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The effects of population growth and advancements in technology on global mineral supply

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ABSTRACT

Over the decades concerns have been raised about the future availability of certain essential minerals due to increased rates of population growth and advancements in technology. This paper seeks to assess the current state of global mineral supply, focusing mainly on the food and energy technology industries. Through analysis of global mineral production and consumption over a 40-year period we are able to ascertain that, for the industries in question, the increasing global demand is being met by constantly growing mineral reserves.

Introduction

In 1978, Goeller and Weinberg wrote a paper addressing the issue of the availability of the earth's resources (Goeller and Weinberg, 1978). At the time there were two schools of thought, those who believed that these resources were being depleted at an alarming rate that would inevitably lead to the ultimate demise of society; and others who believed that there was an indefinite supply of raw materials, and once we exhaust one material there will be a viable substitute to be used in its place. The paper provided an in depth analysis to determine whether or not there were other substitutable sources of minerals and energy commodities that could replace our current supply if our current resources are depleted. The main conclusion drawn was that we need not worry that the depletion of resources will cause a catastrophe, as long as we find an inexhaustible source of nonpolluting energy (Goeller and Weinberg, 1978).

The conversation continues to this day with population growth, economic expansion, and the emergence of new technology putting increasing pressure on mineral resources; there is still concern that we are depleting our mineral supply at alarming rates. In an article in Nature, Jeremy Grantham discussed the impending shortage of two fertilizers, phosphorus and potassium, which are essential for food production and as a result human survival (Grantham, 2012). According to Grantham, hunger and instability will ensue if the uses of these resources are not drastically reduced in the next 20–40 years (Grantham, 2012). Grantham is not the only one with this viewpoint. Although a lot less dramatic, Graedel et al. (2013) studied the substitution potential of 62 different metals in their more prominent applications and analyzed how these substitutes performed in these cases. They found that for a dozen metals their substitutes either did not exist or were inadequate; furthermore, none of the 62 metals had substitutes of equivalent quality (Graedel et al., 2013).

The concern extends to the status of the current global mineral reserves. In his paper "Mineral Supply and Demand in the 21st Century" Stephen Kesler deduced that, in theory, the global mineral reserves should meet world demand for the next 50 years (Kesler, 2007). As shown in Fig. 1, depending on the commodities, the global reserves are 20–100 times larger than the annual consumption.

In 1980, famed business professor Julian L. Simon made a wager against population studies expert Paul Ehrlich that over the next decade the prices of five commodity metals, chosen by Ehrlich, would decrease or stay constant. Simon was reacting to a book written by Ehrlich (1995) claiming that the increased rate of population growth was quickly reducing food supply and other resources and this would lead to worldwide catastrophe. Simon disagreed with this premise and proposed the wager to prove that access to new mineral resources would be found to compensate for the population growth and as a result commodity prices would remain constant. The commodities chosen were copper, chromium, nickel, tin, and tungsten. Simon won the bet with all five

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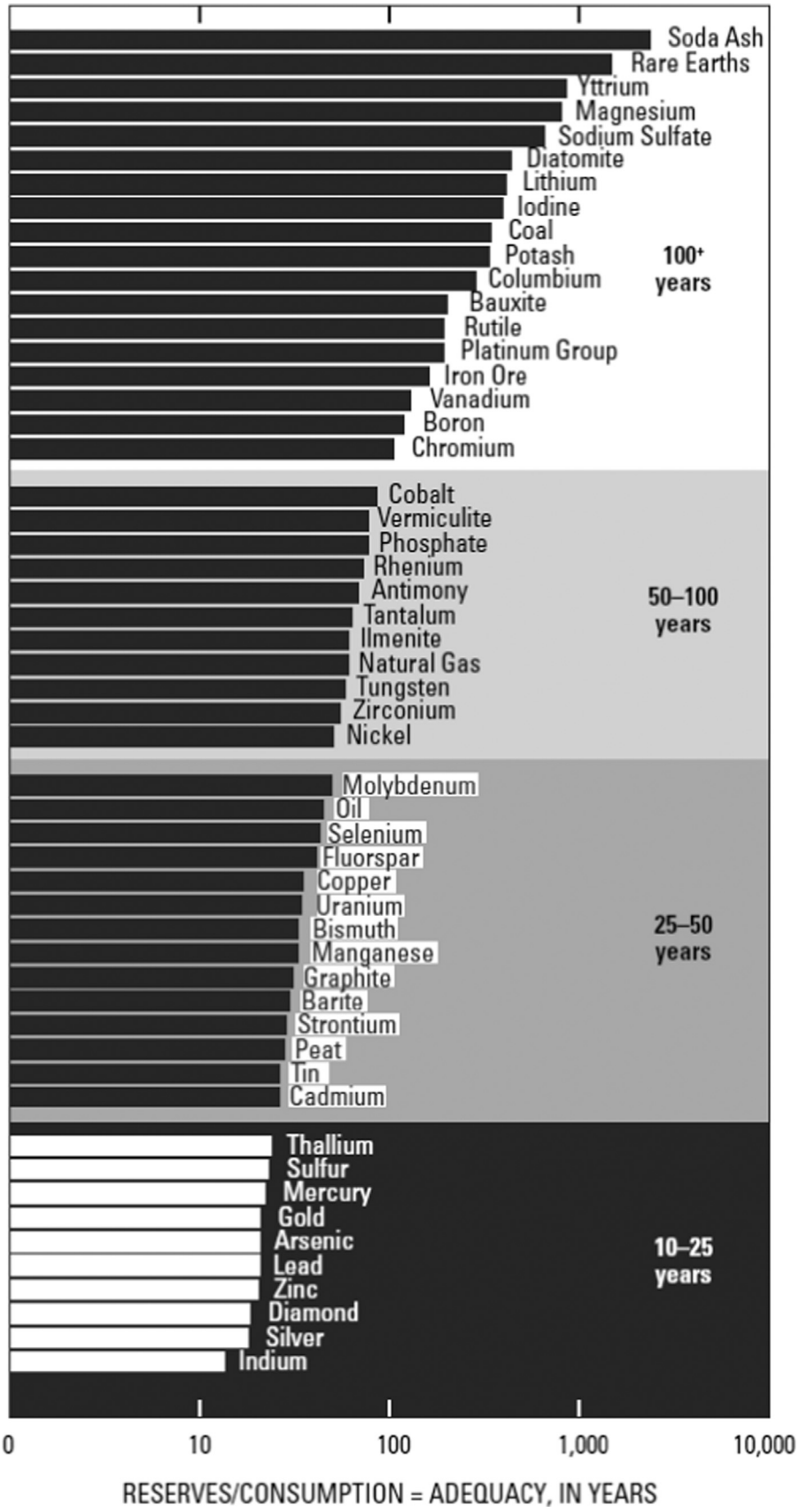

Fig. 1. Global reserves to annual global consumption for mineral and energy commodities in 1992. Adapted with permission from Ref. Kesler (2007).