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Military Geology and Comprehensive Security Geology – Applied Geologic Contributions to New Austrian Security Strategy

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Abstract

Concerning the security of Austria and the European Union, there are fundamental differences between the general circumstances in the second half of the 20th century and those of the present and the foreseeable future. The geopolitical situation in Europe changed after termination of the East-West confrontation of the "Cold War", and the major tasks of civil-military cooperation in the field of applied geosciences also changed. Until the early 1990s the "Arbeitsgruppe Wehrgeologie" of the Austrian Geological Society supported the doctrine of Comprehensive National Defence. This civilian working group liaised with the Head of Military Geosciences and the "Arbeitsgruppe Militärgeologie" of the Austrian Army.

Following a resolution of the National Council on 3 July 2013 concerning a new Austrian Security Strategy, the sphere of activity of the working group has been extended from national to European and even international scope. Since the application of geology for military use is termed military geology, application of geology for the new Austrian Security Strategy might be termed "comprehensive security geology". We therefore propose to use the English term "Working Group on Comprehensive Security Geology" synonymously with future use of the German term "Arbeitsgruppe Wehrgeologie" for the working group of the Austrian Geological Society. Based on the new security doctrine, the projects and range of this working group are being extended within a European and international framework. With regard to Austrian Security Strategy, the term security geosciences can be used as an umbrella term for geological tasks that include contributions from other disciplines, e.g. applied meteorology and geophysics. The Working Group on Comprehensive Security Geology will be of potential use for members of the reserve and regular armed forces, civilian protection tasks, disaster relief, and international commitments through conflict or crisis management. In that respect, future close coordination and cooperation is planned between the Working Group on Comprehensive Security Geology and the Institute of Military Geosciences of the Austrian Ministry of Defence and Sports.

Die aktuellen und absehbaren Rahmenbedingungen für die Sicherheit Österreichs und der Europäischen Union unterscheiden sich grundlegend von jenen in der zweiten Hälfte des 20. Jahrhunderts. Seit dem Ende des früheren Ost-West-Konfliktes und der Veränderung der geopolitischen Situation in Europa haben sich auch die Aufgaben der angewandten Geowissenschaften im Zuge einer zivil-militärischen Zusammenarbeit geändert. Bis in die frühen 1990er Jahre unterstützte die Arbeitsgruppe Wehrgeologie der Österreichischen Geologischen Gesellschaft die Doktrin einer Umfassenden Landesverteidigung. Diese zivile Arbeitsgruppe kooperierte damals eng mit dem Leiter Militärisches Geowesen und der Arbeitsgruppe Militärgeologie des Österreichischen Bundesheeres.

Mit der Entschließung des Nationalrates vom 3. Juli 2013 betreffend die neue Österreichische Sicherheitsstrategie wurde auch der Wirkungskreis der Arbeitsgruppe Wehrgeologie von der nationalen Ebene auf den Rahmen der Europäischen Gemeinschaft sowie den internationalen Rahmen erweitert. Wenn man beispielsweise die Anwendung geologischer Methoden für militärische Zwecke als Militärgeologie bezeichnet, so kann analog dazu die Nutzung geologischer Expertisen für Zwecke der neuen Österreichischen Sicherheitsstrategie als umfassende Sicherheitsgeologie bezeichnet werden. Wir schlagen jedoch vor, die Bezeichnung der Arbeitsgruppe Wehrgeologie beizubehalten und nur im englischen Sprachgebrauch synonym dazu die Bezeichnung „Working Group on Comprehensive Security Geology" zu verwenden. Konsequenterweise weitet sich entsprechend dem neuen Sicherheitskonzept auch der Arbeits- und Wirkungsbereich der Arbeitsgruppe Wehrgeologie auf den europäischen und internationalen Rahmen aus. Betrachtet man umfassende sicherheitspolitische Aufgaben der Geowissenschaften insgesamt, so werden jene der angewandten Geologie etwa auch um Disziplinen der angewandten Meteorologie und Geophysik erweitert. Die Arbeitsgruppe Wehrgeologie der Österreichischen Geologischen Gesellschaft nutzt das Potential Milizangehöriger etwa für Aufgaben der Militärischen Landesverteidigung, für Zivil- und Katastrophenschutz, Assistenzeinsätze und das internationale Konflikt- und Krisenmanagement. Aus diesem Grund erfolgt weiterhin eine enge Absprache und Zusammenarbeit der Arbeitsgruppe Wehrgeologie mit dem Institut für Militärisches Geowesen des Bundesministeriums für Landesverteidigung und Sport.

1. Introduction

Since 1984, the "Arbeitsgruppe Wehrgeologie" has been one of several working groups of the Geological Society of Austria.

Ist main objective during Cold War period was to support a policy of "Comprehensive National Defence", a policy consistent with article 79 of the Austrian Federal Constitution Law. At that time, translation of this working group's title as "Defence Geology" was appropriate. During the Cold War Period, this civilian working group was in close cooperation with the working group "Militärgeologie" (Military Geology) of the Ministry of Defence. Since security of neutral Austria nowadays is largely interconnected with the security of the European community as a whole, the former solely defence aspect became of less importance and, due to the fact that in the German language the meaning and scope of "Wehrgeologie" differ from "Militärgeologie", "Wehrgeologie" ought not be translated as military geology. This paper summarises the scope of applied geosciences in general and of military geology and "Wehrgeologie" in particular, in the context of recent change of security strategy in Austria and therefore the need for appropriate English term for this working group of the Austrian Geological Society.

