Bulletin de la Société belge de Géologie, T. 101 (3-4), 1992, pp. 173-180.
Bulletin van de Belgische Vereniging voor Geologie. Ed. 1993

GEOPHYSICAL CHARACTERIZATION OF LITHOLOGIES FROM THE BRABANT MASSIF AS A CONTRIBUTION TO GRAVIMETRIC AND MAGNETIC MODELLING

by

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ABSTRACT

Density and magnetic susceptibility measurements have been carried out on 62 samples from most lithological types of the Brabant Massif. They provide the necessary parameters for geophysical modelling.

The saturated bulk density of in situ groundwater saturated rocks was calculated from measurements of the dry weight, the solid volume by immersion in chlorothene, and the total volume by immersion in mercury; these also allow the calculation of open pore volume, grain density and bulk density.

The Ordovician and Silurian mudstones and turbidites show small variation around the average of 2.74 (saturated bulk density). The Cambrian Tubize and Oisquercq formations show a large range from 2.52 to 2.82, mainly due to porosity variation. Igneous rocks vary from 2.64 to 2.77, with a pyrite-rich exception (2.99).
From the figures no clear interpretation of the gravity maps can be deduced. In particular, the negative gravimetric Bouguer anomaly Ardooie-Geraardsbergen cannot be explained by the subcrop density pattern, increasing the likelihood of a light batholith at depth.

The susceptibility figures confirm the heterogeneity of the Tubize formation, which remains the chief magnetic unit. A diorite was discovered to be strongly magnetic, contrasting with the usually low susceptibility of the other igneous rocks; it influences the interpretation of the Geraardsbergen area.

KEY WORDS

Brabant Massif, magnetic susceptibility, rock density, petrophysics, gravity modelling, magnetic modelling.

1. INTRODUCTION

Without deep drilling data on the Brabant Massif, its deep geological structure is still a matter of speculation. Many drill cores from the upper part of the Massif are available, however, and kept at the Belgian Geological Survey lithotheque.

As magnetic and gravimetric maps exist over the whole Brabant Massif, they allow geophysical modelling to complement direct observation in order to build a threedimensional model. Geophysical modelling requires the introduction of two key parameters of each rock type; mass density and magnetic susceptibility. The aim of this paper is to present some data on measurements carried out on a wide variety of lithological types of the Brabant Massif. The measurements were made on 62 plugs from 55 core samples from 49 different boreholes, listed in table 1.

