

Compositions of rare earth elements in deep-seabed mineral deposits and implications for rare metal resources

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In seabed mineral resources, polymetallic nodules, ferromanganese crusts, seafloor massive sulfides, and deep-sea sediments are potential critical metal sources. It was evaluated that the rare earth elements potential of these deposits in terms of total rare earth oxide (TREO) grade, ore and TREO tonnage, relative REO distribution (RRD) and basket price. TREO contents of the polymetallic nodules and ferromanganese crusts are averagely 0.13% and 0.185%, respectively. In polymetallic nodule, total basket price is slightly higher than that of the ferromanganese crusts due to their higher NPD group (Nd_2O_3 , Pr_2O_3 , and Dy_2O_3) and lower LC group (La_2O_3 and Ce_2O_3) contents. In deep-sea sediments, TREO grades range from 0.015% to 0.115% (average grade is 0.049%). The average TREO content of the nodules and crusts is three times that of the deep-sea sediments, yet its total basket price is approximately half. This is because the crusts and nodules contain approximately half the NPD and SEGTY group (Sm_2O_3 , Er_2O_3 , Gd_2O_3 , Tb_2O_3 , and Y_2O_3) contents, and double the LC contents of deep-sea sediments. The average TREO content of the polymetallic nodules is 0.13%, with a total ore tonnage of 188 Mt, equating to an estimated tonnage of 0.23 Mt per deposit. The total TREO tonnage of polymetallic nodules from all Korean tenements is estimated as ~1 Mt. In REE-bearing deep-sea sediment, 16,500 Mt of sediment at a TREO concentration of 0.049% equates to a gigantic TREO tonnage of 8 Mt. A comparison with land-based REE deposits suggests that these deep-sea mineral deposits are low-grade mineral deposits with a large tonnage. REE within deep-sea mineral deposits are important by-products and coproducts of main commodities which may enhance the economic feasibility of extracting major commodities.