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FRANTIŠEK FIALA:

DIABASOVÉ A WEILBURGITOVÉ HORNINY SPODNÍHO ORDOVIKU OD CHYŇAVY.

DIABASE AND WEILBURGITE ROCKS OF THE LOWER ORDOVICIAN AT CHYŇAVA.

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Diabasové a weilburgitové horniny spodního ordoviku od Chyňavy.

Diabase and Weilburgite Rocks of the Lower Ordovician at Chyňava.

(Předloženo 30. XII. 1950.)

V severozáp. křídle Barrandienu cca 7 km severně Berouna a asi 1 km jihových. od obce Chyňavy byl v r. 1943—44 hlubinným vrtem zastižen velmi zajímavý profil v spodnoordovických horninách, mezi nimiž daleko převládaly diabasové a weilburgitové vulkanity. Byly tu zjištěny vedle podřízených hornin sedimentárních *afanitické* a *mandlovcovité diabasy, diabasové porfyrity, albitické diabasy, diabasové,* event. *diabas-porfyritové granuláty, tufy* a *tufity, explosivní tufitické weilburgitové brekcie* a mělce intrusivní *weilburgity.* Charakter tufitických brekcií a některých tufů svědčí o tom, že řídká, H_2O bohatá láva pronikla při výlevu explosivně do mokrého a poddajného bahna a v něm granulovala (sr. G. MĚSKA—F. FIALA 1948). Tím vznikly namnoze smíšené horniny, v nichž vulkanická složka, drobně brekciovité struktury, obsahuje mezerní výplň sedimentární a kromě toho uzavírá úlomky břidličné, na okrajích kausticky přeměněné a místy pronikané weilburgitickými injekcemi. Rovněž do mezerní břidličné hmoty vnikají slabé injekce magmatické, převážně tvořené chloritem a menším podílem albitu.

Stářím odpovídají horniny profilu především spodní části stupně $d\gamma_1$ (šáreckých břidlic, spod. Llanvirn), menší část profilu zastupuje zde stupeň $d\beta$ (vrstvy komárovské, Skiddaw), podle J. ŠUFA a F. PRANTLA (1945) v této oblasti jen málo vyvinutý. V podloží této převážně vulkanické serie, v níž jen ojediněle vystupují polohy břidličné, se nalézají pískovce a slepence vrstev krušnohorských ($d\alpha$ — tremadok). Další podloží, vrtem nezastižené, tvoří algonkické břidlice.

Stručný přehled profilu.

0,00— 11,20 m	Efusivní amfibolický diabas, při podloží a nadloží mandlovcovitý, ve střední části afanitický.
11,20— 12,50 m	Diabasový tuf nazelenale světlešedý.
12,50— 20,50 m	Explosivní tufitická weilburgitová brekcie chyňavského typu, ve spodní části hrubšího zrna.
20,50— 21,80 m	Diabasový tuf (deskovec), stlačený.
21,80— 32,70 m	Mandlovcovitý diabasový porfyrit šedozelený až červenošedý.
32,70— 34,25 m	Písčitý jílovec s krevelovými oolity a hnízdy oolitického krevele.
34,25— 94,15 m	Afanitický, zelenavě šedočerný diabasový porfyrit s mandlovcovými okraji (34,25—37,00 a 93,00 až 94,15) a mandlovcovou vložkou mezi 55—57 m, mělce intrusivní. Vzorek z 60,5 m byl analysován kol. prof. dr. R. ROSTEM.
94,15— 96,70 m	Písčitý jílovec s oolity a hnízdy krevelovými.
96,70—106,00 m	Mandlovcovitý albitoligoklasový porfyrit, šedozelený, řídce porfyrický, v horní části řídce mandlovcovitý. Petrograficky představuje přechodní typ mezi porfyrity a weilburgity.
106,00—109,00 m	Tufitická explosivní weilburgitová mikrobrekcie.
109,00—111,00 m	Mandlovcovitý diabasový porfyrit.
111,00—112,60 m	Tmavošedá jílovitá břidlice spodních šáreckých vrstev $d\gamma_1$.
112,60—118,00 m	Tufitická explosivní weilburgitová mikrobrekcie.
118,00—160,50 m	Serie tufů a tufitů diabasových až porfyritových, místy s velmi podřízenými vložkami břidličnými, částečně slabě oolitickými, s chloritovými, místy krevelovými oolity.
160,50—165,30 m	Weilburgit porfyrický, částečně mandlovcovitý, mělce intrusivní. Vzorek ze 164 m byl analysován prof. drem R. ROSTEM.
165,30—188,00 m	Tufové brekcie, tufity, tufitické pískovce, šedočervené břidlice, mandlovcovitý diabas a pestré diabasové tufy ($d\beta$?).
188,00—203,00 m	Pískovce, droby a slepence krušnohorských vrstev (tremadok). V hloubce 202 m byla v nich zastižena strmá žilka bílého krystalického kalcitu s pyritem a druzovitým černým cronstedtitem, o němž bude podána dodatečně zvláštní zpráva.

Petrografie.

Weilburgity.

Po prvé v českém ordoviku byly v chyňavském profilu konstatovány horniny, odpovídající velmi značně weilburgitům, jež popsal E. LEHMANN (1941) z devonu lahnské oblasti v záp. Německu.

Lahnské weilburgity, zařazované dříve k diabasům, event. spilitům, jsou podle LEHMANNA mělce intrusivní, silně mandlovcovité horniny, složené především z *alkalických živců* a *chloritu;* obsahují hojně *karbonátů,* jež však podle LEHMANNA pocházejí z velké části z proražených sedimentárních devonských vrstev. Chemicky jsou weilburgity charakterisovány značným obsahem alkalií, velkým podílem krystalové vody a relativně menším obsahem CaO, což vyniká zejména po odpočtu podílu komplexního karbonátu, vázaného na — namnoze dost značný — podíl CO_2. Obsah TiO_2 je většinou rovněž značný. Weilburgity obsahují alkalické živce, většinou *albit,* dosti hojně však též *orthoklas* a *anorthoklas,* oba poslední často ve vrostlicích. Chemicky i petrograficky představují přechod mezi diabasy a keratofyry. Draselné a sodné typy vystupují jednak samostatně, většinou však se jedná o typy smíšené. Na intrusi weilburgitů se podle LEHMANNa váže genese lahnských železných rud. Velký obsah H_2O v magmatu podmínil jeho velkou pohyblivost i při snížené teplotě. Smíšením weilburgitových injekcí a úlomků s hmotou nastříknutých sedimentů (bahna) vznikaly horniny smíšené.

Výskyt weilburgitu u Chyňavy v hloubce 160,5 až 165,3 m popisovaného profilu je prvním známým výskytem těchto hornin v Československu. Současně je dalším dokladem pestré diferenciace středočeských t. zv. „diabasů" staropaleozoických a zajímavým a důležitým dokladem chemické a petrografické odlišnosti některých vulkanitů středočeského staršího ordoviku od běžného typu diabasového.

Hornina při okrajích je bělošedá, uprostřed mezi 162,20—164,20 m zelenošedá. Dost hojné *mandle* průměru 2—10 mm jsou vyplněny většinou *ankeritem* (nešumí v zředěné HCl), jen zřídka *kalcitem,* místy obsahují, hlavně ve střední části, *chlorit.* Dosti hojné jsou, zejména v nejspodnější části, vrostlice bělavých nebo narůžovělých živců, patřících jednak *anorthoklasu,* jednak *albitoligoklasu* až *oligoklasu.* Jen ojediněle se vyskytl *andesin.* Základní hmota, makroskopicky velmi jemná, se živcovými lištičkami zpeřeně sestavenými, je ve výbrusu dost zřetelně zrnitá. To svědčí, že se tu jedná spíš o mělkou intrusi než o výlev, jemuž by jinak nasvědčovala značně vyvinutá mandlovcová struktura.

Anorthoklasové vrostlice patří velmi ranní fázi krystalisace v hloubce. Jsou na okraji většinou silně zakalené, natavené a korodované. Ve světlejší střední části pozorujeme v nich většinou nepravidelně laločnatě omezené protáhlé struktury, vzniklé počínajícím natavením a rozpouštěním v době výstupu magmatu k povrchu. Podobné útvary popsal z natavených alkalických živců iranských vulkanitů, hl. Demavendu, EM. CHRISTA (1940) jako „drůbkovou strukturu" („Gekröse Struktur"). — V chyňavském weilburgitu byly natavené partie v některých místech silně karbonatisovány, což nasvědčuje značnému podílu CO_2 v magmatu. V jiných vzácnějších případech proniklo odmíšení albitické molekuly ve formě perthitu. *Základní hmota* má strukturu netypicky intersertální, drobně zrnitou, silně krystalickou. Obsahuje hojné tabulkovité *albitoligoklasy,* jevící ve výbrusu často typické rhombické průřezy. Mezi nimi je výplň z drobných krystalků *albitu, orthoklasu,* shluků šedozeleného *prochloritu* (i. l. 1,62), nepříliš hojných karbonatických *pseudomorfos po augitech,* event. *amfibolech,* hojného lamelkovitého *ilmenitu* a kostrovitých krystalků a zrnek *magnetitových.* V živcích je hojně uzavírán *apatit.*

Proti typům Lehmannovým vykazuje weilburgit od Chyňavy některé přechodné znaky, ukazující na bližší spojitost s diabasovým vulkanismem, především výskyt, i když nehojných, karbonátových pseudomorfos po mezerním augitu a výskyt andesinu. Pro jednoznačné pojetí obsahu karbonátu jakožto cizí, magmatem stržené příměsi, není tu dostatečných dokladů.

Chemická analysa provedená prof. drem R. ROSTEM, a její rozpočet je uvedena na str. 29. anglického textu. Velký obsah CO_2 (11,36%) činí její rozpočet podle běžných method přirozeně pochybným a nespolehlivým. Přes to byly provedeny dva rozpočty. V prvním (a) byly po jednoduchém odečtení CO_2 rozpočítány hlavní kysličníky analysy běžným způsobem na 100%. V druhém (b) byl dříve po příkladu Lehmannově odečten komplexní karbonát, složením odpovídající procentnímu zastoupení CaO, MgO a FeO v hornině. Oba rozpočty, uvedené s výslovným poukazem na nejistotu a nemožnost přesného rozpočtu, poskytují zajímavý pohled na chemismus horniny a ukazují zejména značný obsah alkalií, zejména v poměru k jiným „diabasovým" horninám středočeského paleozoika. Hornina stojí v blízkosti nosykombitického až Na-syenitického magmatu P. NIGGLIHO a má blízké vztahy k norským rhombovým porfyrům. Hodnota „*k*" v rozpočtu podle NIGGLIHO je relativně vysoká, zejména ve srovnání s analysami středočeských diabasů silurských; nedosahuje však hodnot, zjištěných v diabasech od Kařízku, patřících vrstvám dobrotivským $d\gamma_2b$ (FIALA 1951). Pro celkový vývoj diferenciace staropaleozoického středočeského vulkanismu má zjištění weilburgitů značný význam zejména vzhledem k vystupování mladoordovických, kaliem bohatých intrusí minetových a minveritových.

Explosivní tufitické weilburgitové brekcie.

S weilburgity a albitickými a diabasovými porfyrity u Chyňavy jsou spojeny mohutně vyvinuté tufy a tufity. Zvláštním typem v serii sdružených hornin jsou smíšené horniny, explosivní mikrobrekcie, vzniklé smíšením eruptivního a sedimentárního materiálu v době explose. Byly zastiženy v hloubce 12,50—20,50 m, 106,00—109,00 m a 112,80 až 118,00 m. Vytékající láva na styku s mořskou vodou, resp. zvířeným bahnem explosivně granulovala. Rozpadala se v drobné úlomky, silně odskelněné vlivem tuhnutí v prostředí naplněném vodními parami. Hmota zvířeného bahna se stala jednak tmelem usazující se brekcie, jednak větší i menší částice bahna byly vulkanickou brekcií obklopeny ve formě břidličných uzavřenin. Tyto uzavřeniny mívají průměr většinou několik centimetrů, na okraji bývají nezřídka ztemnělé následkem kaustického působení magmatu. Hojné magmatické *injekce*, složené z *chloritu, albitu* a někdy též *kalcitu* pronikají do břidlic. Ukazují na velkou pohyblivost weilburgitového a albiticko-diabasového magmatu v posledních fázích jeho vývoje a za teploty značně snížené; příčinou této pohyblivosti byl velký obsah vody v zbytkových magmatech.

Úlomky této mikrobrekcie jsou tvořeny polosklovitými, jindy holokrystalickými úlomky *weilburgitu,* velmi často agregátem jedinců albitoligoklasových *(oligoklasity)* s hojnými mandličkami albitovými, vzácněji chloritovými nebo kalcitovými. *Břidličná základní hmota* obsahuje zrnečka křemene, rudy, šupinky muskovitu a chloritu, shluky organického pigmentu, limonitu a leukoxenu. Břidličná hmota se šíří mezi úlomky granulovaného weilburgitu jako tmel mikrobrekcie. Do něho, stejně jako do břidličných uzavřenin pronikají výše zmíněné jazykovité vstřiky silně chloritického weilburgitu.

Afanitický diabasový porfyrit z hloubky 34,25—94,15 m.

Tento porfyrit je převážně kompaktní, zelenošedá až zelenavě černá hornina. Mezi 34,25—37,00 a 93,00—94,15 m, jakož i v rozmezí 55,00 až 57,00 m je vyvinut jako albitický diabasový mandlovec s hojnými mandličkami bílého kalcitu. Intersertální *základní hmota* se skládá z lištiček *albitoligoklasu,* mezi nimiž se nachází výplň z *albitu, chloritu, karbonatisovaného amfibolu, kalcitu, magnetitu, ilmenitu,* shluků *leukoxenových,* místy málo *křemene.*

Větší část této mělce intrusivní masy tvoří kompaktní, zelenavě černý, afanitický diabasový porfyrit s ojedinělými vrostlicemi plagioklasu *(andesin* až *labrador)* a drobnými chloritisovanými pseudomorfosami po tmavých součástkách v převládající základní hmotě intersertální struktury. *Základní hmota* obsahuje mezi *andesinovými* lištami *chloritovou výplň* s *magnetitem, ilmenitem, karbonátem* a *křemenem.* V některých polohách jsou vrostlice živcové kyselejší, patřice *andesinu* až *albitoligoklasu.* Místy jsou vrostlice kaolinisovaných živců, snad alkalických (?), dosti hojně uzavírajících idiomorfní bělavé krystalky *apatitové.* Některé polohy afanitického diabasu jsou *silně albitisovány,* tak na př. v 63 m a mezi 66—72 m. Místy byly konstatovány *žíly krystalického kalcitu* s hnízdy celistvého *krevele.* V jejich sousedství, jindy i mimo ně, je porfyrit značně oxydovaný a zčervenalý. Ve výbrusu pozorujeme čerstvé plagioklasy v silně limonitisované až zcela neprůhledné základní hmotě; zatlačující limonit vznikl jednak rozkladem ilmenitu a magnetitu v základní hmotě, jednak též oxydací chloritu základní hmoty.

