A CLINOPYROXENE THERMOBAROMETRY TRAVERSE ACROSS COROMANDEL AREA, BRAZIL

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INTRODUCTION

De Beers Exploration has discovered a significant number of kimberlites in the Coromandel area, Brasil. The study area traverses approximately 440 km extending eastwards from the Proterozoic Brasilia belt onto the exposed Archaean basement of the São Francisco Craton (Fig 1). Clinopyroxene thermobarometry was combined with the garnet thermometry to establish a good estimation of sublithospheric P-T variations.

Clinopyroxene grains from a garnet lherzolite source (i.e. mantle-derived) were identified. In addition, the data were filtered to exclude potentially metasomatic grains, according to methods described in Nimis (1998) and Nimis and Taylor (2000). The thermometry results were compared with the Finnerty and Boyd (1984) calibration.

Thermometry data was also obtained from nickel analyses of garnet recovered from kimberlites in the region using the experimental calibration of Canil (1999).

Results

Nineteen kimberlite occurences were found to have sufficient (i.e. greater than 70) mantle-derived clinopyroxene grains for reliable interpretation. Maximum geotherms using 80% of the data (disregarding outliers) and profiled along a cross-section line AB (Fig 1). There are considerable geotherm variations in the extreme NW and SE of the section, and there is a suggestion that geotherms to the SE are comparatively elevated (Fig 2). It is of significance that the most profound disturbance of the geotherm (largest variations) occurs in the on-craton region to SE, using the cratonic boundary delineation of De Almeida (1978, Fig.1). The pipes containing the high temperature populations (labeled 'adiabatic' in Table 1) are also confined to the on-craton SE region. It is suggested that these heating events which disturbed the subcratonic mantle lithosphere in this region were ancient (Archaean) with lesser disturbances being prevalent in the later accreted lithosphere to the NW.

Some of the occurences show two distinct populations of grains in P-T space (e.g. Guara-01 and Dourados-06 in Fig 4). Further occurrences with such populations are indicated in Table 1. It is suggested from the orientation of the higher T population that these grains equilibrated along a mantle adiabat (Table 1, Fig 4). These populations indicate a mantle potential temperature in this region of between 1200^{0}C and 1400^{0}C. Whether this influence was ancient or induced in the eruption process is undetermined.

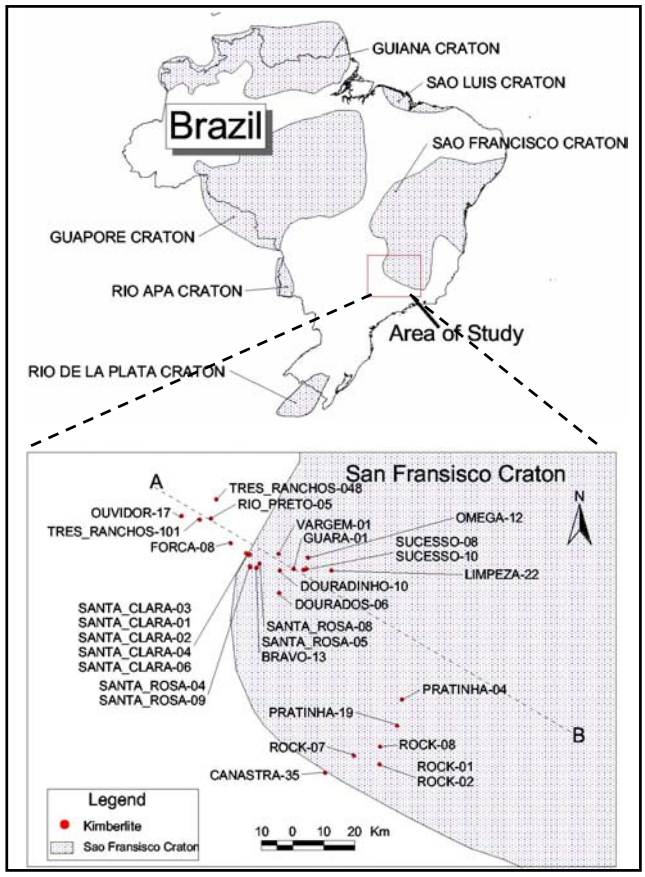

Figure 1: Locality map.

In order to compare the clinopyroxene thermo-barometry results, nickel thermometry data were calculated for occurrences with appreciable garnet grain analyses (>70) within the study area (Fig. 3). There are no observed consistencies between the clinopyroxene and garnet variations across the area of study.

