton fabric of a magnetite crystal (0.06 mm) in the lamprophyre of d.p. L 290 in Gugu.
Evidence of quick cooling.
Polished section.

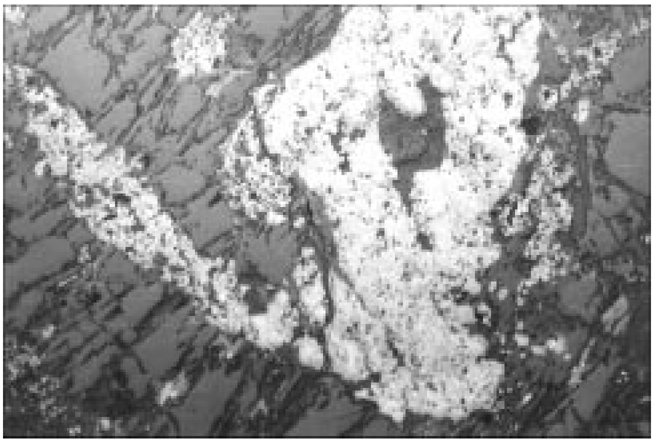
Text-Fig. 46.
Small automorphic crystals of magnetite in diorite porphyry.
d.p. LT 42.
Magnification ×53. Polished section.



Text-Fig. 47.
Small automorphic crystals of magnetite in diorite porphyry.
d.p. LT 42.
Magnification ×53. Polished section.



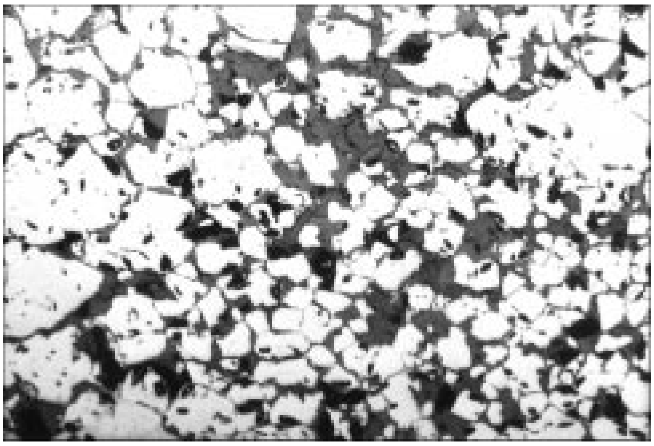
Text-Fig. 48.
Magnetite crystals with many inclusions of rock-forming minerals.
Mafic dyke rock. d.p. LT 571; southern margin of Schönau.
Magnification ×24. Polished section.



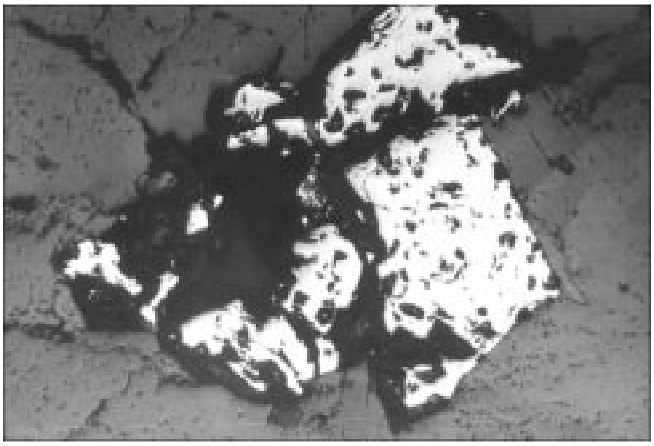
Text-Fig. 49.
Complicated aggregate of two Ti-oxides.
d.p. LT 571.
Magnification ×24. Polished section.

7.2. Ore Mineralization Connected with Greisens, Greisenized Rocks and Quartz Dykes

It was found in addition to rocks mentioned above. GÖD (1989) introduced disseminated ore mineralisation from greisens at Hirschenschlag: pyrite, molybdenite, chalco-

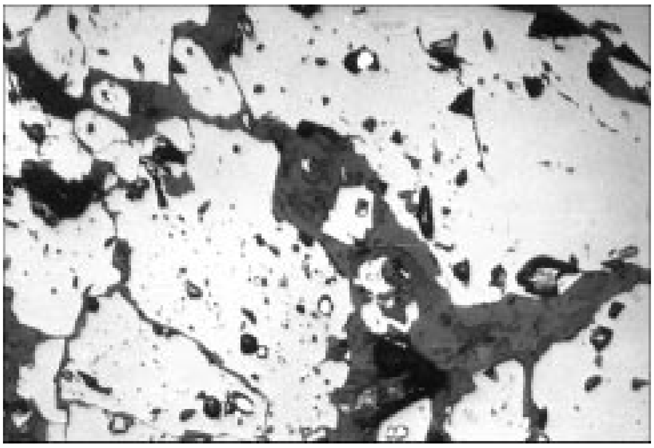


Text-Fig. 50.
Accumulation of magnetite grains in greisen from Hirschenschlag.
Magnification×34. Polished section.

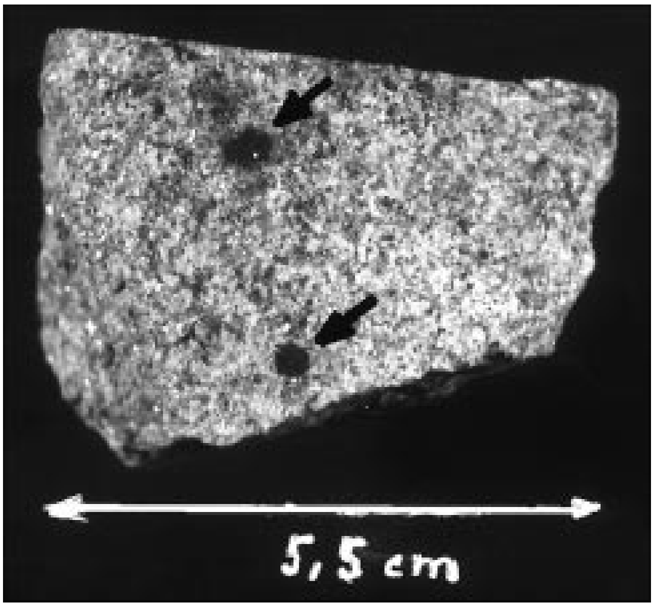


Text-Fig. 53.
A cluster of magnetite crystals in Nebelstein granite.
Magnification×24. Polished section.

pyrite, sphalerite, galena and minor arsenopyrite. The non-sulphide mineralization consists mainly of magnetite and traces of fluorite. The magnetic susceptibility of greisens and greisenized rocks from the area of Hirschenschlag is very variable, it can reach up to 50×10^{-3} SI. Magnetite is concentrated in oval clusters consisting of many individual crystals (Text-Fig. 50). They can enclose small inclusions of pyrite (Text-Fig. 51). Accumulations of magnetite are macroscopically visible also in the Nebelstein granite (Text-Fig. 52 and 53).



