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Gemstones and geosciences in space and time
Digital maps to the "Chessboard classification scheme of mineral deposits"

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ABSTRACT

The gemstones, covering the spectrum from jeweler's to showcase quality, have been presented in a tripartite subdivision, by country, geology and geomorphology realized in 99 digital maps with more than 2600 mineralized sites. The various maps were designed based on the "Chessboard classification scheme of mineral deposits" proposed by Dill (2010a, 2010b) to reveal the interrelations between gemstone deposits and mineral deposits of other commodities and direct our thoughts to potential new target areas for exploration. A number of 33 categories were used for these digital maps: chromium, nickel, titanium, iron, manganese, copper, tin–tungsten, beryllium, lithium, zinc, calcium, boron, fluorine, strontium, phosphorus, zirconium, silica, feldspar, feldspathoids, zeolite, amphibole (tiger's eye), olivine, pyroxenoid, garnet, epidote, sillimanite–andalusite, corundum–spinel — diaspore, diamond, vermiculite–pagodite, prehnite, sepiolite, jet, and amber. Besides the political base map (gems by country) the mineral deposit is drawn on a geological map, illustrating the main lithologies, stratigraphic units and tectonic structure to unravel the evolution of primary gemstone deposits in time and space. The geomorphological map is to show the control of climate and subaerial and submarine hydrography on the deposition of secondary gemstone deposits. The digital maps are designed so as to be plotted as a paper version of different scale and to upgrade them for an interactive use and link them to gemological databases.

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1. Introduction: Gems and geosciences

Gemstones are traditionally dealt with and evaluated by mineralogists, or to be more specific, by a special group of material scientists named gemologists. To get to the bottom of the evolution of gemstone mineralizations and to find out where the "big three", diamond, emerald and precious corundum varieties came from, a lot of time and effort have to be invested in igneous and metamorphic petrology (Altherr et al., 1982; Golani, 1989; Jaques et al., 1990; Coenraads et al., 1995; Mitchell, 1995; Oakes et al., 1996; Sutherland et al., 1998; Mercier et al., 1999; Limtrakun et al., 2001; Baker et al., 2003; Yui et al., 2003; Berryman et al., 2004; Hetman, 2008; Scott Smith, 2008). Only a few of these papers can be quoted here. Other precious stones, may they be of jeweler's quality or only end up in the showcase of a mineral enthusiast or rockhound, are eclipsed by the "big three" and mainly dealt with for their gemological features or listed among other nice crystals in special gemological journals or full-color magazines geared to attract the interest of collectors and mineral enthusiasts. From whatever angle you may look at gemstones, material sciences obviously rank higher than geoscientific disciplines such as geology and geomorphology. A closer look at the evolution of gemstones in time and space, however, may change one's mind. A set of maps is going to be provided and briefly discussed in the succeeding sections to make gemologists and enthusiasts in these special group of minerals alike, acquainted with the temporal and aerial distribution of gemstone deposits on the globe (Russian Academy of Sciences Institute of Geography, 1998). The current paper is a supplement to the "Chessboard classification scheme of mineral deposits" (Dill, 2010a). The maps are designed to be used in context with this study but they may also be handled as stand-alone items by those readers who want to know in which countries, geomorphological environments and geological units gemstone deposits formed. For that reason a short introduction into the geology as well as an overview of the classification scheme has been given.

Data on gemstone deposits have derived from publications as well as data from the internet encompassing more than 650 datasets (not listed in detail in this supplementary paper), from basic maps showing the global distribution of gemstone (Gübelin, 1992; Shigley et al., 2010) and from unpublished maps and reports of geological surveys.

2. Gems and classification schemes of mineral deposits

Before entering into any discussion of the evolution of minerals or gemstones in space and time a classification scheme has to be set up according to which this group of commodities can be presented. Currently, there is no classification scheme of gems and gemstones generally agreed upon that might achieve a geoscientific objective like that (Walton, 2004). There are many publications dealing with one group only, e.g., ruby, or a wealth of textbooks going through the kingdom of gemstones from the noble diamonds through the pearls paying little attention to their geological origin (Garnier et al., 2008). In the present publication, gems and gemstones are not discussed as a stand-alone group of minerals but are considered as an integral part of mineral deposits from aluminum to zirconium, both of which play an important part in the build-up of gemstones. They were subdivided according to the "Chessboard classification scheme of mineral deposits" designed by Dill (2010a) to show the interrelationship of (1) ore minerals (used to extract metals such as Pb, Zn, Cu, Cr or looked for as a source of energy in case of U and Th), (2) industrial minerals and rocks (used for by virtue of their physical and chemical properties and utilized either directly or after appropriate processing) and (3) gemstones and ornamental stones (utilized for their esthetic value or for financial investment). In the "Chessboard classification scheme of mineral deposits" gems and gemstone ranked as high-unit-value commodities are dealt with along with their "less shiny" brethren (red ruby of jeweler's quality vs. opaque corundum used for abrasives) which are named as high-place-value commodities. The latter are not measured by the carat but by the ton. In the