1 Introduction

A magnitude of metallic deposits can be rationally defined by reference to mean crustal contents of elements (Clarke's), thus: “economic” metal content in a deposit divided by Clarke of the metal that equals the tonnage of continental crust that would contain the same amount of trace metal in Clarke concentration” (Laznicka, 2010, 2014). There, by convention, a “giant” deposit starts at \( n \times 10^{11} \) crustal tonnage equivalent, supergiant deposit starts at \( n \times 10^{12} \). Because metal Clarke's vary, metal “giants” magnitudes vary as well so Au “giant” starts at 250 t Au, Cu “giant” at 2.5 Mt Cu, Fe “giant” at 4 Gt Fe. These metal magnitude thresholds vary with Clarke values published by the various authorities; ours are based on Wedepohl (1995). The main advantage of this “macro-geochemical” approach is that it provides rational means for comparison of all metallic deposits with very different Clarke values, free of economic factors, thus compatible with quantitative (macro)geochemical studies of ore deposit formation and distribution. One can thus numerically evaluate efficacies of metal accumulating systems in nature. Based on continuously updated database (Giantdep 3), there are now 1,308 giant and supergiant metal accumulations (1171 giants and 137 supergiants) reported, in 915 deposits and some districts (this is because some deposits contain more than one metal accumulation; the Olympic Dam deposit has five: Cu,Au,U,Ag,REE). As definition of the “ore giants” depends on published quantitative data, those deposits lacking such data are not yet included (about 50 deposits). Fig. 1 shows the distribution of “giants” and “supergiants”

Fig. 1 Numbers of giant and super-giant metal accumulations. Most came from single deposits, but some deposits/districts have two or more metal accumulations (Olympic Dam has 5). From Laznicka (2012).

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among individual metals. Au, Cu, Mo, Ag and Pb absolutely dominate the inventory which is only partly due to the geochemical ability of metals to locally super-accumulate; to a considerable degree this is the consequence of economic desirability where the most desirable metals have been most intensively explored for, hence a largest number of discoveries has been made. Metals with low industrial demand (e.g. Th, Ti, Ga, Ge) have been less eagerly explored, so few deposits have been discovered. Al, Ti and partly Fe that have very high Clarkes would require exceptionally large tonnages of ore types not yet utilized (for example of anorthosite in case of Al).

2 Economic Importance of the Ore Giants

In the 21st century Age of Globalization the bulk of newly mined metals has been coming from exceptional deposits, although the ratio of “giants” to lesser-size deposits varies with individual metals. It is greatest for deposits of REE, Nb, Mo, lesser for deposits of Au, Ag and Sn. This ratio has changed throughout the history, almost exponentially increasing in favour of the exceptional deposits during the past century (Fig.2).

It is anticipated that the “ore giants” will retain their metal supply primacy throughout this century. The discovery of outcropping “giants” and those under shallow cover has peaked in the 1980s but increasing number of concealed exceptional deposits are now being discovered in depth, down to about 3000 m. Increasing depth of ore occurrence, however, will result in reduced variety of ore types and some like placer, laterite, duricrust-hosted deposits will greatly diminish.

3 “Giants” in the Past Century

Very few ore giants had been discovered in the distant past-partly it was because of the small number of “classical metals” (Au,Ag,Cu,Sn,Fe) known then. The rate of discovery has increased after (re)discovery of the Americas, then during the Industrial Revolution in the 1800s caused by the discovery of most chemical elements. Following the beginning of bulk open pit mining in the 1900s, discovery of new and exploitation of earlier found deposits increased further, becoming exponential after 1960 (Fig.3). New ore discoveries coincided with accelerated and increasingly more sophisticated scientific research-most modern ore deposit models are based on prominent “giant” ore types (models). The “porphyry” (Cu,Mo,Au) model has been progressively formulated since about the 1930s, influenced by the “giants” in Arizona, Utah, Colorado and Chile. The Mississippi Valley-Zn,Pb and “sandstone-U” models of the 1960s were followed by the Carlin-Au model after the 1962 discovery. The “domestication” of the VMS and sedex deposits in the 1960s was followed by the Carlin-Au model after the 1962 discovery. The “domestication” of the VMS and sedex deposits in the 1960s was followed by the Carlin-Au model after the 1962 discovery.
by the kuroko deposits in Japan, Rio Tinto in Iberia and Abitibi clusters in Canada (Noranda, Kidd Creek) as well as the Sullivan, McArthur River and Red Dog “sedex”. The “unconformity-U” (Athabasca fringe), Olympic Dam-IOCG, high-sulfidation Au (Yanacocha), orogenic Au (Muruntau, Kalgoorlie, Timmins), and other models followed. The exploration technology kept changing too (Fig.4). Whereas accidental visual discoveries followed by prospectors sightings were responsible for most pre-1960 discoveries, they have been rapidly substituted by multicomponent exploration. Drilling geochemical/geophysical anomalies resulted in most finds.

4 Are the “Ore Giants” Unique?

Most are not, although this seems the case following discovery of new ore types (e.g. Carlin, Olympic Dam). Discovery or re-interpretation of additional comparable or related deposits usually quickly followed, once a successful model was publicized. “Ore giants” are thus magnitude peaks of deposit populations of the given type which, in case of porphyry Cu-(Mo,Au) deposits, include several thousand localities. The discovery of the “giants” is thus statistical and a part of the general exploration approach.

References