Text-Fig. 51.
Greisen near Hirschenschlag.
Inclusions of pyrite in magnetite.
Magnification×53. Polished section.

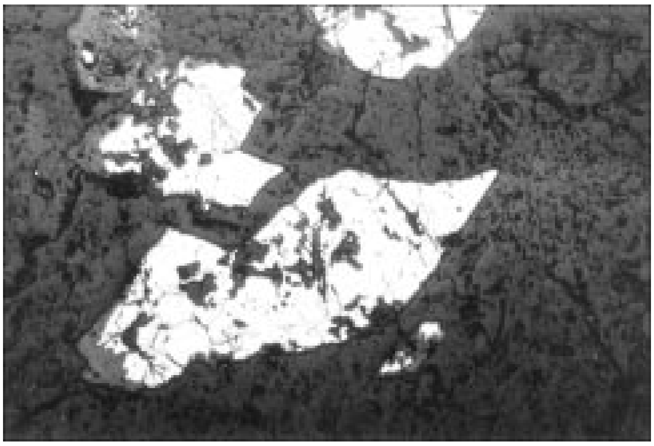


Text-Fig. 52.
Megascopically visible circular accumulations of magnetite in Nebelstein granite.

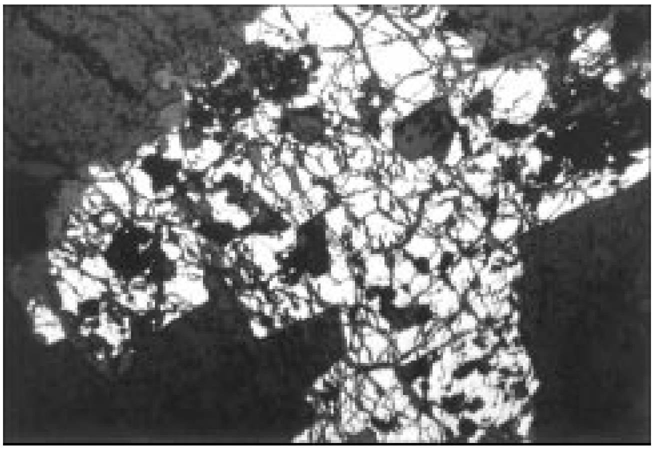
Sulphidic minerals (pyrite, chalcopyrite, arzenopyrite) are unique in granites but they are more frequent in greisens and silicified granitic rocks. The best samples were found in greisenized rocks at Hausschacherforst S of Weitra (d.p. G 434 and G 154). The rocks have a druse fabric where muscovite and quartz are surrounded by pyrite and chalcopyrite or cavities in the rocks are filled by colloform pyrite (see SLOBODNÍK in PŘICHYSTAL, 1992). All sulphides are younger than rock-forming minerals and pyrite appears in two generations. These samples are in fact without oxidic ore mineralization and that is why they have a very low magnetic susceptibility. Generally in the studied rocks, the magnetic susceptibility is in direct relevance on the quantity of magnetite and in reverse proportion to its alteration to hematite.

7.3. The Rubitzko Granite

Ore mineralization connected with the Rubitzko granite and its near-surface dyke equivalents was found only at one locality (LT 47 lying 300 m SE of the Rubitzkoteich).



Text-Fig. 54.
Rhomboidal shape of deformed and limonitized arzenopyrite crystals in Rubitzko granite.
Magnification×24. Polished section.



Text-Fig. 55.
Rhomboidal shape of deformed and limonitized arzenopyrite crystals in Rubitzko granite.
Magnification×24. Polished section.

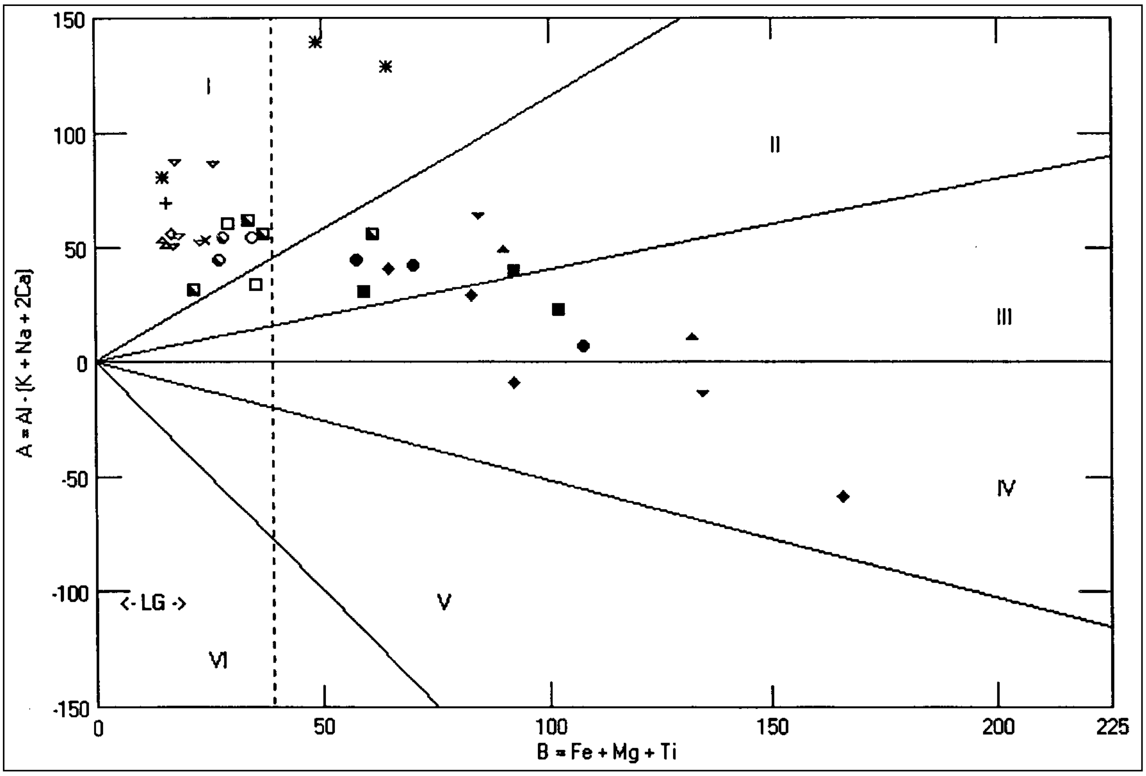
A macroscopically visible mineralization (ore grains up to 1.5 mm) is situated in a very fine-grained and silicified variety of the Rubitzko granite. According to study of the opaque minerals in a polished section (anisotropic effects, rhomboidal shape of the crystals – see Figs. 54 and 55) it is arzenopyrite. Marginal parts of crystals are limonitized. The find of the arzenopyrite is in a good agreement with the RTG-spectral analysis of the sample LT 47 (1381 ppm of As).