Vzorek z 60,5 m byl analysován prof. dr. R. ROSTEM. Analysa a její rozpočet jsou uvedeny v anglickém textu. Celkem se blíží analyse intrusivního diabasu z dobrotivských vrstev $d\gamma_2b$ od Kařízku, publikované F. FIALOU 1951. Podle rozpočtu je hornina na hranici normálně gabbroidního a essexitgabbroidního typu P. NIGGLIHO.

Mandlovcovitý albitoligoklasový porfyrit z hloubky 96,70—106,00 m.

Tato šedozelená, hustě drobně mandličkovitá hornina stojí na přechodu mezi diabasovými porfyrity a weilburgity. Obsahuje hojné mandličky *kalcitové,* kalcitové s chloritickým středem, místy též *krevelem* a *Al-hydrátem* tvořené, ve spodní části též čistě *chloritové.* Hojné jsou vrostlice bělavých až červenavých živců, patřících jednak silně korodovanému *anorthoklasu,* jednak *albitoligo-*

klasu, vzácněji též kyselému andesinu. V anorthoklasu zarůstají apatity. Základní intersertální hmota obsahuje andesin a drobnější oligoklas, místy též albitoligoklas až albit, hojný chlorit s krystalky Ti magnetitu, ilmenitu a apatitu a chloritové pseudomorfosy po augitech. Hojné jsou uzavřeniny přeměněných břidlic.

Zrudněné písčité jílovce.

Diabasový porfyrit z hl. 34,25—94,15 m je patrně velmi mělce intrusivní. S obou stran je lemován polohami (32,70—34,25 a 94,15—96,70 m) světle červenošedého jílovce s dosti hojnými *krevelovými oolity* a hnízdy oolitického krevele. Hornina v jemně písčité a krystalickým kalcitem proniknuté základní hmotě obsahuje hojné úlomky sklovitých diabasů a tufů, většinou lemované krevelem a chloritem, někdy též karbonátem v rozmanitých sukcesích (sr. anglický text) jakož i typické *oolity krevelové,* někdy obsahující světlejší hnízdo *Al-hydrátové,* někdy též jádro albitové a polohy chloritové a kalcitové. V jílovci 32,70—34,25 m obsahuje základní hmota jílovcové i rudní partie hojné drobné *klence ankeritové.*

Tyto jílovce s krevelovými oolity a shluky krevelovými se vyskytují s obou stran diabasporfyritové intruse. V okrajích intruse vystupují rovněž mandličky krevelové (po případě krevelové a Al-hydrátové) a dosti hojné kalcitové žilky s hnízdy krevele. Tyto okolnosti nasvědčují původu krevele z hydrothermálních roztoků vázaných na vystupování diabasových (a ovšem i weilburgitových) hornin.

Obohacování železa v nejmladších fázích.

Jak už dříve zmíněno, pronikají nejmladší fáze weilburgitové a albiticko-porfyritové, velmi bohaté vodou a pohyblivé i za teploty značně snížené, do sedimentů v podobě tenkých injekcí, jež utuhly ve směs převládajícího chloritu a podřízeného albitoligoklasu. Složení těchto posledních nízko temperovaných magmatických frakcí se blíží složení leptochloritů. V nich se obohacuje železo a s nimi disperguje do okolní mořské vody, poskytujíc materiál pro srážení rudních oolitů, hojných v břidličných vložkách nebo mezerní hmotě brekcií a tufitů. V další fázi hydrothermální přechází množství železa do thermálních vodních roztoků, geneticky vázaných na erupce diabasové a weilburgitové. Tyto roztoky poskytovaly další a hlavní materiál pro vznik sedimentárních ložisek železných rud středočeského ordoviku.

Geologicko-paleontologické oddělení
Národního musea v Praze.

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Introduction.

In the northwestern limb of the Barrandian, about 7 km. north of Beroun and about 1 km. SE of the village of Chyňava, a deep drilling in 1943—44 encoutered a very interesting profil in the volcanites of the Lower Ordovician. This volcanic series is composed of *aphanitic* and *amygdaloidal diabases, diabase porphyrites, their granulates, tuffs, tuffites, albite diabases* and *tuffitic weilburgite explosion breccias,* and partly also of intrusive *weilburgites* (E. LEHMANN, 1941). The character of some volcanic rocks, especially of the tuffitic albite-oligoclase-diabase and weilburgite-breccias, proves that the highly fluid lava in its effusion invaded explosively into a wet, thin and yielding mud and granulated in it. Thus *mixed rocks* were formed of the type of *schalsteins* and *explosion breccias.* The volcanic series encountered in the drilling belongs partly to the stage of the Šárka Shales ($d\gamma_1$), its smaller, lower, part represents perhaps also the Komárov Beds ($d\beta$), which according to J. ŠUF and FERD. PRANTL are only little developed in the area. Thus the volcanic series corresponds to the stages of the Llanvirnian and Skiddavian. Underlying the volcanic series are sandstones and conglomerates of the Krušná Hora Bed ($d\alpha$ = Tremadoc). Still farther below and not reached by the drilling are Algonkian shales.

The wider vicinity of Chyňava was surveyed in the past by K. M. LIPOLD (1863), JOS. VÁLA and R. HELMHACKER (1877), J. KREJČÍ and R. HELMHACKER (1879, 1885), J. KREJČÍ and R. FEISTMANTEL (1885, 1890). Fairly detailed stratigraphical and volcanological remarks are contained in the papers by JOS. WOLDŘICH (1916, 1917), and in part also in the "Study of the Iron Ores of the Lower Silurian of Bohemia" by L. SLAVÍKOVÁ and FR. SLAVÍK. The explanations to the Geological Map, Sheet Kladno (L. ČEPEK — O. HYNIE — O. KODYM — A. MATĚJKA), and the study of G. MĚSKA and F. PRANTL on the Skalka Quartzites (1946) refer to the area by briefly summarizing the facts. Recently the area was surveyed and described by J. ŠUF and F. PRANTL (1945).

My work is on purpose restricted in scope and deals exclusively with the characteristics of the volcanites encountered in the drilling. The other rocks were taken into consideration only in so far as this proved necessary for judging of the position of the volcanic series.

In a brief survey the sequence of the rocks encountered in the drilling is as follows:

0.00— 11.20 m.	effusive amphibole diabase, partly amygdaloidal
11.20— 12.50 m.	diabase tuff
12.50— 20.50 m.	tuffitic weilburgite explosion breccia (Chyňava type)
20.50— 21.80 m.	diabase tuff
21.80— 32.70 m.	amygdaloidal diabase porphyrite
32.70— 34.25 m.	sandy argillite with hematite oolites and nests of oolitic hematite
34.25— 94.15 m.	aphanitic diabase porphyrite amygdaloidal to the bords, with intercalations of amygdaloids in 55—57 m. and with breccias in 66—72 m.

94.15— 96.70 m.	shales and oolites with nests of hematitic ore
96.70—106.00 m.	amygdaloidal albite-oligoclase porphyrite
106.00—109.00 m.	tuffitic weilburgite explosion microbreccia
109.00—111.00 m.	amygdaloidal diabase-porphyrite
111.00—112.60 m.	dark argillaceous shales of the lower $d\gamma_1$ (Šárka Beds)
112.60—118.00 m.	tuffitic weilburgite explosion microbreccia
118.00—160.50 m.	series of diabase and weilburgite tuffs, here and there with subordinate shaly intercalations, partly slightly mineralized with chloritic, here and there hematitic oolites.
160.50—165.30 m.	porphyritic, partly amygdaloidal weilburgite
165.30—188.00 m.	diabase tuffs, tuffites, diabases and shales ($d\beta$?).
188.00—203.00 m.	sandstones, graywackes and conglomerates of the Krušná Hora Beds ($d\alpha$ = Tremadoc). In the depth of 202 m. they contains a vein of white crystalline *calcite* accompanied by *pyrite* and *cronstedtite.* This mineral will be described elsewhere.

Petrographical Characterisation of the Different Rocks.

The **effusive amphibole diabase** of the depth **0.00—11.20** m. is in its middle and largest part (3.50—10.00 m.) developed as a black hypocrystalline aphanite penetrated by thin limestone veinlets. In its upper part (0—3.5 m.) a strongly weathered amygdaloid is developed; at the base, between 10.00—11.20 m., the rock is likewise amygdaloidal, containing *calcite,* partly also *chlorite amygdules,* 2 mm. in diameter. The aphanitic diabase of the middle part has microscopically an intersertal texture. It contains laths of *labradorite* (extinction $29^0/29^0$, index of refraction $\alpha' \overline{\overline{<}} 1.556 < \gamma' < 1.563$), measuring 0.01×0.1 to 0.05×0.5 mm. The interstitial spaces are filled with a slightly greenish to colorless vitreous interstital material, now partly chloritized, here and there with larger segregated chlorites (index of refraction between 1.59—1.60). In this groundmass there are abundant skeletal crystals and granules of *magnetite,* more rarely of *ilmenite,* columns of pink, non-pleochroic *Ti-augite* (0.06×0.12 mm.) of hourglass structure, at the margin here and there changed into calcite. Here and there slim long-columns of *basaltic amphibole* (0.01×0.03 to 0.02×0.2 mm.) are abundant. This shows a higher double refraction than the augite and a distinct pleochroism between a pale yellowish and a yellowish brown to reddish colour. Here and there aggregates of thin amphibole needles sit at the end of the long augite columns. Less abundant are minute lamellae of *biotite,* rare are minute *apatites.* The *ilmenite* is partly *leucoxenized.* Here and there we can see chloritic pseudomorphs on original *olivine* crystals, 0.15×0.4 mm.

The **diabase tuff** from a depth of 11.20—12.50 m. is a fine-grained, yellowish to greenish light gray rock. It is composed of minute particles of vitreous ash, somewhat chloritized, mostly microvesicular and amygdaloidal. Further it contains fragments of *plagioclases, amphibole, augite, biotite* and some *quartz.* The interstitial material is formed by an aggregate of *quartz* and *kaolin,* here and there by *serpentine,* occasionally also by *calcite.*

The **tuffitic weilburgite explosion microbreccia (Chyňava type)** from a depth of **12.50—17.00** m., with minute fragments of finely microvesicular and strongly devitrified weilburgites and almost holocrystalline oligoclasites up to 2 mm. in diameter. The interstitial material, on the whole not very abundant, is mostly shaly, more rarely carbonatic. It is very often penetrated by chlorite. Sometimes these rocks contain inclusions of brownish gray shales, at the margin darkened by the contact action of the magma (baking, i. e. coking of the coaly pigment). Here and there the interstitial material contains rounded *oolites* up to 3 mm. in diameter, mostly formed of *chlorite,* and further fine fragments of microvesicular glass. The limit of the inclusions against the volcanic material is here and there sharp, elsewhere the merging of the shaly substance into the diabase microbreccia is distinctly visible already to the naked eye or under a magnifying glass.

The rock was formed by the injection of a hot magma into a wet mud. The lava strongly granulated and tore up into minute fragments which mixed with the mud (G. MĚSKA — F. FIALA, 1948). The material of the mud forms now on the one hand the cement of the breccia and on the other hand the shaly inclusions mentioned.

The f r a g m e n t s o f v o l c a n i c r o c k s in the microbreccia have an irregular, mostly lobate shape of 0.1×0.1 to 0.7×1.5 mm. in size. In most fragments belonging to the weilburgites and oligoclasites the material is today almost holocrystalline in consequence of devitrification. It is formed here by one feldspar individual, there by an aggregate of *albite-oligoclase* ($\gamma' > 1.535 \geqq \alpha'$), sometimes also of *albite.* Here and there occurs also a more basic plagioclase *(oligoclase)* with an index of refraction of $\gamma' \geqq$ the index of refraction of the Canada balsam $> \alpha'$. Within the fragments thick-walled, grayish brown, elongated vesicles are abundant, here and there with purely vitreous walls. They are sometimes empty, in other cases filled with *albite,* more rarely with *chlorite* or *calcite.* The shape is mostly rounded, sometimes pyriform or tubular-elongated. Some fragments are strongly penetrated and replaced by *calcite* in which are calcite or chlorite amygdules. In the walls of the vesicles abundant crystallites and trichites are secreted. — Often these oligoclasite fragments contain granules of *quartz,* or also some *apatite* and granules of *pyrite.*

The not too abundant i n t e r s t i t i a l m a t e r i a l between the clastic fragments in the breccia has the character of a s i l t y s l a t e. It contains minute granules of *quartz* (⌀ 0.012 mm.), some *feldspar,* abundant *chlorite* flakes and a brown *organic pigment,* here and there blackened at the contact. Rather abundant are granules of *leucoxene* and fine *muscovite* flakes. Here and there narrow magmatic injections, rich in grayish green *chlorite* and containing fine lath-shaped *albite-oligoclases,* penetrate this interstitial material.

Larger s h a l y i n c l u s i o n s measuring 2—4 cm. in diameter are at the margin usually baked i. e. darkened in consequence of the accumulation of coked bitumen. Petrographically they are of the same character as the interstitial material dsecribed above, which was formed by the mechanical dispersion of the whirled up mud at the time of the eruption and granulation of the lava. They contain granules of *quartz,* opaque *ore, organic pigment* and *limonite* aggregates in the dully greenish gray groundmass rich in *chlorite.* The inclusions are penetrated from the contact limit by tonguelike off-shoots of *weilburgite,* here and there detached and then forming inclusions in the shales. Similar zones of weilburgite material separate from each other and gradually isolate the different parts of the shaly cement. This reaches even microscopic dimensions and results in a microbrecciated structure of the rock. At the margin of such magmatic zones minute chlorite amygdules (diameter 0.02 mm.) are abundant, often bordered by carbonate mixed with limonite.

I described examples of similar microbreccias and mixed rocks formed by the scattering of a thin, granulating lava in mud and by the injection of the interstitial material and shales with low-temperatured younger magmatic phases from the diabase series at KAŘÍZEK (FIALA, 1951). Very abundant and typical examples are given by E. LEHMANN (1941) from the Lahn-Dill Devonian of Germany.

At 17 m. occurred grayish black *shales* with abundant *oolites,* 2—4 mm in diameter. The main component of the oolite is finely lamellar *leptochlorite,* green, here and there brownish in consequence of oxidation. Between crossed nicols the oolites show a deformed uniaxial cross and positive double refraction. Sometimes the oolites are pure chlorite, in other cases they contain a mixture of chlorite and silt; sometimes a nest of bright red *aluminium hydrate* is found in the centre of the amygdules. Here and there large pisolitic formations occur, in which a mixture of oxidized *cslorite* and *hematite* envelopes a fragment of chloritized volcanic glass.

A similar **tuffitic breccia** of somewhat coarser grain follows at **17.00—20.50** m. Fragments of finely vesicular diabase glass, amygdaloidal intersertal diabases and oligoclasites, more rarely fragments of calcitic aggregates and gray shales with oolites are cemented by a greenish, clayey-chloritic interstitial material with isolated flakes of light gray mica and feldspar fragments.

20.50—21.80 m. Compressed, pumiceous, granulated **diabase tuff, Schalstein,** soft and crumbly.

