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Detrital zircon dating of the Palaeoproterozoic Himmerkinlahti Member, Posio, northern Finland; lithostratigraphic implications

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Short Communication

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1. Introduction

The Himmerkinlahti Member is a thin, poorly exposed metaconglomerate – metaquartzite unit in the SE part of the Palaeoproterozoic Kuusamo Belt, Posio, northern Finland (Figs. 1 & 2). It was originally included into the middle part of the Karelian supracrustal rocks of the belt (Laajoki, 2000), but later on its lithostratigraphic position was considered problematic (Laajoki & Wanke, 2002; Laajoki, 2005). In order to have more light to this question, zircons from a granule-pebbly metaquartzite sample (4/190KL91) with abundant opaques and a sericite-rich (pseudo)matrix (see Fig. 7e in Laajoki, 2000) were separated for U-Pb dating at the Geological Survey of Norway. Dr. Ansgar Wanke picked and mounted them at the University of Oulu.

The ion microprobe analyses were performed using the Nordic Cameca IMS 1270 at the Swedish Museum of Natural History, Stockholm. The spot diameter for the 4nA primary O2- ion beam was ca. 25 µm and oxygen flooding in the sample chamber was used to increase the production of Pb+ ions. Four counting blocks comprising a total of twelve cycles of the Pb, Th and U species were measured in each spot. The mass resolution (M/DM) was ca. 5000. The raw data was calibrated relative to Geostandards zircon 91500 reference, which has an age of 1065 Ma (Wiedenbeck et al., 1995) and corrected for background at mass 204.2 and modern common lead (T=0; Stacey & Kramers, 1975). For further details of the analytical procedures see Whitehouse et al. (1997, 1999). The excel-programs by Whitehouse were used for data reduction, and the Isoplot/Ex programs by Ludwig (2001) for line fitting and concordia plots. Decay constants follow the recommendations of Steiger & Jäger (1977).

2. Results

Largely on the basis of size and morphology the zircons from this sample have been set in two rows on the mount. The smaller zircons are euhedral crystals, typically 150 x 50 µm in size. Due to limited instrumental time the SIMS analyses were made only on ten grains, and nine of these from the row, which