8. Basic Geochemical Data of the Rocks

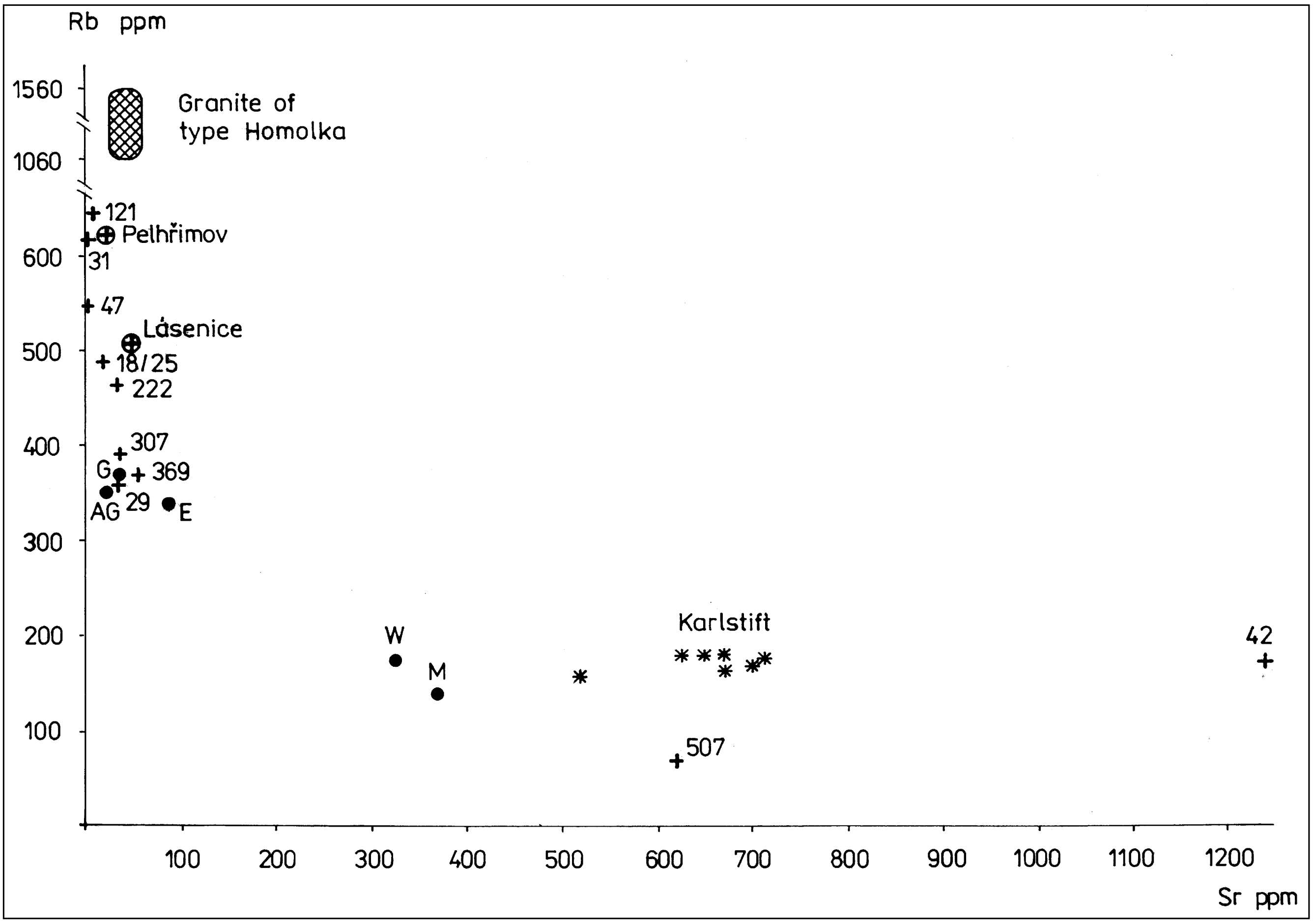
Tables 3 and 4 show the results of major element analyses of the mapped rocks in both areas. In area A (Table 3) all main biotite granites were analysed, i.e. the Weinsberg (W), Mauthausen (M) and Karlstift (K) granites and biotite-muscovite granite (bmg) forming small bodies or dykes. In addition to them, one analysis of gabbro (gab), three analyses of xenoliths or inclusions in biotite granites (xt) and two analyses of diorite porphyries (dp) are included. The Table 4 brings the chemical composition of rocks from the area B: the northernmost projection of the Weinsberg granite (W), a comparision of all varieties of the Eisgarn granite (Em – the aphyric variety, Č – the Číměř variety, L – the Landštejn variety), muscovite aplitic granites (ag), greisen (gre), the Rubitzko granite (R) and its dyke equivalents (felsitic granite porphyries – fgp). The last four samples represent analyses of dyke rocks: granite-granodiorite porphyries with anomalous magnetic susceptibility (anp), minette (m) and diorite porphyry (dp).

