DISTRIBUTION AND TECTONICS OF KIMBERLITES; A CRATON / OFF CRATON STUDY FROM SOUTH AFRICA

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Introduction.

Tectonics of kimberlites is studied on an subcontinent scale in order to understand the distribution and the mechanism of emplacement. The studied area is 400 by 200 km and streches from Sutherland to Britstown (Fig.1). All the kimberlites are post Karoo, cretaceous in age (Smith et al., in press). The underlying basement is divided into three distinct zones: the Kaapvaal craton (Lower Proterozoic), the Namaqua Mobile Belt (Middle Proterozoic), and, sandwiched in between is a group of rock of various compositions and ages (Archean and Proterozoic), bounded by faults which contrasting magnetic signature can be followed below the Karoo series (Fig. 1, inset).

Many occurences were mined without success by local diggers after the turn of the century but their systematic study was done by Robey (1981) who revisited and resampled most of the locations previously recorded or described. Clark et al. (1991) summarized isotopic results on many of these kimberlites. Skinner et al (1994) gave a detailed account of the geological setting, petrography, geochemistry and isotopes chemistry. Because they have no diamond or uneconomical diamond potential they did not received all the attention needed for exhaustive mapping. This paper focuses on extensive and precise mapping of the different occurences and their associated tectonics.

Tectonic pattern.

All the fractures of supposed kimberlitic origin were first mapped from air photograph and reported on 1/50 000 cadastral map. The majority of them were then checked on the field. They often form zones of near vertical parallel dykes and associated jointing, some 20 to 50 m apart, that can be followed for kilometers. Such a pattern is very distinct from the Karoo dolerite tectonic print and was already described by Nixon and Kresten (1973) for the Lesotho kimberlites. These fractures, 0.5 to 2 m wide, often show strong uplifting of the surrounding karoo bed (sometimes vertical). They reveal stringers of very decomposed kimberlite, micaceous calcrete or just few indicator mineral at surface. The jointing accompanying these fractures do not contain igneous material except for few mica seen in some of the fine concentrates. Blows along fractures are quite common. They are few metres wide and often reveal large amount of crustal or mantle xenoliths and megacrysts. Pipes are less common and usely not vey large (10 to 100 m). They can form positive (relatively fresh hypabyssal kimberlite) or negative (calcrete depression) topographic features. Many of these pipes and blows have been dug in the past. The final map of fig.1 shows three major kimberlite provinces: Sutherland, Victoria West and Britstown.

Sutherland is known for the Salpeterkop carbonatitic complex and associated olivine melelitites, patches of kimberlites and ultrabasic rocks but the extension of the kimberlitic province has not been assessed so far. The map of fig.1 shows at least two arcuate mega-swarms averaging 200 km long and 50 km wide and consisting of numerous sub-units of closely spaced parallel fractures.

The Victoria West province consists of three swarms: 1) an arcuate NNE swarm, 2) widely spaced isolated NS single fractures with many pipes and blows, 3) a NW swarm following a former doleritic fracture system.

The Britstown province shows an arcuate swarm on the East and a different, more diffused, tectonic style over the wedge of the craton margin.