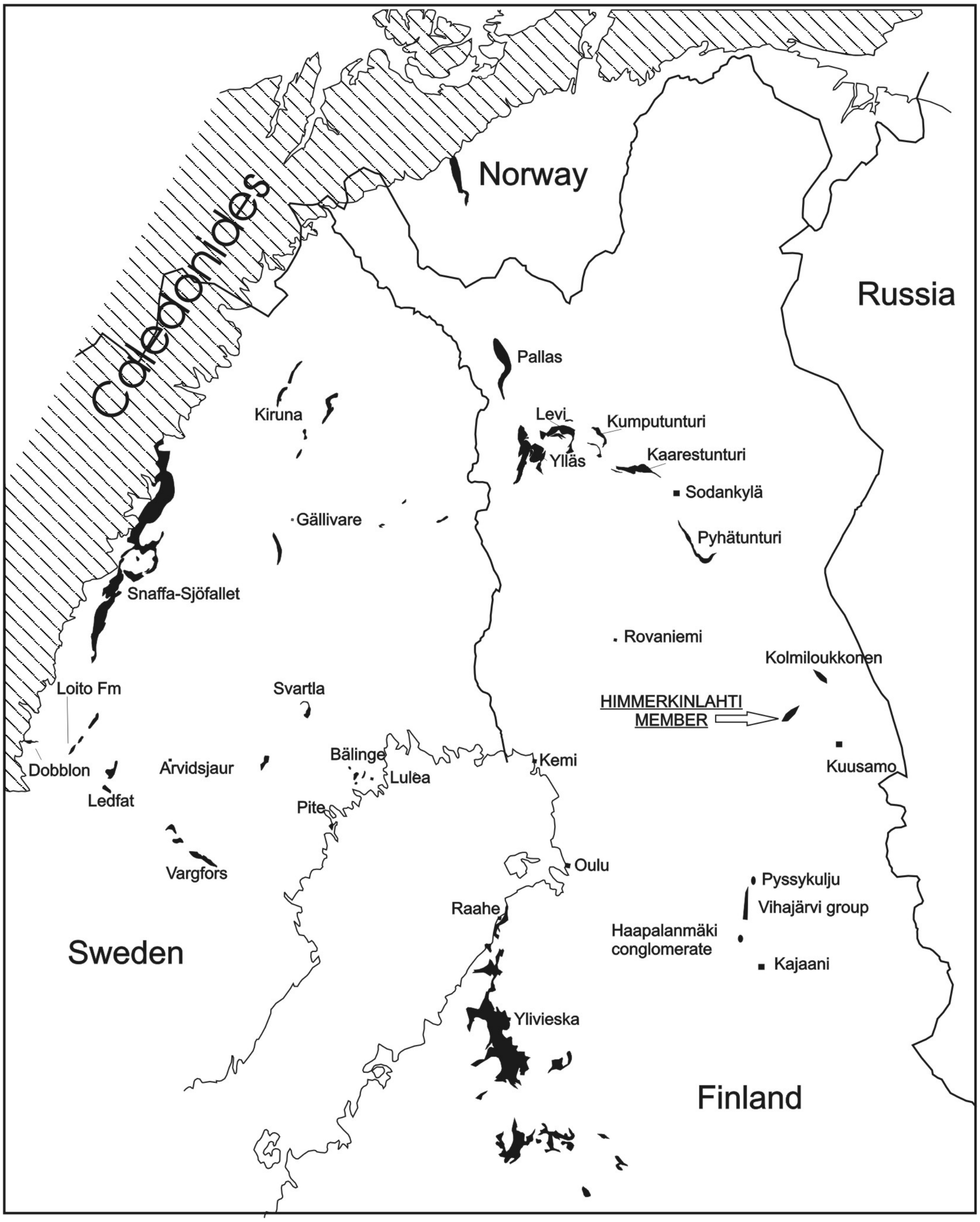

Fig. 1. The Himmerkinlahti, Kolmiloukkonen, Pyssykulju, Vihajärvi, and Haapalanmäki occurrences added on the map of potential sedimentary formations in northern part of the Fennoscandian Shield deposited contemporaneously with the Lainio and Kumpu Groups (modified from Fig. 6 in Hanski et al., 2001). For the geological setting of the Himmerkinlahti Member and the Kolmiloukkonen Formation see Fig. 2.