2. Geosciences and applied Geosciences

Although short definitions of "geosciences" are not in common use (or may be controversial), "geosciences" can be adequately defined from fields of study or examples. International conferences, encyclopaedias, publishers and national funds promote "geosciences". The term "Geoscience" has been used synonymously for "Earth Science" (URL1). Definition of geosciences in the free encyclopedia Wikipedia is in progress, in particular for the German term "Geowissenschaften" (URL2). According to the definition of Meynen (1985), geosciences deal with the Earth and hence are natural sciences. As such they comprise the disciplines of (in alphabetic order): cartography, crystallography, geochemistry, geodesy, geography, geoinformatics, geology, geophysics, geotechnics, glaciology, meteorology, mineralogy, palaeontology, pedology (soil science), petrography (petrology), photogrammetry and remote sensing.

Geosciences play a major role for energy supply and supply of mineral raw materials worldwide, as described in more detail under the term "Applied Geosciences" below. Wikipedia currently emphasises that the definition of the German term for geosciences is not clear-cut, referring to geography as an example that comprises both physical and human aspects. In German-speaking countries, unlike most English-speaking countries, geography is not regarded as a discipline of geosciences or earth sciences. This old contradiction should become obsolete, when focus is given to human impact on the geosphere, as described more fully below, in the paragraph on environmental geosciences. It should be recalled that 2002 was the international "Year of Geosciences".

Because of the complexity of understanding the Earth as a system, particularly when focusing on environmental problems (caused by humans), it is difficult to describe this system exclusively with the methods provided by single geo-disciplines. The definition of "geosciences" as given by Meynen (1985) appropriately emphasizes the "interdisciplinarity" of much problem-oriented geoscientific research. This is true for "basic geosciences" and even more so for "applied geosciences".

The European Science Foundation coordinates a wide range of activities in all areas of sciences, including geosciences and environmental sciences, which have benefited greatly from European multidisciplinary cooperation. "Advances in Geosciences" is an open access journal of the European Geosciences Union for proceedings and special volumes on Earth, planetary and solar system sciences. "Biogeosciences" is a journal on interactions between the biological, chemical and physical processes in terrestrial or extraterrestrial life with the geosphere, hydrosphere and atmosphere, presenting experimental, conceptual and modelling approaches.

Interdisciplinarity is inherent in geosciences, cutting across disciplines, and forming a new method for understanding of the Earth. Several natural sciences are evidently geosciences, including the syllable "geo" such as geology and geomorphology, but also others (not explicitly prefixed "geo") such as climatology, cartography and landscape ecology. Whereas climate and landscape definitely contribute to investigations of "geospace" (meaning our Earth), geodesy provides technical tools for describing the geometry of our planet. Cartography is taught at universities, but computer cartographers do not normally identify themselves as geoscientists. Furthermore, it is questionable if "informatics", when providing "geo-data", and then termed geoinformatics, is a geoscience. Computer cartography and geoinformatics are computer sciences dealing with the investigation of our Earth. Remote sensing is another example where computer science portrays the geospace, but is not always regarded as a geoscience as such (Häusler, 2009 a, fig.1).

In German-speaking countries, four textbooks by Bender (1981-1986) on "Applied Geosciences" are widely distributed. The first volume comprises an introduction to geological mapping, structural geology, pedology, mineralogy, petrology, geochemistry, palaeontology, marine geology, remote sensing, and economic geology. The second volume introduces the methods of engineering geophysics (or applied geophysics) and mathematical standards in geosciences. Volume three deals with hydrocarbons, hydrogeology, engineering geology, and applied geosciences for land-use planning and for environmental protection. The last volume presents techniques for investigating metal and non-metal raw materials, raw material for nuclear reactors, solid fuel and hydrocarbon-bearing rocks. These textbooks on applied geosciences therefore predominantly refer to the application of geology for civilian purposes. Additionally, examples of applied geosciences which are explained in more detail by Häusler (2009 a) include:

- Applied geology (engineering geology, petroleum geology, hydrogeology, mining geology, economic geology, etc.)
- Applied geography (e.g. geoinformatics; (geo)spatial planning)

- Applied geophysics (e.g. engineering geophysics)
- Applied meteorology (e.g. weather forecasting)
- Applied geochemistry (e.g. waste water treatment)
- Applied geomorphology (e.g. investigation of recent glacial landforms or mass movements)
- Applied landscape ecology (e.g. ecosystem research)

Considering complex environmental problems such as global change, where communities and infrastructure are affected, a "trans-disciplinary" approach is useful, e.g. between interdisciplinary geosciences and persons concerned. This process requires interactive communication and cooperation between the geoscientists and the end users of geoinformation.

On the occasion of the 8th International Conference on Military Geosciences, jointly organised by the Institute of Military Geology of the Ministry of Defence and Sports, and the Department of Environmental Geosciences of the University of Vienna, held in Vienna during June 15-19 2009, Häusler (2009 a, b) discussed and defined the scope of geosciences, applied geosciences, environmental sciences, and military geosciences.

3. Military Geology and "Wehrgeologie"

"Military Geosciences" is a term which seems to be useful for encompassing complex geoscientific activities relevant to the military (Häusler, 2009 a, b; 2011 c). Geosciences, applied geosciences and environmental geosciences, and other related sciences not explicitly termed "geo"-sciences, such as atmospheric sciences (meteorology and climatology) or soil sciences (pedology, soil study), may be used to support military operations.

