

GIS-based assessment of aggregates in Carinthia (Austria)

Richard BÄK¹, Maria HEINRICH² & Gerhard LETOUZÉ-ZEZULA³

¹Amt der Kärntner Landesregierung, UAbt 15GB (Geologie und Bodenschutz), A-9021 Klagenfurt, Flatschacher Straße 70

² and ³ Geologische Bundesanstalt, FA Rohstoffgeologie, A-1031 Wien, Rasumofskygasse 23

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Abstract

For the last thirty years the Geological Survey of Austria (GBA) has made assessments of surface-near mineral resources putting emphasis on regional aspects of land use, environment and economy. In collaboration with land use experts, GIS-tools have been developed to evaluate the sustainability of mineral deposits, taking into account possible conflicts during its exploitation. An example for the province of Upper Austria, representing the main target of the 1990's, has been shown at 1998's ICGESA (Letouzé et al., 1998). Recent studies have focused on the province of Carinthia, where a Geological Information System has been designed which includes:

- A GIS-based geological map "Setting of gravels, sands and clays" for the whole province of Carinthia (1:50.000 ArcINFO® concept).

- Assessment, input and evaluation of basic data from archives, boreholes, pits and literature in general, in order to advance knowledge about surface-near mineral resources.

Linking digital geological maps to specific data bases allows for the evaluation of mineral resources quality and usability, thereby contributing to a modern planning instrument within the administration of Carinthia. Internet and intranet availability of such data should initiate strategic mineral planning and strengthen sustainable land use in general.

Equivalent treating of solid rocks is ongoing task required to complete land-use relevant mineral resources' assessment in Carinthia.

European regionalization efforts and the common future of Austria and Slovenia within the European Union may support at least comparable structuring of geological data. This paper outlines such an example for Carinthia, one of Austria's boarder provinces to Slovenia.

Preface

In Austria, each year 42 mio m³ (=75 mio tons) gravels and sand, 1,5 mio tons of clay and 16 mio m³ (=44 mio tons) of hard rocks are produced and used. Nearly the whole amount is used in construction industry. Austria has an average per capita consumption of 15,t tons of such mineral resources (Heinrich, 1995).

Carinthia, Austria's southernmost province, is able to cover the necessities of its gravels and sand consumption from its own

territory. In detail, significant abundance areas in the south-eastern part contrast with shortage areas (due to lacking geological conditions for reasonable accumulation of such sediments) in the western part of the province.

Geological setting

Most of the gravels, sands and clays in Carinthia are originally sedimentary products of glaciation through alpine ice ages.

Carinthia during this period was almost completely covered by glaciers, only the easternmost part stayed ice-free. Metamorphic rocks of the East Alpine Crystalline as well as the paleozoic rocks above the ice level were significantly altered and contributing high amounts of debris. Remaining deposits of gravels and sands in Carinthia show a complex suite of glaci-gene, glaci-lacustrine, glaci-fluviatile and fluvio-lacustrine sediments of the Wuerm glaciation and its residual stages.

GInS – Geological Information System of Carinthia

For a long period, Carinthia's supply with aggregates was only matter of singular licensing while planning was entirely left to the industry. The only matter of public concern and research was the conservation of relevant groundwater bodies, which - in some way - implicated negative consequences for the supply with aggregates out of the same geological setting. Neverthe-

less, hydrogeological research generated a lot of informations about aggregate resources too. The 2001 amendment of the Federal Mining Law put executive power for exploitation of gravels, sand, clay and natural stones into the hands of the provincial governments. In Carinthia, this triggered a complete assessment of aggregates as well as leading-off a GIS-based Geological Information System (GInS) at the regional Geological Survey, designed to fulfil an expert role in risk-, hydro-, mineral resources- and environmental geology. GInS is built up on tow major fundaments, the digital geological map and the digital Geomorphology archive.

