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Critical Minerals for

E. S. Hersh

Global Critical Metal Sector ...

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E. N. Wilson, J. Edmonds

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Sources of Rare Earth Elements in the U.S. and the World

M. D. Campbell, R. W. Gregory, S. S. Sibray, J. L. Conca

Using Redundant Infrastructure and Depleted Reservoirs in the North Sea to Transition to a Hydrogen Economy in the United Kingdom ...

G. Falcone, R. Harrison

Critical Minerals, the Petroleum Geoscientist and the Wider Application of Hydrocarbon Exploration and Development Techniques and Business Practices ...

L. A. Ross, D. Beckett

Abstract

AbstractSources of Rare Earth Elements in the U.S. and the WorldRare Earth Elements (REEs) will remain important to the economies in the U.S. and the world for decades to come. With China currently dominating the world's production, it recently began to develop environmental legislation, which has led to suspending mining and processing operations in parts of China. This has led to Chinese companies looking for alternative sources of REEs in China, but also in other parts of the world. Over the past few years, more than 400 exploration projects have resumed or begun, but many other projects are underway that are evaluating alternative sources of REE, such as from re-cyling waste electronics, in coal, lignite, underclays, waste-ash deposits, and as by-products from phosphate mining and processing, and offshore seabed occurrences of deep-sea nodules. Despite the great investment in deep-sea mining over more than 40 years, there has still been no successful attempt to mine the deep-sea nodules on a commercial scale.Exploration is still based on locating REEs as coproducts in otherwise metalliferous deposits. The authors have all been involved in REE exploration programs over the years whether they discovered substantial REEs in phosphate deposits in Australia, REEs in a variety of geological environments in Wyoming, REEs within lignite and underclay in Nebraska, or associated with uranium deposits within alkaline intrusives on the Seward Peninsula of Alaska.We will discuss the salient features as to the geological context that have produced REE mineralization of economic interest in terms of world reserves and resources (can be difficult to assess because of uncertainties in demand, costs, and supplies of a particular rare-earth element), either as a primary product, as co-product, or as alternative resources. We will show that the Earth exhibits a REE fingerprint in the upper, middle, and lower crust, which is retained in at least one of the metalliferous ore types mined and smelted and retained in the slag used as landfill where the REEs are subsequently released to the shallow groundwater reflecting the same fingerprint of relative abundance.We will discuss 11 major rare-earth projects outside of China that could go into production soon, if the yearly market increase in demand of about 8% is realized over the next few years. Each project will be characterized by the type of REE mineralization, available resources, and potential production estimates. We will also discuss a few of the more interesting REE exploration programs in the U.S. that are likely to be evaluated for their economic potential after their REE content and metallurgy have been established. If only a few of these projects go into production, they will decrease our current dependence on China for REEs and on Russia and other countries for uranium to fuel our 99 nuclear reactors, and of those to be built using new technology.