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Borehole	Locality	Depth	Stratigraphic unit	Code	Lithology	Porosity %	Density			Susceptibility	
							Bulk	Grain	SBD	K	Bulk
96E77	Rekkem	163,5 m	Silurian Pridoli	A	banded turbidite	3.64	2.701	2.803	2.737	354	131
96E77	Rekkem	163,5 m(vert)	Silurian Pridoli	A	banded turbidite	4.69	2.671	2.802	2.718	353	132
97E865	Bellegem	160 m	Silurian Ludlow	A	gray-brown claystone	2.67	2.731	2.806	2.758	303	111
27E148	Kallo	616 m	Sil.Wenl-Ludlow	A	gray slate	2.69	2.760	2.836	2.787	364	132
36E139	Zevekote	247,8 m	Sil. Wenlock	A	gray comp. siltst. + py	15.27	2.333	2.753	2.486	263	113
83W421	Kortrijk	252,1 m	Sil. Llandovery	A	gray slate	1.72	2.732	2.779	2.749	257	94
66E70	Langemark	219,8 m	Sil.Wenl-Ludlow	sl	gray siltstone	1.52	2.759	2.802	2.774	340	123
50E133	Houtem	320 m	Sil. Wenlock	sl	gray lamin. turbidite	1.30	2.740	2.776	2.753	362	132
50E134	Steenkerke	261 m	Sil. Llandovery	sl	banded turbidite + py	0.80	2.757	2.779	2.765	373	135
50E134	Steenkerke	261 m(vert)	Silurian Llandov.	sl	banded turbidite + py	0.91	2.763	2.788	2.772	373	135
59E146	Booischot	1326 m	Silurian	sl	gray laminated siltst.	0.74	2.796	2.817	2.804	338	121
68E169	Tielt	236 m	Middle Ord. to Sil.	A	gray laminated phyll.	13.75	2.407	2.791	2.545	361	150
36E137	Schore	230,4 m	Ord. Caradoc	sl	bluish gray siltst.	4.41	2.700	2.825	2.745	551	204
59E145	Beerzel	472 m	Ord. Arenig-Lland.	sl	gray laminated siltst.	1.34	2.733	2.770	2.746	316	116
85E963	St. Goriks	137,7 m	Ord. Tremadoc ?	sl	gray turbidite	3.35	2.668	2.761	2.702	338	127
85W797	Mater	127,6 m	Ord. Tremadoc ?	sl	banded sandy turbid.	4.42	2.695	2.820	2.740	417	155
85W797	Mater	127,6 m(vert)	Ord. Tremadoc ?	sl	banded sandy turbid.	4.11	2.698	2.814	2.740	360	133
36E117	Leffinge	(325-331 m)	Ord. Caradoc	ss	gray quartzite	0.88	2.684	2.708	2.693	259	97
36E117	Leffinge	(330 m?)	Ord. Caradoc	ss	gray quartzite + py	0.65	2.703	2.720	2.709	320	118
36E138	Keiem	220,85 m	Ordovician ?	A	gray mudstone	5.80	2.629	2.791	2.687	317	121
89E363	Heverlee	122,6 m	Ordovician ?	A	gray slate	2.03	2.737	2.793	2.757	341	124
84W1386	Kruishoutem	313,61 m	Ordovician ?	sl	laminated turbidite	1.73	2.772	2.820	2.789	663	246
71E256	Gijzegem	285 m	Cambrian Jodoigne	ss	gray quartzite	1.87	2.606	2.655	2.624	55	21
71E256	Gijzegem	285 m(vert)	Cambrian Jodoigne	ss	gray quartzite	0.87	2.635	2.658	2.643	55	21
93W560	Martenslinde	277 m	Cambrian Jodoigne	ss	gray quartz phyllite	1.28	2.670	2.705	2.683	103	38
51W125	Stuivekenskerke	250,5 m	Cambr. Oisquercq	A	greenish siltstone	7.10	2.602	2.801	2.673	511	197
51W144	Kaaskerke	247,5 m	Cambr. Oisquercq	A	greenish siltstone	15.88	2.366	2.812	2.524	373	158
51E154	Klerken	245,5 m	Cambr. Oisquercq	A	greenish siltstone	4.84	2.669	2.804	2.717	470	176
70W752	Eke	148,3 m	Cambr. Oisquercq ?	A	green phyllite	5.34	2.661	2.811	2.715	477	179
86E267	Iddergem	122,6 m	Cambr. Oisquercq	A	green to purple phyll.	11.87	2.500	2.836	2.618	455	182
100E9	Oetingen	53 m	Cambr. Oisquercq	A	green to purple mudst.	12.42	2.441	2.787	2.565	293	120
100E9	Oetingen	(id-uncleaned)	Cambr. Oisquercq	A	green to purple mudst.	11.24	2.488	2.803	2.601	343	138
52W154	Kortemark	240 m	Cambr. Oisquercq	sl	green silty sandstone	5.02	2.663	2.804	2.714	470	177