Clinopyroxene thermo-barometry and garnet thermometry indicate complex P-T variations within the sub-lithospheric mantle of the Coromandel area. The extreme on-craton P-T variations are likely emulating the geological disturbances in the crust.

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Table 1: Geotherm data of the occurences with sufficient clinopyroxene grains (geotherm data was defined using P-T plots as shown in figure 4).

Occ Name	Population	Population size (n)	Geotherms mW/m^2			% D/G grains	Distance from the cross-section line (d, Km).	T_{max} (^{0}C)
			Max	Mean (~80% of dataset)	Error (+/-)			
Tres Ranchos-48	1	114	43	37	1	9	15	1380
Tres Ranchos-101	1	76	40	36	1	70	8	1070
Forca-08	1	159	48	39	1	8	6	1090
Santa Clara-01	1	289	46	44	1	51	4	1250
Santa Clara-04	1	105	39	36	1	84	4	1120
Santa Clara-06	1	226	49	37	1	71	4	1260
Santa Clara-02	1	85	45	38	1	53	3	1100
Santa Rosa-09	1	229	45	37	1	69	11	1090
Santa Rosa-04	1	82	43	37	1	68	11	1230
Santa Rosa-08	1	115	45	38	1	29	4	1130
Bravo-13	1	141	**Adiabatic**			50	8	1190
Santa Rosa-05	1	74	**Adiabatic**			53	8	1190
Vargem-01	1	159	46	37	2	79	14	1200
Douradinho-10	1	86	41	36	1	43	3	1040
Guara-01	1	201	50	44	1	28	13	1300
	2	175	**Adiabatic**			21	13	1440
Omega-12	1	74	40	36	1	26	28	960
Dourados-06	1	128	48	45	2	23	12	1030
	2	86	**Adiabatic**			73	12	1300
Sucesso-10	1	37	54	53	1	2	17	1000
	2	34	39	38	1	8	17	1485
Limpenza-22	1	126	49	45	1	21	33	1230

