

A REVIEW OF THE CARBONATITES OF AUSTRALIA.

A.L. Jacques⁽¹⁾; J. Knutson⁽¹⁾; and R. Duncan⁽²⁾.

(1) Bureau of Mineral Resources, Geology & Geophysics, Canberra Australia; (2) R.K. Duncan and Associates, Leederville, Western Australia.

Several major new carbonatite complexes have recently been found in Australia. This paper reviews the geology, mineralogy and geochemistry of carbonatites in Australia and their mineral resources.

Geology, Age and Setting

Most of the carbonatites in Australia are of late Proterozoic age and intrude either cratonised Proterozoic mobile belts or the margins of Archaean blocks (Fig.1). The carbonatites all appear to be spatially related to deep-seated faults, and range in form from major circular bodies (some as large as 10km across), with marked magnetic and gravity signatures to small (< 100m) dykes and plugs.

The oldest is the Mount Weld Carbonatite dated at 2.02 Ga which intrudes Archaean greenstones of the Eastern Goldfields Province of the Yilgarn Block (Fig. 1). The Mt Weld carbonatite is a 3 km wide stock or plug buried beneath alluvium and Tertiary lake sediments. The body has a central carbonatite (dominantly sovite) core surrounded by a 500m wide zone of brecciated, biotite-rich wallrock (glimmerite). An earlier generation of cumulate and orbicular textured sovite is intruded by later dolomite-bearing carbonatites typically containing apatite, magnetite, phlogopite and pyrochlore.

The Pontoon Creek alkaline complex is a major circular body some 10km across which intrudes Archaean granites and gneisses at the eastern margin of the Yilgarn Block (Fig. 1) and is thought to be of Proterozoic age. The complex, which is covered by some 500m of Permian tillite, has a central core of ultramafic cumulates, dominantly magnetite-bearing olivine clinopyroxenite, cut by narrow veins of apatite-rich carbonatite. Peralkaline syenites are also associated.

The Cummins Range Carbonatite lies at the intersection of the King Leopold and Halls Creek mobile belts at the southern margin of the Kimberley Block (Fig. 1). The carbonatite, which has been dated at 905 Ma, intrudes Precambrian metasediments and gneisses as a zoned vertical stock 1.8 x 1.7 km across. A central carbonatite-rich core is enclosed by an envelope of carbonated and micaceous altered pyroxenite which passes into an outer zone of unaltered pyroxenite. The altered zone is cut by numerous ring dykes and cone sheets of carbonatite and a satellite plug of carbonated mica pyroxenite is also present. Sr and Nd isotopic data suggest that the Cummins Range carbonatite may be related to the Bow Hill lamprophyre further north in the East Kimberley (Fig. 1), which is of comparable age.

The Mundine Well carbonatite is a series of lenses 700m in diameter which intrude a partially assimilated synclinal keel of the Archaean metavolcanic Western Shaw belt of the Pilbara Block of Western Australia (Fig. 1). Rock types include apatite-sovite, altered apatite-magnetite-silicocarbonate, apatite olivine sovite, and alkaline pyroxenite.