Borehole	Locality	Depth	Stratigraphic unit	Code	Lithology	Porosity %	Density			Susceptibility	
							Bulk	Grain	SBD	K	Bulk
57W154	Dendermonde	222,9 m	Cambr. Oisquercq	sl	green to purpl. siltst.	12.56	2.444	2.795	2.570	342	140
84W1475	Wortegem	169,5 m	Cambr. Oisquercq	sl	green-purple siltst.	12.96	2.453	2.819	2.583	402	164
88E522	Machelen	209 m	Cambr. Oisquercq	sl	green silty quartzphyll.	3.42	2.651	2.744	2.685	255	96
67W205	Staden	(209-252 m)	Cambrian Rva 1	sl	gray brown comp. siltst.	2.79	2.749	2.828	2.777	475	173
71E231	Aalst	201 m	Cambrian Rva 1	sl	gray slate + chlorite	0.89	2.799	2.824	2.808	395	141
71E231	Aalst	206 m	Cambrian Rva 1	sl	gray slate + quartz vein	0.53	2.815	2.830	2.820	421	150
84E77	Oudenaarde	105,5 m	Cambrian Rva 1	sl	gray siltstone	1.33	2.790	2.827	2.803	502	180
88W1309	Koekelberg	140,6 m	Cambrian Tubize	A	gray brown phyllite	7.60	2.581	2.793	2.657	3.565	1.381
54E196	Nevele	272,7 m	Cambrian Tubize ?	sl	green siltstone, altered	11.92	2.481	2.817	2.601	526	212
71W230	Wetteren	200 m	Cambrian Tubize	sl	green siltstone	3.19	2.703	2.791	2.735	15.674	5.800
87W346	Schepdaal	159 m	Cambrian Tubize	sl	green siltstone + quartz	1.07	2.768	2.798	2.779	515	186
69E330	Petegem	217,5 m	Cambrian Tubize	ss	green coarse sandstone	12.92	2.407	2.764	2.536	413	172
71W250	Vlierzele	202,9 m	Cambrian Tubize	ss	green coarse sandstone	5.14	2.548	2.686	2.600	1.893	743
88W1309	Koekelberg	164,85 m	Cambrian Tubize	ss	coarse sandst. + py, feld.	2.07	2.725	2.782	2.746	9.552	3.506
115E659	Lembeek	21,3 m	Cambrian Tubize	ss	laminated sandy shale	1.34	2.722	2.759	2.736	19.208	7.056
115E672	Halle	16,1 m	Cambrian Tubize	ss	sandstone + feldspar	4.81	2.593	2.724	2.641	696	269
36E137	Schore	220,85 m			porphyry	5.94	2.584	2.747	2.643	311	120
36E135	Keiem	215,6 m			porphyry	1.32	2.722	2.758	2.735	519	191
37E199	Gistel	204,9 m			porphyry	0.63	2.745	2.763	2.752	401	146
53W57	Lichtervelde	409,2 m			porphyry + pyrite	0.73	2.731	2.751	2.738	11	4
53W57	Lichtervelde	410,8 m			porphyry + pyrite	0.73	2.769	2.789	2.776	21	8
53W57	Lichtervelde	410,8 m(vert)			porphyry + pyrite	0.82	2.981	3.005	2.989	64	21
67E149	Roeselare	217,9 m			dacitic porphyry	0.79	2.679	2.701	2.687	180	67
83E403	Deerlijk	191 m			comp. fine-gr. porph.	0.68	2.672	2.690	2.678	147	55
84W1362	Waregem	148 m			porphyry	2.88	2.625	2.702	2.653	261	99
99E974	Goeferdinge	56 m			fine grained tuff	5.47	2.664	2.818	2.718	495	186
100W16	Geraardsbergen	96,15 m			magnetic diorite	0.60	2.769	2.786	2.775	34.211	12.354
59W146	Booischot	1246 m	Middle Devonian		compact conglomerate	1.72	2.762	2.810	2.779	338	123
59W146	Booischot	1246 m(vert)	Middle Devonian		compact conglomerate	1.61	2.765	2.810	2.781	330	119

Table 1. List of samples and geophysical values. Lithology codes: A argillite, sl siltstone, ss sandstone; py: pyrite.
(vert) after depth indication means the plug was cored vertically.
SBD saturated bulk density in g/cm^3. Volume susceptibility K in $SI.10^{-6}$ units, mass susceptibility in $m^3/kg \times 10^{-9}$.

