WHOLE ROCK Pb—Pb ISOCHRON AGE FOR THE PÄÄKKÖ IRON FORMATION IN VÄYRYLÄNKYLÄ, SOUTH PUOLANKA AREA, FINLAND

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SAKKO, MATTI and LAAJOKI, KAUKO 1975: Whole rock Pb-Pb isochron age for the Pääkkö iron formation in Väyrylänkylä, South Puolanka area, Finland. *Bull. Geol. Soc. Finland 47, 113—116.*

This paper is a short comment on the first whole rock Pb—Pb isochron age determination for the Marine Jatulian rocks of the Karelides (Middle Precambrian) in Finland. According to this method the age of the Pääkkö iron formation is 2 080 ± 45 Ma.

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In connection with prospecting for iron carried out in 1973 by the Exploration Department of the Geological Survey of Finland in the South Puolanka area, NE Finland, one of us (K.L.) was asked to study the stratigraphy and genesis of the small Superior-type iron-formation occurrences in Väyrylänkylä. Investigations were started in co-operation with the geochronological laboratory of the Petrological Department to solve the age of these deposits. The results are given in this paper, in which Laajoki is responsible for the geological and Sakko for the geochronological data.

The general geology of the South Puolanka area has recently been described by Laajoki (1973). Detailed studies of the Karelian (Middle Precambrian) iron formations in Väyrylänkylä are being prepared. However, since a brief description of their geology is available in another paper in this bulletin (Laajoki 1975), only a schematic presentation of the stratigraphy of the Pääkkö iron formation (Table 1) is included in this study.

The isotopic composition of total lead was determined in core samples from a variety of rocks in the Pääkkö iron formation and from one schist in the Seppola iron formation (Table 2). The methods applied in extracting, separating and purifying the lead were as follows: The rock specimen was broken into pieces weighing from 20 to 50 grams, which were washed in 6N HCl, rinsed with quartz-distilled water and dried. The pieces were crushed and powdered in an iron pan of a »Schwingmühle»-type mill. Five hundred mg of powder, a few drops of concentrated HNO_3 and 4 ml HF were loaded into a teflon vessel (Krogh 1973) and heated for 48 hours in a teflon-lined steel bomb in an oven at 150°C. The solution was evaporated twice with 1 to 2 ml of concentrated HNO_3 to dryness to destroy the

TABLE 1

The stratigraphy of the Pääkkö iron formation in Väyrylänkylä, South Puolanka area, Finland

Group	Formation	Member	Lithology
Marine Jatulian	Dolomite-Phyllite	Salmijärvi Phyllite	Black schist and phyllite with minor quartzite intercalations
		Pääkkö Iron-Formation (2080 ± 45 Ma) [1]	Quartz-magnetite-banded rock of the oxide facies and quartz-siderite-banded rock of the carbonate facies with phyllitic intercalations.
		Pääkkö Quartzite	Rather impure quartzite with phyllite interbeds.
		Salmijärvi Dolomite	Dolomite
Jatulian (> 2050 Ma) [2]	Quartzite-III		Quartzite with dolomite and phyllite interbeds.
(Tectonic gap)			
PREKARELIDIC BASEMENT GNEISS COMPLEX (2700—2800 Ma) [3]			Granodioritic or granitic orthogneisses and paragneisses.

[1]) This study
[2]) Laajoki 1973, p. 51
[3]) Asa 1971

see footnote on p. 116.

TABLE 2

Description of the samples analysed from the Pääkkö and Seppola iron formations

Sample number and name	Location (drill hole/depth)	Rock-stratigraphic unit
1 a/A558 Siderite-rich mesoband.	R 360/39.60 m	Pääkkö Iron-Formation Member (carbonate facies)
1 b/ » Apatite-rich band.	» / »	» (»)
4 / » Magnetite-amphibole-mesoband.	» /64.40 m	» (oxide facies)
6 / » Quartz-magnetite-banded rock.	» /69.35 m	» (»)
7 / » Pyrite-rich amphibole-carbonate-quartz rock.	» /38.00 m	» (carbonate facies)
A559 Black schist rich in spessartite.	R 337/49.80 m	Seppola iron formation (sulphide facies)
2 /A558 Siderite-amphibole rock.	R 360/51.85 m	Pääkkö Iron-Formation Member (carbonate facies)
8 / » Garnet- and graphite-bearing amphibole-magnetite rock	» /61.30 m	» (oxide facies)

TABLE 3

Analytical Data. Sample numbers refer to TABLE 2

Sample No.	$^{206}Pb/^{204}Pb$	$^{207}Pb/^{204}Pb$	$^{208}Pb/^{204}Pb$
1 a /A558	17.227±0.064	15.545±0.079	35.494±0.200
1 b /A558	16.576±0.018	15.464±0.021	35.219±0.047
4 /A558	17.157±0.025	15.561±0.035	35.513±0.077
6 /A558	18.434±0.050	15.686±0.067	35.560±0.240
7 /A558	19.228±0.019	15.809±0.022	36.017±0.065
A559	19.629±0.074	15.867±0.078	35.787±0.216
2 /A558	24.522±0.055	16.273±0.054	36.298±0.119
8 /A558	26.282±0.029	16.538±0.024	35.759±0.085

fluorides. Four ml 1.2N HBr were added and the sample was again heated at 150°C for 24 hours. The lead was chemically isolated by ion-exchange column. Dovex 1×8, 200/400 mesh resin was washed twice with 1.2N HBr and 1.2N HCl. Lead was eluted with 5 ml 6N HCl and evaporated to dryness.