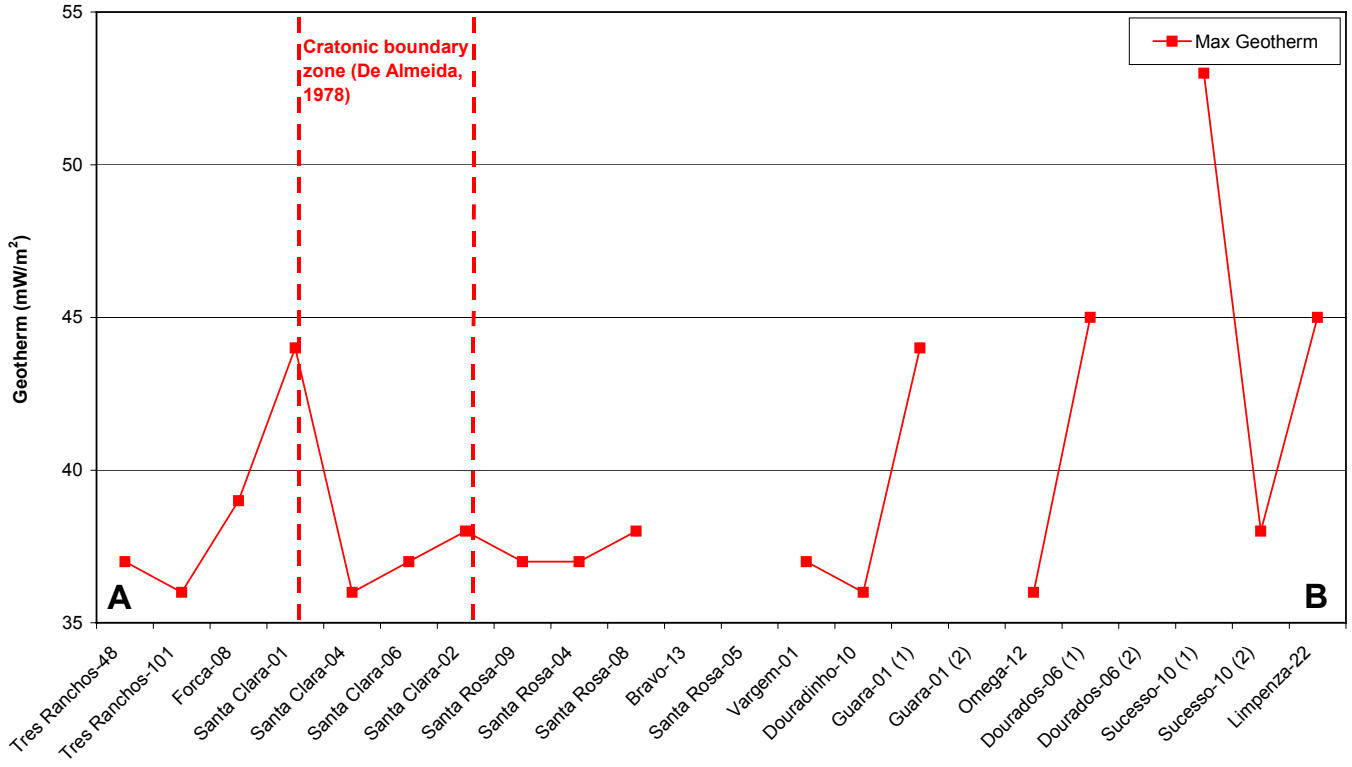

Figure 2: Clinopyroxene thermo-barometry profiles across section AB in figure 1 (occurences that follow an adiabat are indicated by gaps).

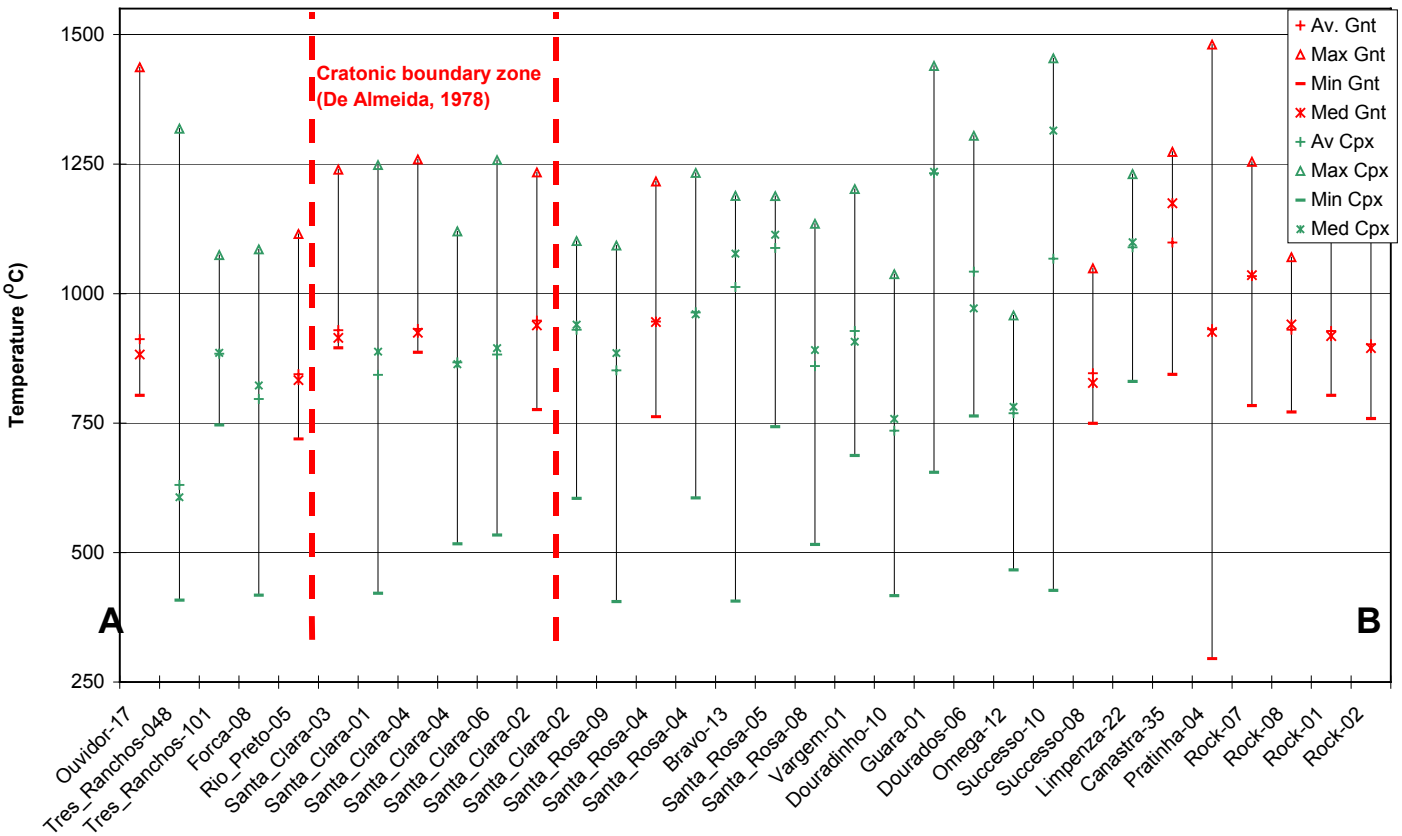

Figure 3: Clinopyroxene and garnet thermometry profiles across section AB (range, average and median).

