3. REE in Clinopyroxene:
The most incompatible behaviour exhibit the Clinopyroxenes which contain only Ti and no Al.
The partition coefficients are generally below 0.03. Clinopyroxenes containing both Al and Ti
are less incompatible. The light REE are strongly depleted. La/Sm reaches 0.15. For the heavy
REE the partition coefficients lie in the range of 0.19. The least incompatible behaviour show
the Ti–free but Al–bearing Clinopyroxenes. La/Sm reaches also 0.15. The partition coefficients
for the heavy REE increase to 0.27. All 3 REE patterns run parallel: for this reason it can be
stated that the presence of Al favours the incorporation of REE, whereas the presence of Ti ham-
pers the REE distribution.

II. Al and Mg in Titanite:
In Titanites Al and Mg are incorporated only in minor amounts. The concentration of Al is al-
ways less 1 Wt%, that of Mg always less 0.5 Wt%. The partition coefficients reach max. values
of DAl = 0.07 and DMg = 0.08. Nevertheless these elements influence the trace element incor-
poration.

1. Zr in Titanite:
Al–free Titanites show a partition coefficient for DZr = 1.54. This coefficient traces back to the
direct substitution Ti ⇔ Zr. The presence of Al in Titanites raises the DZr = 1.66. Two super-
posing mechanisms can be distinguished: a) Ti ⇔ Zr and b) Mg + 2 Ti ⇔ Zr + 2 Al.

2. Nb and Ta in Titanite:
Titanites from the ternary system behave compatible for Nb and Ta (D Nb = 1.24 and D Ta = 6.0).
Ta is by the factor 5 more compatible than Nb. The incorporation of Nb and Ta takes place by
the coupled substitution 2 Ti ⇔ (Nb, Ta) + Al.

3. REE in Titanite:
Al–free, but Mg–bearing Titanites are depleted by the factor 2.5 in light and heavy REE with
respect to the middle REE. The middle REE show max. partition coefficients of 0.4. Titanite
bearing both, Al and Mg, exhibit the same shape of the REE pattern. The middle REE are also
enriched by the factor 2.5. Nevertheless this REE group behaves compatible in these Titanites.
The partition coefficients lie in the range of 1.35 – 1.83. This is an effect of the superposition of
two different couples substitutions (Fig.1).
The REE content of the Al–free Titanites can be explained by a substitution mechanism in the
form of 2 Ca + Ti ⇔ 2 REE + Mg. The Al–bearing Titanites which are compatible with respect to
the middle REE incorporate these elements by an overlay of a second mechanism in the form of
Ca + Ti ⇔ REE + Al. The later coupled substitution seems by far more effective for REE incor-
poration: Al content in Titanites controls the distribution behaviour of the REE.

STEADY STATE FLOW AND RHEOLOGY
OF DEFORMED ERZGEBIRGE GRANITOIDS

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Porphyric coarse grained pre–Variscan granite intrusion dated at 490–420 MY, K–Ar Hofmann et al.
1979 and cropping out in the central part of the Erzgebirge mountains was intensely reworked during
Variscan westward ductile shearing (Milcoch and Schulmann 1992). This reworking was heterogene-
ous producing 1) pervasive S–C granite as the most abundant rock type; 2) low–strain domains elon-
gated in E–W direction, tens to hundreds meters in size and 3) zones of banded quartzo-feldspathic
mylonites.

The mylonitic flat–lying foliations bear east–west trending stretching lineation marked by elon-
gation of quartz–feldspar aggregates and biotite clusters. Ubiquitous S–C relationships indicate west
oriented shearing.

The textural transition from metagranite to banded mylonite during granite deformation is ex-
plained using a rheological model for bi– and polyphase material (Jordan 1988, Handy 1990). At the
initial stages of granite deformation the strain rate and stress were concentrated into interconnected
hard feldspar fraction while quartz was shielded from deformation. Tharp's load carrying framework
rheological model operated during this stage.
Development of S–C fabric is marked by breakdown of rigid feldspar skeleton while weaker phase starts to be interconnected. Strain rate and stress are concentrated to quartz/mica weak layers shielding isolated pockets of rigid feldspar aggregates. Final stage of banded mylonite is marked by decreasing ratio of viscous contrast between both hard and weak phases. Power law creep mechanisms (dislocation creep) operate in both quartz and feldspar monomineralic aggregates which are equally rheologically active.

This progressive microstructural development of deformed granite help to understand 1) a rheological behaviour of continental rocks in mid–crustal levels and 2) steady state flow microstructure of polyphase quartz–feldspar material under amphibolite facies conditions.

CHARACTERIZATION, 3–DIMENSIONAL ORIENTATION AND DECOMPRESSION OF THE ZEV MINERAL ZONES (NE–BAVARIA)

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In the main part of the ZEV (Zone of Erbendorf Vohenstrauss), three mineral zones of NNW–SSE extension were mapped (from W to E): a Staurolite zone with staurolite+garnet (+kyanite+sillimanite) + biotite + muscovite + quartz, a Garnet–Aluminosilicate zone with garnet + kyanite+sillimanite + biotite + muscovite + quartz and a Cordierite zone with cordierite + andalusite + biotite. The Cordierite zone extends along the late Variscan Leuchtenberg Granite, but is also found, in small “isles”, far away off the granite.

In the KTB drill hole the first 7800 m represent the Garnet–Aluminosilicate zone with some migmatic portions and a segment of Cordierite zone at 470 m. Below 7800 m in cuttings the assemblage staurolite + garnet + kyanite + sillimanite + biotite + muscovite + quartz and others with andalusite + biotite + quartz are recovered, the latter which eventually represents the Cordierite Zone.

Garnet of the Staurolite zone show bell–shaped Mn–profiles, but is nearly homogenized in the Garnet–Aluminosilicate zone except for a retrograde rim. In the latter mineral zone e decompressive reaction garnet + muscovite > biotite + sillimanite + quartz is observed. Wherever both aluminiumsilicates occur, sillimanite often seems to be the younger polymorph.

Calculated temperatures with garnet–rim / contact biotite pairs range from 568°C–616°C at pressures below 5–6 kbar as given by the stability of sillimanite. Cordierite zone is characterized by the reaction garnet + aluminosilicate + quartz > cordierite, indicative of a second decompression reaction.

TECNO-METAMORPHIC EVOLUTION OF THE INTERNAL VARISCAN BELT – EXAMPLES FROM EASTERN/WESTERN ALPS, BOHEMIAN MASSIF, MASSIF CENTRAL AND SOUTHERN BRITANNY

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Pressure–temperature–time–deformation (P–T–t–d) paths from metamorphic rocks provide considerable insight to the tectonothermal history of single crystalline segments in an orogenic belt. Most precise information about the P–T–t–d–space evolution of a terrain can be obtained from single metapelite and metasedite samples by relating mineral zonations and successive mineral equilibria to linear and planar (L–S) structures of progressive deformation. When continuous reactions are considered in such rocks, each step of garnet or amphibole growth zonations represents a finite temporal and spatial domain of equilibration within the assemblages and allows to evaluate P and T or P–T changes for each deformational step by geothermobarometry based on cation exchange and amphibole