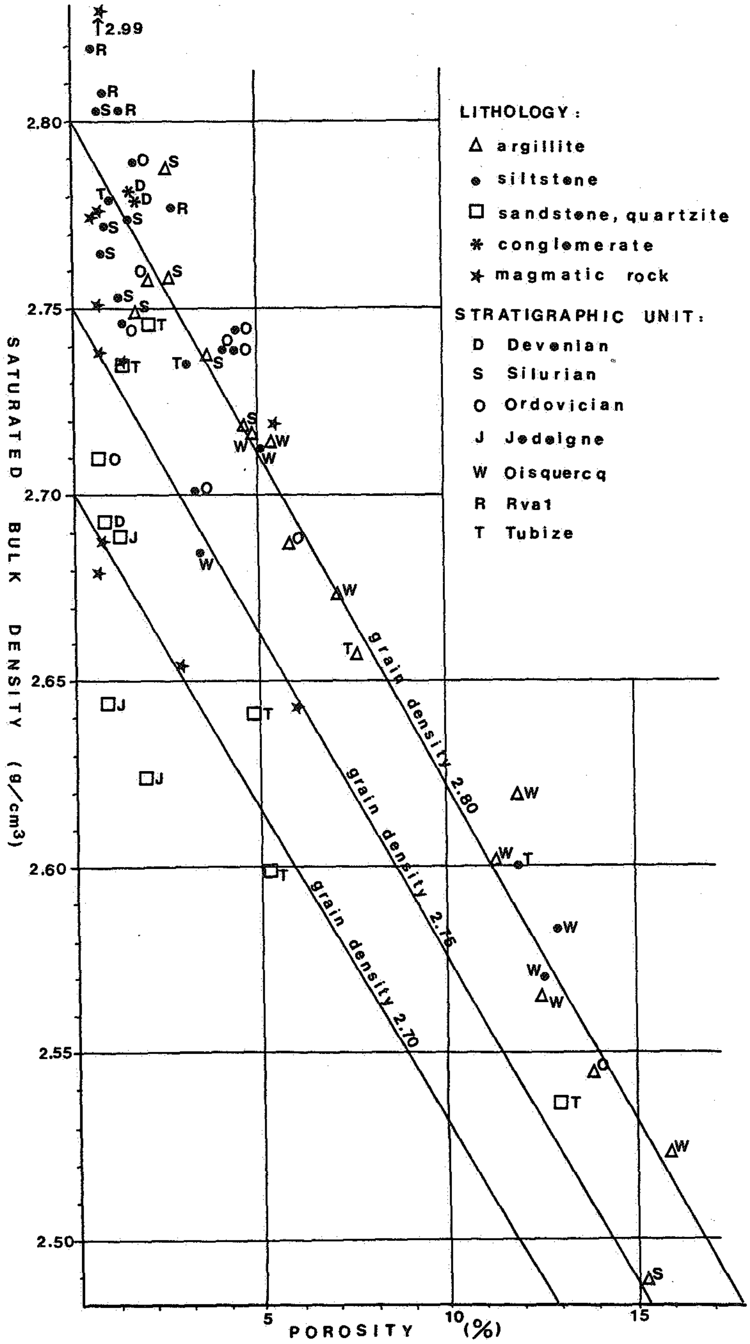

Figure 1a. Plot of saturated bulk density versus porosity. For individual samples.

Lithologies (number of samples)	Porosity (%)	Bulk density (g/cm³)	Grain density (g/cm³)	Permeability (md)
Porphyry (11)	2.00	2.718	2.773	0.01 (n=2)
Siltstone (22)	3.65	2.700	2.802	0.03 (n=5)
Diorite (1)	0.60	2.769	2.786	---
Sandstone (9)	3.30	2.619	2.709	1.06 (n=1)
Argillite (17)	7.56	2.589	2.800	0.08 (n=4)
Chalk (1)	33.25	1.808	2.708	---
Conglomerate (2)	1.66	2.763	2.810	---

Table 2. Average petrophysical analysis results.