Between **21.80—32.70** m. occurs an **amygdaloidal diabase porphyrite,** grayish green or reddish gray, with calcitic, ankeritic, or chloritic, rarely also hematitic amygdules, 0.05—2.00 mm. in diameter. The chloritic amygdules have a radially fibrous chloritic border around the pure serpentine centre. Here and there the amygdules are filled with *hematite,* red *aluminum hydrate* and with *calcite;* at the margin appears some *chalcopyrite.* In other cases the margin of the calcitic amygdules is formed by *albite* (extinction angle $14^0/16^0$). Infrequent phenocrysts are formed by *acide andesine* (14^0), or *oligoclase-andesine* ($10^0/12^0$) and by carbonatized and chloritized *augite.* Here and there occur carbonatic-serpentine pseudomorphs on olivine. The *groundmass* is intersertal to pilotaxitic with small crystals of *basic oligoclase* and *oligoclase-andesine,* skeletal crystals of *magnetite, ilmenite* and *basaltic amphibole* in the strongly chloritized interstitial filling. The chlorite belongs to the *grochauite* (index or refraction between 1.580 and 1.599), here and there also to *prochlorite* (index of refraction about 1.61) ; it is usually replaced by calcite. *Leucoxene* occurs abundantly, some *quartz* here and there; some *epidote* is enclosed in some feldspars. Here and there appears a reddish brown colouring of the chloritic groundmass in consequence of the oxidation and limonitization of the enclosed iron ores. — Between 30.00—30.40 m. the reddishly weathered amygdaloid contains veinlets of white *calcite.*

Between 32.70—34.25 m. follows a fine-grained **tuffitic sandy argillite,** dark reddish gray, fairly hard and slightly mineralized. It contains abundant minute white rhomboids of *ankerite* (0.08—0.22 mm.), abundant clastic granules of quartz and feldspar (albite-oligoclase), fragments of carbonatized diabase glass, infrequent hematite oolites (1 to 3 mm. in diameter), and sporadic remains of brachiopod valves. Here and there there are *nests of oolitic hematite,* several cm. in diameter. — The lower part of this layer, between 33.75—34.25 cm., contains a fairly large share of diabase amygdaloids.

In the thin section the **mineralized hematite part** contains abundant to closely crowded together *hematite oolites* (diameter 1—3 mm.), round to oval, dark red. At the margins they are mostly of non-transparent *hematite,* reflecting dark red; the centre is often clearer to red translucent, richer in *aluminium hydrate.* The oolites are largest in the centre of the mineralized part and grow smaller towards the margins. — More rarely distinctly stratified oolites occur, with an allothigenous core (quartz or fragment of fedspar) enveloped by a reddish gray layer of hematite and chlorite; then there follow a thick chlorite layer and outside a hematite envelope with thin intercalations of calcite. — Other oolites are formed by a granular mixture of *albite* and *chlorite,* bordered by massive hematite, which penetrates from the margin between the granules of the central filling.

At the margin of the hematite aggregates we find very abundant oolitic formations of very diverse composition, e. g.: 1. a calcitic core surrounded by a zonal margin of hematite and silt; 2. the centre is formed by an aggregate of hematite and albite, around which is chlorite with zones of limonite; the margin is formed by hematite with zones of chlorite; 3. the albite centre is bordered by chlorite with torn-off granules of quartz, the margin is carbonatic, limonitized; 4. the chloritic core with enclosed granules of sand is enveloped by alternating zones of hematite and of carbonate and chlorite; 5. a mixture of albite and calcite penetrated by hematite; 6. a fragment of a brachiopod valve surrounded by chlorite and hematite.

Between the oolites is a massive hematitic filling in which minute *ankerite rhomboids* occur, here and there with faces bent in saddle-shape, of an average size of 0.1—0.22 mm. They enclose just as the hematite groundmass a very fine, silty skeleton of quartz and feldspar with a diameter of the granules of 0.01—0.06 mm. Hematite penetrates sometimes from the margins into these ankerite rhomboids.

The non-mineralized part, which encloses the hematite aggregates just described, is reddish gray, silty. I contains quartz silt cemented by a calcitic cement forming larger individuals of 0.2—0.4 mm. in diameter. From the margins the calcite is replaced here and there by *hematite.* Here too minute *ankerite rhomboids* of the type described occur in a great quantity. Abundant are shattered veinlets of calcite. In addition we find here abundant oolitic formations of very diverse composition, e. g.: 1. A quartz aggregate with minute crystals of albite and sporadic flakes and zones of chlorite is bordered by narrow zones formed of a) chlorite, b) hematite, c) carbonate, d) hematite. 2. Quartz with interspersed albite crystals, bordered by chlorite and calcite. 3. A fine-grained aggregate of albite surrounded by chlorite or calcite and chlorite. 4. A fragment of quartz surrounded by a mixture of chlorite and albite. 5. Fragments of feldspars surrounded by hematite. 6. Purely chloritic oolites. In addition to oolites are here inclusions of oligoclasites and carbonatized fragments of diabase glass with albite and opal amygdules. In the whole series of these oolites it is evident that the original material around which the oolite formed was a fragment of lava penetrating the mud. The carbonate, chlorite and hematite were precipitated around it.

In the lower part of this tuffitic sandy argillite near the limit against the underlying amygdaloid larger portions (inclusions or offshoots) of *albite porphyrite* appear. In addition to the normal calcite and chlorite filling bright red *hematite* is aggregated, and sometimes veils entirely the structure of the groundmass.

Farther down, between **34.25—94.15 m.,** a thick mass of **diabase porphyrite** follows, amygdaloidal at the margins (34.25—37.00 and 93.00—94.15 m.) and between 55—57 m., otherwise compact, aphanitic.

34.25—37.00 m.: amygdaloidal albite diabase, greenish gray, with very typical amygdules of white *calcite,* 4—8 mm. in diameter. The amygdules are formed by an aggregate of irregular calcite granules or of such granules running radially from the centre to the surface. There are no phenocrysts. The rock, of minutely intersertal texture, is composed of laths of *albite-oligoclase* (index of refraction $\alpha' \leqq 1.533 < \gamma' < 1.545$), measuring 0.06×0.4 to 0.02×0.8 mm. Between them there is a mesostasis composed of *albite* with interspersed *apatite* needles, of granules of *calcite,* flakes of *chlorite,* chloritized columns of augite and *amphibole,* abundant crystals of *magnetite* (100), and minute skeletal crystals of ilmenite. Here and there are aggregates of *leucoxene* replacing the ilmenite or bordering the chlorite pseudomorphs on dark constituents. Here and there a little *quartz.*

37.00—55 m.: aphanitic diabase porphyrite, greenish gray to greenish black, compact, with a minutely intersertal groundmass. It contains sporadic larger phenocrysts of greenish white, here and there brownish pink feldspar *(andesine,* sometimes also *labrador),* and here and there also whitish angular inclusions of metamorphic sediments. Chlorite pseudomorphs on dark constituents belong to the original *olivine,* partly perhaps also to *amphibole* or *augite.* The groundmass of intersertal texture predominates. Lath-shaped *andesines* (0.04 $\times$ 0.1 to 0.04 $\times$ 0.2 mm.) enclose triangular areas filled with *chlorite,* chiefly *pennine.* Enclosed in the chlorite are small crystals of *magnetite,* skeletal, comb-shaped crystals of *ilmenite,* nests of *carbonate,* here and there some *quartz.* Here and there abundant amygdaloidal cavities filled with quartz or a mixture of *quartz* and *albite.*

In these porphyrites we find fairly abundant columnar crystals of whitish *apatite.* They are grown into strongly corroded crystals of feldspar or into kaolin aggregates representing the remnants of such original feldspar phenocrysts. These apatite crystals are 7.15 mm. long and up to 3 mm. wide. The index of refraction is near that of oil 1.639. In a thin section the mineral is hyaline, without pleochroism; it shows detachment craks in the longitudinal direction, a negative charakter of length, and a low double refraction. Chemically R. ROST proved that it had a phosphorus content. — The compact material, into which the apatite crystals are usually grown, has an index of refraction between 1.540 and 1.559, and is a mixture of kaolin and feldspar remnants. It corresponds to decomposed and strongly kaolinized feldspar. Such apatite crystals were found e. g. at 43 m., 46 m., 47 m. etc.

The sample of rock from 47 m. is a slightly more acidic porphyrite containing feldspars belonging to *oligoclase-andesine* to *oligoclase,* considerably replaced by calcite. In the interstitial, kaolinized and carbonatized groundmass there are abundant granules of *titanite* and sporadic aggregates of *pyrite.*

Here and there the diabase porphyrites are penetrated by abundant steeps fissures filled with white calcite.

At **55—57 m.** minutely **amygdaloides diabase** appears indicating perhaps the upper limit of the lower lava stream or underflowing lava mass. It is greenish gray, contains minute calcite amygdules, phenocrysts of feldspars 1 cm. in diameter, and inclusions of jaspopal. Under the microscope it shows a very fine hyalo-ophitic texture passing into a hyalopilitic texture. It contains very narrow lamellae of *andesine* (0,005 $\times$ 0,06 to 0,02 $\times$ 0,2 mm.) in a chloritic, here and there carbonatized, originally vitreous groundmass, in which granules of *ilmenite* and *magnetite* are rather abundant.

57,00—93,00 m.: aphanitic diabase porphyrite, dark greenish gray, with infrequent phenocrysts of feldspars (diameter 0,6—1 cm.) and minute phenocrysts of chloritized dark components, chiefly *augite.* The feldspars of the phenocrysts belong for the larger part to the original *basic andesine* to *labrador.* They are now strongly kaolinized and partly carbonatized so that their central, more basic part is mostly indeterminable. At the margin they are overgrown by a low-refracting *albite-oligoclase.* The chloritic pseudomorphs on the dark constituents contain here and there some *calcite* and *quartz.* The groundmass, rich in *chlorite,* contains laths of *albite-oligoclase,* aggregates of *carbonate* and *sericite,* abundant crystals of leucoxenized *Ti-magnetite,* crystals of *apatite, quartz* granules and remnants of clouded *glass.* The six-sided apatite crystals grow sometimes into the feldspars.

The sample from 60,5 m. was analyzed by Dr. R. ROST.

	Weight % of the analysis	Molecular %
SiO_2	41,58	49,13
TiO_2	2,15	1,91
Al_2O_3	16,42	11,47
Fe_2O_3	2,59	10,09
FeO	7,86	
MnO	0,17	0,17
CaO	6,45	8,21
MgO	7,32	13,04
BaO	0,00	—
K_2O	1,63	1,23
Na_2O	3,95	4,54
P_2O_5	0,41	0,21
H_2O +	4,75	
H_2O —	0,43	
CO_2	4,70	
S	traces	
Total	100,41	100,00

Calculation according to OSANN

A	5,77	a	4,6
C	5,70	c	4,6
F	25,81	f	20,8
		n	7,9
		s	51,04
		k	0,71

Calculation according to NIGGLI

si	100,5	k	.21
al	23,5	mg	.56
fm	47,9	si′	147,2
c	16,8	qz	—46,7
alk	11,8	ti	3,9
		p	.44
		c/fm	.35
		section	III

Specific gravity . . . . . 2,74.

According to the calculation the rock is on the limit of magmata of the normal gabbroid and the essexite-gabbroid type of P. NIGGLI.

Abundant are in this aphanitic diabase porphyrite strongly albitized layers as e. g. at 63 m. and between 66—72 m. The original feldspar, belonging predominantly to *andesine,* is sometimes kaolinized and surrounded by *albite.* In other cases the albite forms abundant intercalations in some plagioclase laths and replaces the original feldspar along the fissures; in other cases the albite develops independently on the crystal boundaries of the original feldspar in separate individuals. Thus a secondary structure develops here and there, when the younger turbidly yellowish *albites* (or the *albite-oligoclases* mostly rich in albite) growing up on the older plagioclases touch each other with their ends and enclose areas filled with remnants of the older, decomposed plagioclases often completely kaolinized. In addition to albite also *calcite* and slightly greenish, pale *chlorite* are formed in this process from the feldspars. In addition to andesine are represented in the interstices between the secondary albites brownish, strongly chloritized and carbonatized *Ti-augite,* further *titanite-leucoxène* forming aggregates of dark gray granules, and abundant columns of *apatite,* especially marked between 71,40—72,00 m.

Between 66—72 m. the diabase porphyrite is, as already mentioned, considerably a l b i t i z e d, strongly crushed, to that in some layers typical t e c t o n i c b r e c c i a s are developed.

At the lower limit of the aphanitic diabase porphyrite, approximately between 93,00—94,15 m., an a m y g d a l o i d a l a l b i t e d i a b a s e is again developed. It contains yellowish phenocrysts of *albite-oligoclase,* 3—4 mm. in diameter, of a yellowish coloration, mostly fresh, under the microscope sometimes corroded. Index of refraction $\gamma' > 1.533 > \alpha'$, optically positive, extinction in 010 15—16^{0}. In some samples the feldspar phenocrysts are a more basic *oligoclase* or *oligoclase-andesine,* and they are then replaced by a mixture of *albite, chlorite, calcite.* The interstices between the feldspars are filled with a *chloritized groundmass,* enclosing *apatite* needles, *magnetite* granules, strongly leucoxenized *ilmenite,* small crystals of *titanite,* aggregates of carbonate, more rarely *secondary quartz.*

At 83,40 and 84,00 m., less markedly elsewhere, there are developed in the diabase porphyrite veinlets of calcite containing nests of metal gray, lustrous *hematite.* In the vicinity of these veinlets the diabase is reddened to a thicknes of about 1 cm. In such reddened zones the feldspars are practically unchanged, but the interspaces between them are filled with a brownish red material rich in *limonite.* In the centre of such limonitized areas are preserved remnants of the original interstitial chlorite. The ore content of the limonite is derived principally from the exidation of the magnetite and ilmenite granules of the groundmass; in the darkest parts we observe only feldspar laths, little changed, in the non-transparent, dense reddish brown interstitial material.

Between **94,15—96,70 m.** was encoutered a layer of **sandy argillite** with abundantly interspersed *hematite oolites* and there with nests of *hematite* ore. It corresponds completely to the layer described above in the rocks overlying the diabase porphyrite and amygdaloid at 32,70 and 34,25 m. — The rock is reddish gray to red; here and there it contains portions of *red jasper* penetrated by white crystalline *calcite.* The *hematite oolites* have mostly a diameter of 0,5—1 mm. The main part of the rock corresponds to an imperfectly bedded, finely sandy shale with clastic, mostly angular granules of *quartz,* ⌀ 0,02—0,15 mm., and with a slight admixture of organic pigment. Here and there it contains *quartz-albite* injections and flakes of *light mica.* Here and there *hematite oolites* occur, sometimes completely massive, formed by reddish black hematite; elsewhere they are composed by alternating thin layers of dark hematite and lighter red *aluminum hydrate.* In other cases the hematite, or the aluminium hydrate, surrounds a central clastic fragment of feldspar or quartz, or a shale pebble,

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or an aggregate of chlorite flakes. Thin limestone off-shooths penetrate the rock and the oolites.

The mineralized parts are composed of rusty red oolites, 0,6—1 mm. in diameter, sometimes exclusively of hematite, in other cases with lighter centres richer in aluminum hydrate, which have usually a minutely clody texture. The interstitial material between the oolites is formed by *calcite* mixed with silt, in other cases by a mixture of *quartz, albite,* infrequent *hematite* flakes, and *calcite.* In other cases the interstitial material is hematite, which contains fine quartz granules, 0,004 mm. in diameter. Where oolites are less abundant, the interstices are filled with sandy shaly material and angular fragments of quartz, flakes of chlorite and light mica, and fine granules of ore.