Granites and dyke rocks (excluding Ka 16/m and LT 42/dp) are plotted in the discriminating diagram after DEBON & LE FORT (1983) – Text-Fig. 56. Average values of the Homolka granite (blank diamond, after data of BREITER & SCHARBERT, 1995), the Lásenice felsitic granite porphyry (X, after data of KLEČKA & VAŇKOVÁ, 1988) and the Pelhřimov felsitic granite porphyry (+, sample no. 1 of VRÁNA, 1990) are added for comparision. The trend of biotite granites (Weinsberg granite – full square, Mauthausen granite – full circle, Karlstift granite – full diamond) is followed by diorite porphyries (overturned full triangle) and also by granite-granodiorite porphyries with anomalous high magnetic susceptibility (full triangle). All these rocks are fairly sharply divided from varieties of the Eisgarn granite (Landštejn variety – blank square, Číměř variety – blank circle, aphyric variety – partly full circle), two-mica granites of the Weitra – Karlstift – Liebenau area (partly full square), the Rubitzko granite (blank triangle), felsitic granite porphyries (overturned blank triangles), altered red granites and greisen (stars).

The diagram Rb-Sr (see Text-Fig. 57), based on data in Tab. 5, shows much more expressively two different trends among the studied granites, dykes and subvolcanic rocks. The first trend is formed by biotite granites (W – average value of the Weinsberg granite, M – average value of the Mauthausen granite, both data after GÖD & KOLLER,



Text-Fig. 56.
Granites, dyke rocks and acid subvolcanites of the mapped areas in the discriminating diagram after DEBON & LE FORT (1983).
For comparision there are added average values of the Homolka granite and acid subvolcanites from the areas of Lásenice and Pelhřimov in the Czech Republic.
Explanations of symbols see in the text.



Text-Fig. 57.
Granites, dyke rocks and acid subvolcanites of the mapped areas in the Rb-Sr diagram with average values of some compared rocks.
For explanations see text, for a list of samples see Appendix.

1989; stars – the Karlstift granite after SCHARBERT, 1988). This branch has a stable low content of Rb beneath 200 ppm Rb and increasing abundances of Sr towards to the types with high magnetic susceptibilities (Karlstift granite, anomalous dyke rocks). In contrary, the S-type granites have a totally different trend with stable low values of Sr (beneath 100 ppm) and increasing Rb content (E – average Eisgarn granite, G – average greisen, AG – average aplitic granite, all these data taken from GÖD & KOLLER, 1989). Our analyses of felsitic granite porphyries and the Rubitzko granite are compared with the average values of the Lásenice felsitic granite porphyries, the Pelhřimov granite porphyry and the Homolka granite.

9. Discussion and Conclusions

From the paragraphs mentioned above and from the large set of the maps presented the following knowledge concerning both the structure of the Moldanubian Pluton and the origin of the magnetic anomalies within it can be extracted:

The southern area A is prevalently built of relatively older biotite granites (the Weinsberg, the Mauthausen and the Karlstift ones) with younger small bodies or dykes of two-mica granites. As for these biotite granites are concerned, the coarse-grained porphyritic Weinsberg granite is undoubtedly older than the Mauthausen and the Karlstift granites. The Karlstift granite – in our conception – is defined as a porphyritic medium-grained biotite granite with anomalous magnetic susceptibility. Its large superficial and near-surface bodies produce the magnetic anomalies of Liebenau and of Weitra. It is also supposed that the same or similar hidden rocks could provoke the magnetic anomaly near the Nebelstein Mt., i.e. the W-part of the Weitra anomaly and even the Reingers magnetic anomaly. The relationship between the Mauthausen and the Karlstift granites is not clear but the Karlstift granite seems to be an alteration product of the marginal parts of the Mauthausen granite bodies.

The main plutonic rock of the area B is the Eisgarn granite which was – in our new mapping – divided into three varieties:

1) the non-porphyritic fine-grained variety,
2) the porphyritic medium-grained Číměř variety and
3) the porphyritic coarse-grained Landštejn variety.

A zonal structure of the large Eisgarn granite body was found. The non-porphyric fine-grained variety is mostly developed near the eastern contact of the Pluton close to the metamorphic rocks of the Monotonous Group. Towards the centre of the Pluton there is the Číměř variety and almost the all area in the west is built of the porphyritic coarse-grained Landštejn variety. A similar situation was found by MIČKE (1994) in the continuation of the Eisgarn granite to the territory of the Czech Republic.

Such a zonal pattern of the Eisgarn granite gives evidence on relatively shallow conditions of its cooling. The finds of acid subvolcanic to volcanic rocks in the Austrian part of the Pluton form a continuation of the Lásenice volcanotectonic zone where the same rocks yield a Rb-Sr age of 295±5 Ma (KLEČKA et al., 1994). It means that at the Carboniferous/Permian turning time the denudation level of the Moldanubian Pluton was already very similar to the recent one. Our geological mapping revealed also the intrusive equivalent of the subvolcanic vitreous dykes – a new type of the muscovite granite within the area of the Pluton that was called the Rubitzko granite.

The magnetic anomalies found in the southern area A, i.e. the Liebenau and the Sandl anomalies, are caused by the almost completely outcropping magnetic bodies. Twenty kilometers to the north only one – probably a tectonically uplifted block – of the source-bodies evoking the Weitra magnetic anomaly is outcropping; the others are buried. And, finally, the whole magnetic structure producing the Reingers magnetic anomaly in the northernmost part of the area B is practically entirely covered. From these facts we deduce the deepest erosional level in the south and a relatively shallower level in the north. It is in agreement with the previous opinions (published e.g. by SCHARBERT, 1987 and 1992) that the deepest and the oldest rocks are exposed in the southern part of the Moldanubian Pluton. It simultaneously shows the body of the Pluton is not horizontal but it is dipping to the north.