As an umbrella term for all military "geo-activities" such as military geography, military cartography, military geodesy, military meteorology, military geology, military geophysics and others, the abbreviation "Milgeo" is used in the following account. "Milgeo" may be defined as geosciences applied to the military, encompassing military geoscience aspects of education, organisation, methods, products and support. The term "Military Geography" is maintained for the "Milgeo-Organisation" of the armed forces.

3.1 Military Geology

In many countries the terms "military geology" (Militärgeologie) or "war geology" (Kriegsgeologie) are in common use for the application of surface and subsurface geology for military use during peace and wartime. These include (countries in alphabetical order; Schramm, 2006 a):

Czech Republic:	Vojenská geologie
France:	Géologie militaires
Greece:	Στρατιωτή γεωλογία
Hungary:	Geológiai katonai
Italy:	Geologia militare
Portugal:	Geologia militar
Russia:	Воéнная Геология
Slovenia:	Vojna geologija
Spain:	Geologia militar
The Netherlands:	De militaire geologie

Military geology is the application of geology for supporting military operations. Despite the fact that a tradition of military geology has developed over at least two centuries, this use is little known by geologists worldwide and few geologists currently serve in any armed force as geological experts. This is somewhat surprising, because military actions take place not only on the surface of our environment but also below, and therefore any kind of military construction work, excavation of underground facilities, digging of trenches, developing a secure water supply for troops, assessment of cross-country trafficability under changing weather conditions, etc., may require a sound knowledge of soil and subsoil conditions, and of rock formations down to a depth of several tens of meters. In general such knowledge is the core competence of geologists using soil- and subsoil maps, exploratory drilling, engineering geophysics and the applied geological expertise widely used for engineering geology projects. Geologists, who are trained consultants both in engineering geology and hydrogeology, and as staff officers in higher military commands, can therefore provide the best use of geology for military operations. University education and theoretical knowledge are useful, but experience gained from applied projects (e.g. tunnelling, hydropower schemes, water supply and highway construction, etc.) is of greater potential relevance to military application.

Regarding the historic development of military geology, three major phases can be distinguished in German-speaking countries. Firstly, perceptions of the military importance of geology were published shortly after the Napoleonic Wars, when the benchmark work of the former Swiss and later Bavarian officer Johann Samuel (von) Gruner on the relation of geology to war sciences ("Verhältnis der Geognosie zur Kriegs-Wissenschaft") was published in 1826 (Häusler, 2003 a).

Secondly, despite some other early comments on the potential use of geology for the military (Häusler, 2012; Häusler and Kohler, 2003; Schramm, 2011), it took nearly a century until the German officer and fortress engineer Walter Kranz (Kranz, 1913), and the German officer Ernst Wochinger (Wochinger, 1919) realised again that geology had military applications (Häusler, 2003 b).

In addition to "Militärgeologie" for military geology and "Kriegsgeologie" for war geology, in German-speaking countries the term "Wehrgeologie" was used in times of peace in the sense of "defence geology" (Häusler, 2009 a). In 1938, seminal textbooks were published, on "Technische Wehrgeologie" (= technical defence geology; Kranz 1938), and "Wehrgeologie" respectively (Bülow et al., 1938; Kranz, 1938; Mordziol, 1938). These textbooks gave an introduction to the basics of geology and geomorphology as well as applied geology such as engineering geology, hydrogeology, mining geology, soil mechanics, etc., and special military geology tasks as well as case histories from military geologists deployed in the First World War. Consequently, the books introduced future military application of geology and hence war geology rather than defence geology. Although modern textbooks on

military geosciences introduce applied geology in much more detail, the historic examples provided by these concise textbooks on "Wehrgeologie" are still read in German-speaking countries today. Due to the fact that these textbooks had a very high print run, copies are still widely available for purchase, and can be ordered via the Internet.

Lessons learned from the last century clearly reveal that at the beginning of hostilities the use of geologists was slight, but the longer armed conflict lasted the higher became the number of geologists used. This is evident from World War I, when the general staff of the German armed forces as well as of the armed forces of the Austro-Hungarian monarchy initially refused to deploy military geologists, but by the end of hostilities about 300 military geologists had served as such in their allied armies (Häusler, 2000 a; Willig, 2011; Willig and Häusler, 2012, a). The same is true for World War II, when the general staff of Nazi Germany did not initially plan the use of military geologists, but by the end of the war about 350 military geologists (at that time termed "Wehrgeologen") had served as such in the army, navy, air force, or the governmental, civil-military construction agency Todt (Organisation Todt – OT, named after its founder Fritz Todt; Häusler, 1986, 1995 a, b). Obviously the requirements of military geology changed in the first half of the last century. The largely static battlefield conditions of the Western Front during the First World War focused attention on problems associated with static installations: water supply and drainage, fortification and the raw materials necessary for this, and mining. The more mobile conflicts of the Second World War, representing a third phase of development, increased awareness of geology affecting cross-country trafficability and the construction of military airfields. Overall, German military geologists were deployed on a wide range of engineering tasks, particularly on fortification, earthworks, underground construction, provision of aggregates, and assessment of off-road trafficability for a variety of both tracked and wheeled vehicles (Rose et al., 2000 b, p. 107, p. 134; Rose, 2013; Rose and Mather, 2013; Häusler, 2000 b; Willig and Häusler, 2012 b).

