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THE DIABASE DYKES IN THE SONKAJÄRVI—VARPAISJÄRVI AREA, CENTRAL FINLAND

by
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Introduction

Early Proterozoic diabases are abundant in the Sonkajärvi—Varpaisjärvi area, central Finland (Fig. 1.). The distribution of the diabases have been monitored in the course of bedrock mapping (Paavola 1980, 1986 and 1990). The petrography and geochemistry of the dykes have been examined by Toivola (1988), and an attempt has been made to use the Sm-Nd method for dating.

The dykes have intruded into the Archaean (3.1—2.7 Ga old) bedrock. Their predominant strike is NW-SE (cf. Fig. 1.) and their breadth varies from some metres up to ca. 150 metres. The dykes are either primary pyroxene (locally also olivine) bearing rocks or uralitized hornblende diabases. Some of them also contain primary brownish hornblende.

Results

One of the well-preserved rocks (sample 8-JVP-76) was selected for Sm-Nd isotopic work. The data on whole-rock (including a duplicate), plagioclase and orthopyroxene are shown in Table 1 and Fig. 2. These analyses were made in 1986—87 using an old self-made mass-spectrometer (Huhma, 1986), and, mainly due to low concentration of Nd, the quality of the isotopic measurements is not very good. Nevertheless, the data yield an age of 2085 ± 95 Ma with an initial $\epsilon_{Nd} = +2.1 \pm 0.5$. Using our new VG SECTOR 54 mass-spectrometer the minerals will be re-analysed with more precision.

Discussion

Based on fifty chemical analyses from different parts of the area the diabases are compositionally tholeiitic basalts (Figs. 3, 4) with subalkalic character. All the dykes belong to the same differentiation series. Olivine and chromite seem to have fractionated before the dykes intruded. Because of the very constant chemical composition of the diabases they can be considered comagmatic. No remarkable differentiation has been noticed within any individual dyke.

Tectono-magmatic diagrams indicate an oceanic character for the dykes almost without exceptions, although the diabases have most clearly intruded into a continental crust during a tensional process. The dykes are nearly uncontaminated, so the oceanic affinity of their composition may be due to the similarity of the Palaeoproterozoic upper mantle both under the oceanic and continental crust. On the other hand, it is also known that some continental basalts do not plot in the within-plate fields because their geochemical characteristics may have been influenced by e.g. subduction-related processes (Wilson, 1989). The initial ϵ_{Nd}

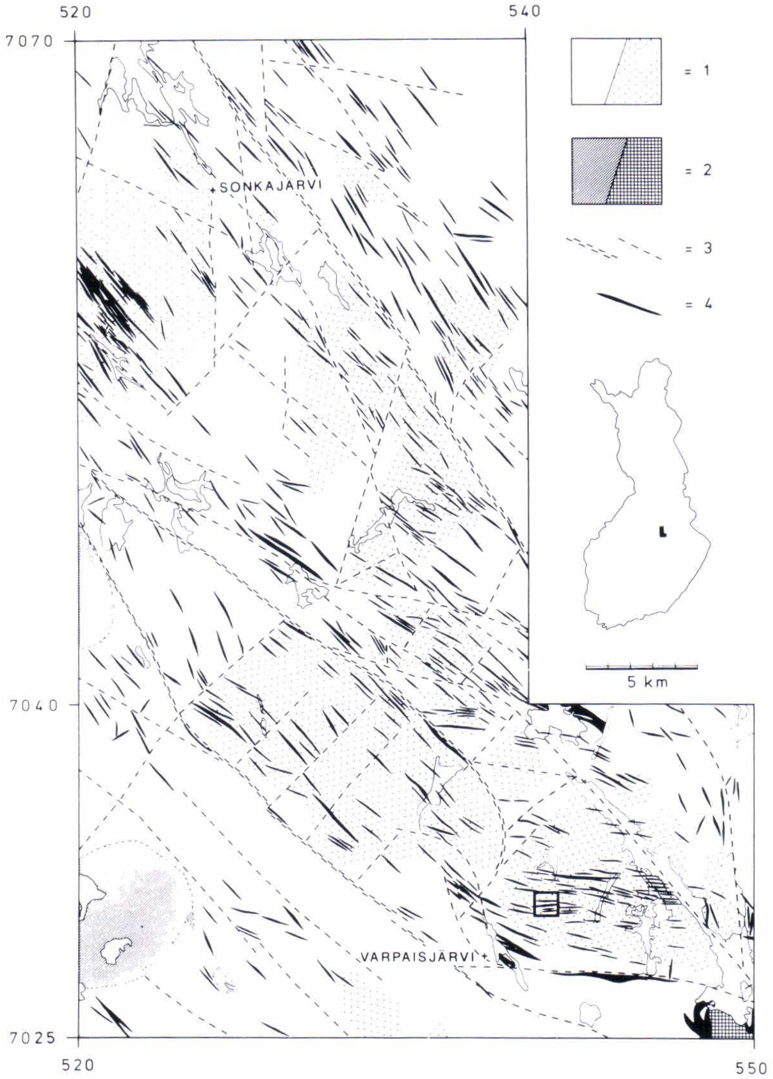

Fig. 1. Sketch map showing the distribution of the diabases in the Sonkajärvi—Varpaisjärvi area. The locality of the dated sample is delineated by the square on the map.
Symbols: 1. Archaean amphibolite-banded tonalitic — trondjhemitic migmatite or granitoid / corresponding hypersthene-bearing rock. 2. Proterozoic intrusive/ metasediment. 3. Fracture or fault. 4. Diabase dyke.

