

Geology and Exploration History of Kimberlites and Related Rocks in South Australia

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There are currently around 200 kimberlitic occurrences known in South Australia. The kimberlites occur in seven discrete provinces spanning a distance of 400 kilometres across South Australia (Figure 1). By the early 1980s all the known outcropping kimberlitic intrusions had been located while subsequent discoveries have generally been concealed bodies located by aeromagnetic surveys.

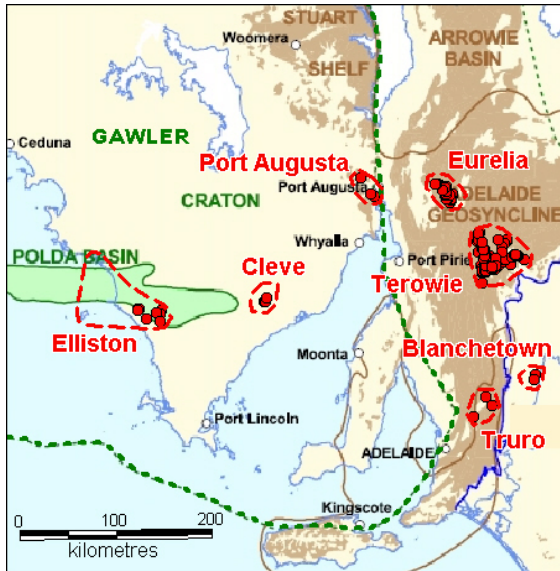


Figure 1. Kimberlitic Provinces in South Australia

ELLISTON PROVINCE

On the western Eyre Peninsula are the nine Mt Hope kimberlites. All were discovered in 1990-1991 by drilling discrete aerial magnetic targets after regional surface loam heavy mineral samples confirmed the presence of indicator grains in the area. Due to complex cover of Upper Jurassic fluvial clayey sandstones and lignite, Tertiary poorly sorted fluvial sands and inter-bedded clays, and extensive Quaternary calcarenites and calcrete, surface indicator patterns are displaced and dispersed away from the kimberlites. The kimberlites are hypabyssal and diatreme facies, porphyritic, possible monticellite?-phlogopite kimberlites. Microprobe studies of chromites from some Mt Hope bodies show strong evidence of mantle metasomatism.

This Province also includes the North Venus Bay (north side Pollda Basin) and Flinders Island kimberlite indicator anomalies. Flinders Island is unique in having large numbers of all types of indicator minerals, including diamonds within the island soil (Cooper, 2002). Source rocks have not yet been located in these two areas.

CLEVE

The eastern Eyre Peninsula contains the three Cleve kimberlite dykes (Wyatt *et al.*, 1991), first drilled in 1986. Stream and loam grid sampling narrowed down the location, with final costean and drilling based on ground magnetics and surface indicator counts. Groundmass perovskite U-Pb was used to obtain a 180 ± 3 Ma date on the Cleve 01 kimberlite (Bristow, unpublished data, in Wyatt *et al.*, 1991).

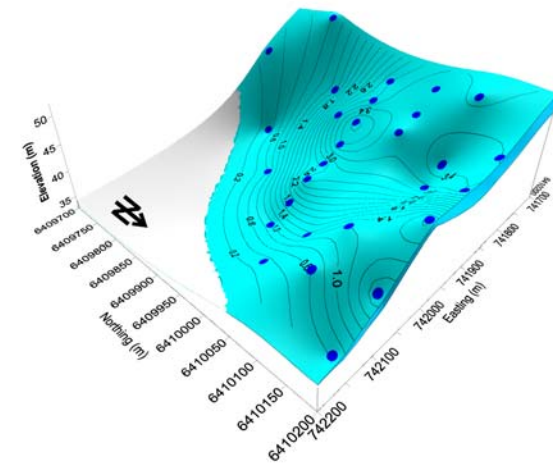


Figure 2. Model of the Sugarloaf Dam kimberlite sill based on drillhole intersections (dark blue circles), with thickness contours overlain. Image is looking southwest.