The intraplutonic magnetic anomalies mostly represent a response of mineralized bodies. The mineral magnetite which is predominantly responsible for the existence of these anomalies is of secondary origin closely bound with the genesis of mineralizations. Many greisens found in the anomalous localities display, thus, high magnetic susceptibilities. Some magnetites were later degraded to low magnetic and non-magnetic iron oxides during progressive alterations.

Neither the Weinsberg granite nor the Eisgarn and the Mauthausen granites which are the most wide-spread plutonic rocks in the areas studied are uniform and homogenous from the radiogeochemical point of view. Different subtypes distinguishable especially in thorium and the uranium concentrations locally also in potassium concentrations can be found in all three granites. Some of these differences are supposed to be primary divergences but many of them are considered to be products of a secondary redistribution.

The distinct redistributions of natural radioactive elements were observed in the close vicinity of the magnetic rocks evoking the Liebenau anomaly where the potassium has moved outside the magnetic body creating the outer rim of high potassium abundances. The magnetic rocks of the Liebenau and the Sandl structures are, moreover, enriched in thorium, locally also in uranium.

Rather different redistributions can be observed in the Weitra magnetic anomaly subarea. While the magnetic rocks found on the eastern slope of the Nebelstein Mt. are accompanied with remarkably increased uranium abundances followed by extremaly low thorium concentrations, the redistribution of natural radioactive elements is not so systematically developed in the shallower eastern part of the Weitra magnetic structure.

Even in the entirely covered Reingers magnetic structure some accumulation of increased potassium concentrations can be observed in the southern marginal part of this structure. The abundances of all three natural radioactive elements seem, on the contrary, to be decreased above the top part of the Reingers magnetic structure.

Appendix

List of Analysed Rocks from the Litschau – Kautzen area

(MS = magnetic susceptibility)

1) Ka 101: Weinsberg granite.
Pit quarry 600 m NE of the church in Ruders.
MS = 0,13×10^{-3} SI.
2) Ka 13: Marginal variety of the Eisgarn granite.
Abandoned quarry at the top of Hoher Stein, 3 km NW of Reinolz.
MS = 0,03×10^{-3} SI.
3) Ka 240: Marginal variety of the Eisgarn granite.
Small pit quarry 700 m ESE of the church in Gross-Radischen.
MS = 0,03×10^{-3} SI.
4) Ka 69: Číměř variety of the Eisgarn granite.
Boulders at the A/CZ frontier mark VI/65, 750 m NW of Pyramide.
MS = 0.03–0.06×10^{-3} SI.
5) Ka 129: Landštejn variety of the Eisgarn granite.
Small abandoned quarry 200 m NW of the church in Eisgarn.
MS = 0,05×10^{-3} SI.
6) LT 385: Landštejn variety of the Eisgarn granite.
S of Mittlerer Graben, 3 km SW of Schönau.
MS = 0.03×10^{-3} SI.
7) Ka 334: Altered green-red granite.
Boulders 200 m S of the church in Reinberg-Dobersberg.
MS = 0,1×10^{-3} SI.
8) LT 369: Hydrothermally altered granite.
The A/CZ frontier S of Černý kříž, 2 km NW of Rottal.
MS = 0.02×10^{-3} SI.
9) Ka 156: Greisen.
Stone chips 800 m ESE of the church in Hirschenschlag.
MS = 3,3×10^{-3} SI.
10) LT 31: Rubitzko granite.
Outcrop 50 m NE of the Rubitzkoteich Pond.
MS = 0.03–0.05×10^{-3} SI.
11) LT 44: Rubitzko granite.
Outcrop 450 m NE of the sport shooting-range in an abandoned quarry at Josefsthal.
MS = 0.04–0.06×10^{-3} SI.
12) LT 195: Rubitzko granite.
Schneiderbühel, the road 250 m SE of the custom hut.
MS = 0.01×10^{-3} SI.
13) LT 46: Coarse-porphyritic felsitic granite porphyry.
600 m N of the sport shooting-range at Josefsthal.
MS = 0.02×10^{-3} SI.
14) LT 121: Deformed felsitic granite porphyry with quartz veinlets.
The A/CZ frontier 450 m S of the point VI-16.
MS = 0.02–0.03×10^{-3} SI.
15) Ka 212: Felsitic granite porphyry.
Boulders 1 km SE of the church in Reingers.
MS = 0,01×10^{-3} SI.
16) Ka 268: Felsitic granite porphyry.
Outcrop 1250 m ESE of the church in Litschau.
MS = 0.03×10^{-3} SI.
17) LT 363: Deformed felsitic granite porphyry.
Rottaler Forst, 1,5 km W of Rottal.
MS = 0.05–0.06×10^{-3} SI.
18) Ka 1: Granodiorite porphyry.
Boulders in abandoned quarry at road from Reinolz to Brünn, 1 km NW of Reinolz.
MS = 10.5×10^{-3} SI.
19) LT 507: Biotite granodiorite porphyry.
Stone chips at the road from Grametten to Eisgarn, 2,5 km N of Eisgarn.
MS up to 7.2×10^{-3} SI.
20) Ka 16: Minette.
Stone chips 200 m W of Hoher Stein, 3 km NW of Reinolz.
MS = 7×10^{-3} SI.
21) LT 42: Diorite porphyry.
Chips 600 m WNW of Waldhauser.
MS = 9.4–10.7×10^{-3} SI.

List of Rocks Analysed for Trace Elements from the Litschau area
(Table 5)

1) LT 29: Coarse-porphyritic felsitic granite porphyry.
Boulders 250 m E of the Rubitzkoteich Pond.
MS = 0.03–0.04×10^{-3} SI.
2) LT 31: See above No. 10.
3) LT 42: See above No. 21.
4) LT 47: Silicified Rubitzko granite with macrosopically visible ore minerals (arzenopyrite).
500 m SE of the Rubitzkoteich Pond.
MS = 0.02×10^{-3} SI.
5) LT 121: See above No. 14.
6) LT 122: Hydrothermally altered Landštejn variety of the Eisgarn granite with pink colour.
150 m E of Kashof.
MS = 0.01×10^{-3} SI.
7) LT 307: Aphyric fine- to medium-grained two mica granite.
Top of Hofbauernberg NW of Litschau.
MS = 0.04–0.06×10^{-3} SI.
8) LT 369: See above No. 8.
9) LT 507: See above No. 19.
10) LT 18/25: Coarse-grained muscovite granite S of the mapped area (number of sample after GNOJEK & ZABADAL (1994).
2.5 km SSW of Hoher Berg (568 m).
MS = 0.01×10^{-3} SI.