GIS-based geological map "Setting of gravels, sands and clays" (Figure 1)

Out of geological maps of different origin and quality, different scale and purpose, a digital map for the whole province of Carinthia was compiled and processed into a 1:50.000 ArcINFO® concept. This because

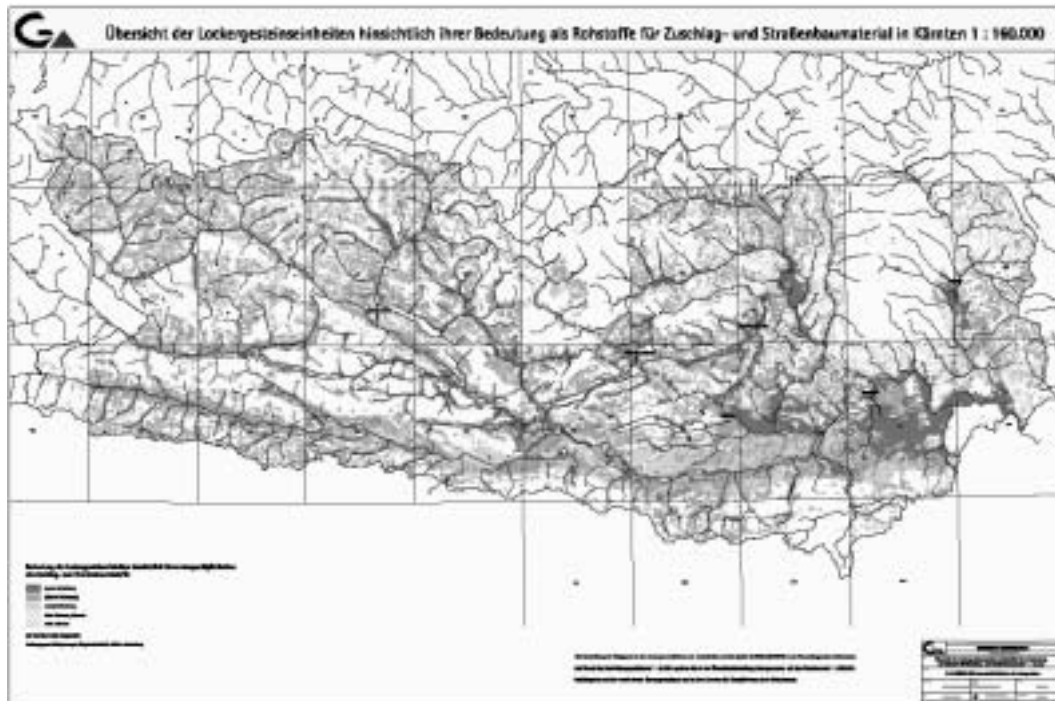


Figure 1. Setting of non consolidated rocks showing their relevance as concrete and road construction material (red/green/brown: high/average/low relevance)

the Survey's official concept of the „Geological Map of Austria 1:50.000” so far only has edited 5 sheets from 34 sheets, which partially or totally cover the province of Carinthia.

All polygons of the new digital map are digitally assigned a) the original legend text and b) a hierarchically structured general legend data base. Classification and description of lithology is according to respective mineral resource's quality. The general legend has turned out to be necessary for combining polygons of different origin and value. This concept should enable the user to generate a map of any scale and any significance, according to his necessities. For the purpose of Carinthia's land use planners the recommended map points out aggregates of “relevance as concrete and road construction material” and distinguishes between high / average / low relevance.

Digital Geo-Archive

Carinthia's Geological Survey had a large amount of analogous data derived from decades of daily assessment which have been structured for a GIS-based digital archive and partially have been put into GInS. Items covered are: *General items, garbage water, railroads, chemical hazards, dump sites, land use, power plants, cable ways, scientific*



Figure 3. Detailed GIS-image of a gravel pit in the vicinity of Bleiburg, Carinthia

projects, bike routes, mining sites, disaster damages, groundwater, road building and geothermal heat pumps.

Research for archive data may start out of the digital archive (Figure 2) or out of the GIS-application (Figure 3). Lists of search criteria are helpful for data selection. In parts this archive is already linked to existing Intranet facilities of the Carinthian government.