PORT AUGUSTA

The kimberlites in this area comprise two sills, the El Alamein, and Sugarloaf Dam sills. Recent work has shown the previously separated El Alamein East and West sills are actually the same body and appear to be nearly horizontal. The Sugarloaf Dam sill thickens towards the northwest and is a gentle syncline with fold axis plunging shallowly towards the southeast (Figure 2). Both sills were discovered in 1973 using surface loam sampling at ever-increasing density.

EURELIA PROVINCE

The province comprises a number of kimberlite dykes, with the first 12 discovered described by Scott Smith *et al.* (1984). They are centred around the town of Eurelia, north of Orroroo, in the Adelaide Geosyncline. The diamondiferous Eurelia K07 kimberlite dyke and blow has been the most extensively studied of this province. The petrological descriptions by Scott Smith *et al.* (1984) came from the vertical drillhole DHR3 completed by Stockdale Prospecting during 1981.

The first kimberlitic rock dated in South Australia was from drillhole CD010, northwest from Eurelia (sample 75210434 in Stracke *et al.*, 1979). Further dykes, some diamondiferous, are still being found currently in this area based on detailed high-resolution magnetic surveys. The Eurelia Province also includes dykes of carbonatitic affinity exposed in creek banks in the Walloway Diapir area discovered by Tucker & Collerson (1972).

TEROWIE PROVINCE

Most of the kimberlites were located by De Beers during the period 1969-1972. This Province contains some of the first true kimberlite rocks found in the State, and probably in Australia. Exploration primarily involved the collection of alluvial heavy mineral samples. The Calcutteroo, Mittopitta, Pine Creek and other kimberlites were discovered by heavy mineral sampling, mapping along gullies, then shallow drilling. A large number of recent discoveries has been made by using high-resolution magnetic surveys. Some of these have been confirmed as weakly diamondiferous in the northern part of the province. It is possible the province merges with the Eurelia Province to the north, but currently there is still a 40km gap between the two.

TRURO

Several small pipes are known from this area. They have been discovered by a combination of stream heavy mineral sampling and detailed magnetics.

BLANCHETOWN

By drilling blind magnetic targets in 1982, Rio Tinto discovered two kimberlitic intrusions below about 214 metres of Tertiary Murray Basin sediments.

As part of a project to systematically map and describe all the kimberlites and related rocks in South Australia, heavy mineral samples have been collected from a number of kimberlites in every kimberlitic field within each province. Not all are true kimberlites (see Cooper *et al.*, 2007), and emplacement ages are not continuous across the State. Table 1 provides the first accurate location details for about half the State's kimberlites, some previously published, and many that have never been published.

The rate of discoveries of outcropping kimberlite has effectively dropped to zero in South Australia. Recent discoveries have all been under sediment cover. This trend will continue with the new frontier being the pervasively sediment-covered Gawler Craton. The discovery of diamonds and kimberlite indicator minerals, showing good mantle conditions on Flinders Island, suggests other parts of the Gawler Craton are prospective for diamonds, and not all areas have suffered the same metasomatism as the Mt Hope kimberlites (see Figure 3).

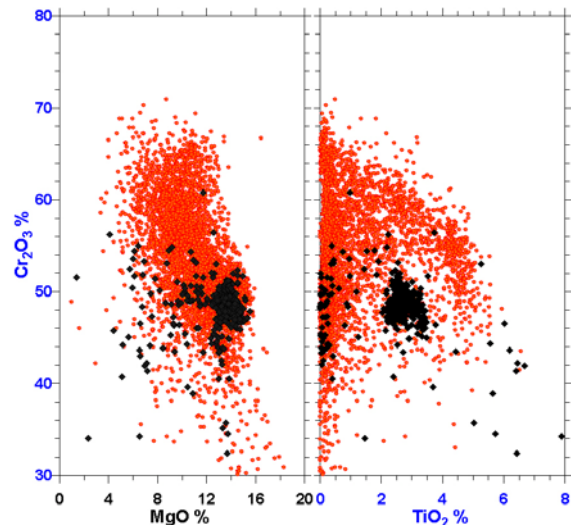


Figure 3. Microprobe analyses of chromite cores from Flinders Island (red, n=4559) and Mt Hope kimberlites (black, n=418) showing stark differences in population chemistry.