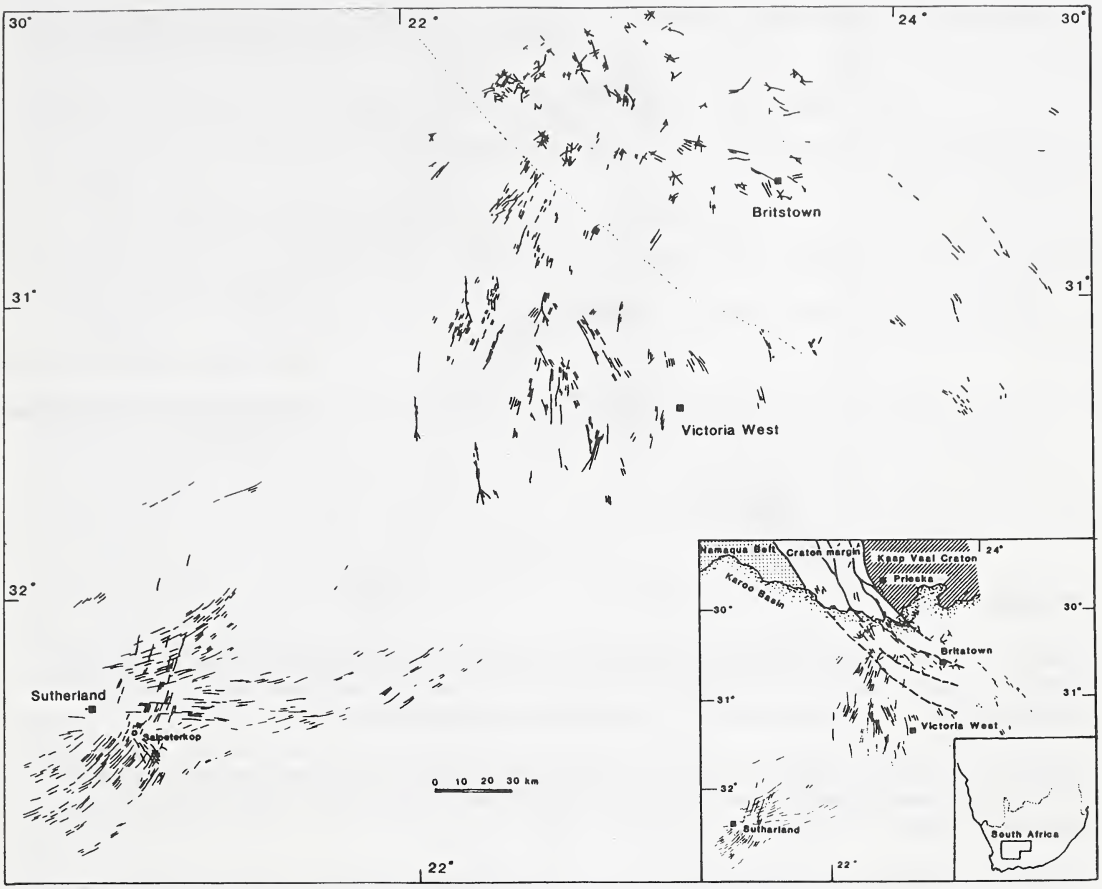

Fig.1 Cretaceous kimberlite-related tectonics in the Karoo region.

Discussion

Looking at a wider portion of the continental crust (fig.2) and using similar results obtained by Greeff (1968) on the Kimberley area, we can see that arcuate swarms is the major tectonic style. It can not be explained in term of any conventional, known, plate tectonic processes. It is believed that each swarm represents a volcanic unit, comparable to a central volcano. However, they were not generated from a central magma body but from the mantle. Their shape, therefore, could reflect whirling movement inside the convective upper mantle.

Emplacement ages (Allsopp et al., 1986; Fitsch and Miller, 1983; Smith,1985; Smith, in press) are consistent within each swarm, taking into account that the life duration of a volcanic system often average 10 millions years. Our interpretation is also consistent with Skinner et al's (1994) geochemical domains within the craton margin area.

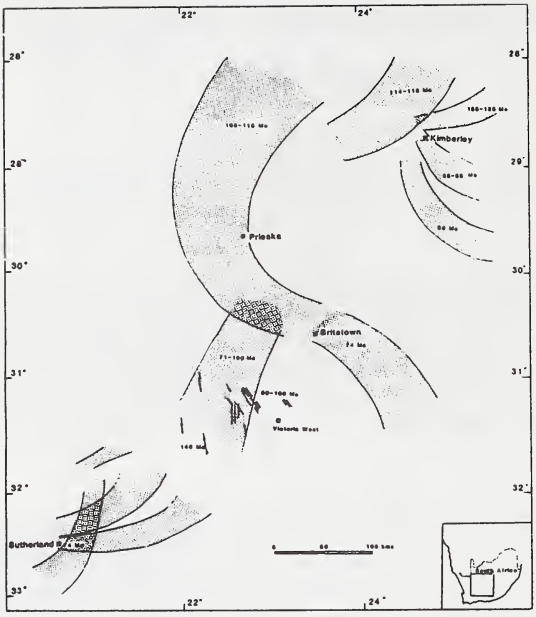

Fig.2 Mega swarm tectonic style for kimberlites from Sutherland to Kimberley.

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