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The Age of the Eisenkappel Granite, Carinthia and the History of the Periadriatic Lineament

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With 1 table

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Schlüsselwörter
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Eisenkappler Granit
Absolute Altersbestimmung
Periadriatisches Lineament

Zusammenfassung

Physikalische Altersbestimmungen an Hornblenden eines Hornblendepegmatits aus dem Randbereich des Eisenkappler Granites (Karawanken, Kärnten) ergaben ein K/Ar-Alter von 244 ± 9 Millionen Jahren. Dies weist darauf hin, daß der Granit herzynischen Alters sein könnte und nicht zu den tertiären periadriatischen Intrusiven zu zählen ist.

Die Position des Granites entlang des Periadriatischen Lineaments und die neuen geochronologischen Daten werden als kennzeichnend für die Bedeutung dieser Struktur in spätpaläozoisch-frühmesozoischer Zeit angesehen.

Abstract

Hornblende from a pegmatite associated with diorite xenoliths in the Eisenkappel Granite has yielded a K/Ar age of 244 ± 9 my, showing that the Granite may well be Hercynian and not a member of the Tertiary Periadriatic Suite.

The marked elongation of the Granite along the Periadriatic Lineament coupled with the new geochronological data gives a further indication of the importance of this structure in late Palaeozoic early Mesozoic times.

Introduction

The Eisenkappel Granite is one of the plutonic bodies within the Karawanken. It is situated between the North and South Karawanken and is elongated along the Periadriatic Lineament. Although the contacts are, in part, tectonic and there may be some deformation along shear zones within the granite, it is generally undeformed and the elongate form is probably original. This suggests intrusion may have been controlled by the Periadriatic Lineament; in this case the age of the Eisenkappel Granite can provide a minimum age for this section of the lineament.

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The fundamental importance of the Periadriatic Lineament is indicated by structural, geophysical and, in the section east of the Judicaria fault, by stratigraphic evidence. There is a marked contrast between the late Palaeozoic history of the Carnic Alps to the south and the Gailtal Alps to the north of the line. In the Gailtal Alps and elsewhere immediately north of the lineament there is a sub-Westphalian unconformity, frequently on crystalline basement and the Carboniferous succession leads into a terrestrial Permian sequence. South of the lineament a Visean unconformity is followed by marine Upper Carboniferous and Permian, including the well known Bellerophon Limestone. Distinct, though gradually decreasing, facies differences persist into the Mesozoic although the Upper Trias Dachsteinkalk and Hauptdolomit are reported to extend across the lineament (VAN BEMMELEN, 1961).

It has been suggested that substantial Permian strike-slip movements occurred along the sector of the Periadriatic Lineament under discussion (DE JONG, 1966).

Geology of the Granite

The Karawanken plutons in the Eisenkappel area include "Tonalite Gneiss" and the younger Eisenkappel Granite. At the present level of erosion the granite within Austria is approximately 18 km long and varies in width from 180 to 400 m. The granite was thrust northward during late Alpine deformation and, at places, overlies Palaeozoic greenschists which in turn rest on Lower Trias Werfen Beds.

EXNER (1972) has given a detailed account of these rocks.

The Eisenkappel Granite is a complex pluton including lithologies ranging from diorite to biotite granite; gabbros also occur as small bodies and "Schollen" within the diorites. Later phases include a porphyritic granodiorite with rapakivi feldspars, aplites and lamprophyres (EXNER, 1972; RICHTER, 1966). Hybrid rocks resulting from reaction between acid differentiates and basic rocks were recorded by GRABER (1929) and were studied in detail by EXNER (op. cit.) at the locality from which our samples were collected.

