Potential and Outlook

Known emery deposits in New South Wales probably developed from contact metamorphism of bauxite within the Tertiary volcanic sequences of the New England and Southern Highlands regions. These offer scope for modest-sized emery deposits around small intrusions or beneath thick basaltic lava flows.

Although suitable bauxitic precursor materials are widespread in the Tertiary volcanic sequences, emery deposits, and evidence of appropriate metamorphism (adequate heat source, plus a well-insulated, dry environment to minimise heat loss) is rare. Plugs such as Gragin Peak (Inverell 1:250 000 map sheet area), where emery is recorded, offer the best possibilities. Dykes (cf. Oregon emery deposits in the USA) or sills could also be suitable agents of metamorphism. Thick lavas flowing over dry ground (to provide the necessary heat and insulation) represent a further possibility. However, records of such occurrences are rare.

Other types of bauxitic precursors are rare elsewhere in New South Wales. Mediterranean-type bauxite interbedded with limestone has not been recognised. Bauxites developed at weathered unconformity surfaces beneath sedimentary basins, as described by Golani (1989), have not been recorded. Loughnan (1975) recorded boehmite, γ-AlO(OH), associated with an Early Permian weathering of basaltic volcanic rocks in the Gunnedah Basin, but these occurrences are poorly developed. Hence, metamorphism of such bauxite seems to offer little possibility for the development of commercial emery deposits. Similarly, contacts between large, hot (probably mafic) intrusions and aluminous metasediments would be prospective for emery, but specific occurrences are not known in New South Wales.

Detailed magnetic surveys offer the best opportunity for the recognition of any significant emery deposits, owing to the common formation of magnetite as part of the process of development of emery.

Nature and Occurrence

Emery is a hard, tough, chemically inert, grey–black mixture of oxides, typically corundum and magnetite, but can include Fe-rich spinels, mullite, hematite, garnet, titanium minerals and other impurities (Holroyd & McCracken 1994; Harben & Kužvart 1996). It is commonly considered in conjunction with corundum (of which it is essentially an impure form), and both are principally used as natural abrasives. True emery consists of corundum and magnetite, with or without hematite derived from magnetite. Spinel emery is a mixture of spinel (pleonaste–hercynite), corundum and hematite, usually forming a heavy, black, fine-grained aggregate with dark crystals of corundum which are commonly cracked and altered to mica. Feldspathic emery is similar, but contains 30% to 50% feldspar.

World production of emery in the early 1990s was about 38 000 tpa, including 24 700 tonnes from Turkey, 10 000 tonnes from Greece and 3000 tonnes from the USA (Harben & Kužvart 1996).

Deposit Types

Emery deposits are formed mainly by contact metamorphism and are most common in crystalline limestone, sintered basic igneous rocks, and chlorite and hornblende schists (Holroyd & McCracken 1994; Harben & Kužvart 1996). The low silica content of the product appears to be caused by silica removal during weathering (e.g. bauxite interbedded with limestone or on bedded basaltic volcanic rocks), or desilicification of aluminous silicates (e.g. originally kaolinite-rich sediments) at the contact with mafic or ultramafic intrusions. Regional metamorphism of bauxitic rocks is indicated in some Mediterranean deposits (Holroyd & McCracken 1994; Harben & Kužvart 1996).

Main Australian Deposits

There is no current production of emery in Australia. Small quantities of emery have been produced from the Richenda River deposits in Western Australia (Carter 1975).

New South Wales Occurrences

Numerous small occurrences of emery have been recorded in New South Wales, typically close to, or in conjunction with, Tertiary volcanic rocks, e.g. Pindari and Gragin Peak near Inverell, Crookwell and Quirindi (Raggatt 1924; MacNevin 1975; Holmes et al. 1982). Bauxite developed on basaltic volcanic rocks are the likely precursors, owing to the high Al_2O_3, Fe_2O_3 and TiO_2 and appropriate ratios of these oxides (Barron 1987) and common presence of textures indicative of weathering.

The Crookwell deposit is a dyke-like massive segregation in Tertiary basalt (MacNevin 1975). The Pindari deposit covers an area of about 40 m by 10 m and is developed on Permian volcanic rocks, near the exhumed base of the Tertiary basalt sequence (Booker 1950; Brown & Stroud 1997). The Quirindi occurrences consist of segregations in Tertiary basalts capping Mesozoic conglomerates and sandstones (Booker 1950). Detrital occurrences in the Tweed River (Raggatt 1924) were probably derived from Tertiary basalts in the headwaters of the Tweed River.

Other recorded occurrences include Nundle, Guyra, Murrurundi, Cooma and Nimmitabel, all in areas of Tertiary basalt (Raggatt 1924; MacNevin 1975).

Recorded production from New South Wales deposits is about 300 tonnes, which was obtained from the Crookwell deposits between 1926 and 1945.

Applications

The principal historical use of emery has been as an abrasive because of its hardness (7.5 to 9 depending on proportion of corundum). The hardness, toughness and chemical inertness of emery enable its use in low- to medium-pressure blasting abrasives, concrete surface hardening, the manufacture of non-skid pavements and stair treads, and non-skid dusting agents for oily floors (Holroyd & McCracken 1994; Harben & Kužvart 1996). Emery is also used in de-husking drums for polishing rice grains, in medium- to low-pressure blasting, stone surfacing and rough grinding of glass and stone sawing (Holroyd & McCracken 1994).

The best grades of emery contain 65% to 68% Al_2O_3 and 16% to 24% Fe_2O_3 (Holroyd & McCracken 1994). Sizes for emery paper typically range from 2.36 mm to 53 µm, with finer flour grades used in polishing glass. Grainsize and particle size distribution are critical.

Economic Factors

Emery was once a dominant material in abrasives markets, but it now only occupies niche markets. Markets are increasingly declining due to competition from synthetic abrasives, and to quality control problems with natural materials caused by their variability and softness owing to imperfections. The niche market for low-value abrasives, non-skid and construction applications are likely to remain, but other markets are likely to decline. Balance between supply and demand is likely to be stable but is susceptible to competition from synthetic materials.

Natural alternatives to emery include corundum, garnet and diamond. Synthetic substitutes include silicon carbide, tungsten carbide, synthetic diamond, and fused alumina.

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