Determining the speed of intracontinental subduction – preliminary results of zoned garnet geochronology in micaschists from the Schneeberg Complex, 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. These (U)HP rocks are exhumed by an extremely fast process (few Ma) as numerous rocks still preserve their high-pressure metamorphic assemblages, which would not be the case if they had time to re-equilibrare at lower pressure conditions. 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 do 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 on. 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 garnets, which experienced only one subduction-exhumation cycle with P-T conditions reaching 600 °C and up to 1 GPa. With dating different parts of big garnet grains we test (1) if it is possible to resolve the duration of garnet growth within single crystals, (2) if both systems, Lu-Hf and Sm-Nd, are needed for better age-constraints, and (3) whether both systems date the same events in the PT-path or give differing information. Additionally we will perform U-Pb geochronology on titanite in order to obtain the age of the first stages of exhumation and on rutile inclusions as well as matrix rutiles to confirm the Eoalpine prograde age with this additional method. Therefore, we will be able 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 samples that will be dated by pseudosection modeling combined with Zr-in-rutile geothermometer, quartz-in-garnet geobarometer, and carbonaceous material geothermometer. 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. 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.