Classic tasks of military geologists for tactical use comprise assessment of subsoil conditions down to a depth of 3 metres to guide construction of defence positions and the enhancement of local natural obstacles for reducing the speed of tank attacks (Fig. 1). Modern textbooks on military geology are lacking and therefore the older textbooks still are in use in German-speaking countries. For the international geoscientific community, textbooks on military geography partly also

Figure 1: Military geology aspects for security operations at the Austrian border with the former Yugoslavia in 1991 to prevent internal conflict spilling over onto Austrian territory (A, B) and during field exercises (C, D). A: Digging of infantry positions in soft rock using shovel and spade. B: Mechanical assistance for excavation of tank position. C: Battle tank Leopard 2A4 and (D) battle tank Kürassier bogged down in unsuitable terrain (Photos courtesy of Austrian Armed Forces Press Department).

deal with aspects of military geology, e.g. publications by Collins (1998), Palka and Galgano (2000, 2005), Boulanger (2002, 2006) and Régnier (2008).

Military geology has been summarized by Rose (2000 a) in the authoritative "Oxford Companion to the Earth". The overall meaning of "Military Geology" as understood within the military geology community is indicated by the descriptions and glossaries of Betz (1975), Bates and Jackson (1987), and Jackson (1997).

According to Betz (1975) in the "Encyclopaedia on Environmental Geology":

„Military geology is a field not known to many geologists. It has been practiced mainly in war time, when geologists were drawn into national service, either as civilians or uniformed members of armed forces."

„To satisfy the requirements of terrain evaluation, military geologists recognized the need for multidisciplinary studies. They took the lead in bringing soil scientists, hydrologists, plant ecologists, foresters, meteorologists, climatologists, geographers, and other specialists into team efforts."

"Evaluation of terrain became the blanket term for the function of military geology. To military geologists, terrain stands for the composite of features at and near the earth's surface, as far as the limits of man's activity extend…."

Bates and Jackson (1987), and recently Mike Rosenbaum in the "Glossary of Geology" (Jackson, 1997) defined "military geology" as:

a) Those branches of the earth sciences, especially geomorphology, soil science, and climatology, that are applied to such military concerns as terrain analysis, water supply, cross-country movement, location of construction material, and building of roads and airfields.
b) The application of geological sciences to decision-making processes required by the military command.

While the specific problems have changed, the basic functions of military geology remained much the same. "Terrain evaluation is, and has been, the focal point of military geology or geoscience" (Betz, 1984; Parry, 1984).

Many important contributions on military geology were reported from national and international military geo-conferences held from 1994 to 2007 (Häusler, 2011 b), and a wide range of historical and recent examples of military geology has been published in the two volumes of the International Handbook Military Geography (Mang and Häusler 2006; Häusler and Mang, 2011).

Those geologists who reported on the history of military geology by contributing to national and international conferences, were or are mostly involved in providing military geology expertise to the armed forces of their respective countries. This was true, for example, for the Swiss military geologists Walter Nabholz (University of Bern; President of the Swiss Geologic Commission; Nabholz, 1971) and Paul Niggli (ETH Zürich; Niggli, 1939). This was or is also true for the British military geologists (in alphabetical order) Frank Moseley (Geology, University of Birmingham; e.g.: Moseley, 2000), Paul Nathanail, (School of Chemical, Environmental and Mining Engineering; University of Nottingham; e.g.: Nathanail, 1998, 2001, Nathanail et al. 2008), Edward P. F. Rose (Department of Geology, Royal Holloway, University of London; e.g.: Rose, 2000 a, b; 2001, 2008 a, b; Rose 2013; Rose and Nathanail, 2000, Rose and Mather, 2013; Rose et al., 2000; Häusler, 2011 a), and Michael S. Rosenbaum (formerly Department of Geology, Imperial College of Science, Technology and Medicine, London; e.g.: Rosenbaum, 1998, Rosenbaum and Rose, 2000), if not for Peter Doyle (Visiting Professor in Geology, University College London, and consulting geologist; e.g.: Doyle, 2000; Doyle and Bennett, 2002; Doyle et al., 2000).

Also, it was or is true for the U.S. military geologists (in alphabetical order) William W. Doe III (Center for Environmental Management of Military Lands, Colorado State University; Fort Collins, Colorado; e.g. Doe et al., 2007), Judy Ehlen (Department of Geology, Radford University, Radford, Virginia; e.g. Ehlen, 2001; Ehlen and Abrahart, 2002; Ehlen and Harmon, 2001), Peter L. Guth (U.S. Naval Academy, Annapolis, Maryland; e.g. Guth, 2008), Russell S. Harmon (U.S. Army Research Laboratory, Army Research Office; e.g. Harmon et al., 2004), Allen W. Hatheway (Department of Geological and Petroleum Engineering; University of Missouri, Rolla, Missouri; e.g. Hatheway and Stevens, 1998), and Maurice J. Terman (Office of the Chief Geologist; U.S. Geological Survey, Reston, Virginia; e.g. Terman, 1998 a, b), if not to the same extent Stephen W. Henderson (Department of Geology, Oxford College of Emory University; Oxford, Georgia; Henderson, 2007), George A. Kiersch (Cornell University; Tucson, Arizona; e.g. Kiersch and Underwood, 1998), James R. Underwood (Department of Geology, Kansas State University; Manhattan; e.g. Underwood and Giegengack, 2002), and Robert C. Whisonant (Department of Geology, Radford University; Radford, Virginia; e.g. Whisonant, 2004)

Historical or contemporary studies in military geology, to name but a few, are known from the French geologist Claude Pareyn (University of Caen; Pareyn and Rose, 2000), the Croatian military geologist Marko Zečević (Zečević and Jungwirth, 2007; Zečević, 2011), the German military geologist Dierk Willig (Head of Bundeswehr Geo-Info Center, Geoinformatics Branch in Euskirchen, Germany; Willig, 2006 a, b; Thelker and Willig, 2013), the Austrian military geologist Hermann Häusler (Department of Environmental Geosciences, University of Vienna; Häusler, 2009 a, b; 2011 a-c, 2013 a, b; Häusler and Mang, 2011; Mang and Häusler, 2006), Werner Leithner (Civil engineer for geology, lecturer at the Institute of Technical Geology, Technical University of Vienna, and consultant officer of AFDRU; Leithner, 2006), Friedrich Teichmann (Austrian Armed Forces, Federal Ministry of Defence and Sports; Teichmann 2001, 2007, 2011), and last but not least, from the senior Austrian military geologist Josef-Michael Schramm (University of Salzburg; Schramm, 1978 a, b; 2006 a, b; 2007).

