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Case study

MetClass: A software for the visualization and exploitation of Dill's (2010) "chessboard" classification of mineral deposits

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ABSTRACT

Rising economic value of a large number of metals as a result of their importance for new technologies and industrial development has renewed worldwide interest for mineral exploration and detailed studies of ore deposits. The Dill's (2010) "chessboard" classification of mineral deposits is the most recent attempt to provide an exhaustive overview of all mineral deposits known to date. However, the voluminous Dills review paper is accessible only in print or as PDF file. In this article, we present MetClass, software that provides advanced solutions to perform efficient research and statistics using Dill's classification and the related database. MetClass allows to assemble all results relevant to a given ore deposit on a user-friendly interface. This software is therefore a valuable tool for mineral exploration and research on ore deposits, as well as an educational solution for students in metallogeny.

1. Introduction

The demand for a large number of metals of economical interest has drastically increased in the last decades as a result of their multiple applications in new technologies and their importance in the exploitation of both conventional and renewable energy resources. Interest for metallogeny was therefore reactivated, which includes both finding new ore deposits and thorough characterization of those already known (e.g., Laznicka, 2014). This also reinforces the need for a global classification of metal deposits providing comprehensive insight into the relationship between metals distribution, host rock types, and the different forms of deposits.

Since the pioneering works of De Launay (1913), who introduced the term "metallogeny" and provided the first classification of mineral deposits, and those of Lindberg (1922) and Lindgren (1933) on deposit terminology and classification, several attempts were made to propose classifications of ore deposits (Bateman, 1950; Schneiderhöhn, 1962; Routhier, 1963; Stanton, 1972; Hutchinson, 1983; Laznicka, 1985, 2005; Schröcke, 1986; Guilbert and Park, 1986; Carr & Herz, 1989; Whitney and Naldrett, 1989; Kirkham et al., 1993; Evans, 1993; Kesler, 1994; Robb, 2004; Dill, 2010). However, some of these works are restricted to a given type of deposit, such as hydrothermal ores (Barnes, 1997). Others focus on one prominent parameter, such the nature of the host rock (Whitney and Naldrett, 1989) or the metallogenic process involved (Routhier, 1963; Guilbert and Park, 1986).

The recent Dill's compilation ("The chessboard classification scheme of mineral deposits: Mineralogy and geology from aluminum to zirconium", by Dill (2010) – published in the 100th issue of *Earth Science Reviews*) is an attempt to provide an exhaustive classification of all mineral deposits known to date. It is also the most comprehensive as it includes most parameters that are pertinent to the deposits characterization, with extensive references to previous studies. The Dill's "chessboard" classification is therefore highly valuable as it makes the present-day knowledge on metal resources widely accessible to the interested scientific community. It is however quite an effort for users to retrieve all the information from Dill's article pertinent to a given type of chemical element, or to specific metallic ores and deposits, and to assemble information dispersed throughout the 420 pages of the volume.

The MetClass software presented in this paper was designed to overcome these difficulties and make the information available in