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Table 1. Kimberlite locations in South Australia. Coordinates are in WSG84 Datum.

Name	Longitude	Latitude	Province	Name	Longitude	Latitude	Province
6633RS99	138.502979	-32.482167	Eurelia	Mulga Creek 01	139.0165919	-33.1884164	Terowie
Angaston 01	139.1241498	-34.5127939	Truro	Mungibbie 01	138.964993	-33.2764351	Terowie
Calcuteroo 01	139.1998847	-33.1198229	Terowie	Mungibbie 02	138.96248	-33.26937	Terowie
Calcuteroo 02 East	139.1939805	-33.1312899	Terowie	Mungibbie 03	138.960037	-33.263402	Terowie
Calcuteroo 02 West	139.195045	-33.131248	Terowie	Mungibbie 04	138.961552	-33.2542966	Terowie
Calcuteroo 02a	139.19509	-33.1306	Terowie	Mungibbie 05	138.9615524	-33.2534792	Terowie
Calcuteroo 02b	139.1946464	-33.1309962	Terowie	Pandappa 02a	139.1913702	-33.1528923	Terowie
Calcuteroo 03	139.1934772	-33.1338799	Terowie	Pandappa 02b	139.191531	-33.1528946	Terowie
Calcuteroo 04a	139.19526	-33.1090021	Terowie	Pandappa 03	139.1858215	-33.1615052	Terowie
Calcuteroo 04b	139.1955487	-33.1095565	Terowie	Pandappa 04	139.2022608	-33.1440677	Terowie
Calcuteroo 04c	139.1955385	-33.1090062	Terowie	Pine Creek 01	139.272983	-33.187521	Terowie
Calcuteroo 04d	139.1972185	-33.111222	Terowie	Pine Creek 02	139.26841	-33.164186	Terowie
Calcuteroo 04e	139.201655	-33.1112229	Terowie	Pine Creek 03	139.278645	-33.1653394	Terowie
Calcuteroo 04f	139.1986065	-33.1109445	Terowie	Pine Creek 04	139.289029	-33.1678163	Terowie
Calcuteroo 05	139.2024833	-33.1311424	Terowie	Pine Creek 05	139.282834	-33.1780949	Terowie
Calcuteroo 06	139.200228	-33.130823	Terowie	Pine Creek 07	139.280509	-33.1691698	Terowie
Calcuteroo 09	139.19983	-33.1203142	Terowie	Pine Creek 08	139.267057	-33.1916666	Terowie
CD10	138.4932691	-32.5131946	Eurelia	Pitcairn E1430	139.215642	-32.967166	Terowie
Cleve 01	136.5228415	-33.5945364	Cleve	Pitcairn E1522	139.223599	-32.961528	Terowie
Cleve 02	136.526441	-33.58682	Cleve	Pitcairn E1524	139.221259	-32.963617	Terowie
Cleve 03	136.53833	-33.558263	Cleve	Pitcairn E1525	139.220408	-32.966004	Terowie
El Alamein East	137.733724	-32.5838873	Port Augusta	Pitcairn E1526	139.226606	-32.962586	Terowie
El Alamein West	137.685583	-32.5666713	Port Augusta	Pitcairn JS	139.2226891	-32.9626686	Terowie
Eurelia K01	138.543858	-32.529034	Eurelia	Sugarloaf Dam	137.57183	-32.421003	Port Augusta
Eurelia K02	138.530165	-32.52092	Eurelia	Terowie 02	138.911319	-33.1520261	Terowie
Eurelia K03	138.577127	-32.558836	Eurelia	Terowie 03	138.911859	-33.1514399	Terowie