Although contact relationships of the granite have been considerably modified by Alpine overthrusting, igneous contacts with the Altkristallin to the south are locally preserved. EXNER (1972) has described a typical sequence of contact metamorphic zones in the sector east of the Vellach. Contact metamorphic rocks, probably derived from Palaeozoic greenschists occur as roof pendants near the western end of the granite; HOLZER (1962) mentioned cordierite hornfels, schistose hornfels and hornblenditic rocks. EXNER (1972) found cordierite-bearing Knotenschiefer deriving from greenschists as drift in the Leppen area. In general the northern contact is tectonic with associated mylonites and it is thus difficult to be sure of our hypothesis that the original shape of the granite was controlled by the Periadriatic Lineament. The major differences in lithology on either side of the granite and the fact that contact metamorphic equivalents of both Altkristallin and the Palaeozoic Series are found, even if only sporadically, lend support to this suggestion.

Sampling

Near the northern contact the granite contains fine-grained dioritic xenoliths along whose margins diffuse zones of hornblende pegmatite occur. Our samples were collected from this pegmatitic material in the disused Miklau quarry, on the left bank of the Leppen river, approximately 1.8 km ESE of Eisenkappel. The quarry also contains a wide variety of hybrid rocks which are described in detail by EXNER (1972, pp. 72—77). Originally granite samples were also collected for Rb/Sr whole rock analysis but the Rb/Sr ratios proved to be too low.

The pegmatite consists of hornblende prisms up to 10 cm in length set in a matrix of plagioclase. Thin sections show that the hornblendes have a complex internal texture — the colour is somewhat variable and flakes of biotite and chlorite are orientated at high angles to the prismatic cleavage.

The chlorite appears to be replacing biotite and there is also a very minor amount of a third mineral, probably epidote.

Samples of the complex hornblende were obtained by hand picking from the coarsely crushed sample and the included minerals were removed by further crushing and heavy liquid, plus magnetic separation. The hornblende concentrate was 95% pure. It proved impossible to get a pure biotite concentrate and material containing an estimated 10% chlorite was analysed. Even allowing for this amount of chlorite the measured K_2O concentration is anomalously low and no meaningful interpretation of the K/Ar data is therefore possible.

Results and Discussion

Measurements were made using techniques described by REX & DODSON (1970).

Analytical data for the hornblende and "biotite" are shown in the table. The hornblende has an apparent age of 244 ± 9 m. y.; correction for "biotite" contamination would be well within the quoted uncertainty. The simplest explanation is that this represents the time of crystallisation of the pegmatite and by implication of the granite also. Because the behaviour of amphibole as a K/Ar clock is not well understood the validity of this interpretation is uncertain. The apparent age of the pegmatite hornblende coincides with a well established group of late-Hercynian ages and is thus not unreasonable. While the true age of the granite might be somewhat older it seems unlikely that it could be as young as the Tertiary Periadriatic Intrusions of Adamello etc. (BORSI et al., 1966).

Clearly it will be necessary to carry out further measurements using other techniques to obtain a definitive age for the Eisenkappel Granite. The present result nonetheless provides further evidence for the long history of the eastern segment of the Periadriatic Lineament; the shape of the granite strongly suggests that a lineament was present at the time of intrusion. It will be important also to examine the granite and its contacts for evidence of the proposed transcurrent movement (DE JONG, 1966, and others) along the line in post Perminan times.

While the early influence of the Periadriatic Lineament now seems well established its role in the late Mesozoic to Tertiary tectonic evolution requires

further examination. Some deformation clearly took place at this time too but it seems questionable if the Lineament played as important a role as often suggested; for example the "Periadriatic Intrusions" are distributed on both sides of the line and major Alpine deformation and metamorphism decreases southwards from the Tauernfenster rather than showing a sharp break across the Periadriatic Lineament.

Table 1 — Analytical Data.

Sample	% K	Vol. ^{40}Ar rad. scc/g $\times 10^{-4}$	% ^{40}Ar rad.	Age. m. y.
Hornblende	0.74	0.07685	85.9	244 ± 9
"Biotite"	2.26	0.1419	89.5	151

$\lambda\beta = 472 \times 10^{-10}$ yr^{-1}; $\lambda e = 0.584 \times 10^{-10}$ yr^{-1}.
^{40}K/K = 0.0119 at %.

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