Data input is supported by especially designed MS-Access® applications. Relevant documents could be scanned and linked to the archive. The functionality



Figure 2. Digital archive at the Geological Survey of Carinthia

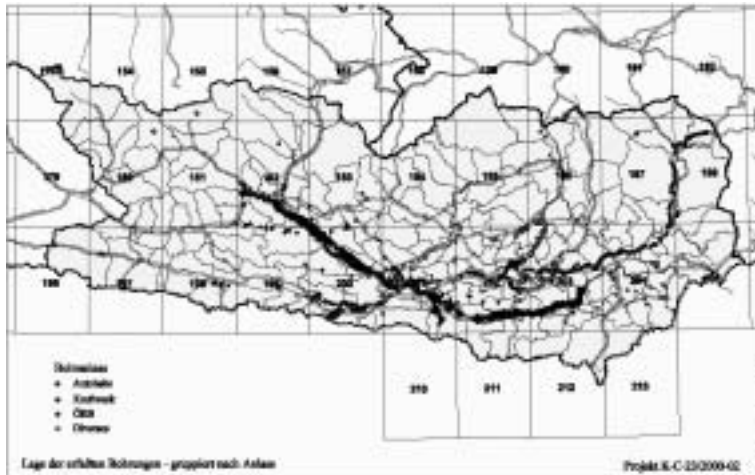


Figure 4. Data input of boreholes for different purpose (highways, power plants, railroads, others)

within MS Windows is optimized through ODBC®-facilities. In order to advance knowledge about surface-near mineral resources, data input for the following items had priority:

Boreholes (Figure 4)

Data from about 4000 wells have been collected from the archive of the Carinthia's Geological Survey, from the archive of Carinthia's Bridge Building Department, from the archives of two regional power plant companies, from the archive of the railway company, out of unpublished

projects and out of geological literature in general.

Open Pits

Information about open pits was essential for mineral resource's quality evaluation. Contributing archives were once again Carinthia's Geological Survey and the archive of the national Geological Survey, in total the documentation 1250 mostly gravel pits have been evaluated (Figure 5, detail see also Fig. 3). Data input fields are numerous, most of them provide lists of possible input data, others are designed for free textual input.

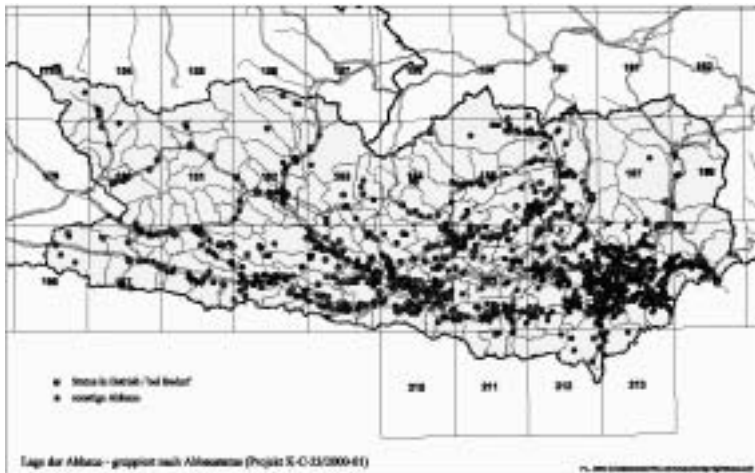


Figure 5. Position of aggregate pits (red/blue: active/inactive)

Towards an Austrian Mineral Resources' Plan

In October 2000, Austrian Parliament engaged the Ministry for Economy and Labour to develop a National Plan of Mineral Resources. Starting on a generalized level the supply with mineral resources of the entire nation should be outlined verbally, by figures and maps. In a second attempt, supply concepts will be worked out together with the regional governments. Work started in spring of 2002 and is scheduled for five years. Overall target is approaching a sustainable development on the mineral resource's sector.

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