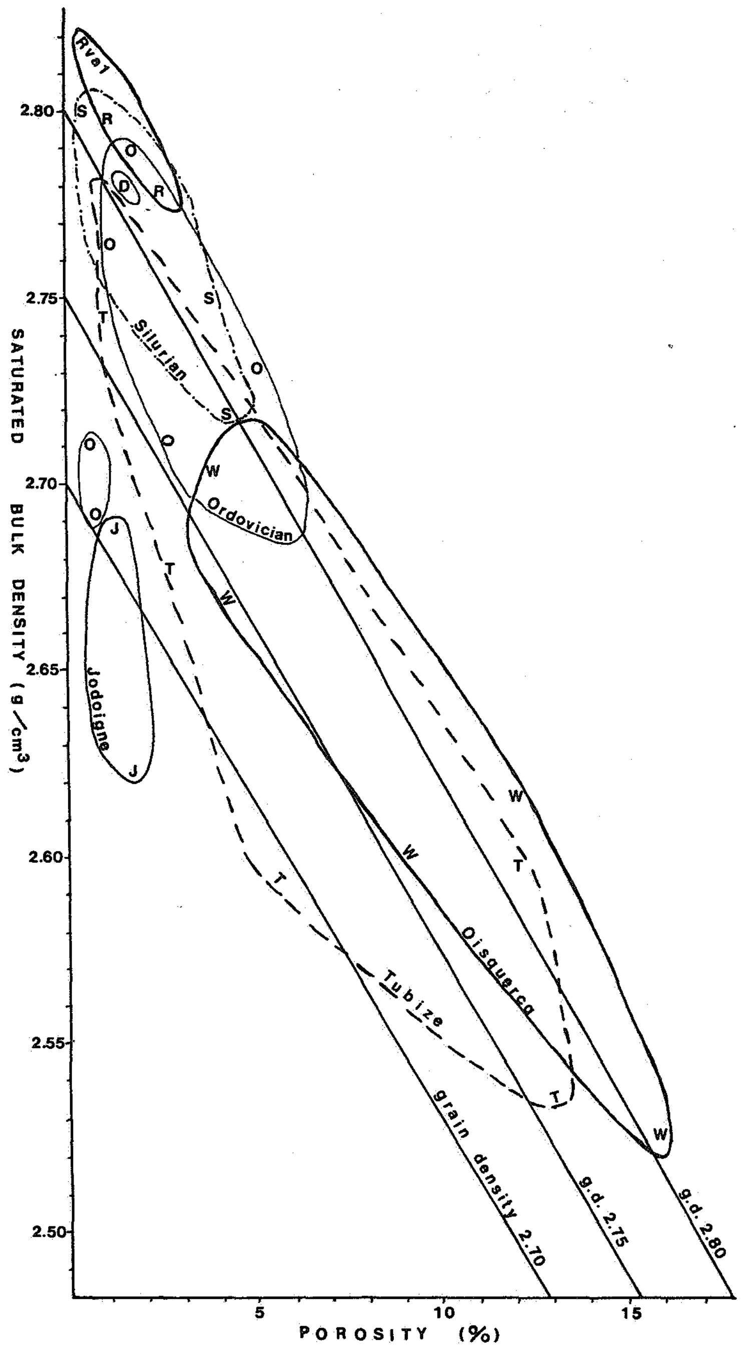

Figure 2. Plot of saturated bulk density versus porosity. Groupe per stratigraphic unit.

2. DENSITY MEASUREMENTS

Porosity, bulk and grain density were measured at the petrophysical laboratory of Fina Research on cylindrical plugs of 23 mm diameter, cored preferentially horizontally from the drill core block. A few plug samples were obtained by coring vertically in the same block, for comparison. Cleaning of samples was performed by solvent extraction in a soxhlet; first with methanol to clean the salt off, until chlorides no longer precipitate from the effluent methanol when tested with Ag NO_3, and followed by chlorothene (1,1,1 thrichloroethane) for cleaning hydrocarbons until no more brown coloration of the solvent is observed after one night of immersion. The maximum working temperature is 70°C.

Porosity calculation is based on estimates of the total and solid volumes of the plugs using the immersion method, which determines the open porosity:

1. Weighing of dried samples (Wdr).
2. Saturation by chlorothene under vacuum.
3. Solid volume (Vs) calculated from weight of saturated sample immersed in chlorothene (Wim) according to :

   Vs = (Wdr-Wim)/density of fluid.
4. Sample saturation under 250 bars pressure and determination of solid volume after pressurization.
5. Total volume (Vt) calculated from weight of chlorothene saturated sample immersed in mercury (Whg) according to: Vt = Whg/mercury density.
6. Porosity calculation : porosity = (Vt - Vs)/Vt.