The **amygdaloidal albite-oligoclase porphyrite** from a depth of 96,70—106,00 m. is a grayish green rock, sparsely porphyritic. In the upper part between 94,70 and 101,00 m. it is minutely amygdaloidal. The amygdules, 2—5 mm. in diameter, are calcitic, in other cases calcitic with a chloritic centre. Here and there in addition fairly abundant minute amygdules occur, which are filled with dark red hematite and light red to yellowish aluminum hydrate. *Chalcopyrite* is usually present in the chlorite amygdules. On the fissures of the diabase are covers of *nacrite,* index of refraction near 1,55. In its uppermost part the porphyrite is penetrated by steep fissures filled with white crystalline *limestone,* which here and there contains nests and zones of *hematite.* — In the lower part, between 101—106 m., the amygdaloid contains dark green, flat chlorite amygdules, more rarely calcite amygdules, usually larger, sometimes attaining a diameter of several centimeters.

The amygdaloidal porphyrite contains fairly abundant phenocrysts of whitish to reddish feldspars, of about 1 cm. in diameter. They belong to very strongly corroded and reabsorbed *anorthoclase,* in other places to *albite-oligoclase,* more rarely to *acid andesine.* — Inclusions of pelocarbonates and dark gray slates are very abundant in the amygdaloid. They are somewhat contact-metamorphosed and *at the margin* we can observe not infrequently a *narrow darkened zone* formed by the coking of the bituminous pigment. The boundary between the inclusions and the diabase are sometimes sharp, in other cases not. Here and there we observe distinct, cord-like *injections* of microvesicular porphyritic *glass* penetrating mostly in the direction of the bedding into the slaty inclusions. Near the inclusions the porphyrite shows a lighter reaction rim with a great amount of minute, chloritic, blackish green amygdules. But at a small distance from the inclusions the porphyrite assumes its normal grayish green colour, the amygdules are larger and mostly of calcite.

Of f e l d s p a r p h e n o c r y s t s we observe in the porphyrite not too abundant, especially pink phenocrysts of *anorthoclase,* sometimes composed of several granules. They are mostly s t r o n g l y c o r r o d e d to considerably reabsorbed, and at the margin they are not infrequently overgrown by a zone of younger albite-oligoclase. In some cases reabsorption is so strong that only small remnants remained of the original crystal. In the marginal, strongly vitrified zone there occur smaller remnants of the original anorthoclase. In the sample from 104,5 m. the strongly corroded core of anorthoclase is penetrated by numerous corrosions, in which the porphyritic groundmass penetrates into the interior of the feldspar crystal; the groundmass is here strongly *chloritic*, with abundant, minute chlorite amygdules and fine secreted laths of *albite*. These corrosions penetrate on the one hand the remelted outer zone of the anorthoclase crystal, dividing it into isolated islands, on the other hand they penetrate to a great extent through the cleavage fissures to inside the crystal forming here a net of corrosive veinlets between which islands of the unchanged feldspar remain preserved. In the corrosions large six-sided columnar crystals of pure *apatite* have been preserved. — The anorthoclase crystals seem to represent products of a very early crystallization phase. Later, at the time of the effusion, they succumbed to remelting, corrosion and reabsorption.

The material proper of this porphyrite has intersertal structure. It contains mostly two generations of feldspars. The older *acide andesine* (measurements: 0,05 $\times$ 0,1 to 0,15 $\times$ 0,4 mm.) is only here and there albitically twinned ($12^0/12^0$); extinction $c\gamma$ 68^0; index of refraction N slightly higher than the index of refraction of Canada balsam. The feldspar of the groundmass is a minutely lath-shaped *oligoclase*, extinguishing parallelly, only rarely twinned, here and there also *albite-oligoclase* to *albite*. Among them is abundant, pale, lamellate *chlorite* with abundant crystals of leucoxenized *ilmenite* and *Ti-magnetite*, here and there with abundant acicular crystals of *apatite*. Here and there are four- to six-sided chlorite pseudomorphs apparently on original *pyroxene*.

The amygdaloid is pierced by *calcite veinlets* containing secreted nests of red *hematite*, here and there also bright red or yellowish *aluminum hydrate*. They are evidently the products of the hydrothermal period connected directly with the last low-temperature magmatic phase. This thermal phase carried iron solutions into the diabase (filling of the fissures and amygdules) and into the adjoining sea water, from which shales and hematite oolites were sedimented.

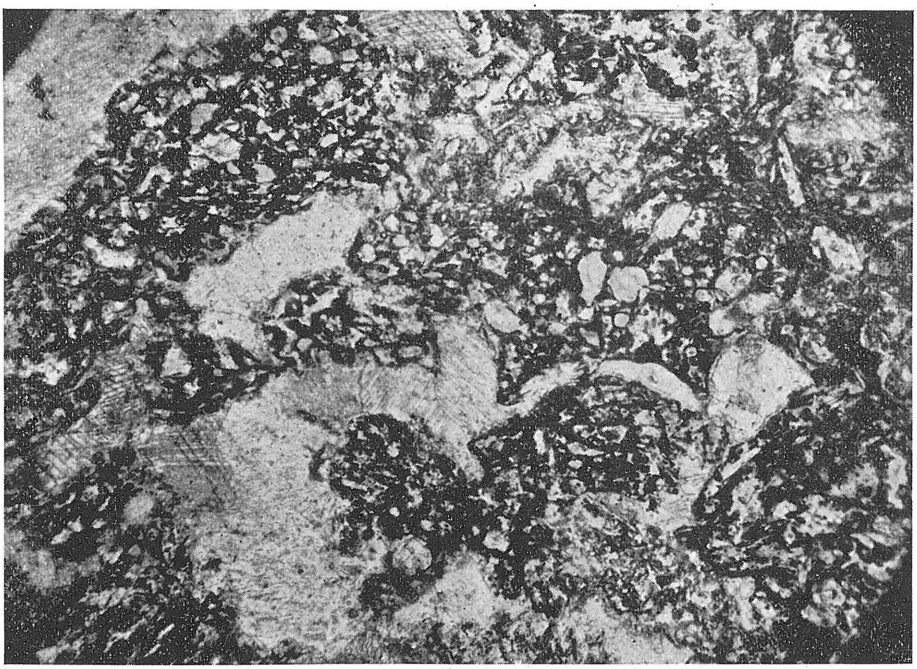
At 101 m., 102,5 m. etc. the amygdaloid included abundant inclusions of grayish brown shales, mostly flat, often crumbling at the margin, and dispersing into the material of the eruptive rock. They are slightly tuffitic and very finely sandy; they contain minute granules of very fine quartz *silt*, some *mica*, *kaolin*, flakes of *sericite* and *limonite*, in some parts also granules of *leucoxene* and some *ilmenite*. *Chamosite oolites*, sometimes with lighter centres or zones of *myeline* (L. SLAVÍKOVÁ—F. SLAVÍK, 1917) are interspersed in them; in other cases they contain fragments of carbonate aggregates, minutely amygdaloidal volcanic glasses, fragments of strongly microvesicular *pumice*, fragments of *oligoclasite* and *chlorite* aggregates. The organic pigment of the shales was to a great extent coked at the margin of the inclusions by the contact action of the magma, and is concentrated in a dark zone border-

2*

ing the margin of the inclusions. At the contact the diabase assumes a light colour and a considerably finer texture; it contains only minute chlorite amygdules. The boundary between the eruptive rock and the sedimentary inclusions is here and there sharp, especially where a dark border zone is developed. In other cases we can see the penetration along the bedding planes into the shales of thin magmatic injections formed principally by chlorite with fine *chlorite amygdules* and here and there with secreted minute *albite* laths. At the boundary between the eruptive rock and the shale we can also observe the penetration of lobes and off-shoots of the eruptive rock into the shales, when particles of the eruptive material separate and detach themselves and remain as inclusions in the shale. The magma of the porphyrite must have been highly fluid and considerably mobile. This mobility as well as the lowering of the point of crystallization were due to the considerable content in water. At the contact with the wet mud the argillaceous inclusions granulated, and the minute, separated particles penetrated into the shale. The above-mentioned injections, rich in chlorite, belonging likewise still to the magmatic phase, intruded also into the shale. Thus mixed rocks were formed, analogous in type to migmatites except for the relatively low temperature of origin and the origin on or near the surface. On the other hand the shaly material dispersed in the granulated material of the eruptive rock, so that here and there the impression of a gradual transition is given.

Between **106,00—109,00 m. a tuffitic explosion breccia** was encountered similar to the one between 12,50 and 17,00 m. It is a grayish green rock, spotted whitish, with angular inclusions of weilburgites and fine amygdaloids, more rarely also of dark gray shales containing dark oolites and granules of volcanic glasses. The interstitial material is here and there shaly, strongly penetrated by *chlorite,* in other cases *carbonatic.* The whole gives the impression of a blackish gray shale interspersed with a finely brecciated material of granulated weilburgite glass. The tuffitic structure was produced by the granulation of the lava and the scattering of lava fragments in the thin mud. In the lower part, between 107—109 m., the rock is developed as pumice breccia with acute-angular fragments of finely porous amygdaloids and rarer inclusions of shales in the grayish green interstitial material of a shaly, here and there also calcitic nature. The interstitial material is penetrated here and there by injections of eruptive material formed predominantly of *chlorite,* light grayish green, in which minute laths of alkali feldspars *(albite-oligoclase)* are secreted.

The inclusions of the amygdaloidal porphyrites contain *calcite,* more rarely *chlorite, amygdules* ⌀ 0,08—0,5 mm., fine laths, sporadically also larger phenocrysts of *feldspar (albite-oligoclase).* The shales have a compact groundmass, strongly saturated with fine flakes of *chlorite;* they contain minute granules of *quartz,* granules of *ore* and fragments of amygdaloidal chloritized *glasses.* The injections of diabase porphyrites have a granular structure, are composed predominantly of fragments



Obr. 1. Diabasový tuf „žabák", s úlomky jemně zpěněné chloritisované pemzy s kalcitovou mezerní hmotou. Z hl. 142 m. Nikoly //, zvětš. ca 52 ×.

Fig. 1. Diabase tuff "žabák" with fragments of finely scoriaceous chloritized pumice with a calcitic interstitial material. From a depth of 142 m. Ordinary light, magn. about 52 ×.

ø 0,1 × 0,2 to 0,4 × 1 mm. formed by the granulation and mechanical disintegration of the lava in contact with the wet mud. They are composed predominantly of feldspars of a fluidal structure (mostly *andesine,* here and there also *oligoclase-albite), chlorite* flakes and *calcite* aggregates; in other places these injections are composed predominantly of chlorite.

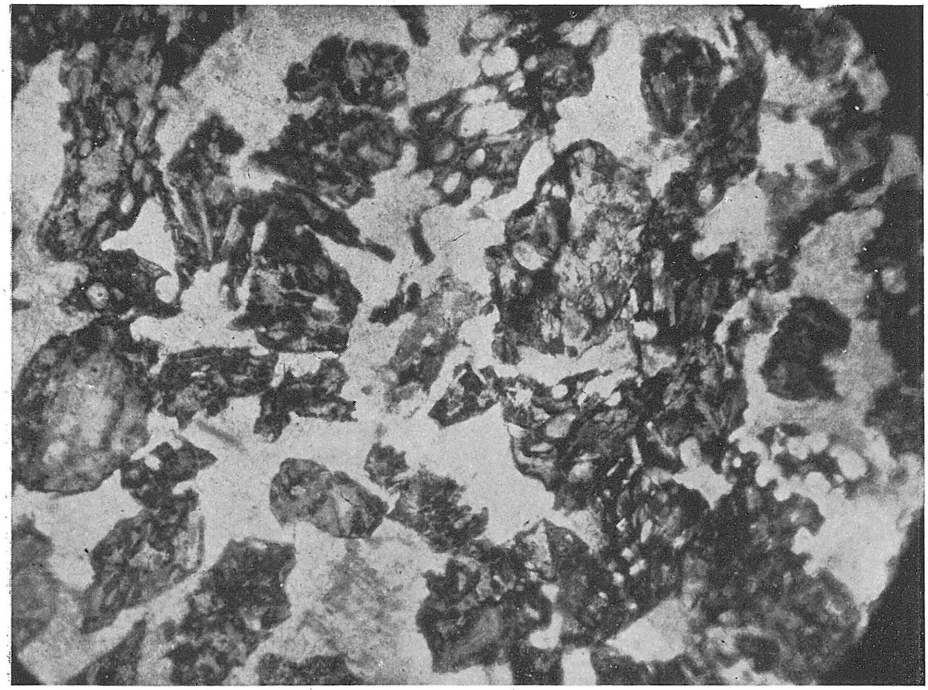
Between **109,00—111,00 m.** a fine **amygdaloidal diabase porphyrite,** was encoutered. Between **111,00—112,50 m.** a dark gray, **argillaceous, micaceous shale** of the stage dγ_1 indistinctly bedded appeared, with rounded, dark oolites and here and there with fragments of microvesicular diabase glasses.

Between **112,60—118,00 m.** a **tuffitic microbreccia** a with minute, lobate and partly still connected fragments of considerably devitrified *weilburgite* (cp. 160—165 m.) and *oligoclasite* reappears again; the *interstitial material is partly shaly* with dark *oolites,* partly calcitic, here and there formed also by magmatic, strongly vesicular chlorite injections. The rock was formed again by the scattering of the granulating porphyritic lava in the thin mud. — The margin of the shaly inclusions is mostly lobate, and off-shoots of the magmatic material from the microbreccia penetrate inside. They are often detached and separated so that they turn into inclusions. Chlorite-magnetite injections are abundant. On the other hand the shale reaches into the interstices between the individual magmatic fragments of the microbreccia, merges into them, and forms the essential part of the cement. Here and there smaller chloritic or shaly *oolite* is formed in the interstitial filling, elsewhere a magmatic injection rich in chlorite penetrates it; here and there *limestone* is developed. The oolites have most frequently a chlorite centre *(prochlorite*, index of refraction 1,62), surrounded by *myeline* (SLAVÍKOVÁ—SLAVÍK 1917), or around the central part composed of prochloritic spherolites a narrow, bedded envelope of prochlorite is developed, and only then follows the myeline zone. In the fragments of the granulated weilburgite material there are numerous elongated amygdules filled with chlorite. In the centre there is most frequently *prochlorite* (index of refraction 1,62), at the margin *leuchtenbergite* (index of refraction 1.559—1.568), here and there also colourless *antigorite.*

At a depth of **118—122 m.** a purplish dark gray oxidized **diabase tuff** is developed, with somewhat rounded fragments of whitish gray, vitreous and amygdaloidal diabases embedded in an interstitial material rich in hematite. In the fragments of amygdaloids there are very abundant *chlorite amygdules,* 0,08—0,2 mm. in diameter, filled at the periphery with greenish yellow *clinochlore* (index of refraction between 1,58 and 1,59) and in the centre with *iron-prochlorite* of a higher refraction and an abnormal double refraction. The groundmass is a brownish green isotropic glass with interspersed granules of *ilmenite* and crystals of *magnetite;* sporadically some *quartz* is developed. Other diabase fragments contain in the glass abundant minute *feldspar* laths and rod-shaped *amphibole* microlites. The feldspars have a subparallel extinction, an index of refraction near 1.545, and belong to the *oligoclase.* The interstitial material between the diabase fragments is strongly veiled by *hematite,* through which individual smaller granules and fragments of microvesicular glasses are seen.