List of Analysed Igneous Rocks from the Freistadt – Gmünd area

1) G 223: Gabbro.
Boulders at isolated cottage, 1300 m NW of Reinprechts.
MS = 0.55–2.7×10^{-3} SI.
2) G 170: Weinsberg granite.
New roadcut 200 m SW of Grünhof.
MS = 0.14×10^{-3} SI.
3) L 179b: Weinsberg granite.
300 m W of Mittereibenberg.
MS = 0.06×10^{-3} SI.
4) L 171: Xenolith of biotite gneiss in the Weinsberg granite.
600 m W of Stummer.
MS = 0.12×10^{-3} SI.
5) L 192: Biotite-garnet xenolith in the Weinsberg granite.
70 m W of the road crossing in Mühlberger.
MS = 0.69×10^{-3} SI.
6) L 179: Mauthausen granite.
300 m W of Mittereibenberg.
MS = 0.12×10^{-3} SI.
7) G 380: Mauthausen granite.
Boulders 300 m N of Muckenteich, 3,6 km SE of Karlstift.
MS = 0.13 – 0.14×10^{-3} SI.
8) G 55: Mauthausen granite.
Northern top of Gemeindeberg, 1100 m SE of Nebelstein.
MS = 0.1×10^{-3} SI.
9) L 153: Karlstift granite.
Southern slope of the elevation point 961 m, 500 m SW of Gotthardl.
MS = 6.8–7.1×10^{-3} SI.
10) G 73: Karlstift granite.
Southern slope of Schöneck, 6 km SE of Karlstift. NE part of the Leibenau magnetic alomaly.
MS = 3.6×10^{-3} SI.
11) L 114: Dark aphyric fine-grained biotite granite with high magnetic susceptibility (a variety of the Karlstift granite?).
Elevation point 912, 200 m SW of Wörnhör.
MS = 2.5–5×10^{-3} SI.
12) G 145: Karlstift granite.
Fuchsbühel, 1300 m NE of St. Martin, central part of the Weitra magnetic anomaly.
MS = 9–10×10^{-3} SI.
13) L 80: Dark inclusion in the Karlstift granite.
Jankusmauer, 400 m NW of the elevation point 1013 m.
MS = 3.1–4.2×10^{-3} SI.
14) G 482: Aphyric to sporadically porphyritic fine- to medium-grained two mica granite.
Small quarry at the road from Weitra to Wultschau, 300 m E of crossroad to Reinprechts.
MS = 0.02–0.04×10^{-3} SI.
15) L 239: Two mica granite.
450 m N of Gotthardl (the Liebenau gold anomaly).
MS = 0.02–0.03×10^{-3} SI.
16) G 131: Dyke of porphyritic fine-grained muscovite-biotite granite.
600 m SW of Sulz.
MS = 0.04×10^{-3} SI.
17) G 323: 7 m thick dyke of fine-grained muscovite-biotite granite.
Roadcut at western crossroad in Mitterschlag.
MS = 0.07–0.09×10^{-3} SI.
18) L 204: Diorite porphyry.
The hill summit S of Durchschnittsau.
MS = 23–30×10^{-3} SI.
19) L 143: Granodiorite porphyry.
400 m SE of Bum.
MS = 0.15–0.23×10^{-3} SI.

Explanation to the Geological Maps
(Plate 1)

- ❍ Geological map 1 : 50.000 of the nothern part of the area A (SW surroundings of Weitra)
- ❍ Geological map 1 : 50.000 of the southern part of the area A (Karlstift – Liebenau)
- ❍ Geological map 1 : 50.000 of the northern part of the area B (Litschau – Kautzen – Heidenreichstein)

Legend

Quaternary
1 = fluvial and deluviofluvial sediment, water basin
2 = peat bog
3 = deluvial deposit

Pleistocene – Pliocene
4 = quartz gravel

Upper Pliocene (?)
5 = limnic sand

Paleozoic
6 = quartz dyke (triangle = quartz boulder in deluvial sediments)
7 = mylonite, ultramylonite with mylonitized surrounding rock
8 = felsitic granite porphyry, felsitic and vitreous microgranite
9 = Rubitzko granite
10 = mafic dyke rock (a = diorite-granodiorite porphyry, b = lamprophyre)
11 = granite-granodiorite porphyry with anomalous magnetic susceptibility
12 = greisen, altered granite
13 = Nebelstein granitic complex
14 = dyke or small body of leucocratic muscovite (±biotite) aplitic granite, aplite, rarely pegmatite
15 = Landštejn variety of the Eisgarn granite
16 = Čímĕř variety of the Eisgarn granite
17 = aphyric medium- to fine-grained variety of the Eisgarn granite
18 = alternation of the aphyric variety and the Čímĕř variety of the Eisgarn granite
19 = Karlstift granite
20 = Mauthausen granite
21 = Weinsberg granite
22 = gabbro

Proterozoic
23 = biotite gneiss, migmatitic biotite gneiss

Other signs
24 = orientation of the long axis of K-feldspar phenocrysts
25 = strike and dip of foliation
26 = fault
27 = fault covered by Quaternary sediments
28 = approximately located boundary

References

BREITER, K. & SCHARBERT, S.: The Homolka Magmatic Centre – an Example of Late Variscan Ore Bearing Magmatism in the Southbohemian Batholith (Southern Bohemia, Northern Austria). – Jb. Geol. B.-A., **138**, 9–25, 1995.

BREITER, K. & GNOJEK, I.: Radioactivity of the highly fractionated Homolka granite in the Moldanubian pluton, southern Bohemia. – Bull. Czech. Geol. Surv. **71**, 2, 173–176, 1996.

CHLUPÁČOVÁ, M.: Magnetic and electric properties of rocks in the Nová Bystřice – Kozí hora locality. – MS Geofond Praha 1985 (in Czech).

