A preliminary study on the metamorphic rocks in Nimu, Tibet

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We report a preliminary study of newly recognized metamorphic rocks exposed at Nimu, southern Tibet, near northern of India-Asia suture.The rocks are fresh and outcrop in metabasalt, biotite hornfels, garnet hornfels, granofels, biotite diorite and marble, largely garnet hornfels and granofels. Garnet hornfels distributes about 390 m while granofels about 80 m, trending roughly from east to west and north-dipping with angle 40°~70°. The profile of Nimu metamorphic rocks crossthe second section of the middle Jurassic Yeban Formation and early Cretaceous Sangri group biotite diorite. The former are composed mainly of volcanic breccias tuff, volcanic breccias, agglomerate, with interlayer of diacite, rhyolite, diacite - rhyolitic crystal tuff and sandstone. Petrographic observation and determination of these two metamorphic mineral assemblages show that they have been metamorphosed to pyroxene-hornfels facies. According to data of electron microprobe analysis, garnet porphyroblasts developed growth zoning and amphiboles are calcic amphiboles. Most of the biotites are ferrobiotites and siderophyllites, while feldspars consist of oligoclases, andesines, and a minor K-feldspar. The metamorphic temperature of 619~661 and 695~702, and pressure of 1.86~1.94 kbar and 3.69~4.56 kbar for garnet hornfels and granofels separately are suggested by calculations using garnet-biotite thermometer, garnet-biotite- plagioclase-quartz geobarometry and plagioclase- hornblende thermobarometry, which imply that these rocks were subjected to middle-high temperature contact metamorphism.

The occurrence, mineral association and metasomatism relationship between minerals, space distribution characteristics of typical mineral, petrochemistry, rare earth and trace element geochemistry of metamorphic rocks in Nimu show that the garnet hornfels are parametamorphic rocks, with the protoliths being a Fe-shale or a shale, and the granofels are orthometamorphic rocks. Primitive mantle-normalized incompatible element dagrams of orthometamorphic rocks display a large ion lithophile elements (LILE) and LREE/HREE enrichment, rare earth element fractionation ($4.33<(La/Yb)N<13.64$) as well as negative Nb, Ta, P and Ti anomalies, with slightly positive or negative Eu anomalies. The high field strength elements (HFSE) in orthometamorphic rocks are rare stable whereas the contents of large ion lithophileelements (LILE), such as K, Rb, Ba etc., are quite variable, probablely relative to the later metamorphism. The orthometamorphic rocks show very similar geochemistry to the typical island arc volcanic rocks, such as Yeba volcanic rocks.

Three groups ages are obtained by U-Pb zircon LA-ICP-MS technique from Nimu parametamorphic rocks, there are 163±3~203±3Ma, 134±2~157±2Ma and 88±1~111±2Ma. We infer that the two older ones with a Th/U>0.1, may be of inherited magmatic origin, while the latest group may represent the time when the protoliths ceased to accept deposits.

To synthesize the studies, the protoliths of metamorphic rocks at Nimu, were considered to be Yeba volcanic rock and it's overlaying in sediments in the southern margin of the Gangdese. The formation of the metamorphic rocks of Nimu consists with the regional high temperature – low pressure metamorphic zone developed at continental margin magmatic are of south Gangdese, which corresponds to the northward subduction of the Indian plate.

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