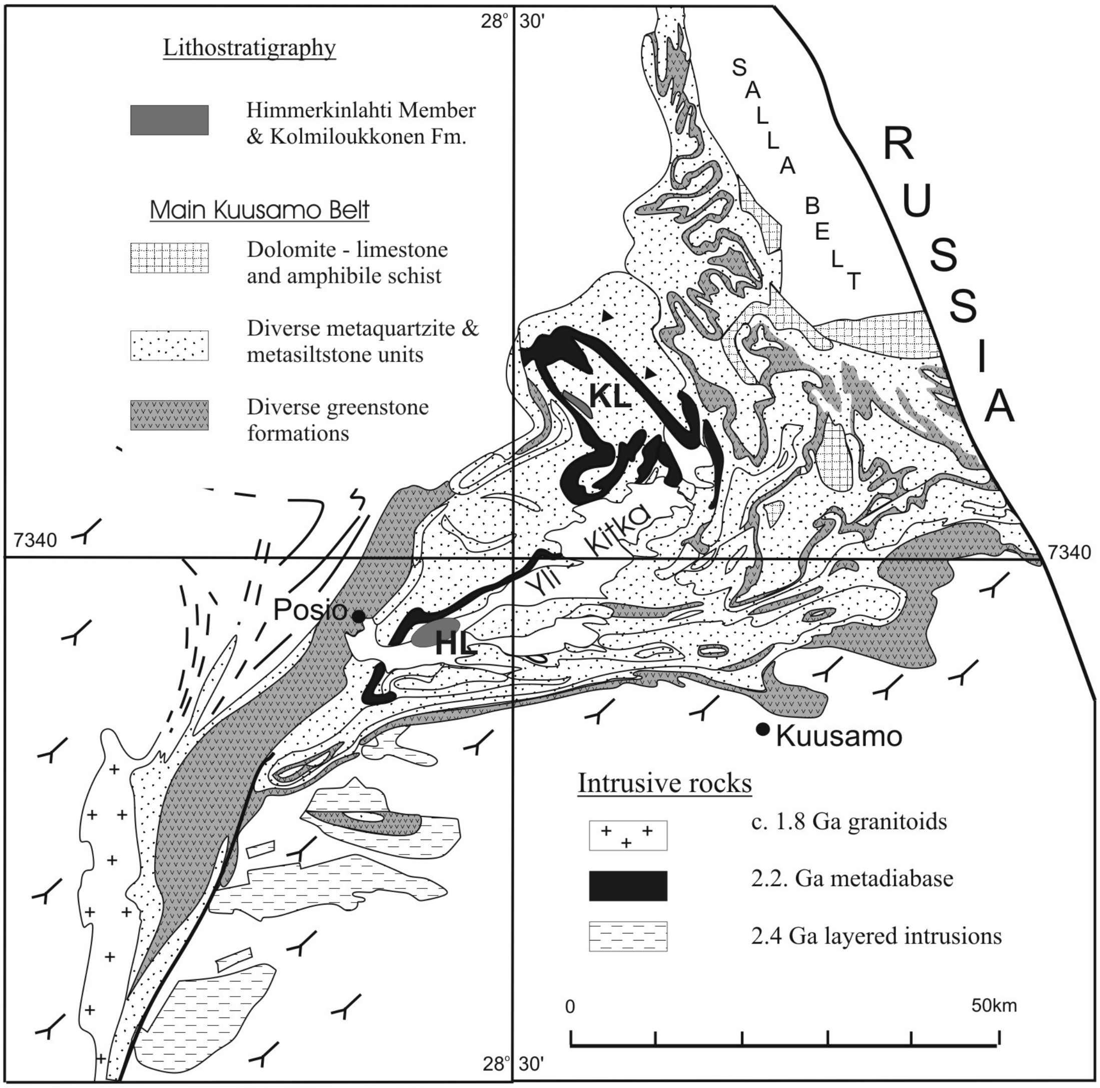

Fig. 2. Simplified geological map of the Kuusamo Belt (Modified from Laajoki, 2005). HL = Himmerkinlahti, KL = Kolmiloukkonen.

consists of smaller euhedral grains. The analytical data are shown in Table 1, and the results are plotted on a concordia diagram in Figure 3. One of the analyses (03b) has relatively high amount of common lead and large error, but the other data are of very good quality. Three grains are Archaean in age, two yield concordant data at ca. 2.22 Ga, one grain (10) is ca. 1.98 Ga and the other four zircons ca. 1.9 Ga. The analysis n1953-08, which gives an age of 2.22 Ga, was made on a large (300 µm) equant crystal, and shows very high content of Th and Th/U ratio of 7.1. Such values have been found typical for some 2.22 Ga zircons in Savo, Peräpohja, and Kuhmo (E. Hanski, H. Huhma & J. Vuollo, pers. comm., 2006)

3. Implications

The data suggest that the Himmerkinlahti Member was deposited after 1.9 Ga implying, that it is significantly younger than the main Kuusamo belt whose deposition has been bracketed between 2.4 Ga and c. 2.1 Ga (Hanski et al., 2001). Because the contacts of

Table 1. SIMS U-Th-Pb data from Himmerkinlahti conglomerate. Sample 4/190KL91 (n1953).

