Chapter 12
German Military Geography and Geology at the Eastern Front 1941–1945

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Contents

Abstract In 1940, prior to the invasion of the Soviet Union, MilGeo, Branch Nine of the German Army General Staff, prepared a series of booklets, including maps depicting the terrain, population and infrastructure of European Russia. At the same time, military geology teams (MGTs) provided trafficability maps for the area west of Moscow at a scale of 1:300,000. During the Second World War, at least 139 German and Austrian military geologists in 34 MGTs were deployed to the Eastern Front. From 1940 onwards, 15 MGTs were assigned to fortress engineers, the Inspectorate of Fortifications, and territorial military commanders and 19 MGTs to Higher Commands of Army Groups, Armies and Panzer Armies. Approximately 3500 military geologic reports and written opinions, which provided insight into terrain characteristics for the attacking and retreating German Armies, were prepared. Military geology teams dealt with a wide range of geotechnical problems, including water supply, earthworks, provision of construction materials for roads and railways and assessment of off-road trafficability for both tracked and wheeled vehicles. Russian engineer instructions on traversing moors and frozen rivers in

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addition to statistical data on thawing and flood periods of rivers allowed for a detailed prognosis of the going conditions for armoured brigades.

Keywords Second World War · Military geography · Military geology · Military geology team · Trafficability · Forschungsstaffel z.b.V. · Operation Barbarossa

12.1 Introduction

After the declaration of military sovereignty in 1935, it was imperative for the *Wehrmacht* (German Armed Forces) to have control of the mapping and survey services in the interest of defence (Klinckowstroem 1945). In order to create a military agency that would look after the interests of the Wehrmacht, the Geodetic Section, up to that time affiliated to Branch One (Operations) of the Army General Staff, was made a regular branch of the General Staff and was designated as Branch Nine: Mapping and Survey Branch. In 1937, Branch Nine of the General Staff proposed centralising the mapping and survey services of the Army, Navy and Air Force into the Armed Forces Cartographic Office. However, it was argued that a hydrographic map had nothing in common with a terrain map and that a pilot chart for aerial navigation served other purposes than did the General Staff map. As a result, the Luftwaffe and Army independently developed their own 1:500,000 scale map series of (greater) Germany (Klinckowstroem 1945).

At the same time as the occupation of Poland in September 1939, the General Staff of the German Army prepared for invasions of Denmark and Norway; the Netherlands, Belgium and France; and the Soviet Union. This paper deals with geographic and geologic information on the Eastern Theatre, which was provided by six different branches of the Wehrmacht:

1. MilGeo, the geographic service of the German Army
2. Technical Military Geology, the leading applied geologic service of the Army High Command deployed to the Inspectorate of Fortifications
3. Technical Military Geology, subordinate to the Army Ordnance Office
4. Technical Military Geology of the *Waffen-SS* deployed to the Operational Headquarters of the SS
5. *SS-Wehrgeologenkorps* (Geological Corps) of the Waffen-SS; and
6. *Forschungsstaffel z.b.V.*, the research staff for special terrain evaluation duties of the Supreme Command of the Armed Forces High Command

Interestingly, despite organisational problems until 1940, in 1941, and independently from each other, these applied military geoscientific branches involved with military geography and geology were organized by different offices of the Armed Forces High Command, the Army High Command and the Waffen-SS. Figure 12.1 does not show command channels as of any given period but rather represents major

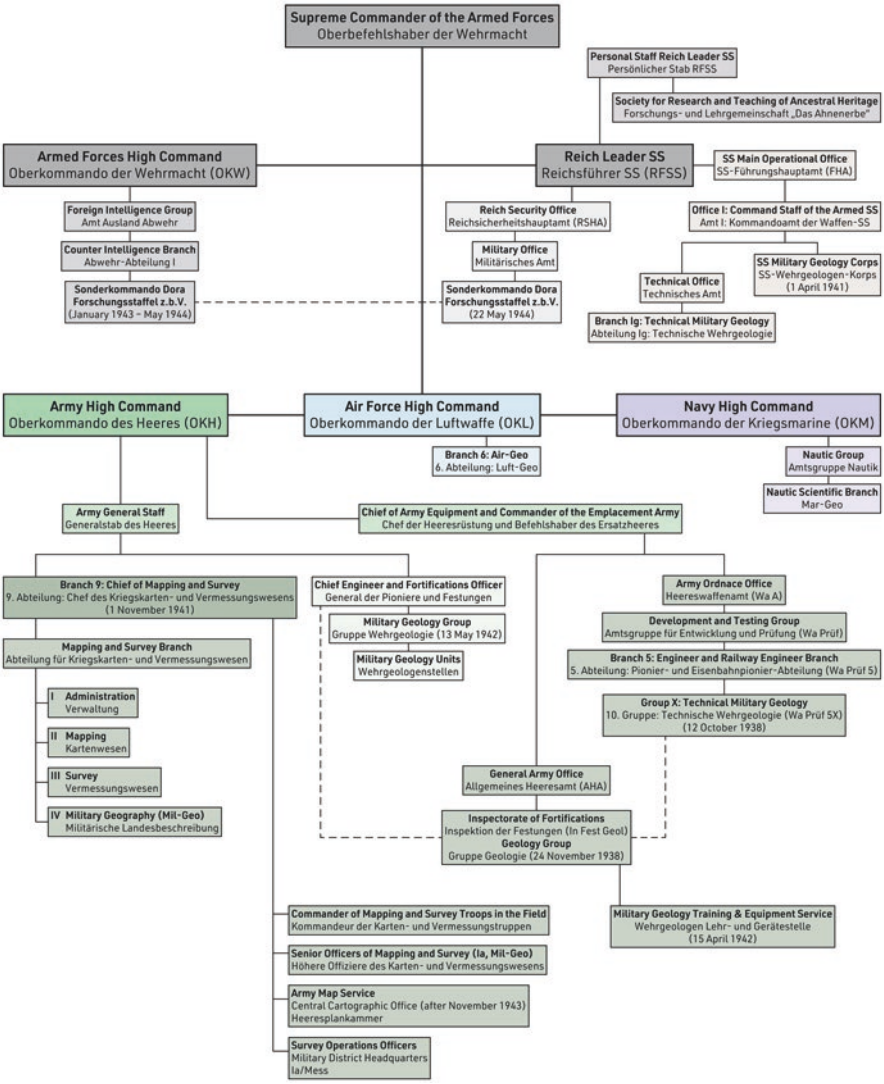

Fig. 12.1 The major functional relationships of mapping and survey services in the Wehrmacht during the Second World War. (Compiled from Klinckowstroem 1945; War Department 1945; CIA 1951; Häusler 1995a; Häusler and Willig 2000; Müller and Hubrich 2009)

functional relationships between offices of the German Army during the Second World War dealing with military geography and geology. The Army General Staff was a functional part of the Army High Command and must not be confused with the General Staff Corps, members of which filled almost all the important command and staff positions throughout the Army. In time of war, the Army General Staff was

stationed at field headquarters, leaving only a small rear echelon in Berlin. The following description gives the nomenclature and function of the most important subdivisions of the Armed Forces High Command related to military geography and geology.[1]

According to the US Handbooks on German Military Forces (War Department 1943, 1945), the Army High Command in peacetime consisted of 12 branches within five sections of the *Oberquartiermeister* (Senior General Staff Officer), including Branch Nine: Topography. At the beginning of the war, several sections of the *Generalquartiermeister* (Chief Supply and Administration Officer) took care of the whole supply and administrative structure of the Field Army. Most of these branches of the Senior General Staff Officer and the Chief Supply and Administration Officer are not depicted in Fig. 12.1, except for Branch Nine of the First Senior General Staff Officer. This branch had been handled by the Chief of Mapping and Survey in the General Staff since 1 November 1941. According to the chart of Klinckowstroem (1945), the Mapping and Survey Branch was at that time affiliated with the Army General Staff as Branch Nine. For the duration of the war, this branch of the Army General Staff, the Mapping and Survey Branch, was headed by a chief of branch called Chief of Mapping and Survey, who was part of the rear echelon of the General Staff and, prior to the start of the Russian campaign, was represented by the Commander of Mapping and Survey Troops at field headquarters (Fig. 12.1). Organisational diagrams of the Chief of Mapping and Survey dating from 1 August 1941, May 1942 and January 1943 were published by Müller and Hubrich (2009). In November 1943, in order to standardise the permanent military mapping and survey establishments, the Army Map Service was reorganised as the Central Cartographic Office, a designation that characterised it as the main centre for all military mapping and survey offices (Klinckowstroem 1945).

The Chief Engineer and Fortifications Office headed both the Group Geology, affiliated to the Inspectorate of Fortifications, which was subordinate to the General Army Office of the Chief of Army Equipment and Commander of the Emplacement Army, and the Military Geology Group of the Army General Staff beginning on 13 May 1942. In addition, the development of geologic and geophysical methods was performed at a desk of the Army Ordnance Office, which, comparable to the Inspectorate of Fortifications (concerned with the training of fortress engineers), was also subordinate to the Chief of Army Equipment and Commander of the Emplacement Army. The Development and Testing Group was responsible for the development and testing of ordnance equipment for all arms and services. The Technical Military Geology Group was the tenth desk of the fifth section of the Engineer and Railway Branch subordinate to the Development and Testing Group (Häusler and Willig 2000).

