

ISOTOPIC AGE DETERMINATIONS IN BERGSLAGEN, SWEDEN: IV. GRANITES OF THE GRÄNGEN AREA, EAST OF HJULSJÖ¹

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ABSTRACT

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Rb-Sr whole-rock isotope analyses of ten samples of Grängen granite yield a best-fit line corresponding to an age of 1663 ± 51 Ma with an initial $^{87}\text{Sr}/^{86}\text{Sr}$ ratio of 0.70844 ± 0.00578 . Four samples of Tallåsberget granite give a best-fit line corresponding to an age of 1639 ± 185 Ma with an initial $^{87}\text{Sr}/^{86}\text{Sr}$ ratio of 0.70191 ± 0.04241 . Isochron relationships appear disturbed by the low-grade retrograde metamorphism which has affected the granites. Taking account of the limits of error it is suggested that the Grängen and Tallåsberget granites in the Hjulsjö region, Bergslagen, Central Sweden, are coeval with the 1.7-1.6 Ga granites of the Småland and Värmland Groups in S and SW Sweden.

INTRODUCTION

The Grängen granite, exposed near Lake Grängen about 7 km SE of Hjulsjö (Fig. 1), is a medium-grained, often porphyritic biotite granite. The granite body is ellipsoidal in plan and extends with its long axis about 12 km in a ENE direction. The granite is bounded by sharp contacts, cutting discordantly across N-S striking metavolcanic leptite formations and metabasite sheets and dikes of the Supracrustal Series (OEN & VERSCHURE, 1982), and crossing a metamorphic isograde that separates cordierite-free leptites in the W from cordierite-bearing leptites in the E. In the cordierite zone the leptite formations are veined with pegmatites and aplites, while subconcordant sheets and stocks of pegmatite-rich leucogranites are also frequent. A large N-S sheet of pegmatite-rich leucogranite is discordantly cut off by the Grängen granite, which itself is virtually devoid of pegmatite (Fig. 1).

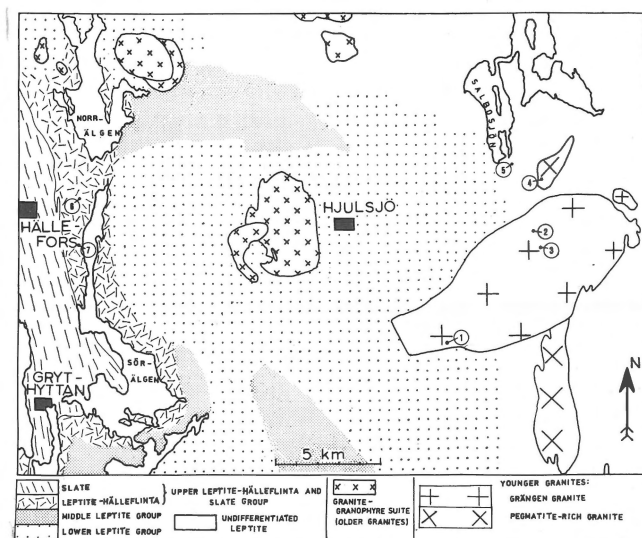


Fig. 1

Geological sketch map of the Hjulsjö area. Encircled numbers indicate sample localities. Grängen granite: (1) 75 BRL 10, 12, 14, 15, 16, 18, 19, (2) 76 BRL 62, 63, and (3) 76 BRL 64; Tallåsberget granite: (4) 78 BRL 311, 312, 313, 314. Localities (5) to (7) refer to metavolcanic leptite formations, which will be subject of a succeeding communication.

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Two generations of granitic rocks can thus be distinguished in the Grängen area: (1) the earlier pegmatite-rich leucogranites, pegmatites and aplites in a zone of high-grade metamorphism, and (2) the later discordant stock of Grängen granite.

