CONTRASTING LOWER CRUSTAL PROCESSES DOCUMENTED IN GRANULITES FROM THE EAST AFRICAN OROGEN AND THE BOHEMIAN MASSIF

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Deeply eroded orogens such as the East African Orogen (EAO) and the Variscan Orogen offer the unique opportunity to study lower crustal processes documented by mineral assemblages and textures, chemical zoning of major and trace elements in minerals, especially garnet, as well as different styles of deformation. HARLEY (1989) presented a detailed compilation of granulite occurrences, PT conditions and differing PT-paths as well as documented the differences in granulites experiencing isobaric cooling (IBC) or isothermal decompression paths (ITD). These contrasting PT paths are typically the result of different tectonic settings and processes.

In the last 25 years ultra-high temperature (UHT) metamorphism has been recognised within more and more granulite facies domains, such as the Saxon and Moldanubian granulites. PERRAKI & FARYAD (2014) postulated an ultra-high pressure stage prior to the UHT overprint based on Grt-peridotite and eclogite occurrences, preserved prograde garnet zoning pattern as well as the finding of diamond and coesite in zircon and garnet, respectively, in the investigated granulites from the Kutna Hora Massif.

Recent work in granulites from the Dunkelsteinerwald, St. Leonhardt and Blumau granulites also points to a possible UHP event before UHT metamorphism followed by a retrograde, locally occurring granulite facies overprint at lower PT conditions as well as hydration of the former dry granulites. Well preserved zoning pattern in felsic and mafic granulites are a clear evidence that the UHT event and probably also the prior occurring UHP event are extremely short lived processes. Based on available age data, zoning pattern and field relationships a time span of about 5 million years is proposed for the UHP and UHT cycles.

In contrast to the short lived granulite facies metamorphic event documented in Saxon and Moldanubian granulites, lower crustal basement rocks from the East African Orogen exhibit partly extremely slow cooling processes of 1-5 °C/my. The EAO is a complex collage of collisional belts involving different orogenic phases and metamorphic overprints starting from around 750 Ma and ceasing around 530 Ma. The granulite facies rocks are exposed in parts of Kenya, Tanzania, Mozambique, Malawi, Madagascar, Sri Lanka, Southern India and Antarctica. The commonly occurring charnockitic and enderbitic gneisses in S-Kenya and Tanzania developed typical coarse grained corona textures during the slow cooling period. In all rocks prograde garnet zoning patterns in major elements are erased while retrograde diffusional modification is widely observed. Detailed 2D mapping of Fe-Mg distribution within garnet and along grain boundaries and neighbouring grains revealed that diffusion along grain boundaries was hampered probably due to the very dry conditions during the high grade event. Trace element diffusion in garnet is considered to be significantly slower compared to major element mobility and thus these elements are useful for defining the metamorphic evolution.

HT/UHT metamorphism as well as slow cooling from these conditions aggravates the reconstruction of a full PT-path and consequently the understanding of the liable tectonic framework. Petrological modeling tools combined with information from relict phases and trace element distribution between phases as well as changes during mineral growth my reveal parts of the obscured prograde history in granulite facies rocks.

HARLEY, S. (1989): Geological Magazine, 126, 215–247.
PERRAKI, M., FARYAD, S.W. (2014): Lithos, 202–203, 157–166.