Since real concentration of mapping and surveying within the Wehrmacht was not accomplished until February 1945, joint tasks had to be solved by co-operation between the top-level agencies responsible for mapping and survey in the Army, Air

[1] See Appendix 12A for German terms not defined in the text or in Fig. 12.1.

Force and Navy. On questions at the Wehrmacht level, Branch Nine of the Army General Staff was invested with Wehrmacht authority (Klinckowstroem 1945) and co-operation was especially close with Branch Six of the Luftwaffe General Staff, which was responsible for photographic survey flights and photogrammetry (Häusler 2007). In addition, Branch Seven, later Division Seven of the Reich Air Ministry, was charged with the production and procurement of maps and produced fluorescent maps for night flights in Russia. The map sections of the regional commands, which had been advanced into Russia, functioned as map supply centres (Drechsel 1947).

12.2 Military Geographical Studies of Eastern Europe

During the war, the military geographic service of the Army General Staff published more than 100 geographical handbooks on about 40 countries, as well as more than 300 map sheets, more than 500 city plans and more than 1300 *Stadtdurchfahrtpläne* (maps showing the best ways to get through cities; CIA 1951). *Generalstab des Heeres, Abteilung für Kriegskarten- und Vermessungswesen, IV Mil.-Geo.* (Fig. 12.1), herein abbreviated as MilGeo (fourth section of the Mapping and Survey Branch), issued more publications on the USSR than on any other country. Military geographical studies on European Russia were classified *Nur für den Dienstgebrauch* (for official use only) and were prepared from August 1940 to August 1942, most of them prior to the beginning of Operation Barbarossa (the German invasion of Russia) in June 1941. In 1942, another series was printed on military geographical studies of Asian Russia as well as booklets on high mountain passes in the Caucasus and, in 1943, secret studies on Russian rivers (CIA 1951).

The handbooks of the Army General Staff on western Russia comprised the following 13 volumes of cardboard folders consisting of handbooks and maps (*Mappe A-N*) (Fig. 12.2):

- *Mappe A*: General Overview (1 March 1941; earlier edition: 10 August 1940)
- *Mappe B*: Baltic Countries (March 1941)
- *Mappe C*: Leningrad Region (10 June 1941)
- *Mappe D*: Karelia and Kola Peninsula (15 June 1941)
- *Mappe E*: White Russia (27 March 1941; second edition: 22 April 1941)
- *Mappe F*: Ukraine (15 May 1941; third edition: 5 September 1941)
- *Mappe G*: Central Russia (without Moscow; 15 May 1941)
- *Mappe H*: Moscow (20 June 1941)
- *Mappe J*: Caucasus (10 August 1941; second edition: 17 August 1942)
- *Mappe K*: Volga River Region (10 July 1941; supplement 1 December 1941)
- *Mappe L*: Ural Mountains Region (30 September 1941)
- *Mappe M*: Vologda-Arkhangelsk Region (5 August 1941)
- *Mappe N*: Northeast Russia (Draft, 1 June 1942)

Fig. 12.2 German handbooks on European Russia printed by the Chief of Mapping and Survey in 1941, many of them provided before 22 June 1941, the beginning of the German invasion of the USSR. (Used with permission from the archive of the Salzburger Wehrgeschichtliches Museum)

The typical MilGeo handbook was a pocket-sized paper folder containing an assortment of booklets and folded maps, each 15 × 22 cm in size (Fig. 12.2). The folder generally contained a comprehensive *Textheft* (text volume) of 100–200 pages with a section in which the entire country was discussed by topics; a section describing the geographic regions of the country; an inventory of roads, railroads, waterways, water resources, health facilities, industrial plants, principle towns, airfields, population and administrative districts; and five to 20 black-and-white maps on a variety of subjects (CIA 1951). Descriptions that were useful for military interpretations, such as economic conditions, administrative boundaries, population, transportation, telecommunications, drainage, vegetation and soil cover, were also included. The folder also usually contained a *Bildheft*, a 100–200-page booklet of photographs with captions. Depending on the region, map types included an *Operationskarte* (Operations map), which showed terrain types, relief and trafficabilities, as well as drainage patterns. A booklet of Stadtdurchfahrtpläne showed the best route for traffic through a city. In general, the Textheft did not provide a military analysis of the data presented, but it did call the user's attention to items of military significance by printing a bold black line in the margin opposite selected passages. For a few areas, however, the text contained a concise military section entitled *Militärische Beurteilung* (military evaluation) or *Gesamtbeurteilung* (overall evaluation) (CIA 1951).

As can be seen on the cover page of Textheft Mappe G (Fig. 12.3), these booklets were produced by MilGeo. They provided excellent descriptions of geomorphology, drainage, vegetation, soils, construction materials and aggregates, and industrial raw minerals. However, except for the personal knowledge of the authors, information was derived predominantly from older literature and maps, and information on military geologic conditions was rare. An exception was a military geologic map of European Russia printed in March 1941 at a scale of 1:2,500,000 with a legend of 17 different terrain units and general conclusions on mobility and

Fig. 12.3 (**a**) Cover of Mappe G: Textheft on Central Russia printed in May 1941, an example from a series of military geographic fact sheets on European Russia. (**b**) Figure depicting this region within the surrounding regions B to K. (Used with permission from the archive of Salzburger Wehrgeschichtliches Museum)

groundwater. Furthermore, the legend included the latitude of arctic permafrost, mean frost duration in months (the period when rivers could easily be crossed), regions with outcrops of hard rock (for surveys of aggregates and construction materials), the occurrence of black soil (chernozem; with comments on camouflage problems) and steep slopes of former marine coasts (Fig. 12.4). This map was provided by the Geology Group of the Inspectorate of Fortifications and very instructively described surface and sub-surface features that were not obvious on topographic maps of the same scale.

Another military geology map at 1:500,000 scale of the Pripyat-Polesie region (Fig. 12.5) was printed in March 1941 as a military geographic Operations map and was attached to MilGeo Mappe E on White Russia. The Pripyat River flows eastward through Belarus through the cities of Brest, Pinsk and Mazyr. The flat to undulating terrain was rich in dry woodland, wet to marshy woodland, marshes, peat and smaller lakes. The legend (Fig. 12.5b) differentiated between nine terrain classes, and the explanations characterised each according to geomorphology, soil type, vegetation and the depth to groundwater. Furthermore, in a second column of the legend, assessments of *Durchgängigkeit* (passability) and *Befahrbarkeit* (trafficability; during non-frost conditions) were made for each terrain. A third column assessed the function of these terrain types as natural obstacles, a fourth

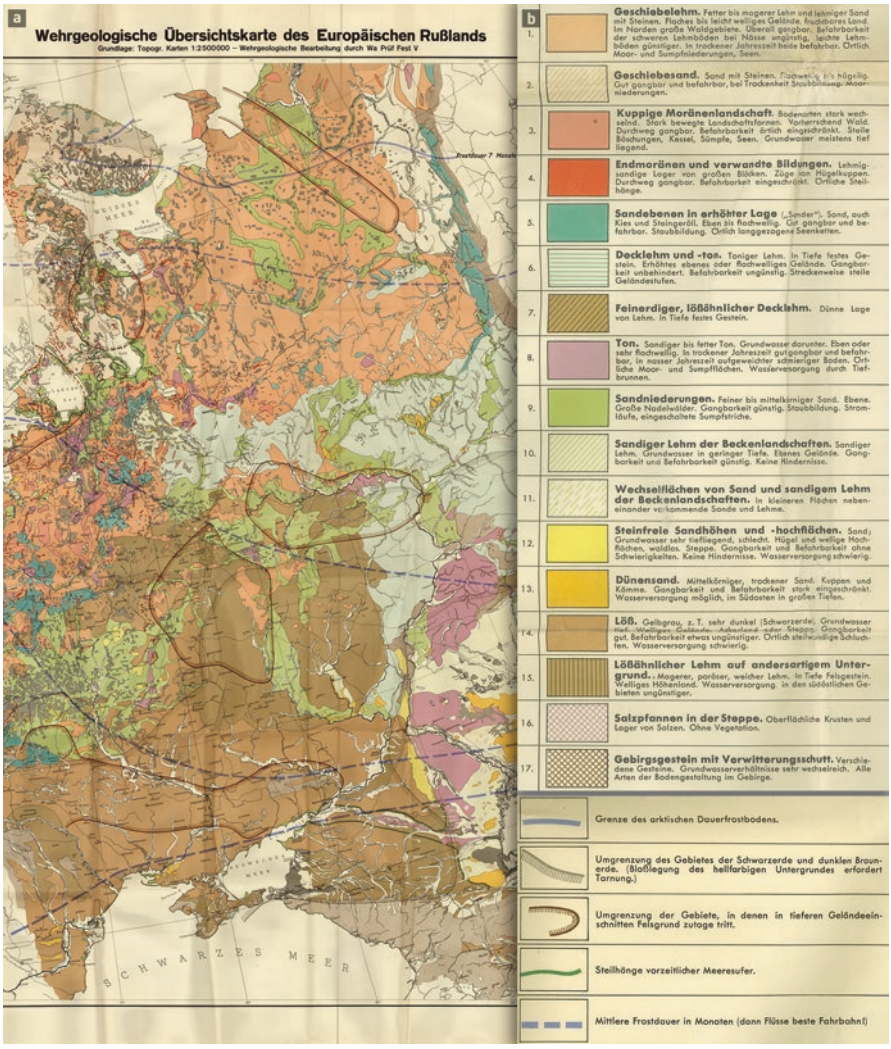

Fig. 12.4 (**a**) Section of the Military Geologic Overview Map of European Russia at a scale of 1:2,500,000. (**b**) A section of the legend from MilGeo Mappe A on European Russia, printed in March 1941. (Used with permission from the archive of Salzburger Wehrgeschichtliches Museum)

addressed the construction of entrenchments and the drinking water supply (according to the depth of the water table) and a fifth provided general recommendations on the trafficability of marshes, visibility and camouflage. Columns 4 and 5 are not shown in Figs. 12.4 and 12.5. Despite missing detailed information on the geologic agent (usually inserted in such maps), it can be concluded that, compared to the style of the military geologic map of Fig. 12.4 (and others), the 1:500,000 scale Military Geographic Operations Map of the Pripyat