In Austria, the Working Group Military Geology was founded in 1983 by Gerhard Fasching, at that time head of the Military Geographic Service of Corps Command II in Salzburg. This mi-

litary working group is still affiliated to the Military Geographic Service of the Austrian Armed Forces, and in 2013 the 10th Military Geology Seminar was held at the Institute of Military Geosciences of the Ministry of National Defence and Sports, in Vienna.

3.2 "Wehrgeologie"

Literally the German term "Wehrgeologie" means defence geology, which in Austria is not synonymous with military geology. After the re-establishment of the Republic in Austria, military geology was used for nearly three decades until the term "Wehrgeologie" again became appropriate. The primary intention in using the term "Wehrgeologie" in Austria in the 1980s (Schramm, 1978 b, 1987, 1989) was to cover all aspects of applied geology for the doctrine of "Comprehensive National Defence", at that time termed "Umfassende Landesverteidigung", according to article 79 of the Austrian Federal Constitution Law. This law embraced two major pillars of national defence, namely civil defence and military defence. Military geology as such referred to application of geology for

Figure 2: Civil and military geology application in case of assistance operations for natural- and man-made disasters A: Dam re-enforcement by filling sand bags for protection of Krems during flood in 2002. B: Engineer tank clearing river blockage after heavy rainfall in 2005. C: Emergency evacuation from sink hole in talcum mining area of Lassing, Styria, in July 1998 (All photos courtesy of Austrian Armed Forces Press Department).

the Austrian Armed Forces, and "Wehrgeologie" was more related to Civil Defence ("Zivile Landesverteidigung"), including civil protection, construction of shelters and emergency water supply, etc. as well as to Economic Defence ("Wirtschaftliche Landesverteidigung"; Fasching, 1995).

When in 1984 Josef-Michael Schramm founded the Working Group "Wehrgeologie" in Austria (Häusler, 2014), the goal of its experts was explicitly to recommend geological practices and serve governmental institutions in the fields of Civil Defence and Economic Defence. Because of its members' core competences in applied geology (e.g. engineering geology, hydrogeology, mining geology), this working group was affiliated to the Austrian Geological Society. Many but not all members of this civil working group also served as members of the military geology working group of the Military Geography Service, if they passed the necessary course of higher military technical service of the Austrian Armed Forces.

The following questions are a few examples that indicate the use of civil information for disaster prevention and military crisis management (Fig. 2):

- According to special geological maps showing availability of soft rocks, where are the nearest deposits of sand and gravel which can be reached by trucks?
- What civilian heavy machinery is available for reducing flood potential and mud slides after heavy rains, and how soon can military Engineer tanks reach the endangered population and infrastructure?
- At which offices are subsurface mining plans available to guide emergency actions in cases of environmental disasters in flooded mines?

Obviously, timely support using local and regional information on surface and subsurface geology depends on cooperation between provincial geologists, military geologists, and MilGeo-officers of the respective provincial military commands.

Fasching (1995) made an early distinction between "Wehrgeologie" in a wide sense (including military geology) and "Wehrgeologie" in a narrower sense, focusing on civil protection and economy.

The following questions give a few examples of national and international scope to help indicate the potential use of geologists, civilian and military, for military commands and troops for disaster risk reduction (Fig. 2 and Fig. 3):

- What infrastructure will be destroyed during worst-case scenarios of floods?
- Where to get sand quickly to fill sand bags to strengthen natural river dams?
- What might be the magnitude of potential after-shock damage to buildings and infrastructure after an earthquake?
- Where are the plans of underground mining caverns and tunnels in case of emergency situations?
- Where best to store contaminated water after a CBRN (Chemical, Biological, Radiological, Nuclear) disaster and which deep wells are suitable for emergency water supply of the local population?

The Austrian Armed Forces do not possess the ability to provide geoscientific maps at both regional and local scales worldwide, appropriate for missions of the Austrian Forces Disaster Relief Unit (AFDRU), very quickly. Taking an earthquake scenario as example, due to time constraints, 72 hours after an earthquake the rescue chances diminish drastically. Therefore, improvisation by military geologists is always of the essence, particularly when it comes to providing proper maps (Leithner, 2006). Civil geophysicists e.g. of the Central Institute of Meteorology and Geodynamics (Zentralanstalt für Meteorologie und Geodynamik – ZAMG) thus provided special Scientific Experts Programme for the NBC Defence School – "Lise Meitner" of Austrian Armed Forces (Duma et al., 2011).