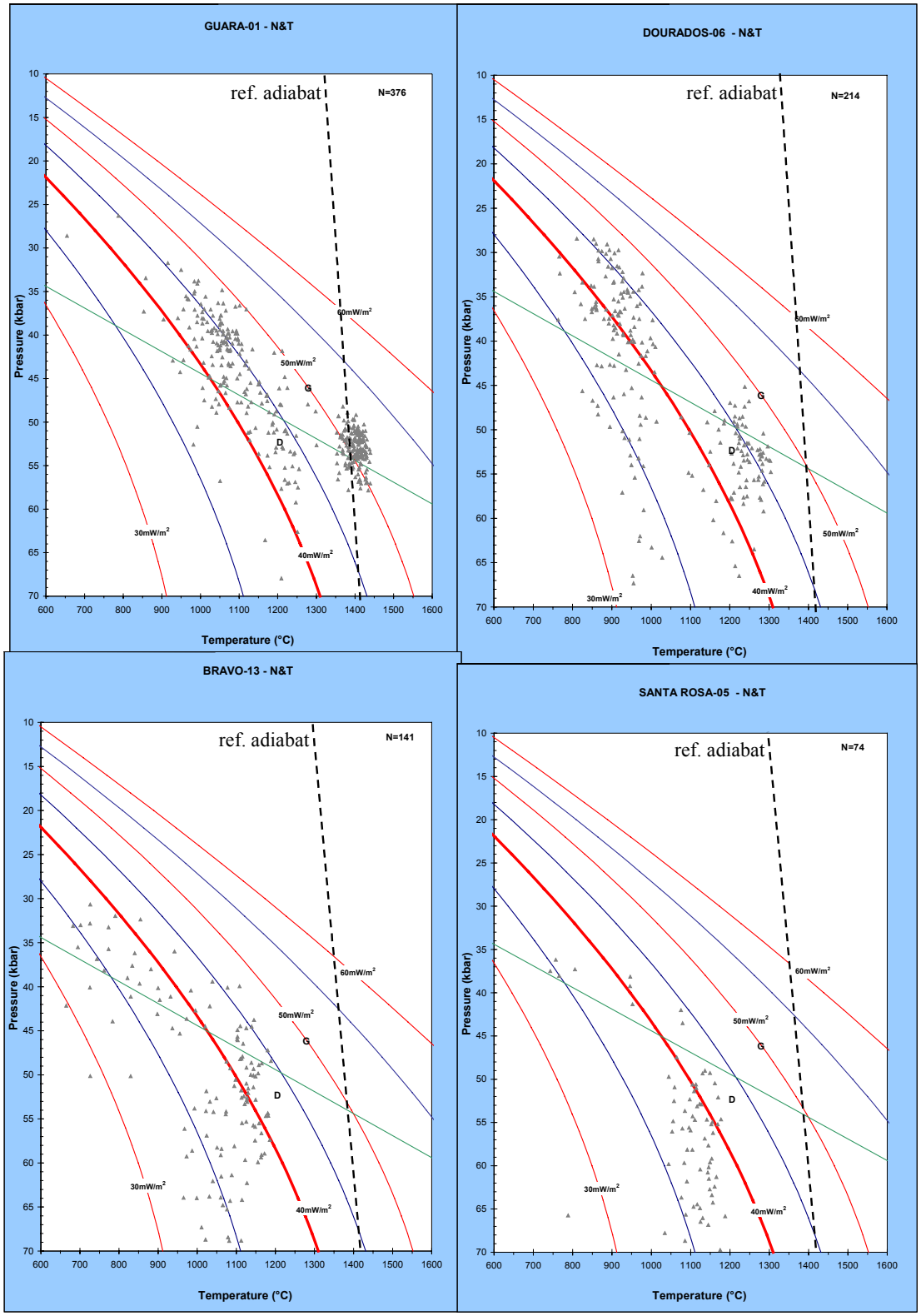

Figure 4: Examples of thermo-barometry plots of several occurrences in the area of study from which geotherms have been calculated and listed in Table 1.