Fig. 12.5 (**a**) Section of a 1:500,000 scale Military Geographic Operations Map of Pripyat-Polesie from Mappe E: White Russia provided by MilGeo in March 1941. (**b**) Section of the legend including a total of nine terrain units with descriptions of soil, vegetation and groundwater and containing general conclusions on trafficability and defence positions. (Used with permission from the archive of Salzburger Wehrgeschichtliches Museum)

region (Fig. 12.5) was also provided by the Geology Group of the Inspectorate of Fortifications.

The stock of the booklet series is unknown, and presumably they were distributed only to higher commands. Colonel Karl-Heinrich Graf von Klinckowstroem, who served as deputy chief of the Mapping and Survey Branch of the Army General Staff from August 1944 to early 1945, stated that ‘Opinions in Wehrmacht circles concerning these studies in military geography were contradictory. While some thought them too bulky and too extensive, others found fault with them for not containing enough details’ (Klinckowstroem 1945, p. 11). These booklets, printed by the German Army Map Service, are not at all well represented in European archives. The best sources for procuring loan copies of such German MilGeo materials from

the Second World War are the German Military Documents Section, the Office of the Adjutant General, the Department of the Army and the US Central Intelligence Agency Map Library (CIA 1951). In recent times, German documents from the Russian Theatre, including the MilGeo booklet series, were scanned within a German-Russian project for digitising German documents that were stored in archives of the Russian Federation (Deutsch-Russisches Projekt 2020).

12.3 Deployment of German Military Geology Teams to the Eastern Front

Although the organisation and map production of the German Army Map Service during the Second World War is well documented (Müller and Hubrich 2009), only a few papers report on the military geology of the Eastern Front (Häusler 1995a, 2000, 2018c; Häusler and Willig 2000). This section briefly introduces the course of events from the beginning of the Polish campaign in 1939 to the planning of the Axis invasion of the Soviet Union in 1940. From that time on, *Geologenstellen* (geologic teams (GTs)) were deployed. In 1941, the GTs were renamed *Wehrgeologenstellen* (military geologic teams (MGTs)) and supported German troops until the end of the war.

Each military geologic team consisted of nine persons. The team leader and his deputy were military geologists holding university degrees, termed *Wehrgeologen*, in particular geologists but also palaeontologists, petrologists and geophysicists. Three non-commissioned officers acted as technicians, and four other ranks served as typists, drilling assistants and drivers for the two vehicles assigned to the team (a car and a 3-tonne truck for bulky equipment; Häusler and Willig 2000). During the four full years of hostilities lasting from the invasion of the western Soviet Union to the retreat of the German Armies, about 139 military geologists were deployed to 15 stationary and 19 mobile MGTs in the Eastern Theatre (Appendix 12B).

The invasion of Poland, which marked the beginning of the Second World War, was a joint effort carried out by Germany, the Soviet Union, the Free City of Danzig and a small Slovak contingent. The invasion began one week after the signing of the Molotov-Ribbentrop Pact[2] on 1 September 1939 and ended on 6 October the same year with Germany and the Soviet Union dividing the whole of Poland under the terms of the German-Soviet Frontier Treaty (Invasion of Poland 2020). In the two years leading up to the invasion of the Soviet Union (Operation Barbarossa), Germany and the Soviet Union signed political and economic pacts for strategic purposes. Nevertheless, the Wehrmacht High Command began planning an invasion of the Soviet Union in July 1940, which Adolf Hitler authorised on 18 December 1940 (Operation Barbarossa 2020). Over the course of the operation, about four million Axis power personnel, the largest invasion force in the history of warfare,

[2] The non-aggression pact agreed upon between Germany and Russia.

Fig. 12.6 Invasion of the western Soviet Union by Axis troops during Operation Barbarossa beginning on 22 June 1941. (Redrawn based on the figure of Kinder and Hilgemann 2000, p. 484)

invaded the western Soviet Union along a 2900-km front. Figure 12.6 shows the operational approach of the Axis troops from the staging area west of the demarcation line on 22 June 1941 until the Battle of Moscow in December 1941, the counter-attack of Soviet troops from January to March 1942 and the German offensive in summer 1942. The Axis troops were organised in *Heeresgruppen* (Army Groups), such as the three Army Groups (North, Centre and South), the Rumanian Army Group Antonescu and a Hungarian Army. As far as is known, MGTs were only attached to German Army Groups, Armies, and Panzer Armies.

At least since the preparation of the MilGeo booklets described above, the Army General Staff was aware of major problems for military operations in a region of about ten million square kilometres. Although the general distribution of climate, vegetation, geomorphology, rivers, geology, soils, outcrops of hard rocks, etc. was well known (see Figs. 12.4 and 12.5), information on the actual conditions of infrastructure and the influence of seasonal changes on trafficability could hardly be assessed in advance (Fig. 12.6). Tasks for the MGTs deployed to Higher Engineer Officers of the Armies and Panzer Armies were manifold. They included, among

others, reconnaissance of valleys and rivers for tactical decisions to be made by armoured divisions, special hydrogeological investigations for drinking water supply where water-drilling companies failed, reconnaissance of aggregates for the construction of roads and railways, and reconnaissance of mineral raw materials for the Armed Forces Economic Office. Therefore, knowledge of Russian geologic and paleontological literature, either original or in translation, as well as geologic maps, hydrologic maps, soil maps and special maps on aggregates and construction materials was of vital importance. To this end, reports and statistical climate and hydrological data from the Climate Institute of Minsk were gathered for a regional prognosis of flooding events in the Central Soviet Union. In addition, listings from the Institute of Geology of Minsk archive were used for the assessment of the thickness of geologic formations, and reports of the former Moor Archive of White Russia at Minsk were used for information on the depth of peat and marshes.

In addition, the military geologists used aerial photography for evaluating the composition and density of forests, in particular in the Pripyat-Polesie region. This also gave an insight into the existence of simple log roads that crossed large peaty areas. Knowledge of Russian engineer instructions, e.g. both on crossing rivers during winter and hindering the crossing of frozen rivers by simple technical means, was very important for recommendations to the Higher Engineer Officers of German Armies.

Retrospectively, from 1940 to 1945, three subsequent operational phases of Wehrmacht operations can be deduced, for which MGTs were deployed along the Eastern Front as follows (Table 12.1):

- *Phase 1*: Soon after the invasion of Poland in September 1939, from February 1940 to April 1941, five GTs were deployed to the Inspectorate of Fortifications East.
- *Phase 2*: In terms of the assignment of MGTs during Operation Barbarossa, two major military phases can be distinguished. According to a secret order of the General Army Office dated 15 April 1941, nine MGTs were assigned to Armies and Panzer Armies of Army Groups North, Centre and South (phase 2a). At the same time as the Battle of Moscow (10 October to 10 December 1941), the General Army Office deployed four more teams to the 1st, 2nd and 4th Fortress Engineers and to the Inspectorate of Fortifications East (phase 2b).
- *Phase 3*: Beginning on 19 November 1943 (only a few months after the disastrous defeat of the German Armies in the battle of Kursk-Orel during Operation Zitadelle that lasted from July to August 1943 and rang in the Soviet summer offensive that resulted in the retreat of the German Armies), another group consisting of 11 MGTs was deployed to Army High Command, High Commands of Army Groups as well as other Higher Engineer Officers.

