

A Note on the Age of the Fyresdal Granite, Telemark, Southern Norway

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Rb–Sr ages (861 ± 50 & 868 ± 50 million years) on biotites of the Fyresdal granitic pluton, Telemark, Southern Norway, indicate the possibility of the region having been affected by the 900–1000 m.y. orogeny or, as it is called, the Dalslandian Orogeny.

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Introduction

The Fyresdal granite lies about 10 kilometers to the south of the village Fyresdal, Telemark, Southern Norway. The granite is emplaced in acid gneisses, schists, amphibolites, and migmatites of Precambrian age of possibly supracrustal origin. A detailed report on the petrological and structural investigations of the area is under preparation.

In the mapped area, the Fyresdal granite is roughly elliptical in outcrop. The granite extends for 15–18 kilometers from east to west and for about 10–13 kilometers from north to south. Bergstadjfjell (936 m) lies in the pluton and marks the highest point in the area.

Field relations

The Fyresdal granite occupies a large part of the mapped area. Contacts of the granite with the country rocks are mostly discordant. This is very clear, particularly in the northern part of the pluton (Fig. 1). However, in some localities, particularly in the southern part, concordant relations are noticed. The country rocks in the area north of the granite dip towards E or NE, while in the south they dip towards W or SW. In both cases they dip at moderate to steep angles. From the contact inwards of the pluton, thin zones of fine grained granite are noticed in some places and the granite shows incipient foliation. These zones could represent chilled margins of the granite to the country rocks.

A large number of inclusions of country rock (amphibolite and quartz diorite) are found in the granite. The inclusions in general do not show any

preferred orientation. A well exposed section of the granite with angular inclusions can be seen on the road section 2 – 3 kilometers south of Momrak (see Fig. 1). Field evidence indicates that the granite is intrusive in character and it seems to have been emplaced in an antiformal structure

Petrography

In hand specimen the granite is medium-grained, equigranular and pinkish to grey in colour; quartz, feldspar and biotite can be recognised. Under the microscope, the rock shows hypidiomorphic granular texture. No preferred orientation of any of the minerals is discernible; on the other hand the rock is massive and homogeneous. The average grain size is 2.5 – 3.0 mm.

Point counting analysis was conducted on 18 thin sections from granite samples. Range of volume percentages of minerals and average modal analysis are recorded in Table 1.

Table 1.

	Range of vol. %	Average mode, vol. %
Quartz	20 – 34	27
Plagioclase	32 – 42	35
Microcline	24 – 39	32
Biotite	2.9 – 6.0	4.5
Sphene	0.1 – 1.4	0.5
Accessories	0.3 – 2.0	1.0
		100.0

Quartz is irregular and anhedral in shape and normally shows undulose extinction. Plagioclase (An_7 – An_{20}) is irregular in the outer parts of the pluton and tends to become subhedral to euhedral with rectangular to equant outline towards the central part. Twinning is on the albite law but occasionally a combination of albite and pericline twinning is seen. Faint normal zoning is seen. In the marginal parts of the granite pluton, pronounced development of albitic rims around the plagioclase is noticed. The albitic rims are restricted to the plagioclase in contact with microcline and were never seen when the plagioclase is in contact with quartz. Plagioclase grains showing myrmekitic intergrowth are more frequent in the marginal parts than in the central part of the granite. Microcline is subhedral and shows the characteristic grid twinning; occasionally carlsbad twins are seen. Biotite is yellowish brown to brown in colour. At places greenish coloured chlorite is seen which is attributed to local alteration of biotite. Accessory minerals are sphene, allanite, epidote, muscovite, fluorite, apatite, and zircon.

Rb – Sr age determination on the Fyresdal granite

Two samples of the Fyresdal granite were used for age determination and the location of these samples are indicated on the geological sketch-map of the area (Fig. 1). Age measurements were carried out on separated biotites. Bio-