Table 1. Sm-Nd data for Nieminen diabase (8-JVP-76).

Sample	Sm (ppm)	Nd (ppm)	$^{147}Sm/^{144}Nd$*	$^{143}Nd/^{144}Nd$+
orthopyroxene # 1$	1.08	2.73	0.2394	0.513327 ± 105
orthopyroxene # 2	0.84	1.85	0.2730	0.513746 ± 57
orthopyroxene # 3	0.79	1.73	0.2771	0.513799 ± 86
orthopyroxene # 4	0.82	1.85	0.2670	0.513755 ± 38
plagioclase	0.12	0.70	0.1055	0.511443 ± 112
whole rock # 1	2.28	7.33	0.1883	0.512655 ± 31
whole rock # 2	2.22	7.08	0.1896	0.512648 ± 23

*: 0.4% error. The concentrations were determined from liquid aliquots.
+: ratios normalized to $^{146}Nd/^{144}Nd$ = 0.7219. Reported errors are 2 σm.
$: not pure orthopyroxene.

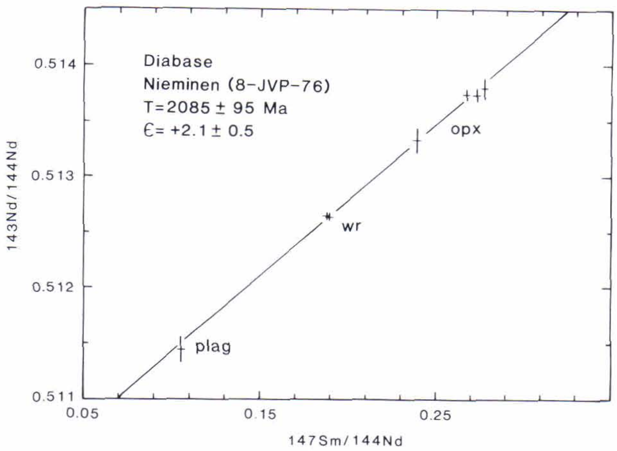

Fig. 2. Sm-Nd diagram for the diabase (sample 8-JVP-76, Nieminen).

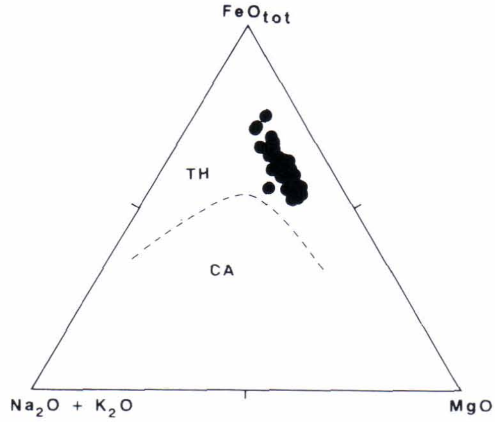

Fig. 3. AFM plot for the diabases of the Sonkajärvi—Varpaisjärvi area. The dashed line separates the tholeiitic and calc-alkaline fields according to Irvine and Baragar (1971).

value of +2.1 implies a long-term depletion in the source, which is characteristic of the convective upper mantle. The source was, however, different from the roughly coeval mantle reservoir with ϵ_{Nd} = +4.2, which fed large volumes of (Jouttiaapa) basalts further north (Huhma et al., 1990).

The diabases of the Sonkajärvi—Varpaisjärvi area have exceptionally well preserved their primary mineral composition and appearance. In most cases this is clearly due to the dry hyperstene bearing granulite host rock, which represents a deep crustal section of the Archaean bedrock.

Comparable dykes associated with the diabases studied frequently appear throughout the Archaean bedrock of eastern Finland. Accordingly, the dykes are an indication of a large-scale tensional process directed to the Archaean crust at that time. Gaál (1986) suggests that the process finally resulted in a continental rifting and NW-trending crustal split when the western part drifted away.

(This paper is a contribution to IGCP Project 257 ''Precambrian Dyke Swarms'')

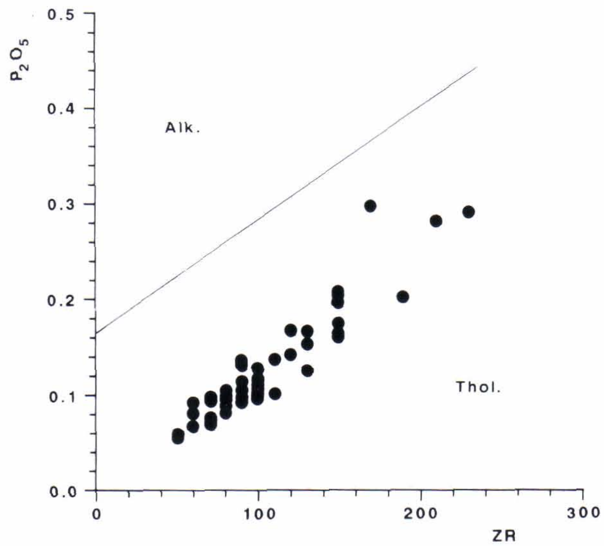

Fig. 4. P_2O_5-Zr diagram showing the composition of the diabases (Winchester & Floyd, 1976).

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