From 1940 to 1945, a total of 34 MGTs were deployed to Higher Engineer Officers of Armies and Panzer Armies; to the headquarters of Army Groups North, Centre and South; to Army Groups A and B; and to Army Group *Südukraine* (South Ukraine) (Table 12.1). It is unknown how many military geology teams of the

Table 12.1 Deployment of military geology teams to the Eastern Theatre during phases 1 to 3 (Häusler 1995a)

Inspector of Fortifications, Fortress Engineer & Territorial Military Commander	Army High Command and High Command of Army Group		
Phase 1 – 3 (1940 – 1943)	Phase 2a (1941)	Phase 2b (1941)	Phase 3 (1943)
Phase 1 (1940): GT 1 – 5			
Phase 2a (1941): MGT19 (FestPiKdr I, Konigsberg)	MGT2: PzAOK 2 HGr Mitte		
	MGT6: PzAOK 1 HGr Süd		
Phase 2a (1941): MGT24 (FestPiKdr II)	MGT11: AOK 16 HGr Nord		
Phase 2a (1941): MGT26 (FestPiKdr IV)	MGT13: AOK 9 HGr Mitte		
	MGT14: AOK 17 HGr Süd		
	MGT20: AOK 4 HGr Mitte		
	MGT21: AOK 18 HGr Nord		
	MGT23: AOK 2 HGr Mitte		
	MGT25: AOK 17 HGr Süd HöPiFü 14; AOK 6		
Phase 2b (1941): MGT32 (InOst)		MGT16: AOK 11 HGr Süd	
Phase 2b (1942): MGT9 (WBefh Ostland)		MGT28: PzAOK 4 HGr Nord (?); PzAOK 3 HGr Mitte	
Phase 2b (1942): MGT7 (WBefh Ukraine)			MGT12: HGr A.; HGr Südukraine; HGr Süd
Phase 2b (1942): MGT8 (HöhWiPiFü/Wehrbezirk Südost; GenKdo z.b.V.; GenKdo 68 AK)			MGT20: HGr Mitte; AOK 4 HGr Mitte
Phase 3 (1943): MGT15 (HöPiFü 23)			MGT34: HGr B (?)
Phase 3 (1943): MGT32 (InOst)			MGT36: AOK 6, HGr B
			MGT37: HGr Mitte (?)
			MGT38: HGr Nord (?)
			MGT39: HGr Nord (?)
Phase 3 (1944): MGT35 (HöPiFü z.b.V. 109)			MGT9: HGr Mitte; HöhPiKdo 2

Abbreviations (in alphabetical order): *FestPiKdr* Festungspionier-Kommandeur (Chief of Fortress Engineers I, II and IV), *GenKdo Generalkommando* (Corps Headquarters), *HGr* Heeresgruppe (Army Group – North, Centre, South, A and B, South Ukraine), *HöhWiPiFü/Wehrbezirk* Höherer Wirtschafts-Pionierführer/Wehrbezirk (Higher Economic and Engineer Leader/sub-area headquarters), *HöPiFü Höherer Pionierführer* (Higher Engineer Officer), *InOst Inspektion der Ostbefestigungen* (Inspectorate of Fortifications East), *WBefh Wehrmachtbefehlshaber* (Territorial Military Commander), *MGT* Wehrgeologenstelle, *z.b.V. zur besonderen Verwendung* (for special duty),? = established due to order of Army General Office but not supported by archive documents

Waffen-SS supported SS Infantry brigades and divisions during the same time (see Sect. 12.4 below).

12.3.1 Phase 1: German Military Geology in East Prussia and in the General Gouvernement (1940)

Geology teams (GTs) had been deployed to the Commander-in-Chief East for supporting fortress construction along the new eastern border of the German Reich since February 1940. Seidlitz (1941) reported that a total of six GTs was established in the General Gouvernement of former Poland and another four in East Prussia.

Military geology reports were provided on aggregates and drinking water; these became the basis for military geology maps at scales of 1:100,000 and 1:300,000.

An archive document of the Army High Command dated 20 August 1940 indicated that there was one group of geologists deployed with the 1st Fortress Engineers at Konigsberg in East Prussia and another, with the general of engineers of the German Military Commander of the General Gouvernement (later termed 2nd Fortress Engineers) at Tomaszów. During that time, geologist Professor Dr. Wilfried von Seidlitz headed these GTs as Inspector of Fortifications/Geology Branch at Bromberg in Poland (today Bydgoszcz). The following five GTs were deployed to the Military Commander of the General Gouvernement (Häusler 1995a):

- GT1: (Fortress Engineer Staff 6): Warsaw
- GT2: (Fortress Engineer Staff 6): Puławy
- GT3: Annopol (Gościeradów)
- GT4: Jarosław
- GT5: Dynów

The proceedings of the sixth military geology course,[3] held in Heidelberg from 14 to 20 December 1940, provided details of these military geology works (Beurlen 1941; Schröder 1941). At the same time, MGT13 provided trafficability maps at a scale of 1:300,000 for the region west of Moscow (Fig. 12.7). These maps were desk studies based on available Russian maps on geomorphology, soils, and the evaluation of moors, and conclusions were drawn on trafficability. Among others, these preparations of the Army High Command suggest that the planning for an invasion of European Russia was in full swing at the end of 1940.

12.3.2 Phase 2: German Military Geology during Operation Barbarossa (June 1941–November 1943)

This section presents the deployment of MGTs in 1941 and early 1942 as well as during the German summer offensive in 1942. It is based on several thousand archive documents from the Heringen Collection stored at the Federal Archive/Military Archive at Freiburg im Breisgau since the 1960s (Holdings RH 32; Häusler 1995a, b; Willig 2009).

At the beginning of Operation Barbarossa, there were three Army Groups: North, Centre and South (Fig. 12.8). Army Group North included two MGTs: MGT11 (AOK 16) and MGT21 (AOK 18); Army Group Centre included four: MGT2 (PzAOK 2), MGT13 (AOK9), MGT20 (AOK 4) and MGT23 (AOK 2); and Army Group South also had four: MGT6 (PzAOK 1), MGT 14 (AOK 17), MGT16 (AOK

[3] Education of military geologists of the Army was organised within special courses. The first military geology course took place in Aachen from 15–20 January 1940. In the same year, five other military geology courses were held in Aachen, Gießen, Tübingen, and Heidelberg. The sixth course in military geology was held in Heidelberg (Häusler 1995a).

Fig. 12.7 Section of the 1:300,000 scale trafficability map, sheet Y56 Gshatsk (west of Moscow), provided by MGT13 of the Army High Command 9 in December 1940. *Steilhang* = steep slope, *schwerer Lehm* = heavy loam, *ungangbar* = impassable, *Trocken: gut befahrbar* = good going when dry. The map was printed as a special edition by the *Reichsamt für Landesaufnahme* (Reich Survey Office) in Berlin. (Used with permission from the Bundesarchiv/Militärarchiv in Freiburg im Breisgau, Document RH32/3098)

11) and MGT25, first assigned to AOK 17 and then assigned to AOK 6 in November 1942. In March 1942, MGT28 was first assigned to Army Group North but in November 1942 was reassigned to Army Group Centre. In order to indicate MGTs that were deployed to different armies, their number is marked with a superscript digit.

At the beginning of the German summer offensive on 9 July 1942, when priority was given to the southern sector of the Front, Army Group South was reorganised into northern Army Group B and southern Army Group A. At that time, the MGTs were also reorganised and deployed to these newly established Army Groups. In October 1943, four additional MGTs were assigned to Army Groups North and Centre and to Army Group B. In November 1943, MGT37 was assigned to the High Command of Army Group North (Table 12.1).

Figure 12.9 highlights trafficability problems caused by the so-called *rasputitsa*, the semi-annual mud season in Eastern Europe (literally 'roadlessness' due to heavy rains and muddy earth roads). On the other hand, due to post-glacial erosive processes, steep valley-side slopes were dissected by gullies (*ovrag*) and broader valleys (*balkas*) were incised, which allowed for localised staging areas of armoured brigades.

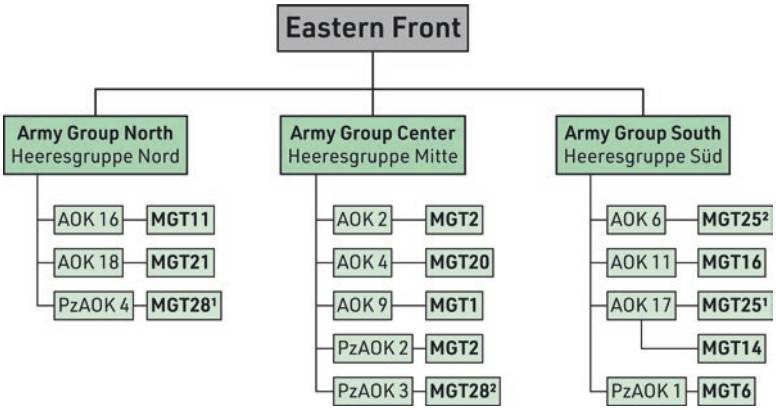

Fig. 12.8 Deployment of 11 MGTs to Army Groups North, Centre and South from the invasion of the Soviet Union until 1942 (AOK *Armee-Oberkommando*, Army High Command, PzAOK *Panzerarmee-Oberkommando*, Panzer Army High Command). For comments on the changing of the affiliation of MGTs to Armies, such as of MGT25 (MGT25[1, 2]), see text

Fig. 12.9 MGT14 during the advance of the High Command of the 14th Army on earth roads in Ukraine towards the Donbas region from July/August 41 to winter 1941/42. (Used with permission from Dr. Helmut Stremme; author's collection)