Eurelia K04	138.5367888	-32.5053248	Eurelia	Terowie 04	138.908636	-33.1693284	Terowie
Eurelia K05	138.609503	-32.551722	Eurelia	Terowie South 01	138.9111615	-33.1769374	Terowie
Eurelia K06	138.600452	-32.54298	Eurelia	Terowie South 02	138.9122971	-33.176046	Terowie
Eurelia K07	138.51812	-32.4907568	Eurelia	Ulooloo 01	138.971863	-33.364475	Terowie
Eurelia K08	138.500561	-32.495936	Eurelia	Ulooloo 02	138.889593	-33.330424	Terowie
Eurelia K09a	138.457337	-32.47007	Eurelia	Ulooloo 03	138.97229	-33.3631978	Terowie
Eurelia K09b	138.43612	-32.456405	Eurelia	Walloway X	138.578986	-32.628828	Eurelia
Eurelia K10	138.510325	-32.490697	Eurelia	Waupunyah 01	139.008044	-33.2067808	Terowie
Eurelia K11	138.525414	-32.479652	Eurelia	Waupunyah 02	139.007763	-33.2059468	Terowie
Eurelia K12	138.509485	-32.483817	Eurelia	Waupunyah 03	138.998696	-33.208416	Terowie
Eurelia K13	138.502664	-32.477538	Eurelia	Waupunyah 04	138.994979	-33.2081581	Terowie
FS03	139.5985849	-34.2132765	Blanchetown	Waupunyah 05	138.99257	-33.2093838	Terowie
FS66	139.5820328	-34.261727	Blanchetown	Waupunyah 06	138.990135	-33.2091276	Terowie
Hiles Lagoon 02	138.962136	-33.200228	Terowie	Waupunyah 07	139.0005443	-33.1978952	Terowie
HLD1 262m	138.964211	-33.1902667	Terowie	Waupunyah 08	139.001294	-33.2021817	Terowie
HLD1 294m	138.9640096	-33.1901643	Terowie	Waupunyah 09	138.998655	-33.2017154	Terowie
Mittopitta 02	139.006858	-33.254982	Terowie	Waupunyah 10	138.999466	-33.2089789	Terowie
Mittopitta 05	139.008736	-33.248479	Terowie	Waupunyah 17	139.0083145	-33.2062261	Terowie
Mittopitta 06	139.0061373	-33.2568661	Terowie	Whyte Yarcowie 01	138.9632097	-33.2343256	Terowie
Mittopitta Diatreme	139.006752	-33.252567	Terowie	Whyte Yarcowie 02	138.9631125	-33.2344358	Terowie
Mt Hope 01	135.1938877	-33.7554577	Elliston	Wonna 01	138.995836	-33.2542279	Terowie
Mt Hope 01 Satellite	135.1955375	-33.7522312	Elliston	Wonna 02	138.9960879	-33.2493875	Terowie
Mt Hope 02	135.343791	-33.785207	Elliston	Wonna 03	138.996658	-33.2483686	Terowie
Mt Hope 03	135.3563276	-33.6824151	Elliston	Wonna 04	138.996026	-33.2483404	Terowie
Mt Hope 04	135.345096	-33.709222	Elliston	Wonna 05	138.993999	-33.24465	Terowie
Mt Hope 05	135.300734	-33.697874	Elliston	Wonna 06	138.994109	-33.2415913	Terowie
Mt Hope 06	135.10887	-33.665019	Elliston	Wonna 07	138.993553	-33.2466413	Terowie
Mt Hope 07	135.091452	-33.666395	Elliston	Wonna 08	138.989136	-33.2463278	Terowie
Mt Hope 08	135.097106	-33.677629	Elliston	Wonna 09	138.995366	-33.2485562	Terowie
Mt Scrub 03	138.9366674	-33.2970837	Terowie	Wonna 18	139.0027011	-33.2663608	Terowie