The granites of the Grängen area and similar granites in the eastward adjoining Lindesberg-Kopparberg region (e.g., the Fellingsbro and Malingsbo granites with surrounding leucogranites and pegmatites) are referred to as the Fellingsbro Group of late-orogenic, so-called 'serorogenic' granites (MAGNUSSON, 1940; KOARK & LUNDSTRÖM, 1979). The Sveco-karelian 'serorogenic' granites in N Sweden include various granites in the age range 1800-1730 Ma (WILSON, 1980). A similar age is generally assumed for the 'serorogenic' Fellingsbro Group granites of central Sweden, which have not been dated radiometrically. However, results of isotopic age determinations presented in this paper indicate a younger age in the range 1.7-1.6 Ga for the Grängen granite (samples 75 BRL 10, 12, 14, 15, 16, 18, 19, 76 BRL 62, 63, 64) and the neighbouring pegmatite-rich leucogranite at Tallåsberget (samples 78 BRL 311, 312, 313, 314) (Fig. 1).

PETROGRAPHY

The medium-grained Grängen granite consists of about 40 vol.% microcline perthite in coarse grains with inclusions of oligoclase and HT-quartz, 35 vol.% anhedral quartz, 20 vol.% euhedral, zoned oligoclase-albite, and 5 vol.% biotite. Apatite and zircon are accessories, while hornblende is sometimes present. The brown biotite is often altered into chlorite and sphene, especially where the granite shows effects of cataclasis along with veinlets of albite-epidote-muscovite-chlorite-fluorite-quartz. Younger veinlets contain a paragenesis of prehnite-pumpellyite-adularia, which is also found in spots in the granite and older veinlets, mostly as replacement of fresh, non-chloritized brown biotite and plagioclase (H. HELMERS, in prep.).

The fine-grained Tallåsberget leucogranite consists of about equal volumetric proportions of microcline perthite, anhedral quartz, and euhedrally zoned oligoclase-albite.

Table I
Rb-Sr whole-rock data of the Grängen granite

Sample Nr	Rb (ppm Wt)	Sr (ppm Wt)	Rb/Sr (Wt/Wt)	$^{87}\text{Sr}/^{86}\text{Sr}$	$^{87}\text{Rb}/^{86}\text{Sr}$
75 BRL 10	293	42.9	6.824	1.2107	20.74
75 BRL 12	260	47.3	5.504	1.1209	16.59
75 BRL 14	307	29.6	10.37	1.4649	32.27
75 BRL 15	290	37.5	7.726	1.2875	23.65
75 BRL 16	300	34.0	8.850	1.3628	27.29
75 BRL 18	264	8.58	30.74	3.3477	113.35
75 BRL 19	303	27.3	11.14	1.5481	34.94
76 BRL 62	169	136	1.241	0.79564	3.622
76 BRL 63	168	139	1.212	0.79353	3.535
76 BRL 64	105	35	2.988	0.90574	8.814

Table II
Rb-Sr whole-rock data of the Tallåsberg granite

Sample Nr	Rb (ppm Wt)	Sr (ppm Wt)	Rb/Sr (Wt/Wt)	$^{87}\text{Sr}/^{86}\text{Sr}$	$^{87}\text{Rb}/^{86}\text{Sr}$
78 BRL 311	233	45.0	5.179	0.0585	15.50
78 BRL 312	270	35.1	7.685	1.2604	23.44
78 BRL 313	220	61.2	3.587	0.95495	10.63
78 BRL 314	290	28.5	10.07	1.4376	31.23

Graphic intergrowths of microcline and quartz are frequent. The sparse biotite is partly replaced by muscovite and/or prehnite. Apatite and zircon are accessories. Almandine is sometimes present. The granite shows abundant pegmatites.

EXPERIMENTAL PROCEDURES AND CONSTANTS

Procedures and accuracies involved in the X-ray fluorescence determination of Rb and Sr and Rb/Sr ratios in whole-rock samples and the mass-spectrometric measurement of ^{87}Rb , ^{87}Sr and ^{86}Sr have been described in a previous communication (OEN & WIKLANDER, 1982), where calculation methods for the best-fit line through data sets and the Mean Squares Weighted Deviation (MSWD) are also indicated. The ^{87}Rb decay constant used for age calculation is $1.42 \times 10^{-11} \text{ a}^{-1}$.