Figure 12.10 displays the major topics in reports written by MGT14 deployed to the Higher Engineer Officer of Army High Command 17. In 1941 and 1942, the 17th Army proceeded from its staging area east of Krakow towards the southeast, to the Sea of Azov and the northern Caucasus (see Fig. 12.6), and retreated in 1943–1944 from the Kuban Peninsula and the Crimea to the Vistula River. About

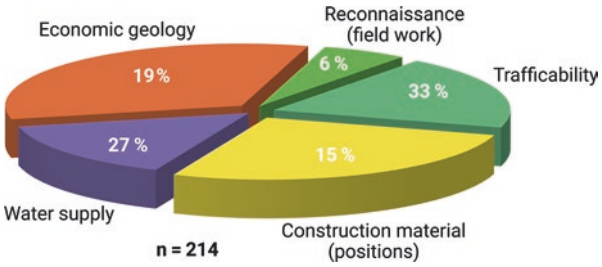

Fig. 12.10 Classification of 214 written reports provided by MGT14 for the Army High Command 17 in European Russia from 1941–1944. The majority of tasks concerned trafficability (33%) and water supply (27%)

one third of the orders of the Higher Army Engineer concerned trafficability and approximately another third, the investigation of drinking water. Field reconnaissance was necessary for investigating proper aggregates and construction materials and for underground investigations on defensive positions. Reports prepared by this MGT also referred to investigations on mineral raw materials such as salt and gypsum at Artemivsk, manganese at Nikopol, coal in the Donetsk area and at Kirovgrad as well as iron ore at Krivoy Rog (today Kryvyi Rih; Fig. 12.10).

12.3.3 Phase 3: Military Geology During the Retreat of the German Armies (November 1943–March 1945)

After the decisive defeat of German troops at Kursk and Orel on 19 November 1943 and the following Soviet summer offensive, German MGTs supported the retreat of the German Armies. Due to rapidly changing positions during the retreat in 1944 and to scarce records of military geology expertise, it is very difficult to draw an organisation chart for MGTs at this time. However, in an order dated 19 November 1943, another group consisting of five MGTs was deployed to Army Group B, Army Group Centre and Army Group North (Häusler 1995a; see Table 12.1). As the German war effort became increasingly directed towards defensive warfare, the need increased for data that were more detailed and more suitable for tactical use (CIA 1951). During the one and a half years of the German retreat, MGTs investigated areas for defensive positions and anti-tank trenches and provided large-scale maps ranging from 1:25,000 to 1:126,000.

In July 1944, the engineer general of Army Group *Nordukraine* (North Ukraine) ordered a military geology report on experiments with blowing up Panzer trenches in various soils. For this purpose, 3.5-m-deep boreholes were drilled 5 m apart along a line, and each was filled with 50 kg of explosives. The result of this test, shown in Fig. 12.11, was so important that 20 copies of this report were distributed.

Furthermore, documents describe field studies on blowing up trenches in Poland in October 1944, directly in front of attacking Soviet divisions. Trafficability

Fig. 12.11 Photo from the report on Panzer trenches blown up at Lvov (Poland) provided by MGT16 for Army Group North Ukraine on 13 July 1944. (Used with permission from the Bundesarchiv/Militärarchiv, Freiburg im Breisgau, Document RH32/2305)

experiments for both Soviet and German standard tanks, such as the Soviet T34 and the German Panther, were also carried out with respect to crossing anti-tank trenches (Table 12.2).

To this end, an evaluation of archive documents in the Heringen Collection revealed that ~1000 military geology *Gutachten* (written reports) were provided by the military geology teams during the first two years of the Eastern campaign (from 1940 to 1941). Another set consisting of 1000 military geology reports was provided during the next year (1942), and ~1500 more reports were provided for German troops from 1943 to 1944. Up to now, a total of 3466 of these reports have been counted, and, adding the monthly mean of late 1944, it can be estimated that a total of about 3500 military geology reports for German troops were provided for Engineer Commanders-in-Chief of Armies and Army Groups in the east until the end of hostilities in May 1945.

12.4 Military Geology of the Waffen-SS

Only a few comments of Klietmann (1965), Kater (1974), Tessin (1980), Häusler (1995a, b), Häusler and Willig (2000) and Kaienburg (2015) refer to the military geology work of the Waffen-SS. With an order of Reich Leader SS, Heinrich Himmler, dated 18 April 1941, the SS Military Geology Corps was installed in the

Table 12.2 Examples of military geologic reports prepared during the retreat of the German armies

Military geology team	Date	Report for superordinate command
MGT36	11 February 1944	Trafficability in Ukraine in the Bug-Dnieper region at a 1:300,000 scale for Army High Command 6
MGT14	27 March 1944	Trafficability and positions in White Russia south of Minsk at 1:126,000 scale for Army High Command 17
MGT16	13 July 1944	Blown-up Panzer trenches in various soils in Poland for Army Group North Ukraine (see Fig. 12.11)
MGT2	15 September 1944	Reconnaissance of a valley depression for tank trafficability near Jedlina, Poland, at 1:25,000 scale for Higher Construction Engineer 8
MGT16	30 October 1944	Experiments with crossing a Panzer trench using Soviet T34 and German Panther tanks east of Bochnia, Poland, for Army Group A

SS Main Operational Office at Berlin (Fig. 12.1). *Chefgeologe-SS* (chief of the military geologists of the Waffen-SS) assigned to the Command Staff of the SS Main Operational Office was the geologist and archaeologist Rolf Höhne, who headed the SS military geologists until the end of the war. In April 1941, Höhne was styled both *Kommandogeologe* (commanding geologist) of the Command Staff Reich Leader SS and chief geologist of the Waffen-SS and also headed the *SS-Wehrgeologen-Bataillon 500* (SS Military Geology Battalion 500). It is very likely that in June 1942, a unit of Höhne's military geology battalion was deployed to the SS Division *Prinz Eugen* in the Eastern Theatre, where a *Bakteriologisches Feldlaboratorium* (hydrologic field laboratory) was used for investigations on groundwater for the medical company of this SS division (Kaienburg 2015).

Military geology companies of the SS Military Geology Corps were assigned either to Army High Commands or to divisions or brigades of the Waffen-SS for duties analogous to those of the Army geology units (Klietmann 1965). In 1943, the SS-Military Geology Battalion 500, based in Berlin, consisted of four companies, each consisted of up to 400 men. The technical companies were ordered independently to battlefields in the east and to France and Italy. They were well-equipped engineer units but were also trained for combat. Their officers were mostly graduate geologists, mineralogists and other earth scientists. Due to losses during the war, only a few documents exist that define the duties of military geologists in the SS Military Geology Corps on the Eastern Front. A listing of 388 references in the library catalogue of the SS Military Geology Corps in Berlin indicates the existence of textbooks as well as geologic, hydrologic and pedologic literature, in particular on Poland and the USSR.

Kaienburg (2015) refers to a military geology company that in the second half of 1941 was ordered from Berlin via Zhytomyr, Ukraine, to Orel, Russia. Presumably in 1941, a military geologic map of the Jwanowo-Jaroslawl area northeast of Moscow at a scale of 1:1000,000 was designed by the SS Branch for Technical Military Geology. Another map prepared by this branch was a general map at a scale

of 1:1500,000 that portrayed the construction industry and mineral deposits in the Moscow area (*Baustoffindustrie- und Lagerstätten-Karte des Moskauer Gebietes*). It depicted quarries, aggregate sources and occurrences of mineral raw materials. In December 1942, it was planned that each SS MGT should be supported by its own dowser, and it is reported that by the end of 1942, three dowsers were already stationed with a division of the Waffen-SS in Belgrade (Kater 1974).

In 1942, when Himmler controlled the German colonisation of Ukraine at Hegewald, his field headquarters in Zhytomyr District, some 12.5 km west/southwest of Kiev (Field Headquarters Hegewald n.d.), an SS Military Geology Battalion called *Einsatzkommando Shitomir* was active in that region. At least two written reports prepared by this battalion, dated 30 December 1942 and February 1943, were provided directly to the Personal Staff of Reich Leader SS. They dealt with well drilling and the reactivation of Russian wells down to depths of 127 m. The yield of 500 m^3 per day was calculated for supporting at least 5000 persons, and three more wells were planned, more than enough for the 100 SS officers and around 1000 soldiers defending the headquarters. This so-called Mission Command Zhytomyr of the Military Geology Battalion, which consisted of 61 personnel, was also used for guarding the Command Staff of Reich Leader SS at Hegewald. A friendly letter from Himmler to the dowser Dr. Walther Wüst, who had visited him in Zhytomyr, indicated that dowsing played a big role in sub-surface investigations there (Prokop and Wimmer 1985). In addition, a military geology report written by the 3rd SS Military Geology Company dated 22 April 1943 refers to geological profiles from the city of Kharkov that were provided to the Corps Headquarters of the SS Panzer Corps, which was attached to Army Group South in Ukraine that participated in the Third Battle of Kharkov (SS Panzer Corps 2020). In 1944, the 4th SS Military Geology Company of the SS Military Geology Battalion 500 also was deployed to the Eastern Theatre and supported retreating SS troops in White Russia. Written reports prepared by MGT21, deployed to the headquarters of the 18th Army of Army Group North, were sent to the SS chief geologist Dr. Rolf Höhne of the SS Main Operational Office.