DEBON, F. & LE FORT, P.: A chemical-mineralogical classification of common plutonic rocks and associations. – Transactions of the Royal Society of Edinburgh, Earth Sciences, **73**, 135–179, 1983.

DUDEK, A. et al.: Explanatory booklet to the general geological map of Czechoslovakia 1 : 200.000, sheet M-33-XXVIII Jindřichův Hradec. – NČSAV Praha 1962 (in Czech).

ERICH, A. & SCHWAIGHOFER, B.: Geologische Karte der Republik Österreich 1 : 50.000, Blatt 18 Weitra. – Geol. B.-A., Wien 1977.

FINGER, F., FRASL, G., FRIEDL, G. & HÖCK, V.: Geology and petrology of the Late Palaeozoic granitoid complex in the Southern Bohemian Massif (Austria). – Proceedings of the 1st Intern. Conf.on the Bohemian Massif, 70–72, Praha 1992.

FINGER, F., FRIEDL, G. & HAUNSCHMID, B.: Wall-rock-derived zircon xenocrysts as important indicator minerals of magma contamination in the Freistadt granodiorite pluton, Northern Austria. – Geol. Carpath., **41**, 2, 67–75, 1991.

FINGER, F. & HAUNSCHMID, B.: Die mikroskopische Untersuchung der akzessorischen Zirkone als Methode zur Klärung der Intrusionsfolge in Granitgebieten – eine Studie im nordöstlichen oberösterreichischen Moldanubikum. – Jb. Geol. B.-A., **131**, 255–266, 1988.

FUCHS, G. & SCHWAIGHOFER, B.: Geologische Karte der Republik Österreich 1 : 50.000, Blatt 17 Grosspertholz. – Geol. B.-A., Wien 1977.

FUCHS, G. & SCHWAIGHOFER, B.: Erläuterungen zu Blatt 17 Grosspertholz. – 66 S., Geol. B.-A., Wien 1978.

FUCHS, W. & THIELE, O.: Geologische Karte der Republik Österreich 1 : 50.000, Blatt 34 Perg. – Geol. B.-A., Wien 1982.

FUCHS, W. & THIELE, O.: Erläuterungen zu Blatt 34 Perg. – 31 S., Geol. B.-A., Wien 1987.

GNOJEK, I., JANÁK, F. & ZABADAL, S.: Ground magnetometry and ground gamma-ray spectrometry in Kautzen area – NW Lower Austria. – MS Geol. B.-A., Wien 1991.

GNOJEK, I., JANÁK, F. & ZABADAL, S.: Ground magnetometry and ground gamma-ray spectrometry in Weitra area. – MS Geol. B.-A., Wien 1992.

GNOJEK, I., JANÁK, F. & ZABADAL, S.: Ground magnetometry and ground gamma-ray spectrometry in Weitra – Liebenau area. – MS Geol. B.-A., Wien 1993.

GNOJEK, I. & ZABADAL, S.: Ground geophysical survey in the combined Schrems – Litschau – Kautzen area, NW Lower Austria. – MS Geol. B.-A., Wien 1994.

GNOJEK, I. & ZABADAL, S.: Ground geophysical survey in the Heidenreichstein – Schrems area, in the Kautzen area (additional survey) and a brief summary from the combined Schrems – Litschau – Kautzen area, NW Lower Austria. – MS Geol. B.-A., Wien 1995.

GÖD, R.: A Contribution to the Mineral Potential of the Southern Bohemian Massif (Austria). – Arch. f. Lagerst. forsch. Geol. B.-A., **11**, 147–153, 1989.

GÖD, R. & KOLLER, F.: Molybdän-führende Greisen in der südlichen Böhmischen Masse. – Mitt. Österr. Miner. Ges., **132**, 87–101, 1987.

GÖD, R. & KOLLER, F.: Molybdenite-Magnetite Bearing Greisens Associated with Peraluminous Leucogranites, Nebelstein, Bohemian Massif (Austria). – Chem. Erde, **49**, 185–200, 1989.

HEINZ, H., BIEDERMANN, A. & KÖHAZY, R.: Auswertung aeromagnetischer Daten im Bundesland Niederösterreich. – Proj. Ber. NC-6p/84, Geol. B.-A., Wien 1986.

HEINZ, H., SEIBERL, W. & BIEDERMANN, A.: Auswertung aeromagnetischer Daten aus dem Bundesland Oberösterreich. – Projekt OC-1c/84, Geol. B.-A., Wien 1987.

HEINZ, H. & SEIBERL, W.: Bewertung und Problematik aerogeophysikalischer Anomalien im österreichischen Bundesgebiet (Stand: Mitte 1990). – Abh. Geol. B.-A., **44**, 1–244, 1990.

KLEČKA, M.: Felsitic and vitreous dyke rocks from the vicinity of Lásenice near Jindřichův Hradec. – Čas. Mineral. Geol., **29**, 293–298, 1984 (in Czech).

KLEČKA, M.: Locality No. 6: Lásenice near Jindřichův Hradec (Vojířov gamekeeper's lodge), a subvolcanic felsic dike with tungsten mineralization. – Lepidolite 200, Field trip guidebook, 53–55. Masaryk University and Mor. Museum Brno 1992.

KLEČKA, M., BENDL, J. & MATĚJKA, D.: Rb-Sr-dating of acid subvolcanic dyke rocks – final magmatic products of the Moldanubian Batholith. – Mitt. Österr. Mineral. Ges., **139**, 66–68, 1994.

KLEČKA, M. & ŠREIN, V.: Locality No. 5: Homolka hill near Lásenice, a topas-bearing muscovite granite with Sn-(Nb-Ta) mineralization. – Lepidolite 200, Field trip guidebook, 47–51, Masaryk University and Mor. Museum Brno 1992.

KLEČKA, M. & VAŇKOVÁ, V.: Geochemistry of felsitic dykes from the vicinity of Lásenice near Jindřichův Hradec (South Bohemia) and their relation to Sn-W mineralization. – Čas. Mineral. Geol., **33**, 225–249, 1988.

KLOB, H.: Über das Vorkommen eines porphyrischen Granites im Raume Sandl – Karlstift – Liebenau bei Freistadt im oberösterreichischen Mühlviertel (Granit vom Typ Karlstift). – Tschermaks Min. Petr. Mitt., **14**, 311–323, 1970.