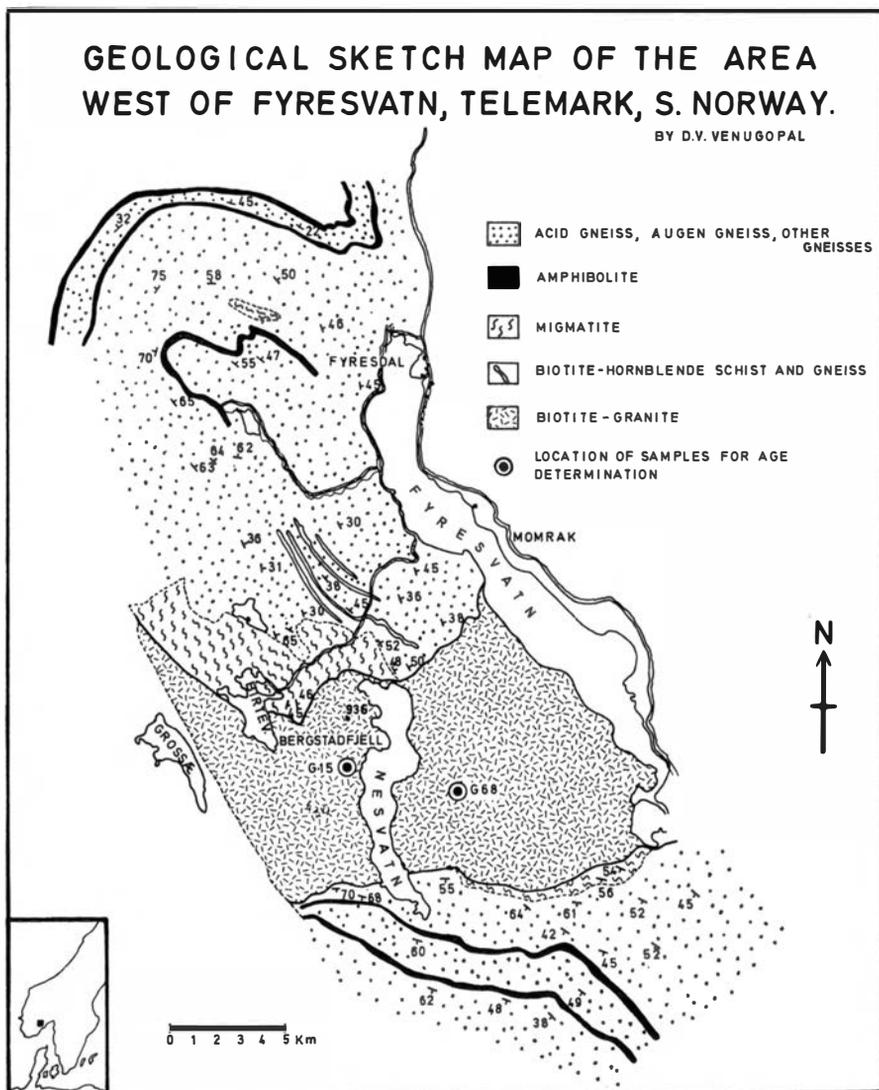


Fig. 1.

tite was separated by using heavy liquids and a magnetic separator. Finally, the crystals were hand picked to ensure absolute purity.

Standard-accepted methods were applied in these age determinations. Rubidium and strontium were determined by isotope dilution using a mass-spectrometer with thermal ionisation and multiplier detection for isotope measurements.

The following are the constants used at the Isotopic Laboratories, Amsterdam for age calculations.

Rb: 85/86—2.5907
 Rb⁸⁷ decay constant used in age calculation is $1.47 \times 10^{-11} \text{ yr}^{-1}$
 Sr : 88/86—8.3751
 87/86—0.710

Analytical data and age results

Sample No.	Analysed mineral	Rb ⁸⁷ ppm	Sr ⁸⁷ rad. ppm	Sr (initial) common	Age in m. yrs
G 68/Fyr/66	Biotite	(a) 1146.44	4.121	33.950	870±50
		(b) 1152.47	4.061	33.791	853±50
G 15/Fyr/66	Biotite	(a) 1473.83	5.255	6.731	863±50
		(b) 1472.20	5.320	6.694	875±50

where (a) and (b) represent duplicate runs for each sample. Mass-spectrometric determinations and the calculations of the results were done by Dr. N. A. I. M. Boelrijk, Isotopic Laboratories, Amsterdam.

Discussion

Since the granite has practically not undergone any deformation and is intrusive in character (except in the border zone where it is foliated to a slight extent), biotite ages could represent the ages of whole rock. Therefore, it may well be taken that the Fyresdal granite was emplaced at ca. 860 ± 50 m.yrs (average). Broch (1964) has summarised all age determinations of Norwegian minerals and rocks until 1964, and in his report he has discussed the possibilities of major orogenies at ~ 900 , ~ 400 , and possibly at ~ 575 million years. Magnusson (1965) is also of the opinion that a regional alteration and metamorphism, referred to as Sveconorwegian Orogeny, is dated at 950 to 1000 million years and took place at the end of Gothian – Dalslandian time.

The area under study has been subjected to deformations of complex nature (at least three fold phases were recognised) and underwent regional metamorphism under upper amphibolite facies conditions. The granitic pluton was emplaced at the waning stages of deformation and metamorphism. In view of these observations, the writer suggests the possibility of this region having taken part in the 900 – 1000 million year orogeny or in other words in the Dalslandian Orogeny.

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