THE PETROGRAPHY, TECTONIC SETTING AND EMPLACEMENT AGES OF KIMBERLITES IN THE SOUTH WESTERN BORDER REGION OF THE KAAPVAAL CRATON, PRIESKA AREA, RSA.

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1) Introduction

Approximately 130 kimberlite bodies are known to occur in the south western border region of the Kaapvaal craton (Figure 1). Based on tectonic/geologic settings as well as petrological groupings five separate domains are recognised.

2) Setting and Petrographic variation

Domain I - The region north of the Doornberg Fault, underlain by unambiguous Archaean, Kaapvaal Basement. The kimberlites are predominantly Group 2 varieties (8). Three Group 1 varieties also occur.

Domain II - The region to the east of the southward extension of the Doornberg Fault, also underlain by Archaean, Kaapvaal Basement. The kimberlites (20) are predominantly Group 1 varieties (eg Britstown pipe). One of the Group 2 varieties namely Sweetput-Soutput is transitional with respect to both petrography and radiometric isotope ratios (re. Clark et al., this volume).

Domain III - The region more or less wedged between the Doornberg and Brakbos faults, and underlain by Marydale Group basement rocks considered to be largely Marydale of Archaean age (Cornell et al. 1986). All the kimberlites (45) are Group 2 varieties, but most display petrographic tendencies towards Group 1 varieties (e.g. the presence of significant numbers of ilmenite xenocrysts). All fall well within or close to the isotopically enriched field of Group 2 kimberlites on the Nd/Sr diagram (Clark et al., this volume) but some have significantly lower initial Nd ratios.

Domain IV - The region south of Domains II and III but north of Domain V, underlain by mid-Proterozoic rocks forming part of the Namaqua Mobile Belt. Most of the kimberlites are Group 1 varieties (26) but two Group 2 kimberlites also occur. Mixed radiometric ages have been recorded and one kimberlite (Pampoenpoort) has a slightly enriched Nd-Sr signature.

Domain V - The region south of latitude 31°30'S underlain by Basement of uncertain nature. All the kimberlites (7) are barren Group 2 varieties exhibiting transitional characteristics both with respect to petrography and isotope geochemistry (Skinner, 1989). Petrographically they are closer to Group 1 varieties than the kimberlites occurring in Domain II. The types, size and abundance of specific matrix minerals vary widely even on a thin section scale.

Examination of heavy mineral concentrates from the kimberlites reveal that many of the Group 2 kimberlites in this region contain ilmenite as well as chrome-poor garnet and clinopyroxene megacrysts.

3) Emplacement Ages

Seventeen kimberlites have been dated by a variety of techniques and by different analysts (re. Table 1 and Figure 1). The wide diversity of ages (ranging between 67 and 167 Ma) in this comparatively restricted area, is somewhat unusual and contrasts sharply with many other areas of kimberlite emplacement. One exception is the field of kimberlitic rocks in East Griqualand, also located close to the Kaapvaal craton boundary (SE border region). Here emplacement ages, ranging between 63 and 194 Ma have been recorded (e.g. Nixon et al., 1983).

TABLE 1

Domain	Kimberlite	Group	Age	Method
I	Witberg Pipe	1	114	1
I	Sanddrift	2	126±2	2
II	Sweetput-Soutput	2/1	114±1 & 90±14 to 117±13	2 & 4
II	Britstown	1	74±1	2
III	Welgevonden	2	122±3	2
III	Kalkput	2	114.1, 116.4 & 117±0.4	3 & 5
III	Markt	2	127±3	2
III	Jonkerwater	2	119±2	2
III	Middelwater	2	118±3	2
IV	Pampoenpoort	1/2	103±1	2
IV	Hartebeesfontein	1	74±1	2
IV	Lushof	1	67.7 & 78.3	3
IV	Uintjiesberg	1	101±1	2
IV	Beyersfontein	1	81.5±1.5	5
V	Droogfontein	2/1	100±25 to 143±24	4
V	Skietkop	2/1	136±9 to 167±8	4
V	Melton Wold	2/1	138±14 to 145±13	4

Methods - 1.Rb-Sr model mica ages 2.Rb-Sr isochron mica and whole rock ages 3.Zircon U-Pb ages (Davis, 1977 & 1978) 4.Perovskite ion-probe ages (Barton unpubl. data) 5.Zircon U-Pb ages (Pidgeon unpubl. data)

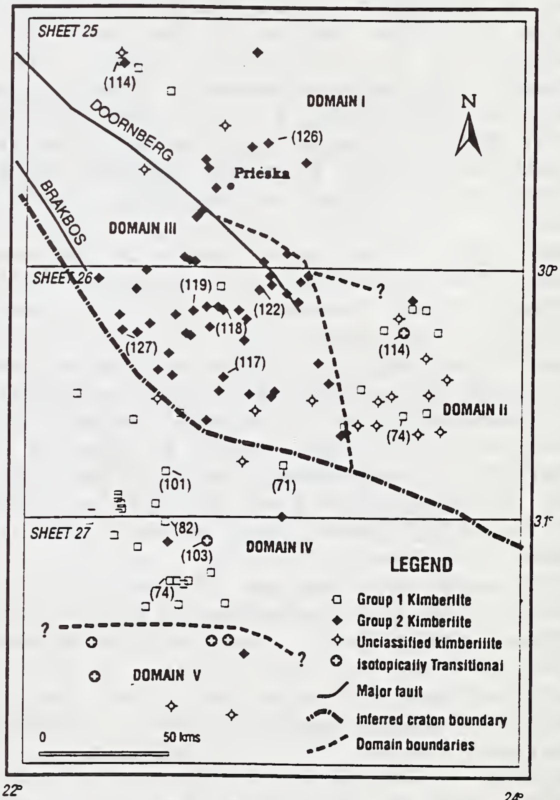

Fig 1. Distribution of kimberlites in the vicinity of Prieska - south western marginal zone of the Kaapvaal Craton

Although the ages and age distribution patterns might appear to be complex and may represent random events, some order can be applied to this data by relating ages to petrographic type, location within specific domains and relative position of these bodies within the overall distribution patterns of all Jurassic/Cretaceous kimberlites in South Africa. In terms of the latter, Group 2 kimberlites in this region could be expected to be around 115 Ma, assuming generation from a simple hotspot system active below a NE moving plate. On a similar basis the expected age of Group 1 kimberlites in this area would be around 75 Ma.

Most of the Group 2 kimberlites (7/10) range between 114 and 127 Ma, whereas most of the Group 1 bodies (4/7) range between 73 and 82 Ma. In both Groups, average ages (120 and 75 Ma respectively) are close to the expected hotspot age. Group 2 kimberlites with anomalous older ages are all transitional types and all occur within Domain V. Of the anomalous older Group 1 kimberlites, 2 bodies (both in Domain IV) are around 102 Ma and one (in Domain I) has a model age of 114 Ma. The latter is similar to the lower age of the Group 2 kimberlites and is in fact located in close proximity to Group 2 bodies. The two 102 Ma old Group 1 kimberlites have intermediate ages (between the common Group 1 and Group 2 ages) and can easily be explained in terms of simple hot spot generative mechanisms.

4) Conclusion

The kimberlites in this comparatively restricted region exhibit variations in petrographic character, tectonic setting, emplacement age as well as isotopic and geochemical signatures. Study of this unique geological setting has led to a better understanding of kimberlite genesis and upper mantle processes.

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