After termination of the East-West-confrontation, and the enlargement of both the European Union and NATO, the security-political framework requirements for Austria changed fundamentally. In 2001 the geologist Friedrich Teichmann published an article on the change of traditional "Wehrgeologie" towards civil-military cooperation (CIMIC) focusing on the transition from Cold War to peace support missions (Teichmann, 2011). As military policies have changed during the last decades, so has the use of military geosciences. During the Cold War in Europe, military geography and military geology in the German Armed Forces as well as in the Austrian Armed Forces provided support for tactical decisions of the

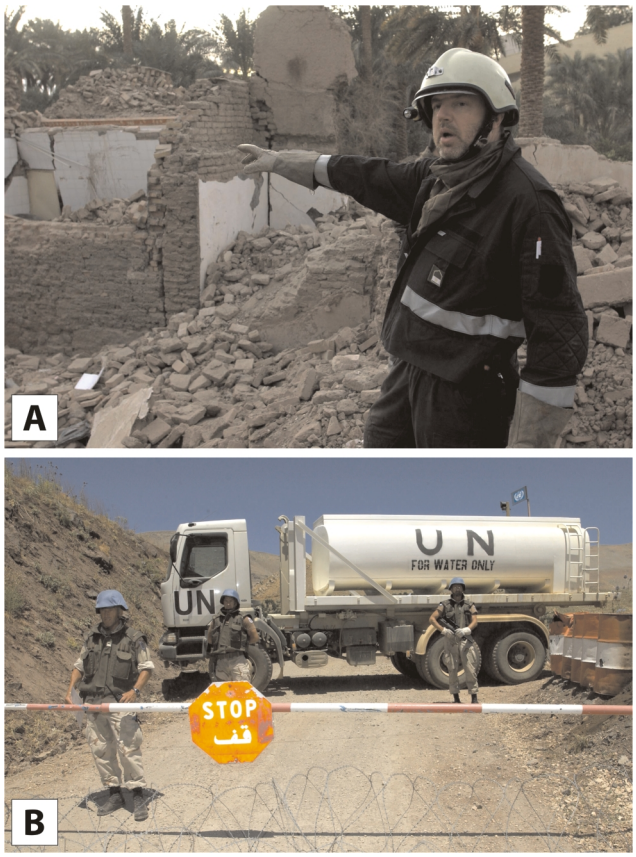

Figure 3: Examples of civil and military geology application for international humanitarian missions: A: AFDRU at Bam, Iran after the December 2003 earthquake, B: Supply of UN post in Syria with fresh drinking water from wells (Photos courtesy of Austrian Armed Forces Press Department).

higher military commands, which partially resembled those during World War II. In addition, environmental issues became important for military geoscientists in the 1980s. Since the "Petersberg tasks" were defined in June 1992 (at the Hotel Petersberg near Bonn in Germany), reorganisation of military geography organisations paralleled the reorganisation of the armies in western Europe. Transformation processes within armies resulted in changes in army support or definition of roles. For military geosciences, this did not necessarily require reduction of the respective organisations: the contrary (Häusler 2009 a, 2011 b).

The "Petersberg tasks" are the military tasks of humanitarian, peacekeeping and peacemaking nature that the European Union (EU) and the Western European Union (WEU) are empowered to undertake. The "Petersberg tasks" cover a great range of possible military missions, from the most simple to the most robust military intervention. They are formulated as:

- Humanitarian and rescue tasks
- Peacekeeping tasks
- Tasks of combat forces in crises management, including peacemaking

Austrian security politics has changed significantly from a commitment to everlasting neutrality (Austrian Federal Law dating October 26, 1955) to peacekeeping and militarily enforced peacemaking operations, which has implications for military geology advice with regard to international operations of the Austrian Armed Forces. The joint organisation of the 8th International Conference on Military Geosciences by the University of Vienna (Department of Environmental Geosciences, Faculty of Geosciences, Geography and Astronomy) and the Institute for Military Geography (Federal Ministry of Defence and Sports) clearly revealed the "state-of-the-art" expertise of members of the Working Group "Wehrgeologie" of the Austrian Geological Society in general and of Austrian military geologists of the expert staff of the Institute for Military Geography in particular (Häusler and Mang, 2011).

It is obvious that CIMIC-aspects of Comprehensive National Defence relate to a changed security and defence doctrine and in particular to security aspects of our rapidly changing environment. The geological aspects of "Geoenvironmental Security" were introduced at the 1996 Warwick Conference on "Geology and Warfare", when Paul Nathanail urged environmental geologists to mitigate threats to national and international security by a better management of natural resources and efforts towards their sustainable development (Nathanail, 2000). Near that time Carius and Lirtzmann (1999) published a book on "Environmental Change and Security", and the "Havard Design & Mapping" company (HDM) provided crucial GIS data about natural disasters for the US Federal Emergency Management Agency (FEMA), designing "GeoSecurity" in 2002 as a new web tool. Steps from national security to global security were targeted in an article on "Geopolitics and Global Security" (Dalby, 1998). More recently the European Union is supporting European aeronautics and security politics through GMOSS, the network of excellence for Global Monitoring for Security and Stability (URL3; Eder and Schramm, 2007). GMOSS is operated by the Center for Satellite Based Crisis Information (Deutsche Gesellschaft für Luft- und Raumfahrt – DLR, Oberpfaffenhofen, Germany) and aims at integrating Europe's Earth observation based civil security research. Numerous articles have been published on security issues related to the environment such as on geographic factors and their implication for NATO`s security (Palaschewski, 2006) or on environmental security analysis of abrupt climate change scenarios (Galgano, 2011), to cite only a few.