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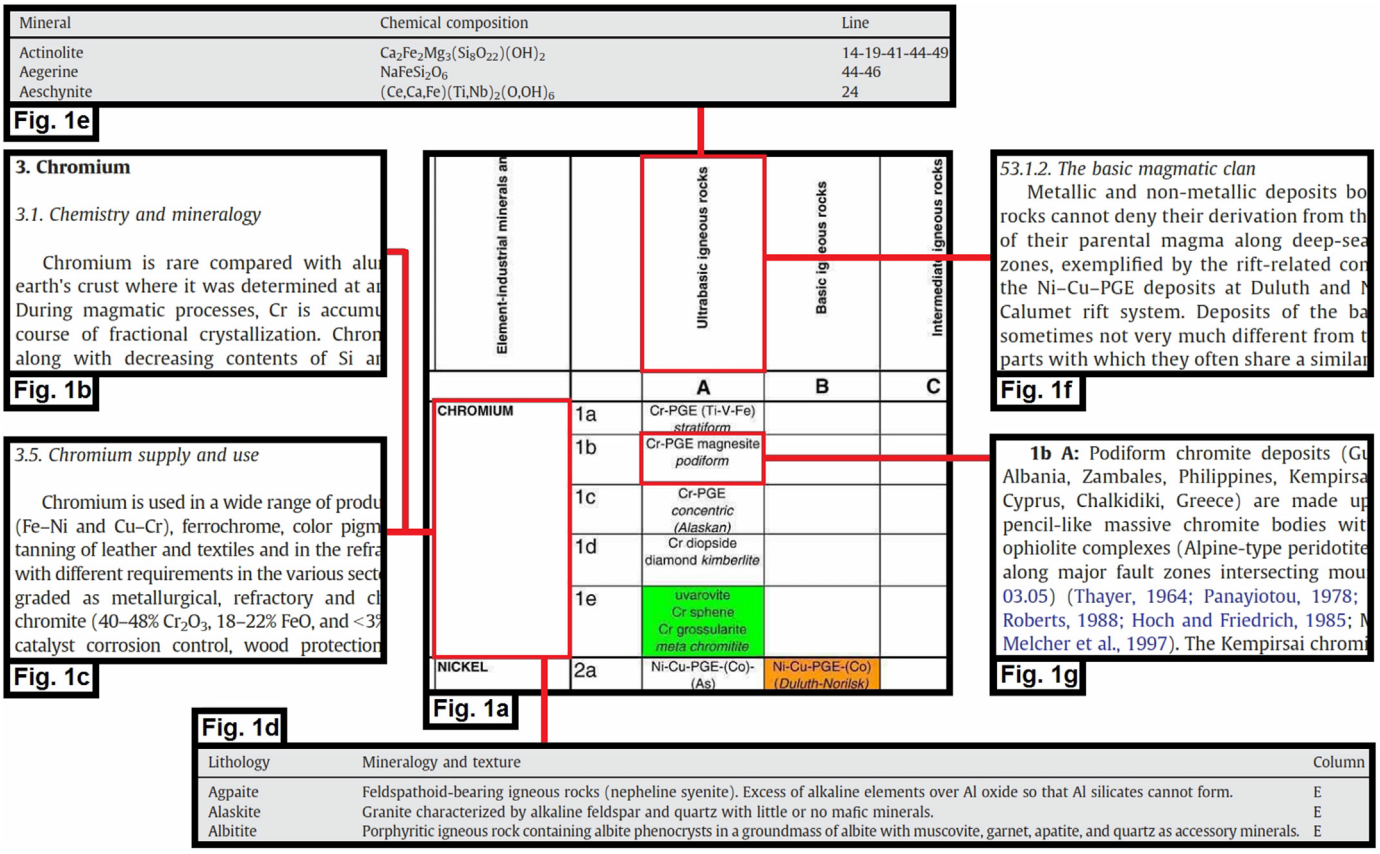

Fig. 1. Schematic representation of the Dill's (2010) "chessboard" table (a) and examples of information relative to the table lines (chemical elements – b, c, d), columns (host rocks – e, f) and cells (ore deposits – g).

Table 1
Types of data sources that were identified by analyzing Dill's article.

"Chessboard" table (12 sources)	Gemstones and ornamental stones
	Industrial minerals and rocks
	Ore minerals and metallic resources
	Element- industrial minerals and rocks
	Host rock type
	Host rock code
	Ore deposit form
	Ore deposit type
	Ore mineralization process
	Ore code
	Ore deposit form code
	Rock subtype code
Article's body (7 sources)	Chemistry and mineralogy
	Supply and use
	Minerals that contains that chemical element
	Deposition environment
	Geodynamic settings
	Rocks with the same type as the ore deposit host rock
	Ore deposit form description

Dill's compilation easily accessible. The software uses the Dill's "chessboard" structure but minimizes the efforts to query the database and optimizes the relevance of the search results.

2. The Dill's (2010) "chessboard" model

Dill's classification is primarily composed of a 20-pages matrix table (Fig. 1a) in which the lines stand for the chemical elements of economic interest and the columns for the host rocks (and/or structures), classified in four main groups: (1) magmatic rocks, (2) ore-bearing structures (pipes and faults), (3) sedimentary rocks and (4) other host types. Additional information pertinent to the chemical elements and host rocks is given in the text of the article and in tables. This includes, for instance, geochemical information on the elements (Fig. 1b), on their industrial use (Fig. 1c), and on related ore minerals (Fig. 1d), as well as petrographic and metallogenic information on host rocks (Fig. 1e,f).

At the intersection of the lines and columns, the cells indicate the different types and forms of ores (sub-cells) relevant to a given chemical element and a given host rock/structure. For more details, each sub-cell refers to relevant information given in the main body of the article, including type localities, geological settings, ores mineralogy and the metallogenic processes involved (Fig. 1g).

Table 1 summarizes the 19 types of data sources that were identified by analyzing Dill's article. Most of them were retrieved from the text but the data also include photographs, maps and drawings.

3. MetClass design and implementation

The MetClass software aims to facilitate retrieval of information from the Dill's "chessboard" table and extraction of complementary data from the article. The structure of the classification is fully preserved so that the search for relevant information can proceed from the chemical elements or/and from the host rocks. The visualization of the chessboard table is optimized and advanced query functions allow to maximize the relevance of the