122—128 m.: grayish green **tuffite** with fragments of fine diabase amygdaloids. The interstitial material, rich in fragments of microvesicular glasses, contains fragments of shales, fragments of feldspar crystals *(basic oligoclase, albite oligoclase,* sometimes also *oligoclase-andesine),* and interspersed with *chlorite oolites* ⌀ 0,2—0,5 mm. In other cases the interstitial material is strongly calcareous. Here and there fragments of subholocrystalline *oligoclasites* occur enclosing minute, elongated amygdules of calcite and chlorite.

128—134 m.: dark gray **shale**, finely micaceous, stage $d\gamma_1$, well bedded, here and there with zones of chloritic oolites crowded together, with pyritic fucoids and aggregates. At 132 m. an intercalation, 20 cm. thick, of greenish tuffite.

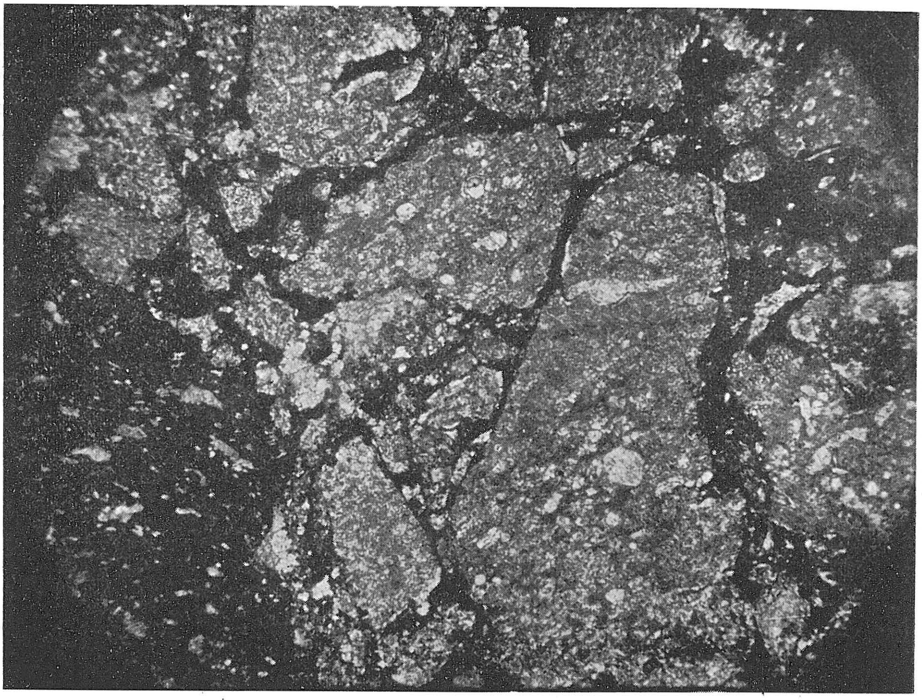


Obr. 2. Tuf diabasový „žabák", s hojnou kalcitovou mezerní hmotou. Z hl. 110 m. Nikoly //, zvětš. ca 52 ×.

Fig. 2. Diabase tuff "žabák" with abundant calcitic interstitial material. From a depth of 110 m. — Ordinary light, magn. about 52 ×.

Between **134—140 m.** a dark grayish green **tuffite** was encountered, above very fine-grained, farther down of minute grain. It contains numerous large chloritic oolites, concentrically bedded around a larger clastic nucleus.

Between **140—142,00 m** a minutely grained **diabase tuff,** white to greenish, is developed, with a carbonate interstitial material of the type of minutely grained "žabák" (frog-stone). It contains minute, lobate fragments of microvesicular vitreous diabases of different types; there are on the one hand fragments of glasses with sporadic chlorite amygdules and without any other structure, on the other hand fragments of a hypocrystalline diabase with feldspar laths and chlorite amygdules. Further there are here abundant fragments of strongly remelted feldspars (apparently *anorthoclase* derived from the deeper weilburgite), fragments of *apatite* and *chlorite* aggregates. In the amygdules of the vesicular diabases we see especially *Mg-prochlorite* (index of refraction higher than oil 1.580, smaller than the index of refraction of oil 1.614), in other cases *calcite*. In some pumice glasses the elongated amygdules and cavities are closely aggregated in a very



Obr. 3. Tufitická weilburgitová mikrobrekcie s břidličnou mezerní hmotou. Z hl. 107,30 m. — Nikoly //, zvětš. ca 14 ×.

Fig. 3. Tuffitic weilburgite microbreccia with shaly interstitial material from a depth of 107,30 m. Ordinary light, magn. about 14 ×.

small quantity of vitreous groundmass. In some fragments laths of *albite-oligoclase* are rather abundant. In others we find a strongly devitrified mixture of *andesine* with abundant amygdules of chlorite and calcite. The interstitial filling, predominantly *calcite,* contains abundant, strongly carbonatized fragments of pumice, here and there granules of clastic quartz and fragments of andesine.

Between **142—150 m.** minutely grained **diabase tuffites** are developed, somewhat compressed and oxidized. They contain fragments of microvesicular diabases, and inclusions of the typical amygdaloids, here and there with large calcite amygdules, and an abundant admixture of clastic shale and sandstone material. The interstitial material is strongly *carbonatic,* coloured red by *hematite,* in other cases *kaolinic.* On the whole the diabase fragments are still more strongly carbonatized than the cement. Calcification is here and there so strong that only the outlines of the original vesicles show that we have here calcified pumice fragments. The chlorite of the amygdules belongs to *Mg-prochlorite,* the index of refraction ranges between the limits of oils 1.614—1.620.

Between **150,00—152,00 m.** a coarser **tuffitic breccia** was encountered with fragments of shaly tuffites, sporadic fragments of white tuffitic limestones, and fine-grained grayish red hematite. It contains a layer of whitish, strongly calcified tuffite.

152,00—152,60 m., calcified whitish **tuffite**, fine-grained, grains up to 1 mm.

152,50—160,50 m.: tuffitic pelite, fine-grained, bluish white gray, distinctly bedded, with lighter and darker zones, diameter of the granules being 0,002—0,04 mm. At 154 m. and 157 m. an admixture of tuff material or vitreous fragments is well marked. Mostly they do not effervesce, only with a growth in depth the $CaCO_3$ content of the argillaceous cement increases. Sporadically fragments of fine amygdaloids occur with amygdules of *chlorite* and *chalcedony;* here and there we see granules of clastic *quartz;* abundant are flakes of light mica.

Weilburgite.

In **160,50—165,30 m.** a layer of a very intervesting amygdaloidal rock was encountered, which according to the microscopic examination is very reminiscent of the rock intruding in the Devonian of the Lahn Basin in the Rhineland, which E. LEHMANN, 1941, described as w e i l b u r g i t e. At the margins the rock is whitish gray, in the middle, between 162,20—164,20 m., dark greenish gray. The amygdules, 2—10 mm. in diameter, are filled with *ankeritic carbonate,* only rarely do they contain *chlorite.* Phenocrysts of whitish or pinkish feldspars, 3—10 mm. in diameter, are fairly abundant. The structure, megascopically very fine-grained, is because of the plumosely aggregated feldspars under the microscope considerably granular. This proves that we have here rather an intrusive rock of shallow depth than an effusive rock, for which the considerably developed amygdaloidal texture would otherwise speak.

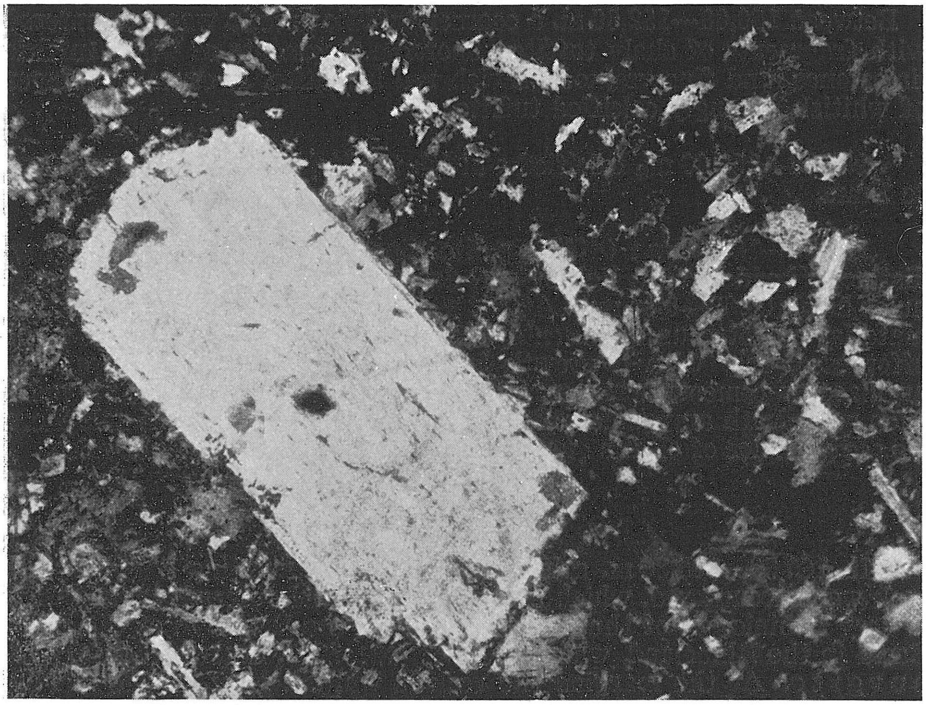
According to the texture of the rock and to the nature of the amygdules three layers can be distinguished here:

1. the upper parts is a yellowish whitish gray rock with ankerite amygdules, almost without feldspar phenocrysts. The groundmass is formed by feldspar laths, between which we see a megascopically compact mesostasis.

2. The middle part is formed by a grayish green rock with sparser ankerite amygdules and abundant phenocrysts of feldspars. The structure of the groundmass is very uniform, fine-grained, intersertal.

3. The lower part is formed by a ligth greenish gray amygdaloid with fairly abundant ankerite amygdules and very abundant phenocrysts of feldspars, which belong on the one hand to a pink anorthoclase and on the other hand to a whitish albite-oligoclase. The groundmass in this lower part of the intrusion is the finest of all three zones mentioned.

The w e i l b u r g i t e o f t h e u p p e r p a r t has microscopically a sparsely intersertal groundmass. It contains laths of *albite-oligoclase*

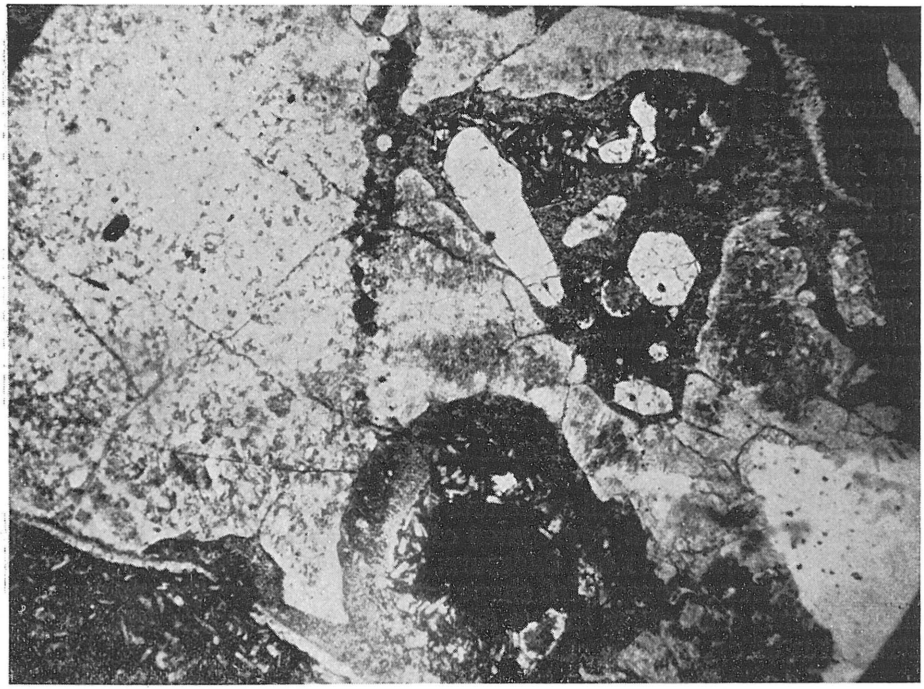


Obr. 4. Vrostlice albitoligoklasu z weilburgitu z hl. 164,50 m. Nikoly XX, zvětš. ca 52 ×.

Fig. 4. Phenocryst of albite-oligoclase in the weilburgite from a depth of 164,5 m. Crossed nicols, magn. about 52 ×.

of 0,04 × 0,08 to 0,06 × 0,5 mm., albitic twinned, extinction 13/13°. Between them there is the strongly kaolinized and slightly silicified *groundmass* with individualized *albite, chlorite* and *carbonate.* The amygdules are formed by an aggregate of *calcite* or *ankerite* granules, between which, and often also in the centre of the amygdule, is a finely scaly aggregate of chlorite of a lower double refraction. Connected with the amygdules are often carbonate veinlets and streaks penetrating the rock.

The m i d d l e p a r t, approximately between 162,50—164,20 m., is formed by a firm, fine-grained, light grayish green rock with *ankeritic* or *chloritic-calcareous* amygdules, 1—2,5 mm. in diameter. The calcareous filling is usually bordered by *chlorite,* in other cases it is penetrated by cockade-shaped chlorite zones. There are few feldspar phenocrysts; they belong either to *andesine* (20°) or to *oligoclase;* crystals of considerably corroded and reabsorbed *anorthoclase* occur rarely. The *groundmass* is composed of minute *albite-oligoclase* laths, with a mesostasis of finely scaly *chlorite, albite* of low refraction, some *orthoclase,* and purely isotropic, only slightly devitrified *glass,* and interspersed *ilmenite.* At 162,5 m. is the upper limit of this middle part



Obr. 5. Vrostlice anorthoklasu silně korodovaného a nataveného z albitoligoklasového porfyritu z hl. 104,50 m. V korosních dutinách, vyplněných základní hmotou šestiboké krystaly apatitu. — Nikoly //, zvětš. ca 14 ×.