Ralph Thiele, who had studied economic and organisational sciences at the Bundeswehr University in Munich, and political sciences in Munich, introduced a new concept for networking civil-military competences for both crisis prevention and crisis management termed "Vernetzte Sicherheit" (Thiele, 2008). Since the tasks of "Wehrgeologie" have undergone a change and security aspects gained in importance, Fasching (2003, 2012 a, b; 2013) suggested either to introduce the term "Sicherheitsgeologie" instead of "Wehrgeologie" in the German language or to use the equivalent English terms "Security Geology", "Comprehensive Security Geology" or "Security Geocomplex".

The suggestion to substitute the term "Wehrgeologie" by "Sicherheitsgeologie" is not adopted here because in daily use the German term "Sicherheit" is usually related to personal security, security personnel or cyber security rather than to security policy and security politics. Consequently, there is no need to change the name of the working group of the Austrian Geological Society, when it is clearly defined what the future tasks of the "Arbeitsgruppe Wehrgeologie" will be. On the other hand, the suggestion to use the term "Comprehensive Security Geology" for this working group in English language will be adopted, as explained in more detail in the following section.

4. Comprehensive security Geology – the way ahead

According to Article 79 of the Constitutional Law of Austria, Austria's defence policy is based on military national defence, foreign commitments, disaster relief, protecting critical infrastructures, border surveillance, and support for maintaining public order and security in Austria. An unchanging principle of Austrian security policy in the 21st century is neutrality, and security policy based on solidarity takes into account that the security of neutral Austria is now largely interconnected with the security of the EU as a whole (Federal Chancellery of the Republic of Austria, 2013).

Taking this new security policy into account, the tasks of "Wehrgeologie" have changed relative to those geared to the Comprehensive National Defence policy of the Cold War period. Analogous to the definitions given above for applied geology, and applied geosciences, application of geology for comprehensive security tasks can be termed "comprehensive security geology". Consistent with European and international geoscientific tasks within the new comprehensive Austrian security policy the English term "Working Group on Compre-

hensive Security Geology" is being adopted as equivalent in meaning to the German "Arbeitsgruppe Wehrgeologie" of the Austrian Geological Society.

The following principles of the 2013 Austrian National Council Resolution on a new security strategy for Austria need to be taken into consideration by this working group:

- Modern security has become a crosscutting issue, which has to be taken into account in almost every sphere of life and policy.
- Security based on solidarity takes into account that the security of neutral Austria is now largely interconnected with the security of the EU as a whole.
- Modern security policy must be based on a comprehensive and integrated approach. Comprehensive security policy means that external and internal aspects of security are inextricably interlinked, as are civil and military aspects.
- Integrated security policy must be based on a cooperative approach between governmental and non-governmental actors.

Consequently, this policy is taken as a mandate for actively shaping internal security, foreign security, and defence policy comprising national defence, assistant tasks, military disaster relief and international crisis management (Klug, 2013). The following principles of the 2013 Austrian National Council Resolution should be considered the basis for a conceptual framework of the working group:

- Cooperation and coordination between the ministries in planning, implementing and assessing security-relevant measures, both in Austria and abroad, on the basis of a collective national assessment of the situation.
- Appropriate participation in international crisis management measures, missions and operations in accordance with the stipulated criteria for participating in such missions and operations.
- Establishing a pool of capabilities from the civil and military sectors, which Austria can also use in order to make contributions in the context of international crisis management and European solidarity.
- Participation in humanitarian and disaster relief operations.
- Through cooperation among the relevant ministries, federal states and organisations, the resources necessary for this task will be augmented and the capacity to act will be further strengthened.
- Further efforts to establish a regional Central European civil-military disaster relief unit.

The following tasks defined by the Federal Chancellery of the Republic of Austria (2013) for internal security, for foreign policy aspects of security policy as well as for national defence, in particular assistance tasks and military disaster relief, will be subject to interaction of the Working Group "Comprehensive Security Geology" of the Austrian Geological Society:

- 2020 National Crisis and Disaster Protection Management Strategy (Bundesministerium für Inneres, 2009).
- Coordinating governmental crisis and disaster relief management in order to ensure cooperation and coordinated actions of all competent bodies of the Federal Republic of Austria, the civilian protection authorities of the individual federal states and the emergency organisations.
- Strengthening internal security in the neighbourhood areas.
- The Austrian Ministry of the Interior must be capable of contributing to the pool of civil-military capabilities for implementing the EU Solidarity Clause.
- Targeted cooperation in order to strengthen Austria's collaboration with countries in the eastern and southern EU neighbourhoods.
- Support for peaceful resolution of conflict and crisis and promoting international cooperation, at both bilateral and multilateral level.
- Active involvement in and strengthening of the UN as an instrument for managing the global challenges of the 21st century.
- Using the resources of the Austrian Development Cooperation in order to achieve the objectives of then Strategic Guidelines on Security and Development.

