MAGNETIC ORIENTATION OF THE JATULIAN MAGNETISM IN EASTERN FINLAND. A PRELIMINARY NOTE

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The remanent magnetization of subsilicic Jatulian dikes, sills and volcanic beds is described and discussed. The magnetic orientation and pole position are very similar to those measured on Svecokarelian intrusives indicating insignificant plate motion during 2.100 — 1.900 my.

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Introduction

The Jatulian sequence of sedimentary rocks forms the basal cover on the approximately 2 700 m.y. old Precambrian gneissous basement complex in eastern Finland and Karelia. The group typically starts with Sariola (Eskola 1925) conglomerate overlain by a thick series of quartzites. These are followed by dolomites and pelitic schists (the so-called Marine Jatuli, Väyrynen 1928).

The Jatulian rocks are frequently accompanied by dikes, sills and effusive beds of subsilicic composition (Väyrynen 1928, Piirainen 1969, Silvennoinen 1972). Some of then are tholeitic but the majority are spilitic. According to Sakko (1971), zircon and sphene yield a radiometric age of 2 150 m.y. for these magmatic rocks.

The Jatulian sequence is well exposed in eastern Finland where a narrow band rich in quartzites starting from north of Lake Ladoga in the south runs to Lapland in the north. The sedimentary rocks of the group are usually devoid of magnetic minerals, and consequently, the magnetic survey of the sequence has to be made on the intrusive dikes and effusive layers. To find out whether these rocks were suitable for this type of work, samples were collected from four different areas in eastern Finland. A total of 32 locations were sampled and tested for magnetic stability.

Stability

The samples collected were tested for stability using AC demagnetization (Schonstedt GSD-1 demagnetizer) and thermal treatment. They were heated in a one-specimen oven heated by a Bunsen burner so that the temperature as well as

TABLE 1

Directions of remanent magnetization of 2150 m.y. old Jatulian dikes and layers in Eastern Finland

Tohmajärvi area, longitude 62.44° N, latitude 30.32° E.

	Natural remanent magnetization						After AC demagnetization					*Tilt correction*
	N	Decl	Incl	Int	k	α_{59}	Decl	Incl	Int	k	α_{95}	
7306 metadiabase, Hyyppiä	10	–36°	85°	60	167.7	4°	–25°	64°	0.6	2.8	38°	Nearly vertical dikes, no correction applied
7307 » »	9	89°	75°	60	36.4	8°	16°	69°	2.5	21.6	11°	
Average	2	68°	75°		38.1	—	–7°	68°	—	49.4	—	
Herajärvi, Eno, longitude 62.90° N latitude 30.00° E.												No tilt correction applied
7309 diabase, Tiltanvaara .	11	– 6°	69°	1 174	2.98	32°	66°	79°	46	23.8	9°	
7310 diabase, Kauhee	9	69°	69°	135	6.7	21°	4°	53°	3.3	3.8	31°	
7312 diabase, Hutunvaara .	11	4°	42°	25	1225	1°	– 1°	28°	8.4	123.8	4°	
Average	3	15°	54°	—	12.2	37°	7°	55°	—	7.8	47°	

Kuusamo area, longitude 66.12° N, latitude 29.25° E.												Tilt of the bedding	Decl	Incl	k	α_{59}
7348 albite diabase, Kantojärvi	10	113°	50°	290	47.1	7°	119°	52°	15.3	47.6	7°	N40°E, 70°NW	–37°	57°		
7350 albite diabase, Kalliojärvi	14	– 2°	82°	485	19.6	9°	56°	70°	6.8	5.9	19°	N45°E, 52°NW	–19°	39°		
7351 diabase, Kalliovaara..	12	– 9°	52°	110	1260	1°	–14°	39°	46.4	152.5	1°	—	–14°	30°		
7352 greenstone, Iljansuo..	11	23°	81°	52	294.9	3°	10°	62°	0.8	43.3	7°	N60°E, 30°NW	– 8°	35°		
Average	4	40°	76°	—	8.05	34°	33°	68°	—	5.94	41°		–18°	43°	38.8	14.9°
Taivalkoski—Pudasjärvi (magnetite-gabbro) area, longitude 65.75° N, latitude 27.88° E.																
7410 gabbro, Mustavaara .	11	6°	63°	420	177.1	3°	13°	56°	416	113.5	4°	N60°E, 35°NW	– 5°	26°		
7411 » Kylmälä	9	29°	59°	911	3.04	36°	6°	35°	24.5	136.0	4°	N72°W, 35°NE	8°	1°		
7412 » Syöte, Pudasjärvi	11	–25°	13°	6 308	565.0	2°	–11°	23°	124.7	136.1	4°	N68°E, 32°NW	–12°	– 8°		
Average	3	– 4°	48°	—	6.11	55°	1°	38°	—	17.82	30°		– 3°	6°	15.676	32°
Average direction for all Jatulian igneous dikes and beds													– 6°	44°	21.465	33°
Average direction for Jatulian igneous dykes and beds when tilt correction not applied for the Taivalkoski—Pudasjärvi magnetite gabbros													– 4°	51°	28.880	17°

N = number of specimens or samples included, Int = intensity of the remanent magnetization (10^{-5} emu),
k = precision parameter, α_{95} = circle of confidence with a probability of 95 percent.

the remanent and induced magnetization were recorded during the heating (and cooling) period. Most of the samples collected turned out to be either too weakly magnetized or unstable and consequently unsuitable for paleomagnetic work. Only twelve of the 32 samples collected contained a stable component permitting the direction of the remanent magnetization to be measured with a Foster type (Foster 1966) spinner magnetometer utilizing a Förster Oersted-meter as a fluxgate.

Magnetic directions

The magnetic directions obtained are summarized in Table 1.

The directions measured for the Tohmajärvi and Eno area were not corrected for tilt since the dikes are vertical or steeply cutting the sedimentary rocks. No direct indications of tilting of the dikes were observed.

The rocks studied from the Kuusamo area are sills and effusive layers and a tilt correction was essential. The correction applied improved the convergency of the direction so that α_{95} decreased from 41° to 15°. The magnetite gabbro in the Taivalkoski—Pudasjärvi area has a magmatic layering and it is not quite clear whether a tilt correlation should be made or not. Correction did, in this case, divergent the directions measured and α_{95} increased from 17° to 33°.

The average paleomagnetic pole position calculated on the basis of the directions given in Table 1 is

Longitude 60° north and latitude 145° west with $\alpha_{95} = 20°$

if tilt correction is not applied for the Taivalkoski—Pudasjärvi gabbros (if applied, the values would be 58°N and 144°W, $\alpha_{95} = 20°$). This pole site does not differ greatly from that (45°N,122°W) calculated for the 1 900 m.y. old, synorogenic Svecokarelian intrusive rocks (Neuvonen, 1974).

The most reliable part of the present work is that presented by the samples collected from the Kuusamo area. The paleopole based on this area is 47°N and 127°W, which is very close to the 1 900 m.y. pole of the synorogenic intrusive rocks.

Additional samples and more measurements are needed to obtain reliable information concerning the Jatulian paleomagnetic pole position. Even so, the observations made so far indicate that either the plate motion during the time span from 2 150 m.y. to 1 900 m.y. was rather limited in the Fennoscandian region or that the magnetization measured on these Precambrian rocks does not originate from the time of the original crystallization of the igneous magma. If the latter is the case, the similarity observed between the magnetic directions in the different and widely separated areas indicates homogenious uplift of the crust in a very large region including at least the eastern and central parts of Finland and northern Sweden.

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