Sample/ spot #	Ages (Ma)						Ratios (corrected for common lead)						r	Disc.%	Elemental data				$^{206}Pb/^{204}Pb$	f_{206}%
	$^{207}Pb/^{206}Pb$	±σ	$^{207}Pb/^{235}U$	±σ	$^{206}Pb/^{238}U$	±σ	$^{207}Pb/^{206}Pb$	±σ %	$^{207}Pb/^{235}U$	±σ %	$^{206}Pb/^{238}U$	±σ %			[U] ppm	[Th] ppm	[Pb] ppm	Th/U calc	meas-ured	
n1953-01	1866	5	1780	8	1707	13	0.114	0.2	4.769	0.9	0.303	0.8	0.94	-7.6	1295	982	521	0.67	115618	0.02
n1953-02	2638	10	2640	10	2643	20	0.178	0.6	12.462	1.1	0.506	0.9	0.82		50	52	37	0.98	32058	{0.06}
n1953-02b	2653	8	2597	10	2525	19	0.180	0.5	11.901	1.0	0.479	0.9	0.87	-3.1	78	120	59	1.31	32682	0.06
n1953-03	1899	8	1919	8	1938	15	0.116	0.4	5.620	0.9	0.350	0.8	0.90		223	15	89	0.06	45330	0.04
n1953-03b	1828	29	1659	37	1529	56	0.111	1.6	4.124	4.3	0.267	4.1	0.92	-8.3	196	180	88	1.60	1263	1.48
n1953-04	2912	5	2896	9	2874	20	0.210	0.2	16.328	0.9	0.561	0.8	0.94		194	118	149	0.57	77011	0.02
n1953-05	2738	4	2755	9	2779	20	0.189	0.2	14.080	0.9	0.538	0.8	0.96		294	169	212	0.54	85986	0.02
n1953-06	1905	8	1906	9	1907	17	0.116	0.4	5.533	1.1	0.344	1.0	0.92		235	136	103	0.56	79429	0.02
n1953-06b	1930	7	1923	9	1917	15	0.118	0.4	5.648	0.9	0.346	0.8	0.90		215	113	94	0.48	21811	0.09
n1953-07	2230	13	2246	11	2263	17	0.140	0.7	8.130	1.1	0.420	0.8	0.74		71	87	43	1.12	79108	{0.02}
n1953-08	2226	5	2224	8	2221	17	0.139	0.2	7.933	0.9	0.411	0.8	0.94		480	3698	625	7.14	37836	0.05
n1953-09	1893	7	1923	8	1951	15	0.115	0.3	5.643	0.9	0.353	0.8	0.91	0.9	276	530	160	1.88	22333	0.08
n1953-10	1980	7	1952	9	1926	16	0.121	0.3	5.835	1.0	0.348	0.9	0.93	-0.6	274	257	131	0.84	21755	0.09

Disc. % refers to age discordance at closest approach of error ellipse to concordia (2sigma-level). Blank indicates that the analysis is concordant within 2-sigma error.
r refers to correlation between Pb/U errors
f206% is the mole fraction of total 206Pb that is due to common Pb. estimated from measured 204Pb