All isotope analyses were performed by surface ionization on a single focusing 9-inch solid source mass spectrometer with a Faraday cup using a silica gel-phosphoric acid activator on single Re filament. The mass spectrometer was intercalibrated with the CIT shelf lead (Catanzaro 1967) and all data were corrected for bias and mass fractionation.

The Pb-Pb whole rock data (Table 3) are presented on a $^{206}Pb/^{204}Pb$ against $^{207}Pb/^{204}Pb$ plot in Fig. 1. The data define an isochron that corresponds to an age of 2 080±45 Ma (2 σ error) using new decay constants (Jaffey *et al.* 1971). The line was fitted by the method of York (1967). Data for samples 2/A558 and 8/A558 have not been used in calculating the isochron values because they define their own isochron, the slope of which is approximately the same as that in Fig. 1. This subject is being studied further.

The Marine Jatulian rocks (Dolomite-Phyllite Formation) in the South Puolanka area are interpreted to have formed under the conditions of a restricted marginal basin just before the beginning of the flysch sedimentation (Phyllite II) of this part of the area (Laajoki 1973) The reported age (2 080 Ma) of the Pääkkö iron formation thus gives an upper time boundary for the Karelian preflysch sedimentation in the marginal basin of the South Puolanka area. The age obtained is in good agreement with the age determination from the Karelian (Marine Jatulian) dolomite of Kalkkimaa in the Kemi area (2 050 Ma[1)], Wampler & Kulp 1962). Earlier estimates by Kouvo and Kulp (1961) on the basis of the Karelidic galenas and by Wampler and Kulp (1964) on the basis of the Karelian pyrites indicate that the Karelian sediments deposited about 2 100 Ma[1)] ago. The age of the Pääkkö

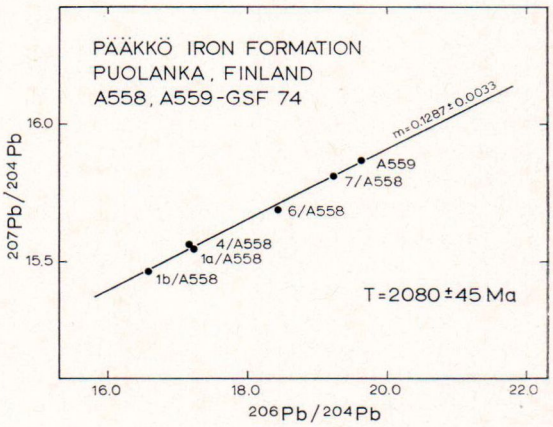

Fig. 1. Pb—Pb whole rock plot of analytical data for the Pääkkö iron formation yielding an age of 2080 ±45 Ma. Sample description is given in TABLE 2 and analytical data in TABLE 3.

iron formation also agrees with the minimum age (2 050 Ma[1]) of the Jatulian quartzites in the South Puolanka area. The latter age was indicated by the age determinations made by Sakko on zircon from the early Karelidic metadiabase intruded into the Jatulian quartzites at Latolanvaara, just 2 km SE of Pääkkö (Laajoki 1973, p. 51). In the Kemi area the corresponding minimum age for the Jatulian quartzites is 2 160 Ma[1] (Sakko 1971). The oldest known U-Pb ages of zircon and sphene from the albite diabases cross-cutting the Jatulian cratogenic quartzites in Finland are 2 250 Ma[1] (Matti Sakko, unpublished results and in Geological Survey of Finland 1973, p. 16).

Two galenas from carbonate-quartz-sulphide veins in the Salmijärvi Dolomite (Table 1) were analysed for their isotopic composition as follows:

	$^{206}Pb/^{204}Pb$	$^{207}Pb/^{204}Pb$	$^{208}Pb/^{204}Pb$
G 267	14.724 ± 0.017	15.196 ± 0.028	34.801 ± 0.066
G 146	14.861 ± 0.012	15.204 ± 0.017	34.753 ± 0.055

The results indicate a common lead age of around 2 200—2 300 Ma.

The iron formations in Väyrylänkylä deposited during the same time interval (2 600—1 800 Ma) as did the majority of the Superior-type iron formations in the world, e.g. those of the Hamersley basin, Krivoy Rog and the Lake Superior region (Goldich 1973).

[1]) If the new decay constants (Jaffey *et al.* 1971) were used, the ages would be approximately 30 Ma lower.

Acknowledgements — The authors are indebted to the following staff members of the Geological Survey of Finland: Dr. Olavi Kouvo for valuable suggestions and help during the study, Mrs. Marita Niemelä and Tuula Hokkanen and Mr. Timo Lahti for skilled technical assistance, Mr. Matti Vaasjoki, M. Sc., for automatic data prosessing programs and Mrs. Anni Vuori for drawing the figure.

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Manuscript received, February 11, 1975.