Fig. 5. Phenocryst of strongly corroded and remelted anorthoclase from the albite-oligoclase porphyrite, from a depth of 104,50 m. In the corrosion cavities filled with groundmass are six-sided apatite crystals. — Ordinary light, magn. about 14 ×.

minutely brecciated, with fragments of microvesicular vitreous portions, which indicate the separate injection of the different parts. *Albite* of a low refraction penetrates the rock in thin, yellowish gray, turbid veinlets, from which it spreads also into the adjoining groundmass. The phenocrysts of *anorthoclase* have usually a turbid, remelted and corroded margin. In the middle light part we find irregularly lobately delimited structures formed with the beginning remelting at the time of the rising of the magma to the surface and the lowering of the pressure. Similar structures have been described as enterolithic structure (Gekröse-Struktur) from remelted alkali feldspars of Iranian rocks by EM. CHRISTA, 1940. In the Chyňava weilburgite the remelted parts of these alcalic feldspars were in some cases strongly carbonatized and replaced by carbonate. This indicates a considerable amount of C_2O and H_2O in the magma. In other parts the immiscibility of the albite molecule took place in the form of perthite.

In the lowest part of the vein between 164,20 m. and 165,00 m. the weilburgite contains abundant larger *ankerite amygdules*, 4—8 mm. in diameter. There are here very abundant feldspar phenocrysts, either of pink *anorthoclase* (diameter about 4—6 mm.), of low refraction, α' approaching 1.526, γ' near 1.533, optically negative, extinction in 010 9^0, in 001 $2\frac{1}{2}^0$, strongly corroded, almost always characterized by the enterolithic structure mentioned above, showing elongated, dark bordered spots. These dark remelted zones enclose here and there islands of fresher, optically positive, albitic twinned albite-oligoclase formed by immiscibility. — Rather abundant are also whitish phenocrysts of *albite-oligoclase.* The *groundmass* has a non-typically intersertal structure. It is considerably crystallized, small-grained. It contains abundant small tabular *albite-oligoclase,* often of a fairly typical rhombic cross-section. The mesostasis is of minute crystals of *albite, orthoclase,* columnar *carbonate* pseudomorphs on augite, aggregates of grayish green, slightly pleochroic flakes of *chlorite.* The chlorite is close to *prochlorite* (index of refraction about 1,62), and is perhaps partly a pseudomorph on dark constituents, but mostly it represents the last and youngest constituent solidified from a magma considerably rich in H_2O. Fairly abundant are dark gray flakes of *ilmenite* and carbonatized *amphiboles* as well as minute skeleton crystals (111) and (100), irregular granules and aggregates of *magnetite. Apatite* crystals are abundantly grown into the feldspars. — Here and there turbidly dark gray structures of three-sided shape occur growing together polysynthetically above each other in one direction and thus reminiscent of the structures of *cronstedtite* at 202 m.

The weilburgites of E. LEHMANN from the Rhenish Devonian of the Lahn region were placed already formerly to the diabases, or spilites. E. LEHMANN determined their chemical and mineral difference from both the diabases and the spilites and their considerable relations to the keratophyric magmata. They are intrusive, strongly amygdaloidal rocks composed chiefly of alkali feldspars and chlorite. Chemically they are characterized by the relatively considerable alkali content, the great quantity of crystal water, and the relatively smaller content in CaO, especially after deduction of the share bound to the — mostly abundant — CO_2. The content in TiO_2 is mostly considerable. They contain alkali feldspars, mostly albite, fairly abundantly also orthoclase or anorthoclase. Potassium and soda types occur either independently or mostly as mixed types. Genetically bound to the intrusion of the weilburgite are the deposits of the Lahn iron ores. The high content in H_2O in the magma caused its great mobility also when the temperature was rather lowered; by mixing with the material of sediments, by injection of the mud with magmatic solutions of weilburgite composition rich in chlorite mixed rocks were formed.

The Chyňava weilburgite agrees to a considerable extent with the types described by E. LEHMANN, though here and there it shows still its relation to albitized diabases. For it contains here and there still also andesine, further carbonate pseudomorphs on pyroxenes, etc. — Certain relations can be demonstrated to the Norwegian rhomb porphyries. — Also the material of the tuffitic explosion microbreccias from the depths of 12,50, 17,00, 106,00—109,00, and 112,60—118,00 m. shows by its material likewise certain relations to the weilburgites.

Dr. R. ROST was so kind as to analyse the weilburgite from a depth of 164 m. at Chyňava. The high content in CO_2 makes the calculations of the analyses after the current methods somewhat doubtful and unreliable. Nevertheless I give here these calculations, as they afford and interesting view of the chemism of the rock and show especially the high content in alkalis. Two calculations were made, one after the simple deduction of CO_2 and calculation of the current oxides of the analysis to 100% (a), and one after deduction of a complex carbonate corresponding to the representation in per cent of CaO, MgO, and FeO in the rock (b). **Analysis and calculations are given here with reservation and reference to the remarks given above.**

	Weight % of the analysis	a) Molecular % after simple deduction of CO_2	b) After deduction of the complex carbonate of Ca, Mg and Fe
SiO_2	38,90	49,06	60,98
TiO_2	1,91	1,81	2,25
Al_2O_3	14,32	10,63	13,20
Fe_2O_3	1,02	10,36	5,14
FeO	8,93		
MnO	0,27	0,29	0,36
CaO	7,95	10,75	4,51
MgO	4,96	9,38	3,94
K_2O	1,57	1,26	1,57
Na_2O	5,16	6,29	7,84
H_2O +	2,97		
H_2O —	0,16		
CO_2	11,36		
P_2O_5	0,33	0,17	0,21
S	0,73		
	100,54	100,00%	100,00

spec. gravity . . . . 2,73.

Calculation after OSANN:

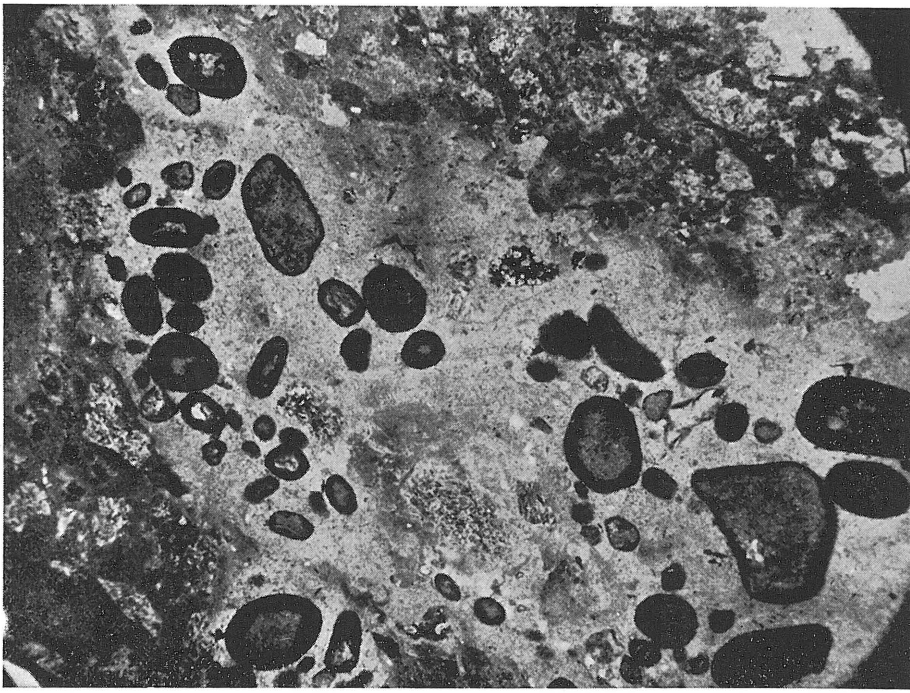
	A	C	F	a	c	f	n	s	k
a)	7,55	3,08	30,78	5,5	2,2	22,3	8,3	50,87	0,62
b)	9,41	3,79	10,16	12,1	4,9	13,3	8,3	63,23	0,85

Calculation after NIGGLI:

	si	al	fm	c	alk.	k	mg	si′	qz	e/fm	section
a)	100,3	21.5	41	22	15.5	.16	.47	162	-61.7	.53	IV
b)	166.6	36	26	12.3	25.7	.17	.42	202.8	-36.2	.47	IV

ti a) 3.7
b) 6.1

In case (a) the calculation approaches the medium type of the theralitic magmata of P. NIGGLI. In (b) the calculation falls between the types of the nosycombitic and Na-quartz-syenite to Na-syenite magmata.



Obr. 6. Uzavřenina oolitické břidlice z weilburgitové mikrobrekcie z hl. 112,80 m. Oolity ve středu chloritové, na okraji břidličné. — Nikoly //, zvětš. ca 14 ×.

Fig. 6. Inclusion of oolitic shale from the weilburgite microbreccia from a depth of 112,80 m. Oolites in the centre chloritic, at the margin shaly. — Ordinary light, magn. about 14 ×.

Remaining Part of the Profile.

Between **165,30—169,00 m.** a variegated, dark purple **breccia** was encountered containing fragments of green porphyritic tuffites, of gray tuffitic sandstones and red shales dα, of gray hornfels, fragments of fine amygdaloids, decomposed grass green porphyritic glasses, fragments of quartz and hematite ore. *Chalcopyrite* is disseminated in the fissures. — The interstitial material is shaly with densely interspersed flakes of kaolin, chlorite and some light mica, quartz granules and granules of non-abundant feldspars (albite-oligoclase, orthoclase) in the fine siliceous-kaolinic mesostasis.

The thin section of the hornfels shows abundant minute granules of quartz, kaolin and chlorite, infrequent fragments of feldspar and a little biotite. — The tuff fragments contain particlets of a carbonate aggregate bordered by chlorite, fragments of strongly carbonatized microvesicular diabase glasses, often with fluidally arranged vesicles. Further there are here fragments of carbonatized amygdaloids, remnants of feldspar laths, holocrystalline oligoclasites, and here and there quartz granules.

Between **169,00—173,00 m.** banded, light grayish green or bluish grayish green **tuffites** rich in calcite were encountered. They contain whitish spots of completely carbonatized microvesicular diabases surrounded by chlorite and often replaced by quartzine. Further there are minute fragments of amygdaloids with amygdules of *calcite, antigorite* and here and there also *quartzine* in the carbonatized groundmass. Further also chloritized fluidal porphyritic glasses with elongated vesicles. The interstitial material is strongly carbonatized, with quartz, chlorite and kaolin; in other cases kaolin predominates. It contains fragments of chloritized glasses, chloritic pseudomorphs on dark constituents, spherolites of quartzine, and minute fragments of quartz and feldspar. — Another sample from 172,5 m. represents a fine-grained, grayish white porphyritic tuffite, considerably firm and strongly carbonatized. The interstitial material is a fine aggregate of quartz and antigorite.

Between **173—175,00 m.: tuffite,** greenish white with fine fragments of pumice, calcareous cement, and an intercalation of white limestone.

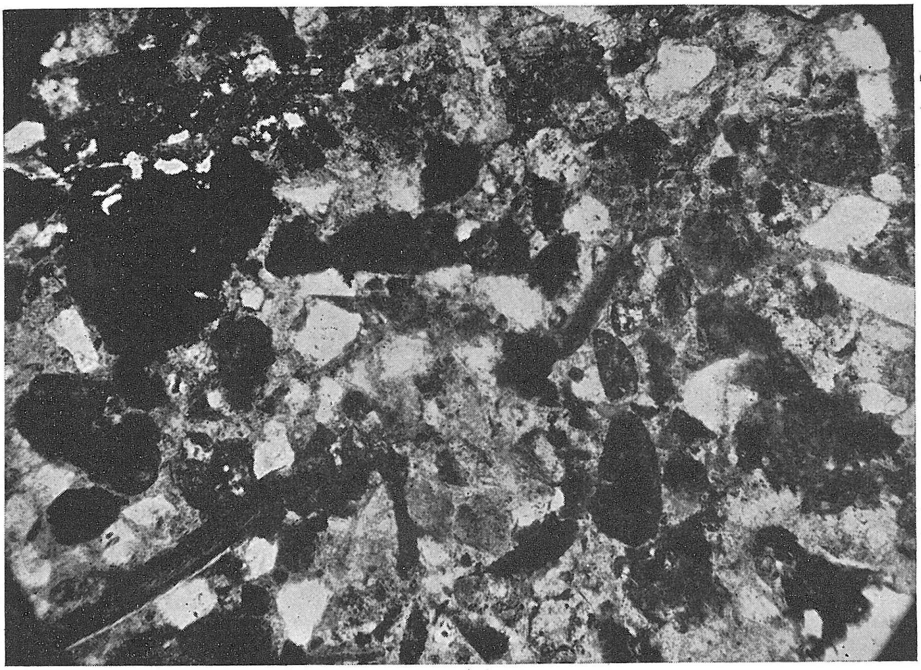
175,00—177,00 m.: tuffitic sandstones, grayish red, crushed, with admixed hematite in fine granules.

177,00—184,20 m.: grayish red **shales,** alternatively of fine and coarser grain. At 180 m. a fairly thin bed of a brick red, tuffitic breccia with red hematite oolites, sporadic fragments of porphyritic pumice, and abundant fragments of brachiopod valves.

184,20—185,00 m.: amygdaloidal diabase, light greenish whitish gray, with calcite amygdules ∅ 1,2—1,7 mm. The groundmass, originally vitreous, is strongly carbonatized. Aggregates of *chlorite, carbonate* and *quartz* minute *quartzine* spherolites, many minute granules of *ilmenite* and *magnetite,* and some carbonate-chlorite pseudomorphs on dark constituents occur here and there among the carbonate. Because of the considerable alteration of the rock its relations to the weilburgite could not be determined.

Between **185,00—188,00 m.** occur **variegated diabase tuffs,** reddish gray, distinctly bedded, here and there brecciated, with fragments of greenish microvesicular diabase glasses strongly carbonatized, in other places replaced by a mixture of carbonate and quartz. The cement is partly carbonatic, partly ashy and, when the latter, strongly oxidized. The ashy constituents are then either completely or at the margin hematitized. This strong oxidation indicates the sedimentation of the tuff at a small depth below the sea level.

At a depth of **188,00—195,60 m. green tuffitic sandstones** of the Tremadoc, fine-grained, slightly compressed were encountered passing here and there into siliceous sandstones or into tuffites. At 190 and



Obr. 7. Tremadocký pískovec z hl. 195,50 m. Klastická zrnka křemene, alkalického živce, přeměněných porfyrových skel, úlomky lasturek brachipodů a zrnka glaukonitu v silně křemité základní hmotě. — Nikoly //, zvětš. ca 52 ×.

Fig. 7. Tremadoc sandstone from a depth of 195,50 m. Clastic granules of quartz, alkali feldspar, transformed porphyritic glasses, fragments of brachiopod valves and glauconite granules in the strongly siliceous groundmass. — Ordinary light, magn. about 52 ×.

190,60 m. they include an intercalation of purplish dark gray fine-grained tuffs. The tuffites themselves contain in addition to sporadic quartz granules a fairly abundant material of green, decomposed *porphyritic glasses* showing sometimes traces of a fluidal structure (R. KETTNER) with zones of *ilmenite* and *titanite* granules. The chlorite belongs to *clinochlore* (index of refraction at the limit of oils 1,57—1599).

Between **195,60—196.00 m.** was found an **alternation of green sandstones with mineralized shales** of the Krušná hora Beds dα, containing sponge spicules and fragments of brachiopod valves.