KOLLER, F., HÖGELSBERGER, H. & KOEBERL, C.: Fluid-Rock Interaction in the Mo-bearing Nebelstein Greisen Complex, Bohemian Massif (Austria). – Mineralogy and Petrology, **45**, 261–276, 1992.

KOLLER, F., GÖD, R., HÖGELSBERGER, H. & KOEBERL, C.: Molybdenite mineralization related to granites of the Austrian part of the South Bohemian Pluton (Moldanubicum) – a comparison. – Proc. Vol. of IAGOD Erzgebirge meeting, 318–326, Prague 1994.

KOUTEK, J.: The Mrákotín granite. – Rozpr. II. tř. Čes. Akademie, **34**, S. 18, Praha 1925 (in Czech).

LIEW, T.C., FINGER, F. & HÖCK, V.: The Moldanubian granitoid pluton in Austria: Chemical and isotopic studies bearing on their environmental setting. – Chem. Geol., **76**, 41–55, 1989.

LOCHMAN, V., BREITER, K., KLEČKA, M. & ŠREIN, V.: Muscovite granite with topaz (Homolka type) – an extreme differential in the SW part of Moldanubian pluton central massif (22–33 Veselí n. Lužnicí). – Zpr. geol. Výzk. v R. 1990, 95–96, Praha 1991 (in Czech).

MIČKE, R.: Geological mapping of the Central Massif of the Moldanubian Pluton between Slavonice and Staré Město pod Landštejnem. – MS. Diploma thesis. Dept. of Geology and Paleontology MU in Brno, 1994 (in Czech).

MUELLER, R.F. & SAXENA, S.K.: Chemical petrology. – Springer 1977.

NOCKOLDS, S.R.: Average chemical composition of some igneous rocks. – Bull. Geol. Soc. Amer., **65**, 1007–1032, 1954.

PŘICHYSTAL, A.: Final report on geological mapping in Kautzen-Reingers area (Niederösterreich). – MS Geol. B.-A., Wien, S. 20, 1992a.

PŘICHYSTAL, A.: Final report on geological mapping in Weitra -Karlstift area (Niederösterreich). – MS Geol. B.-A., Wien, S. 21, 1992b.

PŘICHYSTAL, A.: Final report on geological mapping in Liebenau area (the South Bohemian Pluton). – MS Geol. B.-A., Wien, S. 23, 1993.

PŘICHYSTAL, A.: Final report on geological mapping in Litschau area (the South Bohemian Pluton). – MS Geol. B.-A., Wien, S. 35, 1994a.

PŘICHYSTAL, A.: Description of documentation points in the sheet 1 : 50.000 Nr. 6 Waidhofen an der Thaya, sheets 1 : 10.000 Nr. 6–16, 6–17, 6–21 and 6–22. – MS Geol. B.-A., Wien, S. 44, 1994b.

PŘICHYSTAL, A.: Magmatic rocks with anomalous magnetic susceptibilities and subvolcanics from the Austrian part of the Moldanubian Pluton. – Mitt. Österr. Miner. Ges., **139**, 362–363, 1994c.
PŘICHYSTAL, A.: Bericht 1994 über geologische Aufnahmen im Moldanubikum auf Blatt 6 Waidhofen an der Thaya. – Jb. Geol. B.-A., **138**, 3, 473–474, 1995.

SEIBERL, W. & HEINZ, H.: Aerogeophysikalische Vermessung im Raum Weitra. – Ber. Projekt NC-6q/84. ÖAW/GBA, Wien 1986a.
SEIBERL, W. & HEINZ, H.: Aerogeophysikalische Vermessung des Weinsberger Waldes. – Ber. Projekt OC-1d/85, GBA, Wien 1986b.
SEIBERL, W. & HEINZ, H.: Aerogeophysikalische Vermessung im Raum Pregarten. – Projekt ÜLG-20/87–1, GBA, Wien 1988.
SCHARBERT, S.: Mineralbestand und Genese des Eisgarner Granits im niederösterreichischen Waldviertel. – Tschermaks Min. Petr. Mitt., **11**, 388–412, 1966.
SCHARBERT, S.: Rb-Sr Untersuchungen granitoider Gesteine des Moldanubikums in Österreich. – Mitt. Österr. Miner. Ges., **132**, 21–37, 1987.
SCHARBERT, S.: Rubidium-strontium systematics of granitoid rocks of the South Bohemian Pluton. – Proc. 1st Inter. Conf. on the Bohemian Massif, 229–232, CGÚ Praha 1988.
SCHWAIGHOFER, B.: Erläuterungen zu Blatt 18 Weitra. – Geol. B.-A., Wien 1978.

TALWANI, M. & HEIRTZLER, J.: Computation of magnetic anomalies caused by two dimensional structures of arbitrary shape. – In: Computers in mineral industries, part I., Stanford Univ. Publ. Geol. Sci. **9**, 464–480, 1964.

VON QUADT, A. & FINGER, F.: Geochronologische Untersuchungen im österreichischen Teil des Südböhmischen Batholiths: U-Pb Datierungen an Zirkonen, Monaziten und Xenotimen des Weinsberger Granits. – Eur. J. Mineral., **3**, Beih. 1: 281, 1991.
VRÁNA, S.: The Pelhřimov volcanotectonic circular structure. – Věst. Ústř. Úst. geol., **63**, 3, 143–156, 1990.

WALDMANN, L.: Aufnahmsbericht von Privatdozent Dr. Leo Waldmann über Blatt Gmünd-Litschau (4454). – Verh. Geol. B.-A., 38–41, 1930.
WALDMANN, L.: Geologische Specialkarte der Republik Österreich 1 : 75.000, Blatt 4454 Litschau und Gmünd. – Geol. B.-A., Wien 1950.
WALLBRECHER, E., DALLMEYER, R.D., BRANDMAYR, M., HANDLER, R., MADERBACHER, F. & PLATZER, R.: Kinematik und Alter der Blattverschiebungszonen in der südlichen Böhmischen Masse. – Arbeitstagung Geol. B.-A., 35–48, 1991.

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