Conventional density values are calculated at follows:
bulk density = Wdr/Vt
grain density = Wdr/Vs.

A saturated bulk density (SBD) for use in gravimetric modelling is calculated using a water density value of 1.001 g/cm^3 for complete saturation of the pore volume:
SBD = bulk density + (porosity x water density).
The results appear in table 1.
Table 2 shows average petrophysical results according to purely lithological criteria. The distinction between siltstone and argillite is based on visual macroscopic inspection only. Permeability measurements expressed in millidarcy, carried out on twelve selected plug samples, are shown for comparative purposes only and will not be further discussed. The average grain density is above 2.8 for argillites, siltstones and conglomerate, around 2.7 for sandstones, and intermediate for igneous rocks.

Note the low open porosity in igneous rocks (porphyry and diorite), and the relatively large porosity in argillite, which decreases its average bulk density. One Cretaceous chalk sample was analyzed for comparison.

3. MAGNETIC SUSCEPTIBILITY MEASUREMENTS

The magnetic susceptibility of the cylindrical plugs was measured at the Centre de Géophysique du Globe. It was obtained in a weak alternating field of 80 Am^{-1} at 970 Hz, with a Kappabridge KLY-1, with a precision of 4.10^{-8} SI.

The magnetic susceptibility is determined by measuring the inductivity change of the pick-up coil caused by insertion of the sample. In the Kappabridge the pick-up coil is supplemented with an auxiliary compensation coil to balance the bridge purely by electrical means with a devider, without any mechanical disturbance of the pick-up coil. The transfer factor of the devider for attaining balance is a linear function of the change of pick-up coil inductivity.

The bridge is calibrated in SI units for a sample of 8 cm^3. In the lowest ranges, to allow for a linear temperature drift, the bridge is balanced five times at regular intervals.

Usually the bulk susceptibility is obtained by averaging the three measurements obtained along three perpendicular sample axes. As the samples have a large length to diameter ratio only a single reading along the axial direction could be taken.

Before their measurement, the samples were oven-dried at 50°C for at least 48 hours in order to obtain their dried weight. The dried weight was used to obtain the specific or mass susceptibility in SI units expressed in m^{3}Kg^{-1}. The volume of the samples was calculated on the basis of this dried weight and of the bulk density determined by Fina Research.

The volume susceptibility K in SI units is calculated with the following relation :

$$K=\frac{8}{V}\Theta=\frac{8}{m}d.\Theta$$

Where : V = sample volume in cm^3,
m = sample mass in g,
Θ = reading,
d = bulk density in g/cm^3
The volume susceptibility in SI units is dimensionless.

The low-field susceptibility which is the ratio of the induced magnetization to the intensity of the magnetizing field depends on the nature (chemical composition), concentration, effective grain size and shape of the magnetic minerals present. If magnetite is the dominant magnetic phase, the susceptibility is generally a measure of its concentration.

The results appear in table 1.

4. GEOLOGICAL UNITS

Table 1 lists the results according to broad geological units. It gives a brief description of each sample, including a lithological code argillite, siltstone, sandstone to outline broad categories for density and porosity interpretation.
For modelling purposes, it is important to define homogeneous geological formations. The formations building up the Brabant Massif are described in detail by De Vos *et al.* (1993) and can be summarized as follows:

The ***Tubize group*** (s.l.) includes phyllite, siltstone and fine to coarse sandstone with variable feldspar content. This formation is characterized by its chlorite content, greenish colour and frequent magnetite-bearing horizons. Its age is late Precambrian (?) to early Cambrian.

The ***Oisquercq group*** contains mostly greenish to purplish phyllites and siltstones, without stratification and without magnetite. The lower part, called Rva 1 by Legrand (1968) is made up of brownish to greyish siltstone or mudstone. Its age is early to middle Cambrian.

The ***Jodoigne formation*** consists of grey quartzites and quartz phyllites. Its age is middle or upper Cambrian.

