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Possible polyphase metamorphic evolution of high grade metabasic rocks from the Songshugou ophiolite, Qinling orogen, China

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The Proterozoic Songshugou ophiolite consists of a series of ultrabasic and tholeitic metabasic rocks. They were emplaced as a lense shaped body into the southern margin of the Qinling Group. Isotope composition and trace element geochemistry display an E-MORB and T-MORB signature for the mafic rocks (Dong et al., 2008). Within the ophiolite sequence some rudimental fresh peridotites (dunites and harzburgites) within serpentines display low CaO (<0.39 wt.%) and $Al2O_3$ (<0.51 wt.%) as well as high MgO (41–48 wt.%) contents, which can be classified as depleted non-fertile mantle rocks. The metabasic rocks comprise the mineral assemblage garnet, amphibole, symplectitic pyroxenes, ilmenite, apatite, ±zoisite, ±sphene and show a strong retrograde metamorphic overprint. Garnet typically contains many inclusions within the core but are nearly inclusion free at the rim. The cores have sometimes snowball textures indicating initially syndeformative growth. Albite and prehnite were found in central parts of garnet. In the outer portions, pargasitic amphibole, rutile and a bluish amphibole, probably glaukophane were found. Garnet zoning pattern clearly show a discontinous growth seen in an sudden increase in grossular and decrease in almandine components. The symplectitic pyroxenes are of diopsidic composition which enclose typically prehnite and not albite, as common in retrograde eclogitic rocks. Different stages of garnet breakdown to plagioclase and amphibole, from thin plagioclase rims surrounding the garnets to plagioclase rich pseudomorphs, can be observed in different samples. Based on symplectitic pyroxenes a high pressure metamorphic event can be concluded (Zhang, 1999). The garnet breakdown to plagioclase and the symplectites clearly indicate a rapid exhumation phase. The age of the metamorphic event is probably related to the closure of the Shangdan ocean during the early Paleozoic. It is unclear if the garnet rims grew during a later stage of the metamorphic cycle or developed during a separate event.
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