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Determining the speed of intracontinental subduction – preliminary results of zoned garnet geochronology in micaschists from the Schneeberg and Radenthein Complexes, Eastern Alps

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In collisional orogens continental crust is subducted to (ultra-)high-pressure (HP/UHP) conditions as constrained by petrologic, tectonic and geophysical observations. Despite a wealth of studies on the subduction and exhumation of UHP rocks, the duration of prograde metamorphism during subduction is still not well constrained.

We plan to apply Lu-Hf and Sm-Nd geochronology on metamorphic rock samples to date the duration of garnet growth, which represents a major part of prograde metamorphism from the greenschist-facies onward. Micaschist samples from the Schneeberg and Radenthein Units in the Eoalpine high-pressure belt (Eastern Alps) will be used for dating as they contain cm- to dm-sized garnet blasts, which experienced only one subduction-exhumation cycle. With dating different parts of big garnet grains, we test whether (1) it is possible to resolve the duration of garnet growth within single crystals, and (2) Lu-Hf and Sm-Nd systems date the same events in the PT-path or yield complementary information. Additionally, we will perform U-Pb geochronology on titanite in order to obtain the age of the first stages of exhumation; in addition, dating of rutile inclusions as well as matrix rutiles will be used to test Eoalpine prograde age. We will also apply U-Th-Pb monazite dating (EPMA and LA-ICPMS) to some of the samples. Collectively, these data will allow us to compare the duration of subduction and the timing of initial exhumation in a single sample. We then will constrain the PT-path of the dated samples by pseudosection modeling combined with Zr-in-rutile, quartz-in-garnet, and carbonaceous material geothermo(baro)metry. We already have preliminary results for Zr-in-rutile thermometry of rutile inclusions in garnets and matrix rutiles for samples from both locations. We measured Zr content with an EPMA and used the calibrations of Tomkins et al. (2007) and Kohn (2020). The calibration of Kohn (2020) gives overall slightly lower temperatures, but all obtained temperatures lay in a range of c. 500-600 °C in accordance with previously published data. In addition, EPMA, µ-XRF, LA-ICPMS, and µCT will be used to control if garnets preserved major and trace elemental growth zoning and to provide

spatial 3D information on inclusion patterns. µCT analyses were already successfully used to obtain the chemical centre of the garnet grains in order to be able to cut them directly through there center. This is important for all in-situ chemical analyses. With dating different parts of single garnet crystals separately with Lu-Hf and Sm-Nd geochronology, we will add tight time constraints to the PT-path and constrain the duration of garnet growth.

With this contribution we formulate the working hypothesis that prograde subduction together with exhumation is a fast process. The basis for testing the idea of fast prograde metamorphism is that many geochronological studies propose a prograde duration of < 10 Ma and studies using geospeedometry sometimes propose an even shorter duration, which is the impetus for this investigation.

References:

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