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The role of high-pressure metamorphic rocks in collisional processes with a microplate involved

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High-pressure (HP: p >10 kbar) rocks, especially easily recognizable eclogite lenses, are markers of a collision of major continental plates in Phanerozoic times, but how about a collison with a microplate? To answer this question, petrological studies were undertaken on garnet-bearing metamorphic rocks. Especially pressure (P) - temperature (T) pseudosections were calculated to reconstruct the P-T path of such rocks. Areas in the Andes and their eastern foreland (Argentina, Ecuador) and the Carboniferous realm of western and central Europe were studied, where microplates either had collided with the South American plate or had been located between colliding Laurussia and Gondwana. The following features resulted: (1) laterally extended zones of HP rocks mark collisional sutures, but eclogite lenses are virtually absent; (2) these HP rocks are dominantly metapelites which have experienced pressures as high as 1.2 to 1.5 GPa; (3) these pressures were reached between 450 to 550°C, followed by a P release at increasing T; (4) the T peak in the range of 500-650°C at P between 0.5 and 0.8 GPa is often characterized by the blastesis of plagioclase occasionally together with staurolite; (5) this event was pre-dated by two deformational events. The second deformation occurred during the early exhumation.

Considering the regional geology of the study areas, these features are interpreted as follows: Prior to the collision a basin, extending over at most some hundred kilometers perpendicular to the basin axis, existed between the colliding microplate and the major plate. Eventually, a rifting event had caused the separation of the microplate from the major continental plate. The basin, which was opened by this event and filled with sediments, could have developed further to a back-arc basin. Then, the extensional regime turned to a compressional one. During compression the basin sediments on top of thinned continental crust were buried beneath the overriding major plate resulting in the formation of the aforementioned HP metapelites. Soon after the normal-thick section of the microplate came in contact with the major plate, the collisional process ceased and erosion affected the moderately thickened and extended collisional area. Mainly erosion but also a subhorizontal forced-flow led finally to the exposure of the HP rocks. The lack of lenses of eclogites, which had experienced pressures >2 GPa as common in the collisional zones between major plates, is due to the impossibility to form a subduction channel during the early collisional stage. A subduction channel, where fragments of subducted oceanic crust can be exhumed from greater mantle depths, can only develop after a considerable portion of oceanic crust was subducted. This is not the case for the aforementioned relatively narrow basins which are only thrust beneath a major plate but not subducted to great mantle depths.