The sandstones (grain 0,08—0,4 mm.) contain subangular granules of quartz, quartz shales, abundant green granules of chloritized or glauconitized volcanic glasses, apatite crystals and feldspar fragments, fragments of the groundmass of porphyrites, and fragments of phosphoritized valves. Accessorily *apatite, zircon, titanite-leucoxene, carbonate,* etc. Here and there occur fragments of finely scoriaceous porphyritic glasses with sporadic feldspar crystals and abundant chlorite amygdules. — The cement is finely sandy with quartz granules, abundant mica and sporadic flakes of chlorite. — Abundant quartz-carbonate veinlets penetrate the rock. Some parts of the sandstones are strongly carbonatized.

At a depth of **196,00—203,00 m.** there follow coarse-grained **sandstones to quartz conglomerates,** slightly calcareous, also belonging to the Krušná hora Beds dα (Tremadoc). They contain *quartz* granules, ⌀ 0,1—0,2 mm., fairly well rounded, more rarely granules of *quartz shales* to fine grained *quartzites*. In some parts the cement is siliceous, in others siliceous-calcareous. Such calcareous parts have between the clastic granules usually larger interstitial spaces than the siliceous ones. Here and there they contain nests of *pyrite* and aggregates of green *chlorite*. The cataclasm of the rock is considerable. At about 202 m. a steep veinlet of white crystalline *calcite* with *pyrite* and drusy black *cronstedtite* was encoutered. This will be treated in a separate report.

Summary.

The drilling profile studied from the Lower Ordovician of Chyňava belongs for the greater part to the Šárka Beds (dγ, Lower Llanvirnian). The Komárov Beds (dβ — Skiddavian) seem to be less developed in this area. The lower part of the profile belongs to the Krušná hora Beds (dα — Tremadoc). The profile, whose rocks belong predominantly to volcanites and tuffs, supplied further proofs of the great variety of the Lower Paleozoic volcanic rocks of the diabase series. In the upper part of the drilling diabases and diabase porphyrites were encountered, which in the direction towards the margins pass into albite porphyrites. Farther down follow weilburgites and diabase tuffs and tuffites. In the Tremadoc sediments fragments of decomposed vitreous porphyric material appear as clasts.

For the first time in the Ordovician of Bohemia at Chyňava rocks of weilburgite type were determined, corresponding to a very considerable extent to the weilburgites described by E. Lehmann from the Devonian of the Lahn area in Western Germany. They contain phenocrysts of strongly corroded and remelted *anorthoclase,* further phenocrysts of *albite-oligoclase,* rarely of *oligoclase. Andesine* was found only sporadically. In the groundmass *albite-oligoclases* to *albites,* not infrequently showing rhombic cross sections, predominate by far; *chlorite* and *carbonate* are abundant. Here and there the presence of carbonate pseudomorphs on augite indicates relations to the albite diabases. From a chemical point of view the high content in CO_2 of the rock makes the calculation of the analysis by the current methods somewhat subjective, for it cannot be determined with certainty how much of the content in CaO, MgO and FeO bound in the abundant carbonates belongs to the original magma, and how much was added later. There is no basis at Chyňava for designating the whole content

of carbonate as foreign, dragged along by the magma, allothigenic, as LEHMANN does for the weilburgite of the Lahn area. In any case the calculation of the analysis indicates a high content of alkalis in comparison with the diabase rocks of the Paleozoic of Central Bohemia. The value "*k*" (in the calculation according to Niggli) is relatively high, when compared with the analyses of the Silurian diabases of Bohemia. But it does not attain the values determined in the somewhat younger diabases from Kařízek (cp. F. FIALA, 1951). Rather characteristic is the relatively smaller content in CaO (in the calculation of the analysis after deducting a complex carbonate), which suggests interesting relations to Na-syenite magmata (rhomb porphyries). — The analysis of the diabase porphyrite from 60,5 m. approaches on the whole the analysis of the diabase from the Dobrotivá Beds ($d\gamma_2b$ — Upper Llanvirnian) from Kařízek published by F. FIALA, 1951. The diabase porphyrite of Chyňava shows moderately higher values of *al* and *alk*, and somewhat lower values of *fm, c, k* and *mg*. The value $k = 21$ is constantly relatively high in comparison with the values of the Silurian diabases of Bohemia.

Diabase and porphyrite tuffs and tuffites strongly developed at Chyňava are connected with the weilburgites and with the diabase and albite-diabase-porphyrites. A special type are the tuffitic explosion breccias, mixed rocks, formed by the mixing of eruptive and sedimentary material at the time of the eruption. Fragments of the following lava granulating at the contact with the sea water mixed extensively with the material of the whirled-up mud. The mud became on the one hand the cement of the sedimentary breccia, and on the other hand was enveloped by it in the form of shaly inclusions, not infrequently showing traces of the contact action of the magma. Abundant magmatic *injections* composed of *chlorite, albite* and sometimes also *calcite* penetrate the shales. These injections indicate the great mobility of the weilburgite and albite-diabase magma in the last stages of its development, when the temperature was already considerably lowered. The cause of this mobility was the considerable content of H_2O in the magma.

The composition of these last, low-temperatured magma fractions approaches the composition of leptochlorites. The iron is concentrated in them and disperses with them into the surrounding sea water, supplying material for the precipitation of oolites, abundant in the shaly intercalations and in the interstitial material of the breccias and tuffites. In the further, hydrothermal, stage much iron passes into the aqueous thermal solutions bound genetically to the diabase and weilburgite eruptions. These solutions supply the further and chief material for the formation of sedimentary deposits of iron ores in the Ordovician of Central Bohemia.

February 1951.

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VYSVĚTLIVKY MIKROFOTOGRAFIÍ.

Tab. I.

Obr. 8. Diabasový porfyrit silně albitisovaný, s typickou intersertální strukturou. Mezerní výplň mezi lištami živců převážně chloritická. Z hl. 63 m. — Nikoly //, zvětš. ca 52 ×.

Obr. 9. Mandlovcovitý albitoligoklasový porfyrit z hl. 29 m. Ve středu mandlí chlorit, okraje kalcitové. — Nikoly //, zvětš. ca 14 ×.

Tab. II.

Obr. 10. Weilburgitová explosivní mikrobrekcie z hl. 108 m. V mezerní břidličné hmotě jsou uzavřeny úlomky zpěněných weilburgitů. — Nikoly //, zvětš. ca 14 ×.

Obr. 11. Styk weilburgitové explosivní mikrobrekcie s břidličnou uzavřeninou. Jednotlivé úlomky granulovaného weilburgitu pronikly do břidlice, břidličná hmota tvoří tmel mezi weilburgitovými částicemi brekcie. Okraj břidličné uzavřeniny kontaktně ztemnělý. Z hl. 102 m. — Nikoly //, zvětš. ca 14 ×.

Tab. III.

Obr. 12. Styk břidličné uzavřeniny s obklopující ji weilburgitovou mikrobrekcií. Proužky břidlice vnikají mezi úlomky mikrobrekcie a tvoří její tmel. Z hl. 16 m. — Nikoly //, zvětš. ca 52 ×.

Obr. 13. Styk břidličné uzavřeniny s obklopující ji weilburgitovou mikrobrekcií z hl. 102 m. Okraj uzavřeniny ztemnělý, úlomky weilburgitu vnikají dovnitř uzavřeniny. Tmel mikrobrekcie břidličný. — Nikoly //, zvětš. ca 14 ×.

Tab. IV.

Obr. 14. Weilburgitová mikrobrekcie s vrostlicí živcovou (vlevo dole) a chloriticko-břidličnou mezerní hmotou. Z hl. 108 m. — Nikoly //, zvětš. 14 ×.

Obr. 15. Tufit diabasový s oolity v břidličném tmelu. Z hl. 127 m. — Nikoly //, zvětš. ca 14 ×.

Tab. V.

Obr. 16. Natavená vrostlice anorthoklasu z weilburgitu z hl. 165 m. Typická „střívková struktura“ (Gekröse Struktur). — Nikoly //, zvětš. ca 14 ×.

Obr. 17. Natavená a korodovaná vrostlice anorthoklasu z weilburgitu z hl. 165 m. Typická střívková struktura („Gekröse Struktur“). — Nikoly //, zvětš. ca 14 ×.

EXPLANATIONS OF THE MICROPHOTOGRAPHS.

Pl. I

Fig. 8. Diabase porphyrite, strongly albitized, with typical intersertal texture. Interstitial material between the feldspar laths predominantly chlorite. From a depth of 63 m. — Nicols //, magn. about 52 ×.

Fig. 9. Amygdaloidal albite-oligoclase porphyrite from a depth of 29 m. In the centre of the amygdules chlorite, on the margin calcite. — Nicols //, magn. about 14 ×.

Pl. II

Fig. 10. Weilburgite explosion microbreccia from a depth of 108 m. In the interstitial shaly matter fragments of microvesicular weilburgites are enclosed. — Nicols //, magn. about 14 ×.

Fig. 11. Contact of the weilburgite explosion microbreccia with a shaly inclusion. The individual fragments of granulated weilburgite penetrated into the shale, the shaly material forms the cement between the weilburgite particles of the breccia. The margin of the shaly inclusion is darkened, baked by contact. From a depth of 102 m. — Nicols //, magn. about 14 ×.

Pl. III

Fig. 12. Contact of a shaly inclusion with the surrounding weilburgite microbreccia. Zones of shale penetrate between the fragments of the microbreccia and form its cement. From a depth of 16 m. — Nicols //, magn. about 52 ×.

Fig. 13. Contact of a shaly inclusion with the surrounding weilburgite microbreccia from a depth of 102 m. The margin of the inclusion is darkened, fragments of the weilburgite penetrate inside the inclusion. Cement of the microbreccia shaly. — Nicols //, magn. about 14 ×.

Pl. IV

Fig. 14. Weilburgite microbreccia with feldspar phenocryst (left below) and with chloritic-shaly interstitial material. From a depth of 108 m. — Nicols //, magn. 14 ×.

Fig. 15. Diabase tuffite with oolites in a shaly cement. From a depth of 127 m. — Nicols //, magn. about 14 ×.

Pl. V

Fig. 16. Remelted phenocryst of anorthoclase from the weilburgite at a depth of 165 m. Typical enterolithic structure ("Gekröse Struktur") (E. Christa). — Nicols //, magn. about 14 ×.

Fig. 17. Remelted and corroded phenocryst of anorthoclase from the weilburgite at a depth of 165 m. Typical enterolithic structure ("Gekröse Struktur"). — Nicols //, magn. about 14 ×.

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REDAKTOR IVAN KLÁŠTERSKÝ

FRANTIŠEK FIALA: DIABASOVÉ A WEILBURGITOVÉ HORNINY SPODNÍHO ORDOVIKU OD CHYŇAVY. DIABASE AND WEILBURGITE ROCKS OF THE LOWER ORDOVICIAN AT CHYŇAVA.

V DUBNU 1951 VYDALO SVÝM NÁKLADEM V POČTU 1100 VÝTISKŮ NÁRODNÍ MUSEUM V PRAZE - VYTISKLA STÁTNÍ TISKÁRNA, N. P. 02. - CENA BROŽOV. VÝTISKU 58·- Kčs

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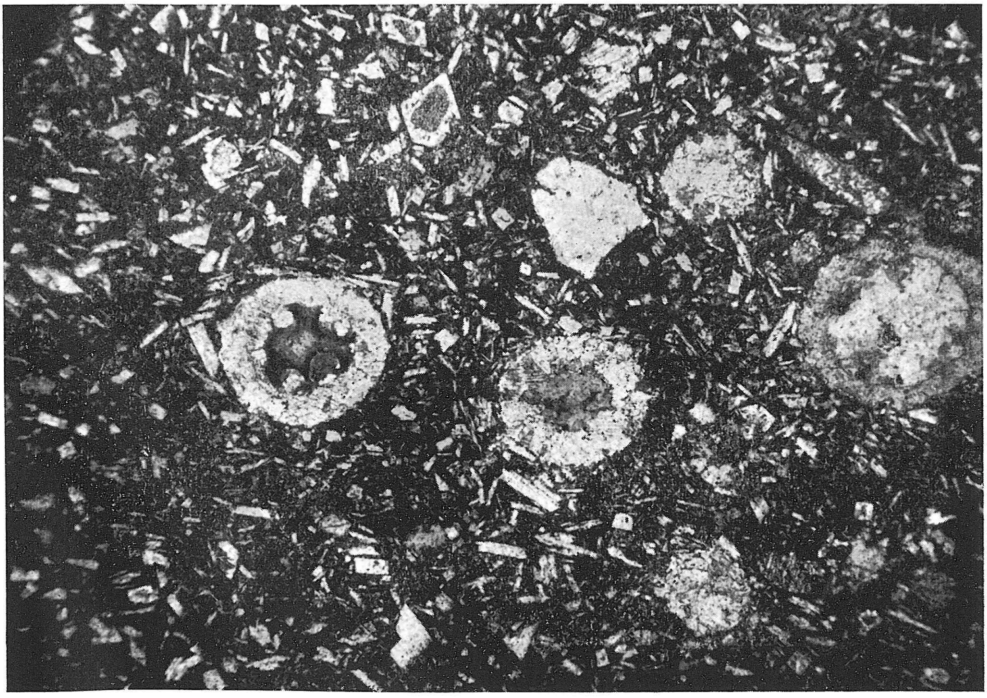

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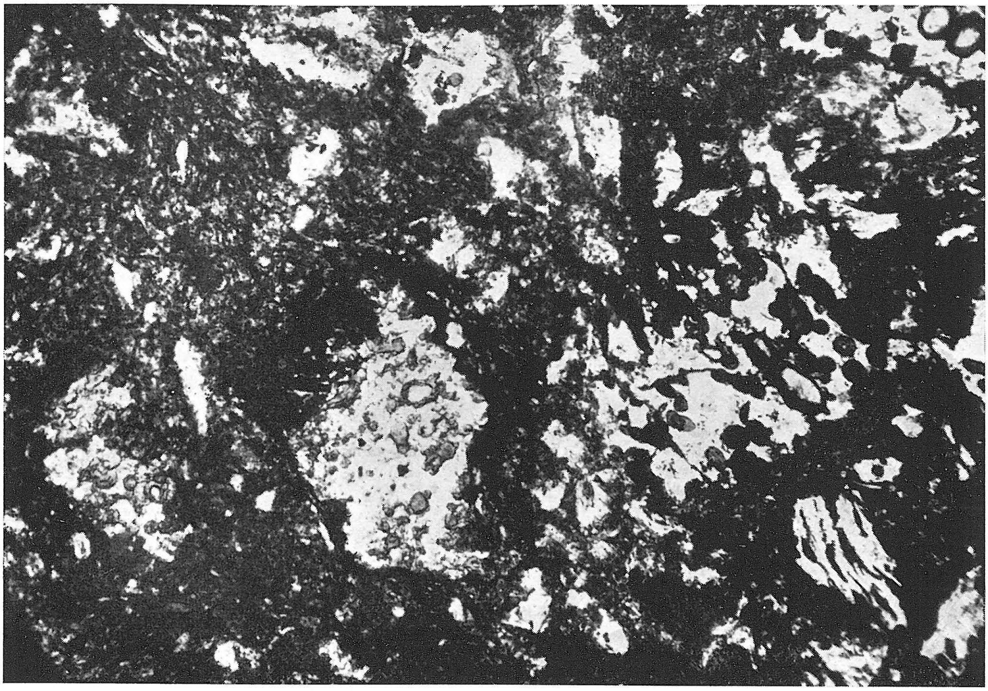

