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Bauxite Red Mud Residue as a Mineral Resource

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Refining bauxite to produce alumina for aluminum smelting feedstock yields a caustic red mud residue. Globally, over 100 bauxite refineries produce about 117 Mt to 187 Mt of red mud annually. Through 2011, about 2.5 Bt of red mud has accumulated in various storage sites. Red mud residue from refineries in 25 countries has a mean composition of about 19% Al_2O_3 (), 38% Fe_2O_3 (), and 8.4% TiO_2 all of which are recovered in the aluminum smelting process. Estimated global tonnages of these oxides are approximately 570, 1,140, and 240 Mt respectively. Critical minerals such as Ga, Sc and REE are concentrated in red mud residue. Globally, mean concentrations are 107 ppm Ga, 131 ppm Sc, and 1,805 ppm TREE. Estimated tonnages are on the order of 3.2 Mt Ga, 3.9 Mt Sc, and 54 Mt REE.

Historically, Greater Antilles bauxite was processed at Grammercy, LA, Corpus Christie, TX, and at five plants in Jamaica. Recently, Greater Antilles bauxite was being shipped to refineries in Canada, China, Ukraine and Russia. Red mud residue from two refineries in Jamaica contained 23–27 % Al_2O_3 , 9–12 % Fe_2O_3 , and 1.4–1.7 % TiO_2 as well as 1,900 to 2,600 ppm TREE and 130 to 170 ppm Sc.

While the major oxide content of red mud is relatively uniform, the critical metal content may be more variable and depend on the bauxite source. Recovery of critical elements has encountered a variety of economic and technical obstacles, but recently, several companies (Rio Tinto, Noranda, UC RUSAL) have initiated recovery of Sc from the red mud residue at their refineries.

The vast bulk of red mud residue remains an environmental problem. However, an increasing number of industrial mineral applications (over 1,200 patents) ranging from building material to pollution control and ceramics may help to alleviate environmental concerns.