12.5 Terrain Evaluation by the OKW-Forschungsstaffel in the Eastern Theatre

In January 1941, the Counter-Intelligence Branch of the Armed Forces High Command (OKW) launched Operation Dora to update terrain information for North Africa and reconnoitre the frontier between Libya and Chad. *Sonderkommando Dora* (Special Command Dora) consisted of about 100 personnel and a scientific unit of about ten military geoscientists, such as geographers, cartographers, geologists, astronomers, meteorologists and road specialists. The military scientific teams were fully motorised and supported by reconnaissance flights (Häusler 2007, 2011, 2018a, b). When Sonderkommando Dora's mission in Libya ended and the teams returned to Germany in January 1943, the Command was not closed down but

continued to function as an administrative headquarters with battalion status. From April 1943 to the end of the war, this research group was termed the *Forschungsstaffel z.b.V.* (research unit for special terrain evaluation). According to Roscoe (1953, p. 75), this OKW research unit

> … was outstanding in its photo-reconnaissance and photo-interpretation work applied to special military needs, its mobility from one theatre to another the celerity with which it produced the required information and its famous "combination mapping method" by which the scientists from the different earth sciences worked in teams in performing the air reconnaissance, the photogrammetry, and especially the photo interpretation necessary to produce military maps…

Documents of the Reich Marshal of the Greater German Reich, Hermann Göring, dated 22 May 1943, refer to future tasks of the Forschungsstaffel for Eastern Europe. Among others, they included (for reasons unknown to the author) a special order for the construction agency, *Organisation Todt*, on the mapping of the catchment of the Pripyat River. An office of the Forschungsstaffel was established at Riga, Latvia, early in the summer of 1943, and work began on a plant association map of Lithuania (1:1000,000 scale) and a vegetation and groundwater survey of the oil-shale area in the Narva region, southwest of Leningrad. A group based in Kiev worked on drainage problems along the Pripyat River and on irrigation possibilities in southern Ukraine (Smith and Black 1946). Paralleling the deployment of MGTs in the east, the Forschungsstaffel developed new methods for integrated terrain analysis. Based on a combination of the interpretation of plant associations on aerial photography, reconnaissance flights and local expeditions, maps of, e.g., the Konka depression south of Zaporizhia (Zaporozhye east of Nikopol) at a scale of 1:50,000 and of the Pripyat region at a scale of 1:300,000, were prepared and provided.

A very interesting example of terrain evaluation refers to the wetland and swamp area of the Pripyat region in Eastern Europe, which was assessed as impassable by the Wehrmacht High Command prior to the attack of the German Armies in 1941 (Häusler 2006). Figure 12.12 depicts a section of the 1:300,000 scale passability map of the Pripyat marshes south of Minsk provided by the Forschungsstaffel in March 1944. Its key included three terrain classes: swampland, mossy peat and moist sandy soils, each with typical vegetation and military interpretation focussing on passability and trafficability. With the exception of winter periods, swampland and mossy peat were assessed as impassable (no-go areas), whereas non-flooded, soil-covered areas were assessed as good for all vehicles, particularly during winter. Where meadows were covered by bushes or deciduous forest prevailed, soil type was printed in big characters across the area (Fig. 12.12). This map was designed based on Russian and Polish sources that were enhanced by field reconnaissance, including details on vegetation, size and composition of road bridges (with an index of numbered bridges) and calculations of bearing capacities, the width of valleys and the depth of lakes. Additional MilGeo support for mapping the region in 1944 was provided by High Commands of the Army Groups Centre and South as well as by the Senior Officer of Mapping and Survey (East and Northeast; see Fig. 12.1). The most important difference between the 1:300,000 scale Pripyat map (Fig. 12.12) dated March 1944 and the 1:500,000 scale overview map of the Pripyat-Polesie

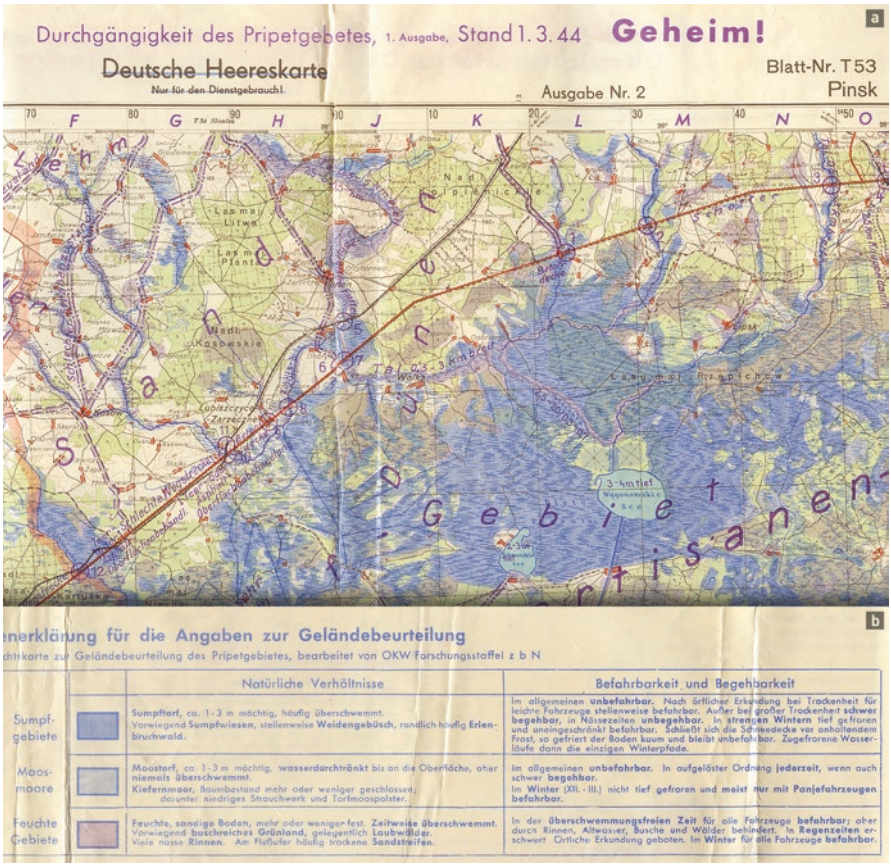

Fig. 12.12 (**a**) Section of map *Durchgängigkeit des Pripjet-Gebietes* (Passability of the Pripyat Region), Sheet T 53, Pinsk, White Russia, at the original scale of 1:300,000 dated 1 March 1944. *Trockene Böden* = dry soil, *Sand* = sand and *Lehm* = loam. (**b**) A section of the legend. The map is classified *Geheim* (secret). (Modified from Häusler (2006, 2007, 2011, 2018b) and reproduced with permission from Stiftung Preußischer Kulturbesitz, Berlin)

region, shown in Fig. 12.5, printed in March 1941 was the higher topicality and accuracy of the wetlands, vegetation and road net on the 1944 map that resulted from aerial photo interpretation and field reconnaissance. Another very important aspect that was relevant for tactical purposes was the simple but instructive choice of three terrain types (swampland, mossy peat and moist sandy soils) compared to the more detailed legend of the older 1:500,000 scale Pripyat-Polesie map (Fig. 12.5) with its nine terrain units. It can be concluded that all this updated information on the region was very useful for decision-making by the military commanders and, thus, the trafficability 1:300,000 scale map of the Pripyat area prepared by the Forschungsstaffel was of tactical use for the German Panzer Armies.

The Forschungsstaffel of Sonderkommando Dora was subordinated to the Military Office of the Reich Security Office until the end of the war by a secret order

from the Chief of the Armed Forces High Command (WFSt/Ic Nr. 005639/44 g.K.) dated 22 May 1944. By order of Reich Marshal Hermann Göring dated 2 May 1943, it was responsible for reporting to the Reich Research Council (Häusler 2007) with regard to technical matters. Interestingly, despite this new assignment, the priority of orders did not change, and therefore the tasks of the Forschungsstaffel for German troops remained the same as during its deployment to the Armed Forces High Command.

Another so-called one-package affair of the Forschungsstaffel produced during the retreat of the German Armies was an evaluation of the region northeast and northwest of Warsaw in late 1944. Figure 12.13 is one example of several Panzer maps at 1:100,000 scale that were designed based on German maps of (former) Poland overlain with the German Army grid, scientific interpretation of aerial photos and field reconnaissance in test areas of typical terrain. The Panzer maps were printed as special editions of the terrain evaluation maps for Army troops at a 1:100,000 scale. The map key comprised six thematic layers originally listed under A-F. Terrain trafficability for tanks (A) was divided into four classes; crossings of terrain such as steep slopes, dams and rivers (B) were assessed for five classes; woodland (C) was separated into four classes; and three types of roads (D) included details on the bearing capacities of bridges and important viewpoints. Special aspects for wheeled vehicles (E) were marked for areas containing loose sand, and map key F accentuated dammed areas that could potentially be flooded. For the latter purpose, tables on water levels measured at gauging stations in the region and months with ice load for the Vistula River were added.

