ABSTRACT

Detrital minerals (garnet, muscovite, amphibole and rutile) and pebbles from the Saxothuringian flysch of NE-Bavaria (Famennian - Viséan; Erbendorf Paleozoic and Frankenwald), as well as detrital muscovites from the Givetian siltstones of the Barrandian were analysed using an electron-microprobe. The aim of this work was to obtain a more detailed petrological characterisation of the synorogenic detritus. The results of these analyses should allow a comparison of the detritus with the crystalline rocks exposed nowadays, to determine the provenance of the flysch and to quantify the rate of exhumation at the active margin of the Saxothuringian.

The composition of the detrital garnets remains more or less the same from the Famennian to the Visean. Garnets from pebbles of the Teuschnitz Conglomerate reveal significantly higher Grossular-contents than the detrital garnets. Garnets from rocks of potential provenance areas with a chemical composition equal to that of the garnets from the pebbles are not known yet. A comparison of the detrital garnets with garnets from potential source-rocks shows, that the detrital garnets do not fit very well to the crystalline rocks exposed nowadays. But, analogies occur to garnets from metapelites of the Zone of Erbendorf-Vohenstrauß (ZEV) and to garnets from metagreywackes and metapelites of the Domazlice- and Tepla-Crystalline units (Tepla-Barrandian). A recycling of detrital garnets from the greywackes of the Cambrian Tiefenbach-Wechselfolge of the Frankenwald may also be possible.

The results of U-Pb age determinations of detrital zircons from the Famennian greywackes also indicate an erosion of ZEV-type crystalline rocks: Detrital zircon-fractions from the Famennian flysch (Dörr et al., 1991; Schäfer & Dörr, 1994) plot on the discordias of zircons from metapelites of the ZEV, which date the Early Variscan medium-pressure metamorphism at 380 Ma (Teufel, 1988). One abraded, single detrital zircon from the Famennian flysch also yielded an age of ca. 380 Ma (Schäfer & Dörr, 1995; Schäfer et al., 1995). These results could be interpreted as a first hint at a rapid exhumation of metamorphic rocks at the active margin of the Saxothuringian.

The detrital amphiboles from the Famennian greywackes of the Erbendorf Paleozoic reveal very homogeneous compositions. Mostly, they are magnesio-hornblende and tschermakitic hornblende. A comparison with amphibole-data from rocks of potential provenance areas clearly demonstrates that the Randamphibolite-Series (= marginal amphibolites) of the Münchberg Massif (or an equivalent, already eroded unit) may have been a part of the provanance area of the Famennian greywackes of the Erbendorf Paleozoic. In that case, the Randamphibolite would have been already exhumed in the Famennian (ca. 365 Ma), shortly after its Early Variscan metamorphism (ca. 380 Ma).

The analyses of the detrital micas from the Givetian clastic sediments of the Barrandian reveal a homogeneous mica-population with low Si-contents. In the Famennian greywackes of the Erbendorf Paleozoic, the chemical compositions of the detrital micas reveal a strong variation. Detrital micas with both low- and high Si-contents (3,06-3,45 Si/formula unit = Si/f.u.) occur. The samples from the Carboniferous flysch of the Thuringian Facies contain mica-populations with

homogeneous, low Si-contents (3,04-3,12 Si/f.u.) as well as mica-populations with strongly varying Si-contents (2,99-3,42 Si/f.u.). The chemical compositions of the latter micas show the same spread as the chemical compositions of the detrital muscovites from the Famennian greywackes of the Erbendorf Paleozoic. The samples from the Carboniferous flysch of the allochthonous Bavarian Facies contain homogeneous mica-populations with low Si-contents. Muscovites from pebbles of the Teuschnitz Conglomerate reveal the same strongly varying chemical compositions as the detrital micas.

The results of the muscovite analyses are interpreted by applying the phengite-geobarometer of Massonne & Schreyer (1987): Accordingly, the detrital muscovites of the Givetian siltstones of the Barrandian reveal no hints at an erosion of medium- to high-pressure metamorphic rocks in the provenance area of these clastic sediments. But, in the Famennian flysch of the Erbendorf Paleozoic detrital phengites occur, that indicate an erosion of high-pressure metamorphic rocks in the provenance area of the flysch. Pressure estimations using the detrital muscovites with the highest Si-contents reveal minimum pressures of $\geq$ 13 kb. Similar Si-contents and metamorphic pressures are known from potential source rocks (e.g. the eclogites of the Münchberg Massif). The strong variation of Si-contents of the detrital micas could be explained by the erosion of a tilted metamorphic profile or the erosion of a crystalline unit which contains muscovites formed under various retrograde conditions during exhumation. This crustal profile, which exposes rocks of various metamorphic grades, remains part of the provenance area throughout the Visean.

K-Ar age determinations of detrital muscovites from the Carboniferous flysch (performed by the workgroup of H. Ahrendt, University of Göttingen) reveal 3 different groups of ages: 369-408 Ma, 490-505 Ma and 619 Ma (Ahrendt et al., 1995; Neuroth, in Vorb.). The muscovites with ages between 369 and 408 Ma can be correlated with the cooling after the Early Variscan metamorphism. The muscovites with an age of 619 Ma can be derived from rocks of the Cadomian basement. Because of homogeneous, low Si-contents, the muscovites with ages of 490-505 Ma could be derived from Early Paleozoic granitoids.

These data point to an persisting erosion of crystalline rocks of the Münchberg Massif / ZEV / ZTD-type in the provenance area (ZTD = Zone of Tepla-Domazlice). But, the provenance region comprises not only the front of the Variscan orogen, but also the higher levels of the crystalline hinterland, consisting of Cadomian basement with Early Paleozoic granitoid-intrusions (Tepla-Barrandian). This interpretation is supported by the development of the feldspar/quartz-ratios of the Saxothuringian greywackes, that show an increase from the Famennian to the Visean.

By the results of the examinations upon the composition of the Saxothuringian greywackes, the Münchberg Massif (including the Randschiefer-Series) and the ZEV/ZTD can be determined as the provenance area of the flysch. Furthermore, the combination of the results of the microprobe analyses with age data from the flysch and the crystalline units gives hints at the rate of uplift and exhumation at the active margin of the Saxothuringian. These data allow to outline the paleogeographic and tectonic evolution of the provenance area: Already at Famennian time, Early Variscan medium- to high-pressure metamorphic rocks, i.e. crystalline rocks of the Münchberg Massif / ZEV / ZTD-type, are exhumed and get eroded. It is very likely, that the Randamphi-

bolite and the Liegend- and Hangend-Series of the Münchberg Massif have already reached the surface at that time.

There is only a period of ca. 15 Ma between metamorphism and exhumation of the crystalline rocks. Detrital muscovites with high Si-contents could be derived from high-pressure metamorphic rocks, for which more than 20 kb (≈ 70 km depth) are proved in the crystalline units of the provenance area. Therefore, an exhumation rate of 5 mm/a can be calculated.

Not later than in the Early Visean the accretion of the Saxothuringian plate ("Unterplatte" = basal plate) to the active margin is documented by wildflysch containing olistoliths of the Paleozoic of the Bavarian Facies. In the late Visean the Saxothuringian foreland (Thuringian Facies) is also integrated into the provenance area. Simultaneously, crystalline rocks of the Münchberg Massif / ZEV / ZTD-type are still being eroded. During the late Visean these crystalline units are thrusted over the sediment-dominated part of the provenance area.

The situation at the SE-margin of the Saxothuringian could be explained by the model of a “tectonic wedge”. The composition of this wedge is controlled by the accretion of the basal plate as well as by the overthrusting of exhumed crystalline units.