

# A petrological and geochronological study of the Koralpe-Saualpe-Pohorje (KSP) Complex (Eastern Alps)

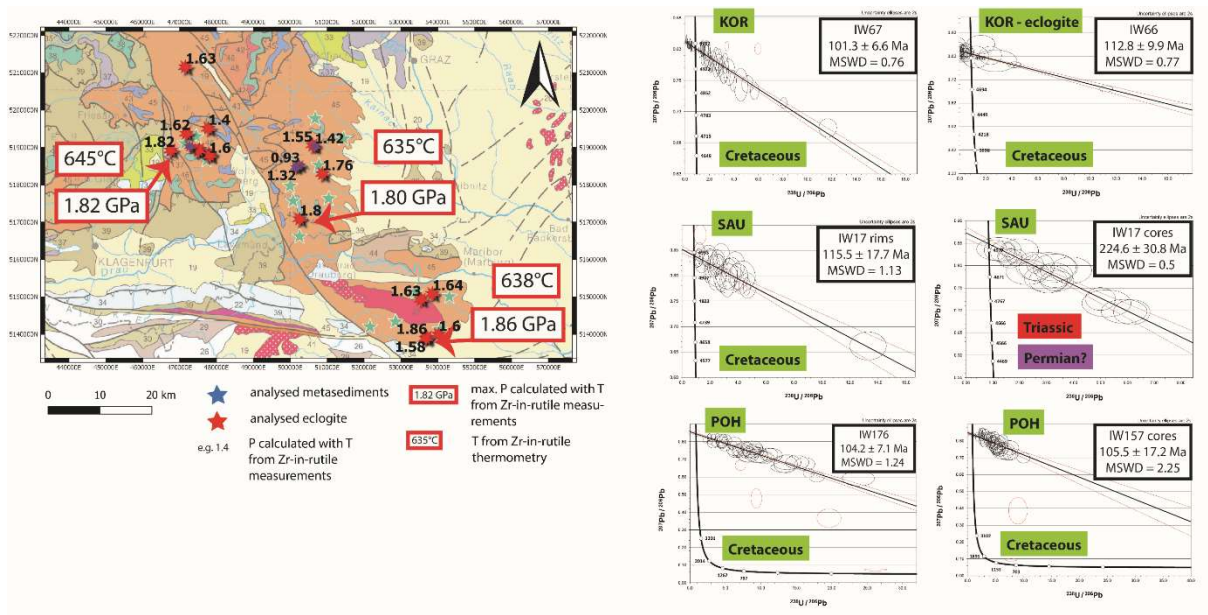
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The KSP Complex in the Eastern Alps stretches from SE Austria to NW Slovenia and is a lithologically heterogeneous (U)HP nappe with abundant eclogite lenses embedded in gneissic and metasedimentary rocks. An increase of metamorphic peak pressure-temperature (PT) conditions from NW to SE with UHP conditions for Pohorje was previously proposed based on thermodynamic modelling. The formation history of the KSP Complex is still debated. Here, we investigate in detail the PT conditions during the formation of the complex along a NW-SE transect following the direction of subduction with a new combined approach for this area of Raman spectroscopy of quartz inclusions in garnet, Zr-in-rutile thermometry and U/Pb dating on garnets. This is the first study within the KSP complex where quartz inclusions in garnet elastic barometry was conducted to determine the entrapment pressures, which correspond to the minimum pressure conditions present during the entrapment of quartz inside garnet. Approximately 5000 quartz inclusions inside the inner part of the garnets were investigated. The garnet rims contain almost no inclusions. The eclogites yield pressures of max. 1.9 GPa across the KSP complex, indicating no pressure increase from the NW to SE (Fig. 1). The metasediments and gneisses show overall lower pressures with ca. 1.4 GPa. Temperatures based on Zr-in-rutile thermometry was conducted on 194 rutile grains in different microstructural positions. The results do not indicate a temperature increase from NW to SE, with ca. 640 ( $\pm 30$ )°C across the whole KSP Complex (Fig. 1), based on very similar Zr contents of ca. 270 ppm. The new approach of in situ U/Pb dating on garnets allows the age determination of the different growth zones in garnet and makes it an ideal tool to decipher metamorphic processes. The metasediments provide the following ages (Fig. 1) for the Koralpe 101.3  $\pm$  6.6 Ma (throughout garnet); Saualpe 224.6  $\pm$  31 Ma (core) and 115.5  $\pm$  17.7 Ma (rim); Pohorje 104.2  $\pm$  7.1 Ma to 105.5  $\pm$  17.2 (throughout garnet). Garnet in eclogite from Koralpe is 112.8  $\pm$  9.9 Ma. In general, the garnets in eclogite from the KSP complex are very poor in U. The obtained ages are interpreted to be metamorphic peak ages with a Cretaceous event at c. 100 Ma and a Triassic/Permian event reported in garnet cores from metasediments from Saualpe which is in line with existing literature. Combined with results of previous studies of eclogite ages, we suggest, that the eclogites are former (probably Permian) gabbro intrusions that experienced HP conditions during the Eoalpine orogeny. Whereas garnet ages of metasediments from Saualpe provide evidence for a polymetamorphic history.



**Figure 1:** Left) Geological map from Schuster et al. (2015) with results for metamorphic peak PT of eclogites and metasediments. Right) U/Pb isochron plots for the dated metasediments and eclogites from the KSP complex.