RB-SR DATING OF ALKALINE AND MAFIC INTRUSIVES FROM THE PRETORIA SALTPAN IMPACT CRATER AND ENVIRONS. D. Brandt[1], W.U. Reimold[1] & C.B. Smith[2]. [1]Econ. Geol. Res. Unit, Dept. of Geology; [2]Isotope Res. Unit, Bernard Price Institute of Geophys. Res.; Univ. of the Witwatersrand, P.O. WITS, 2050, Johannesburg, R.S.A.

INTRODUCTION: The Pretoria Saltpan crater is a simple, bowl-shaped crater located in the southern portion of the Bushveld Complex, some 40 km NNW of Pretoria, at 25°24'30" S and 28°04'59" E in the Transvaal Province of South Africa. The crater position is approximately 20 kilometers to the west of the margin of the Pienaars River Alkaline Complex (Fig.1). The near-circular structure has a 1.13 km rim-to-rim diameter and exhibits a well-preserved, uptilted granite rim, which is largely overlain by granitic breccia. The breccia overlies Karoo sediment in places, indicating a **post-Karoo age** for the cratering event.
Lamprophyre and alkaline volcanic rocks have been mapped in the crater rim [1]. The origin of the Pretoria Saltpan crater has been a matter of controversy for the last century. Two models have been proposed, namely, a cryptovolcanic or meteorite impact origin. The coincidence of the occurrence of the crater with that of mafic and alkaline intrusives has been the main argument against the impact hypothesis and is still forwarded by proponents of an internal origin of the Pretoria Saltpan crater - despite the findings of impact-diagnostic shock metamorphic effects, in Saltpan breccias [2]. Here we report geochronological data for volcanics from the crater rim and crater environs that prove unequivocally that the volcanics in the crater rim are part of a 1.2-1.3 Ga regional event.

PREVIOUS WORK: The geology of the crater environs and the possibility of occurrences of mafic and alkaline rocks in both the wider region and within the crater have been disregarded in previous work. In contrast, our group carried out detailed mapping of the crater rim and its environs, together with comparative petrographic, chemical, and chronological studies on samples from the crater and its environs in order to test the possibility of an association of the basic and alkaline intrusives with the cratering event. Chronological data obtained in the past for samples from the Pienaars River Alkaline Complex, which forms an integral part of the study region, are summarized in Table 1, together with the ages previously determined for various intrusives from the crater rim. From these results it is evident that all intrusives from the crater and the Pienaars River Alkaline Complex were intruded around the same period and may all be part of the same igneous event at about 1.3 Ga ago. The exception to this age are the fission track data for a crater carbonatite [3]. Two different studies yielded reliable and comparable ages for the Saltpan cratering event: 1) ^{14}C age determinations on algal debris from the upper 20 metres of the core sediments [4] indicated a mean sedimentation rate of about 1 metre/2000 years. This accumulation rate indicates an age of approximately 200 ka for the lowermost crater-fill sediments. 2) A very similar age of 220 ± 52 ka was obtained [5] by fission track dating of glass fragments recovered from a drill-core through the crater interior. These relatively young ages for the cratering event are in excellent agreement with the well-preserved state of the crater. Clearly the crater age is quite different from that of the alkaline and ultramafic intrusives in the general region.

THIS STUDY: Rb-Sr dating was carried out on a phonolite sample from the crater rim, a lamprophyre sample from the crater environs (Sample 21-E), and a peralkaline syenite from the previously undated Roodeplaat Complex (Fig.1). Mineralogical and chemical comparisons of alkaline volcanics and lamprophyre samples from the crater rim and crater environs showed that all these occurrences are very similar [6]. The isotopic data are presented in Fig.2 and Fig.3. All three rock types were altered to some extent. This is related to the scatter of points at the lower end of the data spread (Fig. 3), which indicates some degree of open system behaviour, particularly in plagioclase, the whole-rocks and at least one of the hornblendes. One biotite sample (Bio-3: Fig.2) was visibly altered and was excluded from all regressions. The best age estimate is considered to be 1342 ± 11 Ma for the unaltered biotites, the hornblende (Hld-4), and the clinopyroxene (cpx-9). The initial ratio of 0.7026 is controlled by the clinopyroxene and the hornblende, and is similar to values for megacrysts in the 1180 Ma Premier kimberlite [7]. These rocks are of direct mantle derivation, apparently from a lithospheric source similar to that of the Pretoria area kimberlites.

