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Combined active and passive Pluton Emplacement into a thickened Crust - first Results from the Fürstenstein Intrusive Complex (Bavarian Forest, Germany)

C. Dietl, M. Gößmann, H. de Wall

Institut für Geologie, Universität Würzburg, Pleicherwall 1, D-97070 Würzburg (carlo.dietl@mail.uni-wuerzburg.de)

The Fürstenstein Intrusive Complex (FIC) is a composite, granitoid pluton in the Moldanubian basement of the Bohemian Massif. It consists of at least three magma pulses of distinct intrusion ages (U-Pb at zircons, Chen et al. 2002.):

- dark, medium grained and biotite $\pm$ hornblende $\pm$ sphene bearing diorites (331-334 Ma)
- a fine to medium grained two-mica granite of unknown age
- medium grained biotite granites (Eberhardsreuth and Tittling granite, respectively), with the Tittling granite giving zircon ages between 321 and 323 Ma
- the coarse grained Saldenburg granite, which is characterized by a steep, NE-SW trending magmatic flow fabric made up by K-feldspar megacryst (312-318 Ma).

The Saldenburg granite makes up about 80% of the FIC´s 140 km^2 and encompasses the western and central part of the pluton. The Eberhardsreuth granite occupies the northern rim of the FIC, while the Tittling granite occurs at its eastern margin. The two-mica granite takes up the entire south of the igneous complex, where it is part of a NW-SE trending HT shear zone. The diorites form huge stoped blocks and are incorporated within the Saldenburg, Tittling and two-mica granites, respectively. The FIC is commonly interpreted as late- to post-Variscan.

Combined application of the Al-in-hornblende barometer (Anderson and Smith, 1995) and hornblende-plagioclase thermometer (Blundy and Holland 1990) gave PT conditions for the intrusion of the FIC of 4.5-5.1 kbars (equilibration pressure of hornblende with quartz) and 628-650˚C (equilibration temperature of hornblende with plagioclase).

Since no lithology (besides the Saldenburg granite) shows any visible preferred mineral orientation measurements of the anisotropy of the magnetic suceptibility (AMS) were carried out to decipher the emplacement history of the FIC. The measurements showed that each of the individual igneous phases owes a distinct magnetic fabric:

- the magnetic foliation within the dioritic stoped blocks strikes WNW-ESE;
- magnetic foliations within the Eberhadsreuth and Tittling granites are parallel to the pluton's contact;
- within the two-mica granite the magnetic fabric follows the NW-SE direction of the southern shear zone;
- in the Saldenburg granite the magnetic foliation and lineation is concordant to the alignement of the K-feldspar megacrysts.

From our observations we conclude that the FIC was emplaced into a deep seated and mechanically weak system of extensional faults, which belongs to the regional scale Pfahl fault system by a combination of active and passive emplacement mechanisms as follows:

- The diorites were emplaced – probably as dykes – into NE-SW trending, mechanically weak zones which resulted from right-lateral movement along the Pfahl and associated transform faults.
- During continuing dextral transform deformation the dioritic dykes were rotated clockwise and brecciated by the now intruding Eberhardsreuth, Tittling and two-mica granites. The two-mica granite was emplaced close to a left lateral strike-slip NW-SE trending fault and developed consequently a magnetic foliation parallel to this fault zone.
- Until this stage all igneous phases were emplaced more or less passively due to extensional and rotational movements along the Pfahl system. However, the intrusion of the voluminous Saldenburg granite was accompanied by magma

chamber expansion (ballooning) and led to the developement of a contact parallel, concentric magnetic foliation at the rims of the FIC, i.e. within the Eberhadsreuth and Tittling granites. The steep NE-SW trending magnetic and magmatic foliation within the Saldenburg granite developed under the same NW-SE directed stress field as the magnetic foliations in its precursors. However, the cease of rotational deformation along the Pfahl zone preserved this fabric and is probably also responsible for the end of intrusive activity in the FIC.

By this means the FIC provides an excellent example for a composite pluton emplaced by a combination of several passive and active (i.e. forceful) mechanism into a relatively deep crustal level. The close relation of the pluton and its intrusion mechanisms to the Pfahl fault system indicates that even below the ductile-brittle transition a pluton‘s rise and emplacement is controlled by regional tectonics.