The Ordovician rocks consist of grey turbiditic sequences, most typically in the Tremadoc, with a high proportion of massive mudstones and siltstones in the Caradoc and Ashgill, and quartzitic intercalations in the Caradoc.

unit (number of samples)	grain density	SBD	porosity %	volume susceptibility K x 10^{-6}	observation
Silurian argillite (5)	2.805	2.750	3.08	326	without 36E139
Silurian siltstone (5)	2.792	2.774	1.06	357	
Ordovician arg. + siltst. (8)	2.799	2.738	3.40	413	without 68E169
Ordovician quartzite (2)	2.714	2.701	0.76	289	
Jodoigne quartzite (3)	2.673	2.650	1.34	71	
Oisquercq argillite (7)	2.808	2.630	9.58	417	
Oisquercq siltstone (4)	2.791	2.638	8.49	367	
Oisquercq Rva 1 (4)	2.827	2.802	1.39	448	
Tubize arg. + siltst. (4)	2.800	2.693	5.94	5.070	
Tubize sandstone (5)	2.743	2.652	5.26	6.352	
Porphyry without pyrite (6)	2.727	2.691	2.04	330	
All volcanic rocks (10)	2.772	2.737	2.00	241	incl. 53W57, 99E974
Diorite (1)	2.786	2.775	0.61	34.211	

Table 3. Average values per lithological unit and type.

The Silurian consists of grey turbiditic sequences and mudstones. Most rocks in the Ordovician and Silurian have been dated by microfossils, in contrast to Cambrian rocks where lithological criteria have to be used to determine the stratigraphical position.Porphyritic rocks are rhyolitic to dacitic in composition, and generally upper Ordovician in age. One diorite sample is included.

A middle Devonian conglomerate is also included, from the rim of the Kempen basin overlying the Brabant Massif to the northeast.

5. DISCUSSION OF RESULTS

The density features of the investigated samples are illustrated in figure 1. Porosity is plotted against saturated bulk density (SBD) which is the density value to be used for gravimetric modelling. In fig. 1 a, different symbols and letters are used for different lithologies and stratigraphic subdivisions. In fig. 1 b the fields of the stratigraphic units have been delineated. Average values are listed in table 3 per lithological unit and type.

Saturated bulk density is determined by grain density and porosity, a relationship clearly visible on fig. 1. Some lithological units are rather homogeneous, others show a widely varying SBD due to porosity variation; this is especially the case for the Oisquercq group.

Sandstones, quartzites and porphyritic rocks generally plot to the lower left of the diagram because of their low grain density. The quartzitic Jodoigne formation has an average SBD of 2.65, a quartzitic intercalation in the Caradoc 2.70. These units are clearly distinguished on the plot.

SBD figures for the Silurian vary between 2.71 and 2.80, the argillites showing slightly smaller SBD because of higher porosity (see table 3 and fig. 1). For the Ordovician, a variation between 2.68 and 2.79 is observed. Two argillites of this stratigraphic range, one Silurian and one Ordovician, have exceptionally high porosity and were left out of the average calculation. The reason for the high porosity is as yet unknown but could be related to a type of alteration, although the rocks look fresh. The Middle Devonian conglomerate plots in the middle of the Silurian samples (fig. 1) suggesting that most of the rounded shale pebbles building them up are of Silurian origin.

The rocks of the Cambrian Oisquercq group have a porosity varying between 3.4 and 15.9% and a grain density between 2.78 and 2.84 (one sample from Machelen is lighter, see table 1). The corresponding SBD value varies between 2.52 and 2.72, which makes it rather speculative to assign a value for modelling purposes. The lowermost unit of the Oisquercq group called Rva1, is represented by four samples characterized by a very high grain density (2.827 on average), low porosity (1.39%) and high resulting SBD (2.80); they plot on the upper left in fig. 1.

The Tubize group, like the Oisquercq group, shows a wide range of SBD values. Its grain density varies from 2.686 in a coarse sandstone to 2.817 in fine siltstone. The porosity varies from 1.07 to 12.92%. The average SBD is 2.65 for sandstones and 2.69 for siltstones, which is slightly higher than for the Oisquercq group.

