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Rb-Sr Isotopic Measurements on Granite-Gneisses from the Granatspitzkern, Hohe Tauern, Austria

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Mit 2 Abbildungen

Österreichische Karte
1 : 50.000
Blätter 152, 153

Schlüsselwörter
Radiometrische Altersbestimmung
Hohe Tauern
Granatspitzkern

In recent years two new sections through the Zentralgneis of the Granatspitzkern have been exposed, during construction of the Felbertauern road tunnel and the nearby oil-pipeline tunnel. FRISCH (1970) has described the geology of the southern part of the road tunnel.

The analyses reported here were carried out on samples from the oil-pipeline tunnel but the lithologies are closely similar to those described by FRISCH (op cit.). The samples were collected and made available by the Geologische Bundesanstalt, Wien; they come from widely spaced intervals along the tunnel and comprise leucocratic granite-gneisses whose texture varies from strongly foliated to almost unfoliated. The essential minerals are quartz, plagioclase and K-feldspar with minor biotite and variable amounts of white mica. Sample localities are indicated on F i g. O n e.

Rb-Sr isotopic analyses of nine whole-rock samples are reported in the Table and are also plotted in F i g. T w o. The data show considerable scatter with McIntyre Model 3 regression (BROOKS et al., 1972) giving 265 m. y with a large error of ± 39 m.y. (2σ) if the data are treated as a single population. A possible explanation for this scatter is open-system behaviour during Alpine metamorphism. If this is the explanation for the scatter, a positive correlation between scatter on the isochron diagram and degree of metamorphism might be expected. Examination of the intensity of foliation and the amount of apparently-secondary white mica (mainly as "envelopes" around large K-feldspars) reveals no such positive correlation.

An alternative approach is to consider the possibility that the samples came from more than one granite. Because of the nature of the sampling procedure no details of the geological relation of one sample to another are known. However

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there does seem to be a relation between the Rb-Sr isotopic behaviour and geographic location along the tunnel. Thus FT5, the most strikingly discordant point is an isolated sample less than 2 km from the north portal. Samples FT4, FT3 and FT9 were all collected between 2.0 and 2.8 km from the south portal and they are possibly also distinguished petrographically from the main group in having generally weaker foliation, less white mica, frequently perthitic K-feldspar and large, inclusions-packed ("gefüllte") plagioclase. If these three samples are considered in isolation they yield a McIntyre Model 1 isochron of 219 ± 25 m.y. within experimental error. The initial ratio is 0.7188 ± 25.

The remaining samples (FT1, 2, 6, 7, 8) from between 2 km N and 3 km S also seem to be a fairly homogeneous group, having more white mica and with plagioclase mainly in the form of a fine grained mosaic. Treating these five samples together also yields an isochron within experimental error, with a McIntyre Model 1 age of 314 ± 32 m.y. This regression yields a "reasonable" granitic initial ratio of 0.7058 ± 50.

Geologically this alternative interpretation of the data, based on the geographical grouping of the samples, would suggest that samples FT1, 2, 6, 7, and 8 were formed 314 m.y. ago and subsequently deformed and metamorphosed without disturbance of the whole-rock Rb-Sr system. Samples 3, 4 and 9 appear to be younger and in view of their high initial ratio they could be the result of remobilisation of rocks similar to the first group. These samples have been less deformed, than the first group, either because the remobilisation postdates the last major deformation or because of their different structural position. From the evidence available it is not possible to conclude definitely that the 219 m.y. isochron age dates the time of the postulated remobilisation. The measured Upper Permian to Triassic age could reflect some very late Hercynian event and, indeed, similar ages have been found elsewhere in the Alps (CLIFF, 1971; HANSON et al., 1966).

However as recent work has emphasised (FARHAT, 1975) remobilisation of granitic material may fail to rehomogenise the strontium isotope composition and yet yield statistically acceptable isochrons. It is possible that the disturbance of the whole rock Rb/Sr systems in samples FT3, 4 and 9 took place during Alpine metamorphism.

It is not possible to draw any conclusion about the age of FT5 because of its isolated position in the tunnel. Isotopically it does not apear to be closely related to the other eight samples even though it is petrographically quite similar.

Conclusions: 1. The data confirm that in the Granatspitzkern, as elsewhere, the Zentralgneis is Variscan in age; the 314 m.y. age obtained from five of the analysed samples is considered the best estimate of the age of emplacement of the original granites.

2. Two alternative explanations for the scatter of the data are discussed. It seems likely that some of the samples underwent a remobilisation, either in late Variscan or in Alpine time.

A c k n o w l e d g e m e n t s : I am grateful to the director of the Geologische Bundesanstalt, Wien, for making the samples available and to A. R. GLEDHILL who made most of the isotopic measurements.