CONCLUSION: Rb-Sr data for these samples indicate an age of 1342 ± 11 Ma for the alkaline rocks of the Saltpan crater and associated rocks of the Roodeplaat Complex. This is consistent with previous estimates, but is considered to be a more precise determination. These results support the argument that the intrusives of the entire region, including the crater area itself, are more or less coeval and have no association with the cratering event at ca. 200 ka ago.

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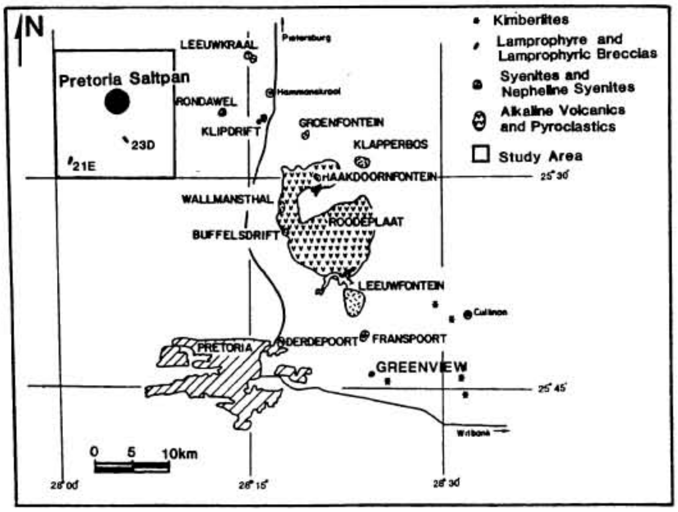
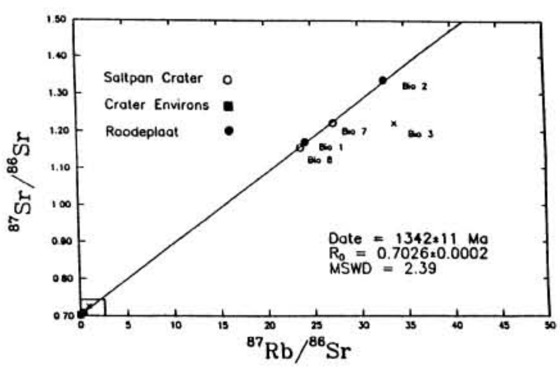


Fig.1 Location of the Pretoria Saltpan and mapped surroundings with respect to identified members (shown as outcrop) of the Pienaars River Alkaline Complex (modified after Harmer, 1985).



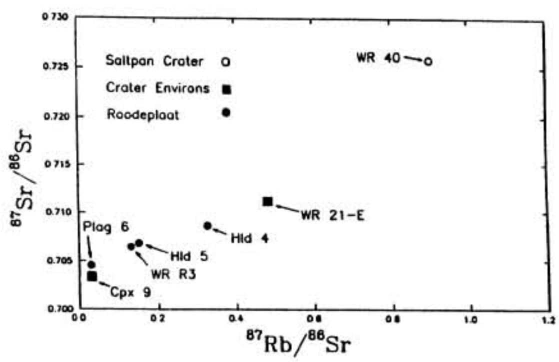


Fig.2 Isochron diagram for studied samples using Cpx 9 and Hld 4 as the lower limit constraints. Crosses indicate samples excluded in these results. This combination gives the best fit isochron age.

Fig.3 Diagram of the "lower end" values, combinations of which were used to calculate isochron ages (cf. text). Scatter is attributed to alteration.

Rock Unit/Sample	Age in Ma	Type of Determination	Source
Pilanesberg Complex	1250±60	K-Ar, biotite	[8]
Leeuwfontein	1420±70	U-Pb, zircon	[9]
Crater Carbonatite	600 ±90,	Fission Track, apatite	[3]
	1900±400	Fission track, zircon	
8 Pienaars River Alkaline Complex Samples	1300±143	Rb-Sr, zircon	[10]
Crater Lamprophyre	1360	K-Ar, biotite	[11]
Crater Lamprophyre	1459±22	Rb-Sr, biotite	[12]

Table 1. Age data on alkaline volcanic rocks from the crater and the Pienaars River Alkaline Complex.