The magmatic rocks generally have a low porosity, but the variation in grain density causes a large spread in SBD values. The relationship of petrographical and chemical composition to grain density has not been investigated and deserves further study in a systematic way in all the volcanic occurrences of the Brabant Massif. Pyrite increases the grain density, as exemplified in the Lichtervelde borehole, where a grain density value above 3 was recorded. When no pyrite is present, a good estimate of the average SBD of most porphyritic rocks is 2.69 (table 3). This is much lower than for Rva1 mudstones, Ordovician and Silurian argillites and siltstones, but higher than for sandstones and quartzite facies, higher than the average Oisquercq group, and similar to the abundant fine-grained facies of the Tubize group. The diorite from Geraardsbergen has very low porosity and a rather high density (resultant SBD of 2.775).

The interpretation of the magnetic susceptibility figures is more straightforward than of the density figures.

Most sedimentary rocks cluster around volume susceptibility values of 0.0003 to 0.0005 SI, which seems to be the background for fine-grained detrital sediments containing negligible magnetite (see tables 1 and 3). Coarse-grained rocks have even lower values; the Jodoigne quartzite has an average value of 0.00007 SI. The porphyritic rocks with high pyrite content at Lichtervelde show susceptibility values as low as 0.00001 SI. Most magmatic rocks have low values, close to the general background.

One notable exception is the diorite at Geraardsbergen, with a moderately high volume susceptibility of 0.034 SI. It shows on the magnetic maps as an elongated body of about 4 km long oriented NNW-SSE. It was described by Corin (1965) as a fine-grained rock with doleritic texture and acidic plagioclase (10% An).

The main lithological unit with a magnetic susceptibility above background is the Tubize group. It contains many magnetite-bearing horizons, both coarse- and fine-grained, alternating with non-magnetite bearing ones. As a result, its magnetic properties are heterogeneous,as can be deduced from table 1. Volume susceptibility varies from 0.0004 to 0.0192 SI with no relation to facies. Averages of 0.0050 and 0.0063 SI were computed for fine-grained rocks and sandstones respectively (table 3).

6. CONCLUSIONS FOR GEOPHYSICAL MODELLING

From the present knowledge it may be concluded that the magnetic anomalies in the Brabant Massif area can be explained mainly by the extension and inner structure of the Tubize group. It appears necessary however to propose the presence of some layers with a magnetic susceptibility that is much higher than hitherto measured, in the order of 0.05 to 0.1 SI. Indeed, in a trial modelling (Chacksfield *et al.*, 1993) a hypothetical value of 0.02 SI had to be introduced as an average for the magnetic body constituting the core of the Brabant Massif. The present average of 0.006 SI (table 3) is too low. A magnetic volcano-sedimentary core in the central axis of the Brabant Massif is not excluded. The presence of occasional volcanic rocks and of arkosic horizons of possible volcanic origin, points in that direction (De Vos *et al.*, 1993).

The occurrence of more magnetic intrusive bodies of the Geraardsbergen type is not excluded along the southern margin of the Brabant Massif.

The measured density values offer many possibilities for modelling work on the observed gravity field. The positive areas seem to correspond mainly to Ordovician and Silurian fine-grained sediments. Most other field correspondences are speculative at the moment, and a lot more trial modelling should be done.

The density figures obtained close to the subcrop of the Paleozoic rocks under its Cretaceous cover fail to explain the negative gravimetric anomaly in the southwest of the Brabant Massif. A density contrast of at least 0.05 with the surrounding rocks is necessary to explain the anomaly (Chacksfield *et al.*, 1993), which is not provided by the known volcanic rocks occurring in the volcanic arc showing the same WNW trend south of the anomaly. It is therefore necessary to postulate the presence of a light granitic batholith at depth, as has been proposed in the past (Legrand 1968; De Meyer 1983, 1984; André 1991).

Finally, it should be observed that not all facies types of the Brabant Massif have been analyzed for their geophysical characteristics. The Cambrian Mousty formation and several Ordovician formations defined in the outcrop area (Herbosch *et al.*, 1991) have not been studied. Also a thorough analysis of the magmatic rocks seems necessary. New sedimentological data may also lead to refining the stratigraphy. It is therefore recommended to continue this work on available borehole and outcrop samples.

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Manuscript received on 24.02.1993 and accepted for publication on 9.03.1993.