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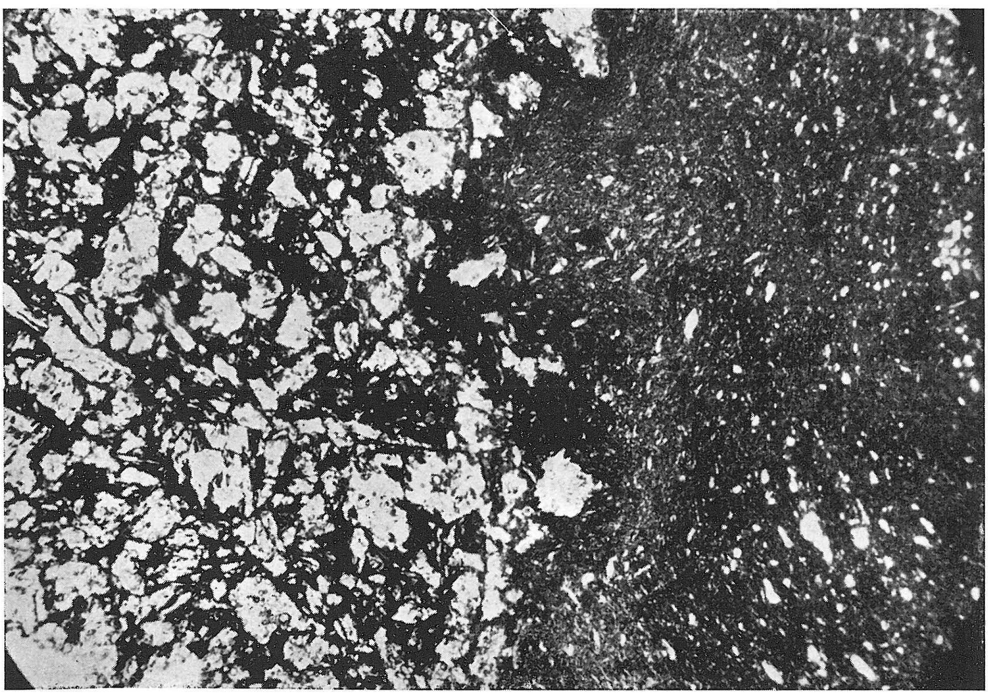

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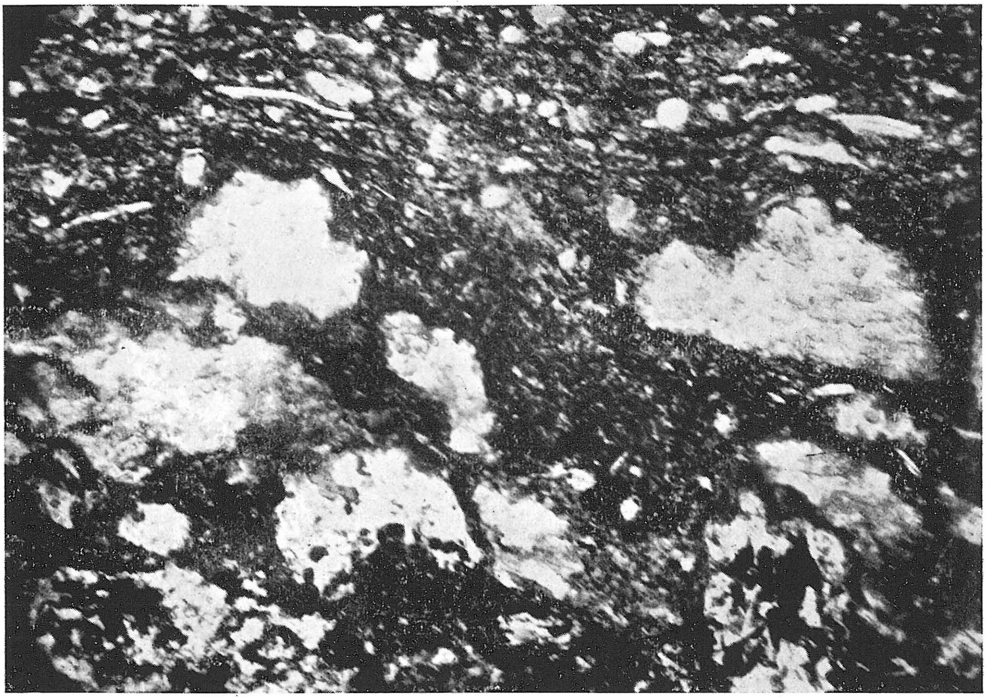

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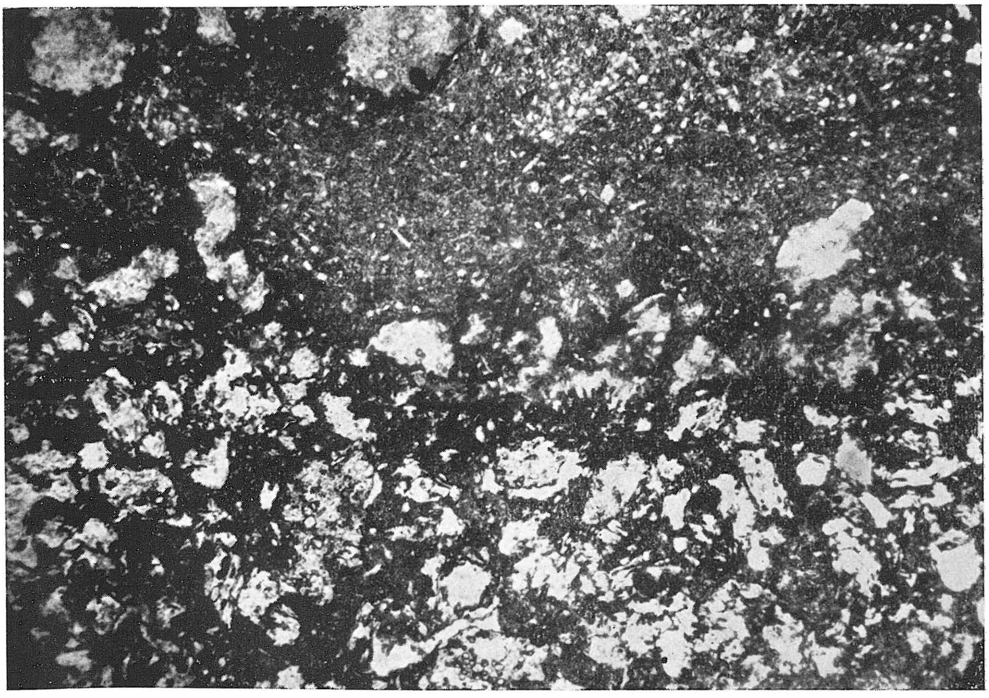

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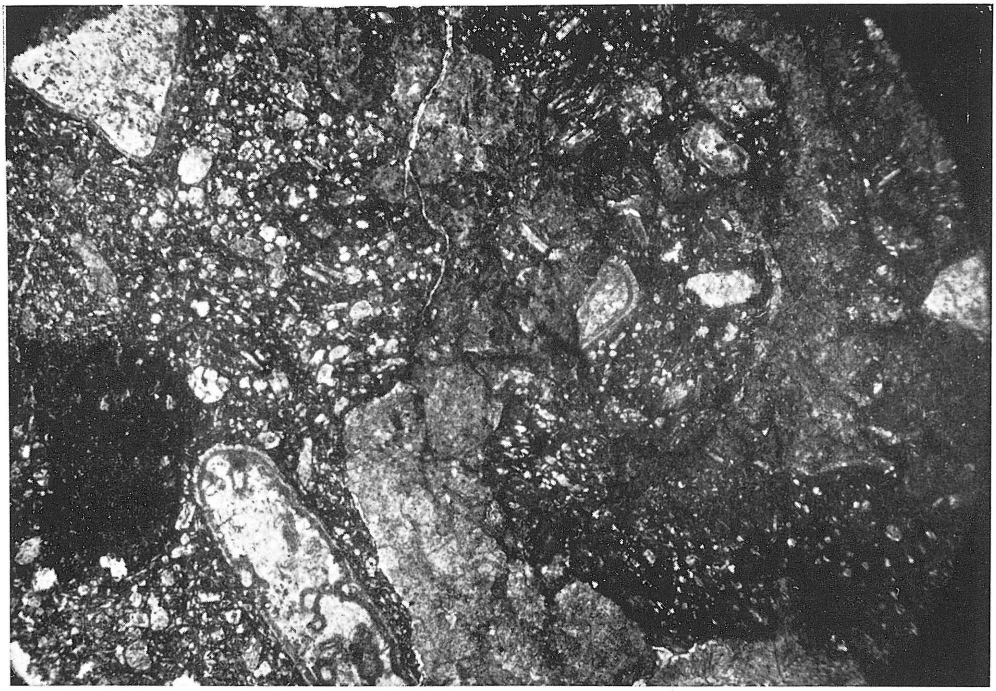

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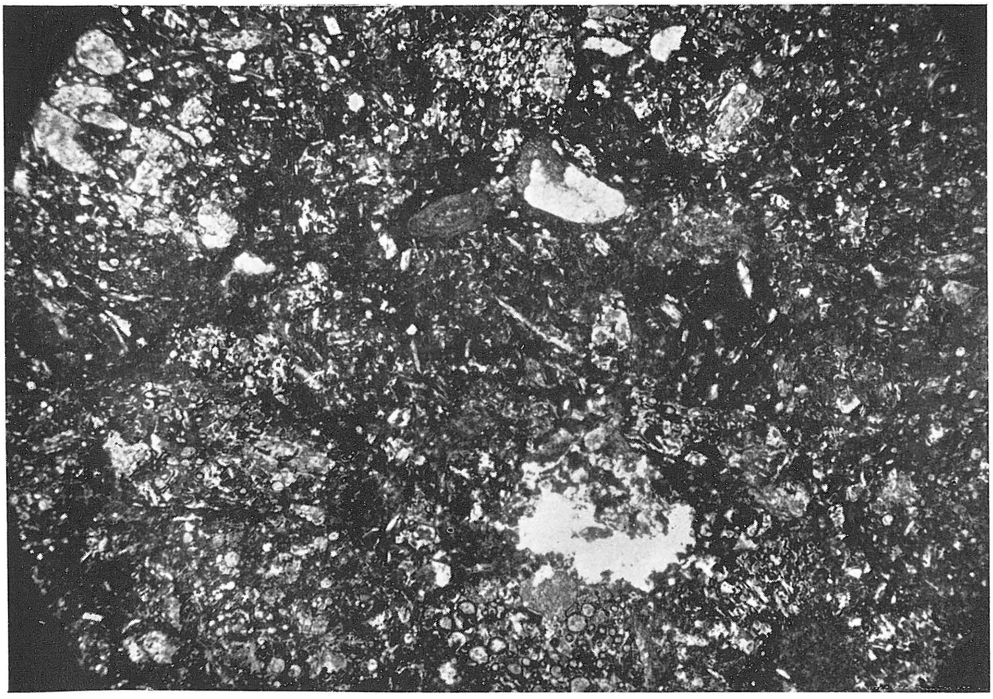

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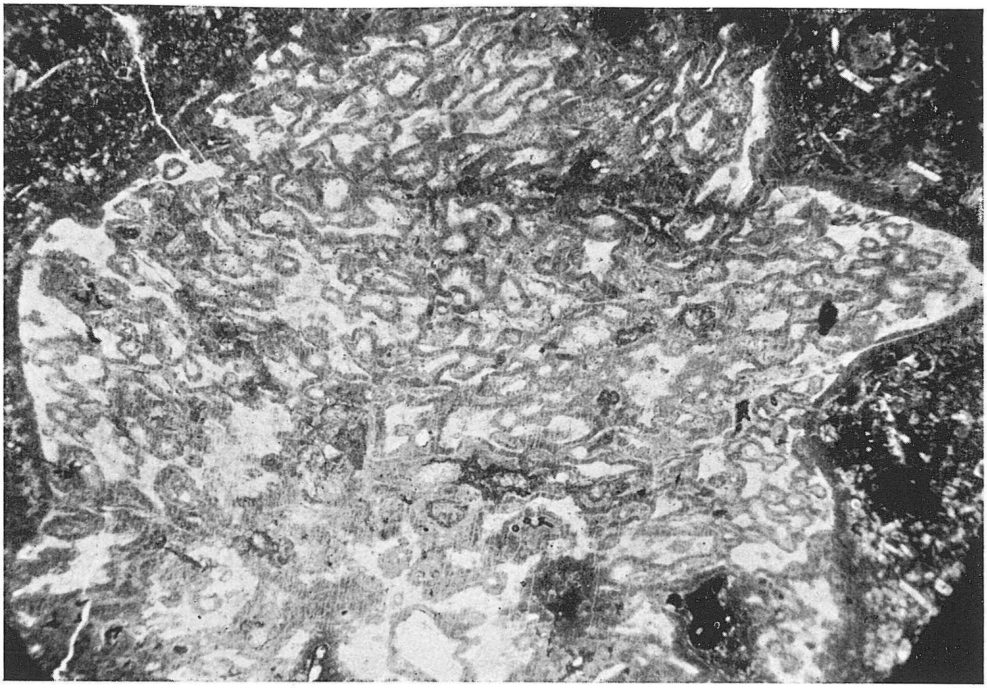

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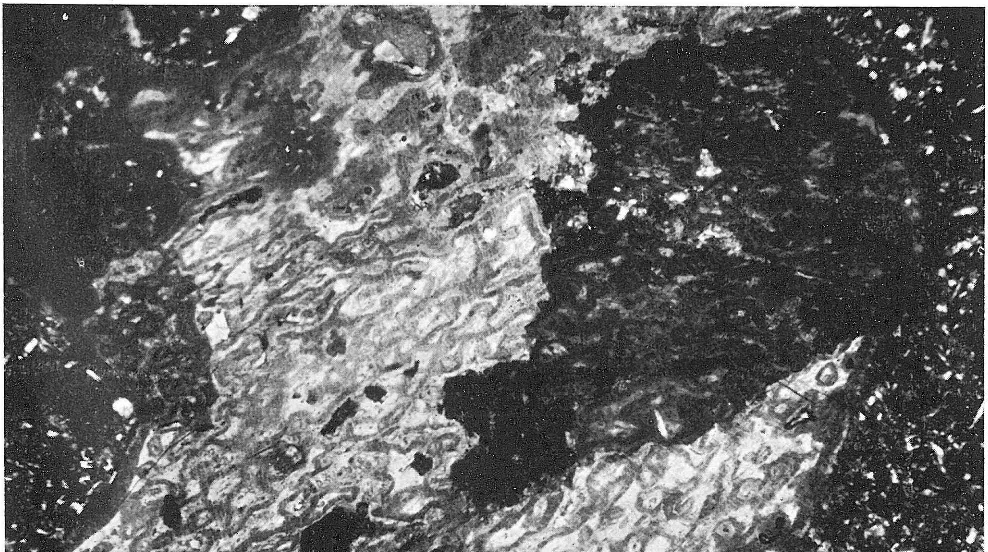

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