RESULTS AND DISCUSSION

The Rb-Sr whole-rock data of ten samples of Grängen granite and four of Tallåsberget granite are listed in Tables I and II and plotted in the $^{87}\text{Sr}/^{86}\text{Sr}$ - $^{87}\text{Rb}/^{86}\text{Sr}$ diagram of Fig. 2. Both the Grängen and Tallåsberget data show a linear correlation, but not an isochron relationship (MSWD = 9 and 4, respectively). The best-fit line for the Grängen granite corresponds to an age of $1663 \pm 51 \text{ Ma}$ with an initial $^{87}\text{Sr}/^{86}\text{Sr}$

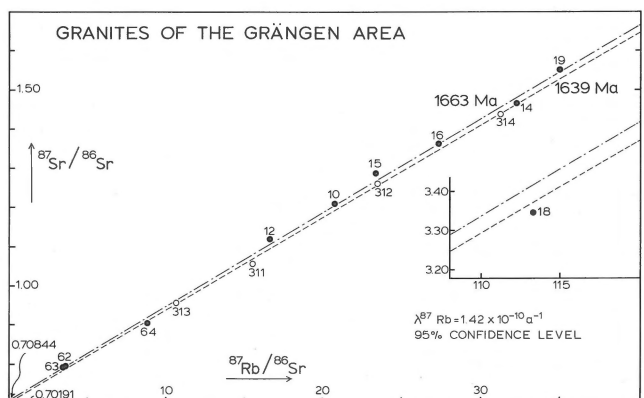


Fig. 2
Plots of Rb-Sr data of Grängen granite and Tallåsberget granite. Closed circles; Rb-Sr data of the Grängen granite, open circles; Rb-Sr data of the Tallåsberget granite.

ratio of 0.70844 ± 0.00587 , that for the Tallåsberget granite to an age of 1639 ± 185 Ma with an initial $^{87}\text{Sr}/^{86}\text{Sr}$ ratio of 0.70191 ± 0.04241 (errors at 95% confidence level as computed from the scatter about the regression line).

The seemingly younger Rb-Sr whole rock age of the Tallåsberget granite as compared to that of the Grängen granite is inconsistent with field observations showing that a Tallåsberget-type granite is cut off by the Grängen granite. Considering the limits of errors it may be concluded that the Tallåsberget and Grängen granites represent successive phases of one period of granitic magmatism and metamorphism 1.7–1.6 Ga ago. These granites are thus coeval with the 1.7–1.6 Ga Svecokarelian 'Younger Granites' of the Småland and Värmland Groups (WELIN ET AL., 1977; OEN & VERSCHURE, 1982; OEN, 1982). Granites of this age in Central and South Sweden are thus not restricted to the Småland-Värmland granite belt. The Grängen and Tallåsberget granites have been grouped with petrographically similar granites in the Lindesberg-Kopparberg region into the Fellingsbro Group. The present results suggest that the Fellingsbro Group may in fact represent a group of 1.7–1.6 Ga granites. Alternatively, the 1.7–1.6 Ga Grängen and Tallåsberget granites may possibly have to be separated from the Fellingsbro Group of granites, for which an age near 1.8 Ga has been assumed previously. More age determinations of Fellingsbro Group granites are needed, and are actually being undertaken, to solve the problem.

The Grängen granite and its wall rocks show a low-grade prehnite-pumpellyite facies retrogradation, which has also affected the Tallåsberget granite (H. HELMERS, in prep.). This retrograde metamorphic event, of which the age is as yet not known, is held responsible for the lack of isochron relationships as displayed by the investigated granite samples (see also OEN, 1982; OEN & WIKLANDER, 1982).

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