

State-of-the-Art Literature of Global Heavy Minerals

H.C.S. Subasinghe*, A.S. Ratnayake and T.D.U. Wijewardhana

*Department of Applied Earth Sciences, Faculty of Applied Sciences,
Uva Wellassa University, Badulla 90000, Sri Lanka
chandimasubasinghe00@gmail.com

Minerals having specific gravities greater than common minerals such as quartz and feldspars (i.e., $<2.65 \text{ g/cm}^3$) are known as heavy minerals (HMs). Titanium, zirconium, and rare earth elements (REEs) containing minerals are key players in the global HMs industry that have diversified industrial applications. This study aims to discuss the global distribution, genesis, exploration, and processing of HMs to understand and summarise the status of the global heavy minerals. Over 400 research articles of different disciplines such as geology, geochemistry, geophysics, mineral processing and engineering, mining and metallurgy, mineral economics, and policy studies were referred to compile this review. Heavy mineral deposits are distributed in more than 45 countries in the world. The major HMs deposits are located in Australia, Asia, and Africa, as secondary coastal places neighbouring the Indian Ocean. Onshore and offshore HMs deposits in America and Europe also considerably contribute to the global market. The HMs deposits are categorised as primary (magmatic, hydrothermal, metamorphic are endogenous processes) and secondary (weathered, eroded, and transported sediments are exogenous processes) deposits. The combination of traditional and sophisticated geological, geophysical, and geochemical techniques is currently used in HMs exploration. However, there is a lack of exploration and discovery of new HMs deposits. Therefore, the global mining industry has gradually downgraded. Physical separation followed by chemical treatments is commonly used to process HMs and extract valuable components. For example, the heavy minerals are initially concentrated using gravity, magnetic and electrical separation techniques. The separated HMs are then transferred to reduction, smelting, and acid leaching processes. However, HMs require limited chemicals in upgrading and processing compared to other mineral industries. Stockpiling, legacy contracts, and government policies preside the production, supply, and market balance of the HMs industry. Mining and utilisation planning followed by the United Nations Sustainable Development Goals are a timely requirement for the sustainability of HMs industry and to overcome challenges such as environmental, health issues, and social resistance. Consequently, the mining and processing industry should strengthen prospective new resources, adopt environmentally friendly processing methods, and recycle waste materials wherever possible to overcome supply risks and environmental impacts in the future.

Keywords: Heavy minerals distribution, Primary deposits, Secondary deposits, Exploration and production, Supply drivers

The AHEAD/DOR Grant to ASR is acknowledged.