Figure 12.13 depicts sections of the 1:100.000 scale Panzer map near Włocławek (west of Warsaw). Most important for the assessment of terrain for tank trafficability, comparable to the classifications of MGTs of the Army High Command, was the classification of soil type and vegetation. The going of sandy to loamy but dry soils

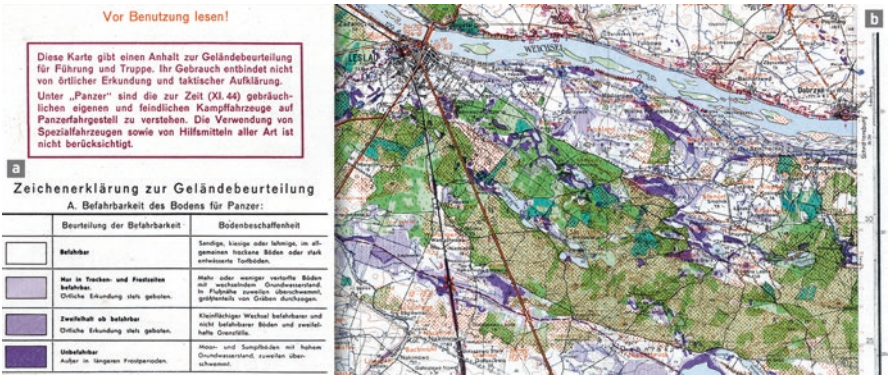

Fig. 12.13 Section of the legend (**a**) and map (**b**) of *Panzerkarte: Sonderausgabe der Truppenkarte zur Geländebeurteilung* (Panzer map: special issue of troop map for terrain evaluation) at the original scale of 1:100,000, sheet Piotrkow-Leslau-Sompolno-Klodawa, west of Warsaw, provided by the Forschungsstaffel in December 1944 (author's collection)

was assessed as good. Relatively large areas of peaty soils with changing groundwater levels were assessed as good during dry and frost seasons. Moors and peaty soils with high groundwater levels were classified as no-go except after longer periods of frost. Trafficability of smaller areas with rapidly changing soil conditions was described as questionable, and therefore local reconnaissance was recommended. An insert was printed on each of these terrain evaluation maps in magenta, which had to be read before using the map (*Vor Benützung lesen*; Fig. 12.13, upper left). It was clearly stated that the tank map only gave general information on trafficability and required local reconnaissance by the Military Commander. In addition, tanks were defined as armoured-tracked vehicles, as they were known in late 1944. Interestingly, this series of tank maps prepared in late 1944 was printed neither by the Forschungsstaffel itself nor by a motorised Mapping and Survey Unit of the Commander of Mapping and Survey Troops (Fig. 12.1) but by the Reich Survey Office in Berlin.

12.6 Russian Military Geology in the Second World War

Although Russian military geology had a long tradition, the first textbooks on military geology were published in 1924 and 1930. Czech officer and military geologist Dr. Karel Hlávka reported that any information on the organisation of Russian military geology during the Second World War was missing (Hlávka 1933). His paper on the military geology of the Russian Army in the 1930s gave an impression of the use of Russian hydro-technicians and geologists in the Soviet Armed Forces at that time. Military geologic education in the Russian Army during peacetime was jointly organised by the Office of Military Topographic Service and the Organisation of Geologic and Geographic Surveillance, together with members of scientific institutions and government offices. During peace, hydro-technical departments were deployed to 21 Army Corps that dealt with drilling, water supply, drainage and the use of flooding for tactical purposes, in particular as anti-tank obstacles. These departments also supported the medical service. Special departments of railway engineers dealt with the construction and maintenance of roads. During the mobilisation of divisions, corps and armies, technicians with geologic knowledge were deployed to military construction departments. In preparing for mobile warfare, the concept of military geologic and hydrologic maps at scale 1:200,000 was developed, and topographic maps at that scale became the basis for military geology specialist maps; in some regions, maps with larger scales were used. In order to highlight the geomorphologic relief, 10-m contour lines were drawn in brown, hydrology was printed in blue and objects such as roads, railways and houses were in black. Details on the thickness of geologic formations and the military use of soft and hard rocks were added. Detailed information on rivers and lakes was of particular interest. As a consequence, different types of Russian military geologic maps were provided, such as hydrogeologic maps, maps on the occurrence of construction materials and – according to Hlávka (1933) – also passability maps. The

ultimate goal of these maps, including applied scientific and military explanations, was to avoid too much detailed information for Army staff, the Air force and the Sanitary Service. Unfortunately, the military geologic organisation of the Russian Army during peacetime was not known to Hlávka.

About half a century later, on 19 June 1986, Csapovski published a short comment on Russian military geology in the Journal of the Armed Forces of the Russian Federation (Red Star 2020). As a former head of the First Military Geology Department, he provided general information on the use of special Soviet military geology teams during the Second World War for the supply of engineer staff during attack and defence. Attempts by the author to contact Soviet authorities on the organisation of Russian military geology during the Second World War via the Austrian Military Attaché in Moscow failed in both November 1989 and August 1996.

Only a few archive documents of the Bundesarchiv – Abteilung Militärarchiv in Freiburg im Breisgau obtained as spoils of war refer to Russian military geology. A short document of the Army High Command (OKH; Anon. 1941a) reports that German MGT11 seized important documents from a Russian Military Geology Unit. The OKH ordered that literature and maps in Russian libraries, institutes and collections, relevant for a further German advance during Operation Barbarossa, be carefully collected, particularly in archives in Moscow and Leningrad. A second short document of the Inspectorate of Fortresses East (Anon. 1941b) describes a Russian hydrologic map with explanations on the military geology preparations of the Soviet Army; unfortunately, the original documents are missing. Another document dated 17 February 1944 indicates that, in 1940, a Russian, but ethnic German, geologist and mining geologist was deployed as a military geologist to *Bauverwaltung* 71 (Construction Administration 71), which was active in Minsk in 1942.

12.7 Final Remarks

During nearly four years of the Russian campaign, about 140 military geologists deployed to 34 German MGTs served the High Commands of eight Armies and four Panzer Armies. Providing about 3500 written geologic reports for terrain evaluation, these MGTs played a substantial role in supporting the tactical requirements of Higher Engineer Officers of Armies of Army Groups North, Centre and South during both attack and retreat. In addition to preparing military geographic and military geologic information prior to Operation Barbarossa, the heads of the MGTs, geologists educated in applied geology, were trained in military geology during previous campaigns. Such efficiency of terrain evaluation in a barely known country with extreme climatic conditions would not have been possible without the use of official data from Russian offices and research institutions. Among others, the German military geologists used statistical data on freezing and thawing periods for crossing large rivers, drilling profiles for drinking water supply, the occurrence of hard rocks and soft rocks for the provision of construction materials for roads and

railways, and detailed pedologic maps and reports for the assessment of trafficability during different seasons. All these data were commandeered from Russian institutes and provincial archives, translated into German and listed in explanations or drawn as diagrams on military geology specialist maps depicting, e.g., groundwater fluctuations and flooding periods. The advantage of this system of German military geology lay in the fact that only one or two military geologists provided all terrain information necessary for tactical decisions of the Higher Engineer Officer of a German Army or Panzer Army.

Despite the small amount of information on the organisation of Soviet military geology during the Second World War, it can be taken for granted that engineers of the Russian Army were either supported by technicians with geologic backgrounds or advised by military geology units. During Operation Barbarossa, the German MGTs made use of Russian topographic maps at scales 1:300,000 to 1:400.000 as well as of Russian literature on geology and palaeontology and Russian specialist military maps. In addition to spoils of war, German military geologists studied archives, e.g., at the Geological Institute at Minsk, at the Climate Institute of Minsk and at the Moor Archive of White Russia at Minsk. Field reconnaissance as well as aerial photo interpretation enabled them to make detailed analyses of Russian terrain conditions, information that was not available from the booklets of the German Military Geographic Service provided prior to the attack on the Soviet Union. In summing up, terrain evaluation was of the essence for attack and defence, and the German Army High Commands and its adversaries had similar military geology units taking the best advantage of the terrain during the war.

Appendix 12A: Glossary of English/German Military Terms

English terms for the organisation of the Wehrmacht used in this paper follow those preferred by the War Department (1943, 1945), Klinckowstroem (1945) and CIA (1951).

English	German
Fortress Engineer	Festungspionier-Kommandeur
Armed Forces Operations staff	Wehrmachtführungsstab (WFSt)
Branch	Abteilung
Commander-in-Chief	Oberbefehlshaber
For special duty	z.b.V. (= zur besonderen Verwendung)
General Army Office	Allgemeines Heeresamt (AHA)
General Staff Corps	Generalstab
Geodetic survey	Landesaufnahme
Higher Engineer Officer	Höherer Pionier-Offizier
Higher Construction Engineer	Höherer Landesbau-Pionierführer
Militray Commander	Militärbefehlshaber
Office	Amt
Regional Command (administrative area of an air fleet)	Luftgau

Acknowledgements University Professor Dr. Helmut Stremme, former head of Military Geology Team 14 in eastern Europe, is acknowledged for personal communication and the provision of original photos from the Eastern campaign. The author thanks Mark Schmidt (Germany) for information on the SS-Wehrgeologenkorps. Thanks are due to the Federal Archive/Military Archive in Freiburg im Breisgau, where approximately 1,000 archive documents from military geology teams deployed to the Eastern Front were studied in 2018. Special thanks go to Colonel (ret.) Dr. Bruno Koppensteiner and Warrant Officer (ret.) Professor Gernod Fuchs from the Salzburg Military Historic Museum (Salzburger Wehrgeschichtliches Museum) for providing German handbooks on European USSR published by the Chief of Mapping and Survey as well as German military geologic maps of European Russia.