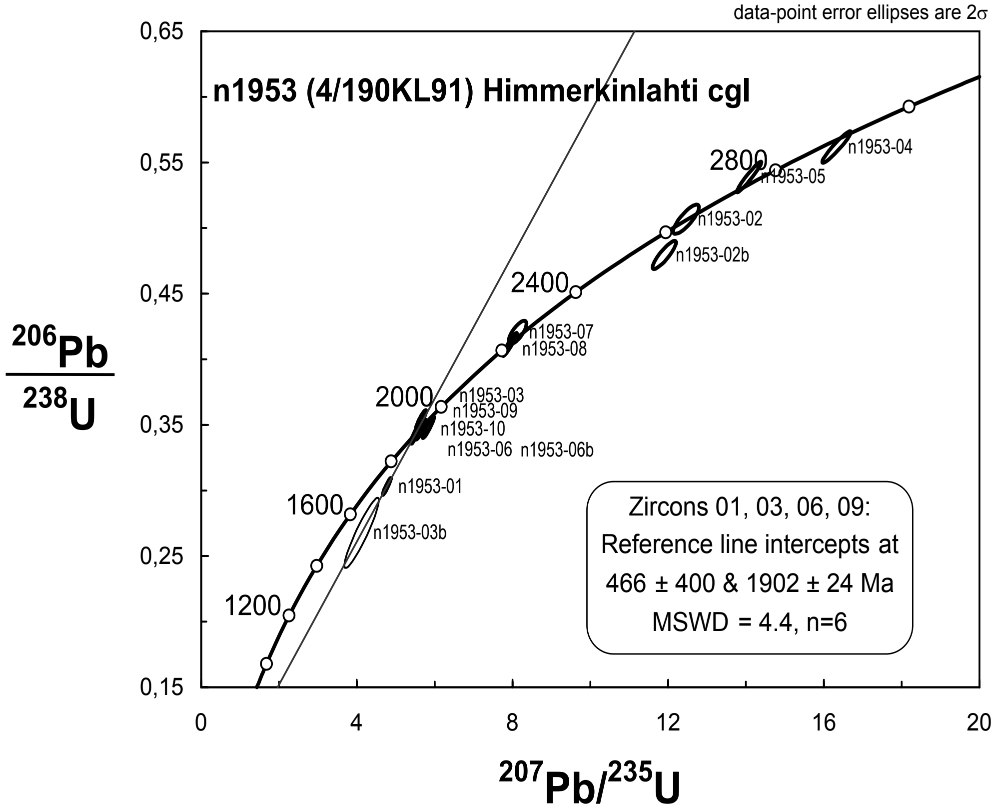

Fig. 3. U-Pb Concordia plot for zircons from the Himmerkinlahti conglomerate.

the member are not exposed and all the outcrops in Himmerkinlahti are small and solitary it cannot be argued whether the underlying schists and metaquartzites and the overlying schists and metabasite (Fig. 4 in Laajoki, 2000) also belong to this younger sequence. The fact that they face to the same direction than the Himmerkinlahti member (Fig. 3 in *op. cit.*) seems to support this possibility. The younger rocks may continue under the lake Yli-Kitka, which covers the core of the Kitka syncline (Fig. 2). The Kolmiloukkunen Formation lying c. 25 km NE of Himmerkinlahti (Fig. 2) may also belong to this younger group, because it overlies the same quartzite as the Himmerkinlahti Member and its conglomerates likewise contain metabasite clasts (Laajoki, 2005, p. 323 & Fig. 7.17h).

The ca. 2.22 Ga zircons may have been derived from the metagabbros and metadiabases of this age intruded into the Kuusamo belt, e.g. the 2209 ± 9 Ma old Jäkäläniemi metadiabase (Silvennoinen, 1991) and the 2216.2 ± 3.8 Ma old Tokkalehto metagabbro (Evins & Laajoki, 2001). This is supported by the presence of abundant metagabbro-metadiabase and plutonic plagioclase clasts in the Himmerkinlahti conglomerates (Laajoki, 2000).

The maximum sedimentation age of the Himmerkinlahti Member implies that the subaerial erosion and associated weathering as expressed by its conglomerates took place after 1.9 Ga. They are most likely related to the post-1.88 Ga molasses-like development in northern Fennoscandia (Fig. 1, cf. Hanski et al. 2000, 2001). Consequently, being relatively young, the Himmerkinlahti Member can no more be included into the main Karelian sequence of the Kuusamo belt (lithostratigraphic legend in Fig. 2).

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