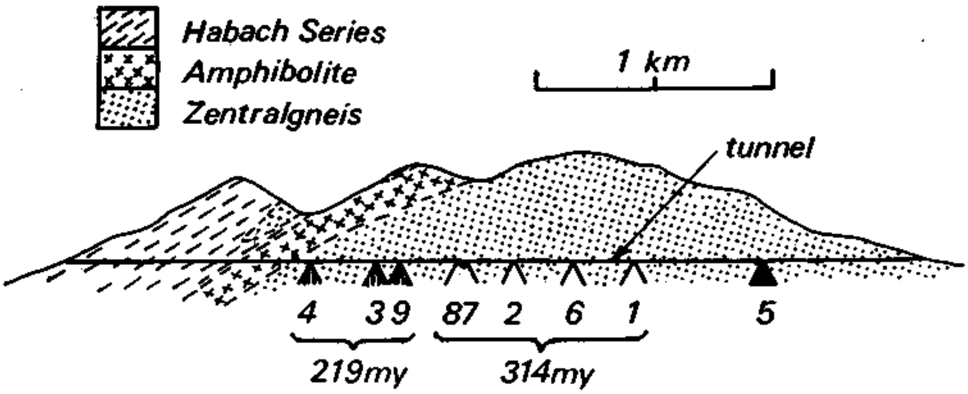

Fig. 1. Sketch section along the line of the TAL Pipeline tunnel (south to the left) showing the locations of the analysed samples. Approximate surface from FRASL and FRANK (1966). The different triangular symbols indicate the sample groupings discussed in the text.

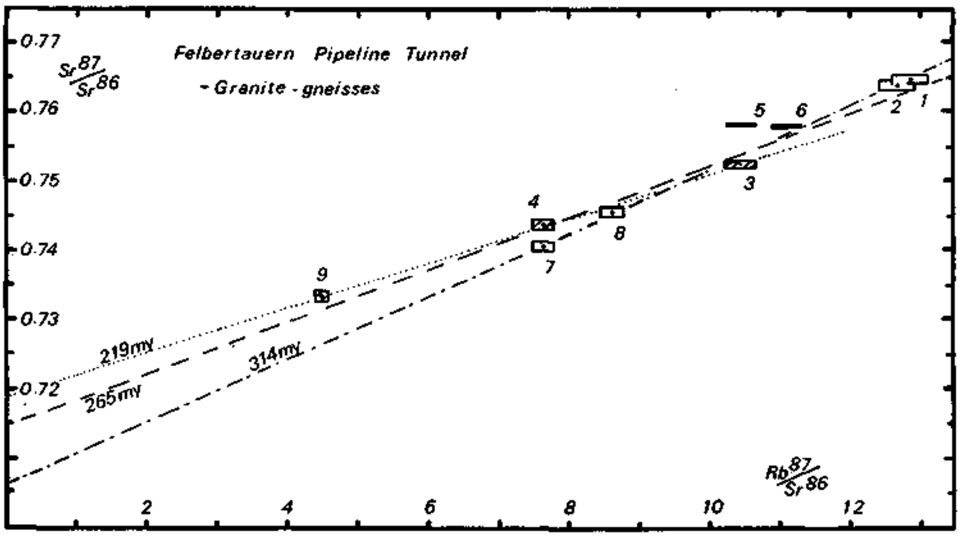

Fig. 2. Isochron diagram for the analysed samples. The dashed line is the best fit to all the data; dotted line — best fit to southern group of samples; dash-dot line — best fit to central group. Ages calculated using $\lambda = 1.47 \times 10^{-11} yr^{-1}$.

Tab. 1. Felber Tauern oil pipeline tunnel: Rb-Sr data.

Sample No. & Location *)		Rb [1]) ppm	Sr [1]) ppm	Rb^{87}/Sr^{86}	Sr^{87}/Sr^{86} **)	
FT1 2450 N		271	61	12.88	0.7646	
FT2 3440 N	(i)	281	64	12.71	0.7642	0.7637
	(ii) [2])	279	64	12.70	0.7632	
FT6 2980 N		265	69	11.14	0.7579	
FT5 1370 N		251	70	10.47	0.7581	
FT3 2610 S		253	70	10.47	0.7524	
FT8 3290 S		247	83	8.63	0.7456	
FT4 2048 S		229	87	7.64	0.7438	
FT7 3390 S		249	94	7.65	0.7405	
FT9 2795 S	(i)	218	141	4.50	0.7328	0.7333
	(ii)	216	139	4.51	0.7338	

*) Locations given in meters from north (2450 N) or south portal.

**) Isotopic analyses made with a modified AEI MS5 mass spectrometer with digitised output. Precision on Sr-isotopic compositions is better than 0.1%.

[1]) Analysed using cation exchange separation and isotope dilution.

[2]) Sample analysed by the author at the Laboratorium für Geochronologie der Universität Heidelberg.

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