English	German
Reich Marshal of the Greater German Reich	Reichsmarschall des Großdeutschen Reiches (Hermann Göring)
Reich Research Council	Reichsforschungsrat
Reich Security Office	Reichsicherheitshauptamt (RSHS)
Reich Survey Office	Reichsamt für Landesaufnahme
Section	Gruppe
Senior General Staff Officer	Oberquartiermeister

Appendix 12B German and Austrian military geoscientists assigned as military geologists to geology teams (GT) and military geology teams (MGT) in Eastern Europe during the Second World War

Family name	First name	Nationality	Service years	Assignment
Achilles		German	1943	MGT7
Ahrens	Wilhelm	German	1940	MGT3
Arnold	Hellmut	German	1942–43	MGT7, MGT28
Bantelmann		German	1944–45	MGT11
Becksmann	E.	German	1942–44	MGT25
Berger	F.	German	1942–44	MGT11, MGT20, MGT38
Beschoren	Bernhard	German	1940	GT2
Beurlen	Karl	German	1940–41	MGT19
Beyer	Kurt Albert	German	1941–42	MGT11, MGT19, MGT24
Biener		German	1943	MGT29
Bistritschan	Karl	Austrian	1944	MGT1
Blüher		German	1941–44	MGT13
Brand	Erich	German	1940–44	MGT2
Breddin	Hans	German	1941–42	MGT14
Brüning		German	1944	MGT21
Bubeck		German	1944–45	MGT11

Family name	First name	Nationality	Service years	Assignment
Bülow	Kurd von	German	1941	MGT25
Denckmann		German	1943	MGT20
Dietz	C. (?)	German	1943–44	MGT15
Dorn	P.	German	1940–44	GT1, GT2, MGT7, MGT23, MGT24
Eckardt	(G.)	German	1943	MGT2
Eder		German	1943	MGT15
Eichele		German	1944	MGT10
Eigenfeld	Rolf	German	1943–44	MGT15, MGT29
Erich		German	1942, 1944	MGT7, MGT23
Ernst	Otto	German	1944	MGT37
Evers		German	1941	MGT14
Exner	Christoph	Austrian	1942–44	MGT19, MGT25
Fischer	Gerhard	German	1943–44	MGT13
Fischer	Ulrich	German	1943	MGT2, MGT25
Flum		German	1944	MGT9
Freyberg	Bruno von	German	1942	MGT8
Gallwitz	Hans	German	1944	MGT20
Genieser	Kurt	German	1942–45	MGT2, MGT9
Gerloff	Joachim	German	1943	MGT2
Groß (Gross)	Walter	German	1944	MGT23
Güth		German	1940	GT2
Haberfelner	Erich	Austrian	1944	MGT6
Hahne	C.	German	1941–44	MGT9, MGT13, MGT29
Haller	Wolfgang	German	1941–42	MGT23
Häusler	Heinrich	Austrian	1943–45	MGT6, MGT8, MGT16, MGT25
Hegenbart		German	1941–44	MGT20, MGT21
Herbst	Georg	German	1941	MGT11
Hertlein		German	1941	MGT11
Hirsch		German	1943–44	MGT13
Hohl	Rudolf	German	1944	MGT20
Hohnfeldt		German	1941	MGT14
Hübl	Harald Hans	German	1944	MGT2, MGT8, MGT9
Hunger	Richard	German	1944	MGT29, MGT39
Jacobsen	Werner	German	1942–44	MGT14
Jährling		German	1944	MGT39
Jörg	Erwin	German	1942	MGT7, MGT14
Keilbach	von	German	1941–42	MGT19
Keunecke		German	1944	MGT26
Kienow	Sigismund	German	1944	MGT12
Klein	(S.)	German	1940, 1942	GT2, MGT24
Kleinschrott	J.	German	1942–44	MGT23, MGT28
Kliemstein	H.	German	1940	MGT19
Knetsch	Georg	German	1943	MGT16

Family name	First name	Nationality	Service years	Assignment
Kobold		German	1942	MGT14
Kölbel	Heinrich	German	1944	MGT6
Kralik	(Bruno)	German	1944	MGT7
Kuckelkorn	Leo Jakob Medard	German	1943–45	MGT28
Kühn	Othmar	Austrian	1940–42	GT5, MGT25
Kumm	A.	German	1941–44	MGT9, MGT21
Kutscher	Fritz	German	1943	MGT16
Lange		German	1943	MGT13
Läuter	H.	German	1943–44	MGT20
Lemcke	Kurt	German	1941–44	MGT12, MGT13, MGT20
Lemke	Erich	German	1942–44	MGT7, MGT23
Leopold		German	1942	MGT26
Leschik	(Th.)	German	1943, 1945	MGT21, MGT23
Mägdefrau	Karl	German	1944	MGT36
Marschall		German	1944–45	MGT11
Martin		German	1942–44	MGT16, MGT36
Mempel		German	1944	MGT16
Mixius	Friedrich	German	1941	MGT2
Müller-Deile		German	1942–44	MGT7
Mutschlechner	Georg	Austrian	1942–44	MGT28
Neppel	(Arthur)	Austrian	1944	MGT21, MGT23
Niedermayer	Josef	German	1943–44	MGT8
Nöring	Friedrich	German	1944	MGT6
Oesterle		German	1944	MGT24
Ortmann	Karl	German	1941–42	MGT2
Papp	Adolf	Austrian	1941–42	MGT24
Peters		German	1941	MGT14
Petrascheck	Walther E.	Austrian	1944	MGT28
Pickel	Wilhelm	German	1942–44	MGT26
Pinkow	H.	German	1943	MGT23
Prey	Siegmund	Austrian	1940–44	GT2, MGT2, MGT35
Prosch		German	1941	MGT19
Putzer	Hanfrit	German	1940–44	GT2, MGT16, MGT19, MGT36
Raupach	Friedrich, von	German	1943–44	MGT2, MGT16
Richter	Wolfgang	German	1942	MGT26
Rode	Karl	German	1941–44	MGT14, MHT16, MGT34
Rost		German	1943	MGT23
Rotter		German	1943–44	MGT7, MGT12
Rücklin		German	1942–45	MGT11
Schilly		German	1944–45	MGT21
Schmidt	Wilhelm	German	1942	MGT25
Schröbler	Fritz	German	1941–42	MGT14, MGT22

Family name	First name	Nationality	Service years	Assignment
Schröder	Fritz	German	1940–43	GT1, MGT13, MGT14, MGT20
Schuh	Franz	German	1941–43	MGT7, MGT14
Schulte	Heinrich	German	1942–43	MGT9, MGT20, MGT35
Schulz	Günter	German	1943–44	MGT6, MGT20
Schulz	L.	German	1943–44	MGT6, MGT19, MGT8, MGT32
Schwan	Werner	German	1941–42	MGT20, MGT24
Schwarzbach	Martin	German	1942–43	MGT25
Schwegler	Erich	German	1940	GT1
Seidlitz	Wilfried, von	German	1940–41	GT1, MGT19
Seifert	Alfred	German	1940–44	GT1, MGT2, MGT28
Senarclens-Grancy	Walter, von	Austrian	1942–43	MGT8
Siegfried	Paul	German	1942–44	MGT12, MGT14
Simon	Wilhelm	German	1942–44	MGT9, MGT16, MGT28
Sindowsky	Karl Heinz	German	1941	MGT6, MGT24
Spielberger		German	1944	MGT29
Spoerel		German	1944–45	MGT23
Steffan		German	1944	MGT9
Steinhäuser	Walther	German	1943	MGT6
Stremme	Helmut E.	German	1941–45	MGT2, MGT14, MGT25
Taschenmacher	Willy	German	1940, 1944	GT1, MGT9
Thamm		German	1943–44	MGT7, MGT15
Thiele	H.	German	1944	MGT20
Thomas	E.	German	1943	MGT21
Thust		German	1943–45	MGT7, MGT9
Tröger	Walter	German	1942	MGT19
Tropp	Wilhelm	German	1944	MGT6, MGT29
Trusheim	Ferdinand	German	1941–42	MGT11
Voigt	Erhard	German	1941–44	MGT2, MGT21
Vollrath		German	1944	MGT39
Waldmann	Leo	Austrian	1940–41	GT4, GT5, MGT24
Walter		German	1940, 1944	GT5, MGT23
Watznauer	Adolf	German	1944–45	MGT2
Weber	(Alfred)	German	1943–44	MGT15
Wegerich		German	1941	MGT14
Wepfer	Peter	German	1941–44	MGT14, MGT15, MGT16, MGT21
Wieseneder	Hans	Austrian	1944	MGT37
Wunschik	Alfons	German	1940–41	GT3, GT4, MGT24
Zöbelein		German	1944	MGT38

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