Constraining the process of intracontinental subduction: implications from petrology and Lu-Hf geochronology of eclogites from the Austroalpine Nappes

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The nucleation of subduction zone remains a widely discussed topic in the global tectonics. The prevalent view is that subduction starts within an oceanic plate. However, there is strong evidence that subduction can also be initiated within a continent. To test this hypothesis, we combine petrology, isotope geochronology and thermodynamic phase equilibrium modelling on eclogites from the Austroalpine Nappes of the Eastern Alps.

The high- and ultrahigh-pressure rocks occur in a ~400 km long belt from the Texel Complex in the west to the Sieggraben Unit in the east without remnants of Mesozoic oceanic crust. Garnet growth during pressure increase was dated using Lu-Hf chronometry. The results range between c. 100 and c. 90 Ma, indicating a short period of subduction. Combined with already published data, our estimates of metamorphic conditions indicate a field gradient with increasing pressure and temperature from northwest to southeast, where the rocks experienced ultrahigh-pressure metamorphism. The oldest Cretaceous eclogites (c. 100 Ma) are found in the Saualpe-Koralpe area which comprises widespread gabbros formed during Permian to Triassic rifting. This supports the hypothesis that subduction initiation was intracontinental and localized by a Permian rift. In the Texel Complex two-phased garnets yielded a Variscan-Eoalpine mixed age indicating re-subduction of Variscan eclogite-bearing continental crust during the Eoalpine orogeny. Jurassic blueschist-facies metamorphism at Meliata in the Western Carpathians and Cretaceous eclogite-facies metamorphism in the Austroalpine are separated by a time gap of ~50 Ma and therefore do not represent a transition from oceanic to continental subduction but rather separate events.