The Ryoke metamorphic belt: a crustal-scale shear zone forming a detachment fault (MTL) in the Mid-Cretaceous SW Japan

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The strain geometry of a Cretaceous metamorphosed accretionary complex in SW Japan is one of the key geological constraints in understanding the Late Cretaceous tectonics of the forearc region at the eastern margin of Eurasia. We studied the strain geometry and strain path of lower greenschist to lower amphibolite facies metamorphic rocks from the mid-Cretaceous low-P/high-T Ryoke metamorphic belt, which during the mid-Cretaceous were located at mid-crustal depths close to the volcanic front. Strain analysis focused on deformed radiolarian fossils in metachert and sandstone/chert clasts within metapelite. The X-direction of the strain ellipsoid of the schistosity-forming deformation is oriented E-W, and the XY-plane of the strain ellipsoid developed parallel to schistosity. The metachert and metapelite exhibit plane strain to general flattening strain that probably largely resulted from the schistosity-forming deformation. Our analysis reveals that the schistosity-forming deformation occurred under bedding-normal compression, resulting in flattening strain throughout the Ryoke metamorphic belt. The X-direction of the strain ellipsoid of the schistosity-forming deformation is oriented parallel to the length of the Ryoke metamorphic belt throughout the SW Japan arc. The schistosity formed parallel to bedding planes that developed horizontally in non-metamorphosed accretionary complexes of SW Japan; the XY-plane of the strain ellipsoid is approximately horizontal. These observations indicate the occurrence of horizontal shear deformation within the middle crust (˜15 km depth) at the time of Ryoke metamorphism. In the case that a mid-crustal horizontal shear zone changes in form to a high-angle fault near the surface (i.e., a listric fault), horizontal displacement at depth changes to strike-slip movement near the surface. Therefore, the schistosity-forming deformation could have resulted in the formation of the strike-slip fault at the surface within the forearc region of the SW Japan arc, which is now recognized as the MTL; the detachment fault could have formed a forearc sliver during the mid-Cretaceous.