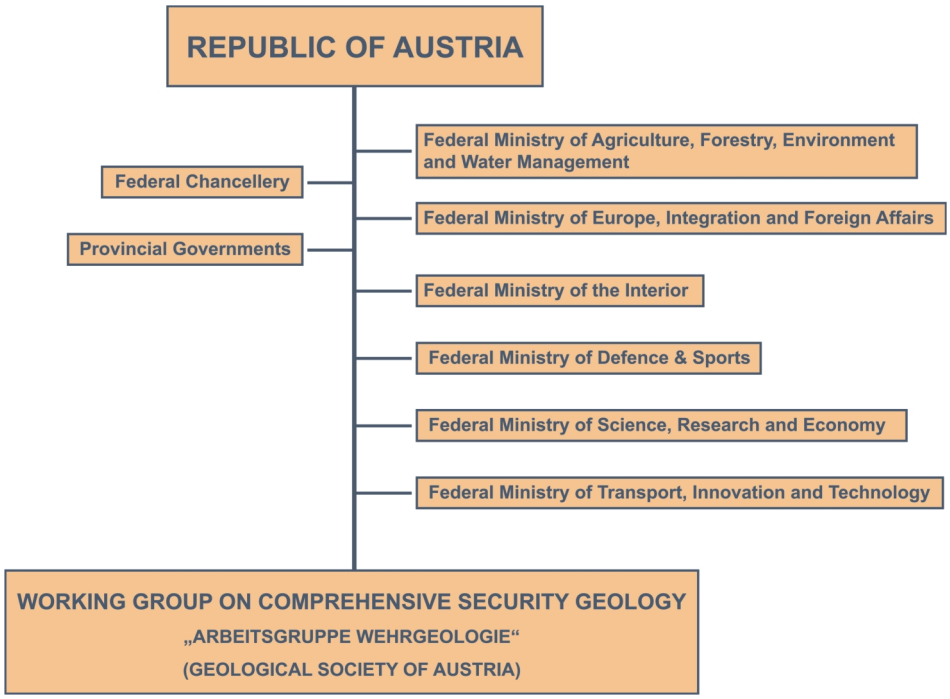

Figure 4: Informal organigram of selected Austrian state authorities, which benefit from the expertise of the Working Group on Comprehensive Security Geology of the Austrian Geological Society (by author).

Core competences of members of the Austrian Working Group on Comprehensive Security Geo-

logy lie in university education in geology and applied geology in professional specialisation and expertise as civil engineers or consulting engineers in the fields of applied geology, and in applied geosciences such as engineering geology, hydrogeology, hydrocarbon geology, coal geology, economic geology, forensic geology and, last but not least, military geology. Together with experts e.g. in applied meteorology and geophysics, applied geologists will contribute to the use of comprehensive security geosciences. The Working Group intends to make full use of the potential in the active reserve.

The organigram of Fig. 4 depicts a non-hierarchic structure of advisory tasks of the Working Group on Comprehensive Security Geology for governmental authorities such as the Federal Chancellery, offices of federal ministries and provincial governments. Support of federal ministries in particular comprises the best use of the knowledge of this expert pool for missions in accordance with the new Austrian Security Strategy such as:

- Emergency supply with water of drinking water quality (Federal Ministry for Agriculture, Forestry, Environment and Water Management).
- Applied geological projects and consulting for the Austrian Development Cooperation; support for humanitarian projects (Federal Ministry of Europe, Integration and Foreign Affairs).
- Civil protection and state crisis and catastrophic management; active involvement in European and international disaster relief; foreign aspects of security policy and international cooperation on both bilateral and multilateral level in the Balkans, the Middle East, North Africa and sub-Saharan Africa. Enhanced commitments in the Danube region, Black Sea region and Caucasus region (Federal Ministry of the Interior).
- Civil-military cooperation with the NBC-Defence School Lise Meitner. Civil-military cooperation with the Institute for Military Geosciences, its Working Group Military Geology and its expert staff of military geoscientists. Joint projects within the Austrian security research program KIRAS are planned, and between Austrian research institutions and the Science Commission of the Austrian Armed Forces (Federal Ministry of Defence and Sports, MoDS).
- Geoscientific support of the Bureau for Security Policy, MoDS as a basis for joint discussions in the Cabinet Assembly of the Austrian Federal Government.
- Enhancement of education and research in applied geosciences; cooperation with applied geoscientific research institutions; cooperation with federal offices such as the Geological Survey of Austria and the Central Agency for Meteorology and Geodynamics (Federal Ministry of Science, Research and Economy). Cooperation with departments of Joanneum Research and with the Austrian Academy of Sciences.
- Support of natural resources management, provision of mineral raw materials and underground storage of e.g. hydrocarbons; applied projects on research and development (Federal Ministry of Transport, Innovation and Technology).
- Cooperation with departments of the provincial governments regarding water resources management, warning and alarm centres, crisis management and disaster relief.
- Cooperation with geoscientific civil-military institutions and exchange of information in Europe and abroad.
- Applied geoscientific support of authorities and organisations for emergency management as well as of non-governmental organisations such as the International Red Cross and Red Crescent Movement for missions in Europe and in an international context.

The future challenges for the Working Group on Comprehensive Security Geology lie in planning the optimal support of both civil and military decision makers and stakeholders for missions and operations at national level, supranational level, and international level. The added value of these activities results in bundling of civil-military core competences and avoiding duplication of databases and preparatory work.

Future assistance operations will increase in number and magnitude depending on environmental change, probably resulting from climate change, when population and infrastructure will be at higher risk. Socio-economic implications of natural and man-made disasters will also depend on economic development. Support of missions of armed forces, for example, will depend on the enforcement of national security policy for security forces, including the military. Administration for mission scenarios will depend on the organisation of crisis prevention and disaster management. Best practice of applied geoscientific support will depend on the progress of new methods developed within research projects. Planning of comprehensive geoscientific support should be independent from actual governmental structures and competences or from transformation processes of the armed forces.

Having learned lessons from history, we can modify a saying in Latin and express the opinion "Si vis pacem, para pacem": regarding Comprehensive Security Geology it is better to learn the basics in peace time rather than to re-learn applications during conflicts and disasters. To sum up: there is no need to change the German term for the Working Group "Wehrgeologie" of the Austrian Geological Society, which has acted and still acts as a successful link between civil and military geo-institutions and stakeholders in Austria, even when new environmental and socio-economic aspects of key interest arise in a renewed European security architecture.

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