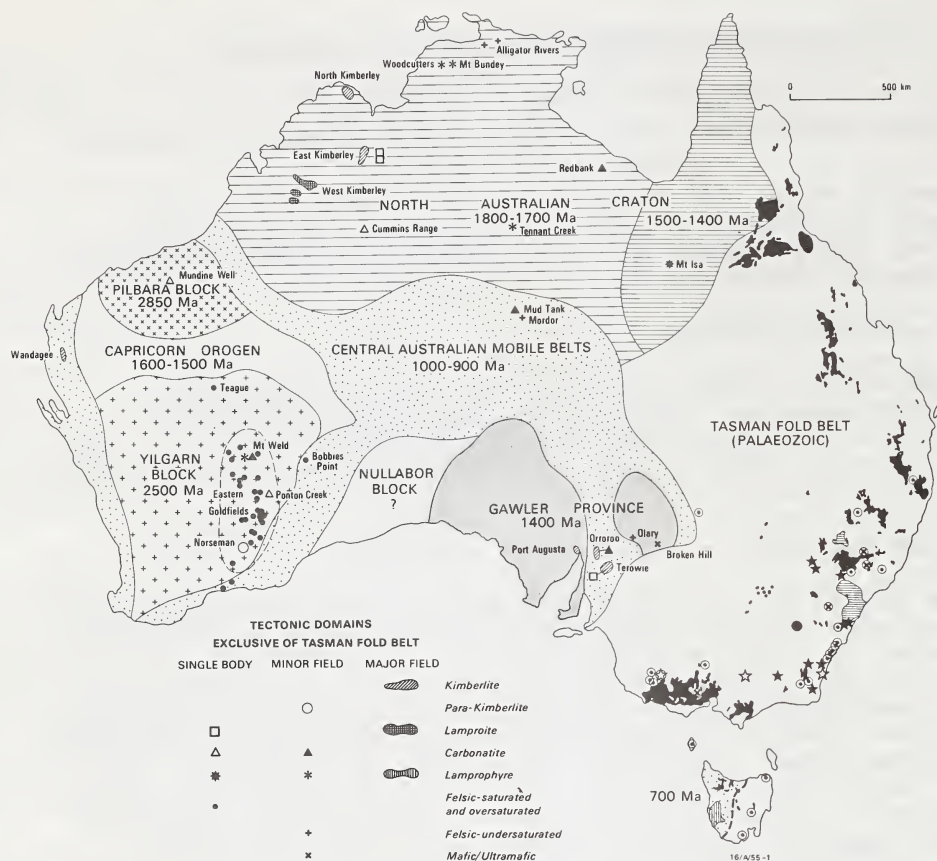


Fig. 1. Distribution of carbonatites and other alkaline rocks in Australia. Details of alkaline rocks in the Tasman Fold Belt are given in Jaques et al., (1985).

The 730 Ma Mud Tank Carbonatite intrudes Early Proterozoic granulites of the Strangways Metamorphic Complex in the southeast part of the Arunta Block in central Australia (Fig.1). The complex consists of a number of carbonate-rich lenses surrounded by mica-rich zones emplaced into poly-metamorphic granulites and granitoid cataclasites. Inclusions of syenite and granulite (some boudinaged) have been pervasively metasomatised and contain albite and alkali pyriboles. Mud Tank Carbonatite appears to have been emplaced at mid-crustal levels (≥ 15 km) possibly during faulting related to the development of the late Proterozoic Amadeus Basin. Mud Tank differs from many other carbonatite complexes in having lower abundances of LREE and other incompatible elements and a slight decoupling of LREE from HREE.

The Redbank breccia pipes are a suite of some 50 carbonate-rich copper-bearing breccia pipes which intrude middle Proterozoic volcanic and dolomitic sedimentary rocks of the Macarthur Basin. Intense K-metasomatism and geochemical enrichments have previously been interpreted as indicating a carbonatitic affinity, viz. a carbonated K-rich trachytic magma. Recently the presence of carbonatitic volcanism has been questioned and the Redbank mineralisation interpreted as resulting from mixing of Cu- and sulphate-rich basinal brines with reduced, hydrocarbon-bearing fluids from underlying country rocks with mineralisation occurring in fractures.

The Walloway carbonatite comprises small dykes and plugs of carbonate-rich lamprophyric rocks which intrude late Proterozoic metasediments of the Adelaide Fold Belt. The Walloway intrusions are closely associated with Jurassic (170 Ma) Orroroo kimberlites and isotopic and geochemical data suggest a genetic relationship (Nelson et al., 1988).

Resources

The Mount Weld Carbonatite hosts a world-class REE deposit together with discrete deposits of Y, Ta, Nb and P developed in a 10-70m thick regolith zone over the carbonatite (Duncan and Willett, 1990). The REE mineralisation is mostly contained in supergene Th-deficient monazite but significant amounts of Y and HREE are contained in secondary churchite. The mineralised zone forms a discrete zone at the centre of the body and contains some 15.4 Mt at 11.2% REO plus yttrium with a cutoff grade of 5%. Included in this resource is a high grade zone of 1.35 Mt with a grade of 23.6% REO and a cutoff grade of 20%. Reserves of other metals include 250 Mt of phosphate at 18% (10% cutoff grade), 145 Mt of tantalum ore at a grade of 0.034% Ta₂O₅ (0.02% cutoff) and 273 Mt of niobium ore at a grade of 0.9% Nb₂O₅ (0.5% cutoff).

A REE-enriched regolith zone up to 60m thick is also developed over the Cummins Range Carbonatite and hosts sub-economic LREE, Nb, U and P mineralisation in the form of secondary monazite, and detrital monazite, apatite, pyrochlore and apatite. A resource of 3-4 Mt with a grade of 2-4% REO is inferred (Andrew, 1990).

The Mud Tank Carbonatite yields fine gem quality zircons (alluvial), and degraded mica-rich rocks (hydrobiotite and hydrophlogopite) are currently being evaluated as a vermiculite deposit.

Oxidised high grade ore has been mined from the Redbank copper deposits in the past. A subeconomic resource of 4 Mt with a grade of 2.5% Cu from primary ore bodies has been identified at the two major prospects and the deposits are currently being re-evaluated.

References

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