Petrogenesis linkage among the Mesozoic high Mg andesites, garnet-bearing dacites and porphyries, rhyolites and leucogranites from West Qinling, central China

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An integrated study of petrography, mineral composition, geochronology, whole-rock geochemistry and Sr-Nd-Hf isotopes was carried out for the high Mg andesites, peraluminous garnet-bearing dacites and porphyries, rhyolites and leucogranites in the West Qinling, central China. We use these data to evaluate intracrustal processes in a collisional orogen. Crystallization ages of these magmatic rocks are ~234-244 Ma. The petrography, mineral chemistry and geochemical and isotopic compositions indicate that the high Mg andesites were generated by mixing between mantle-derived magma and crustal melt, and entraining of abundant old crystals cargoes at crustal level. The garnet-bearing igenous rocks and rhyolites define a common evolution trend in chemical compositions. They display more strongly peraluminous and more evolved Sr-Nd-Hf isotopic compositions with increasing SiO_2 contents. Four types of garnets have been identified: xenocryst, orthocryst, antecryst and peritectic phase. These results suggest that the peraluminous garnet-bearing porphyries and rhyolites were produced by fractional crystallization of andesitic magma, accompanied by assimilation of crustal materials and entrainment of various crystal cargoes. The leucogranites display strongly depleted HREE ($(Dy/Yb)_N$ = 14-22) and pronounced negative Eu anomalies, suggesting that they were produced by muscovite dehydration melting of metapelite under fluid-absent conditions leaving abundant residual garnet and plagioclase in the source. All these observation together suggest that multiple dispersive magma reservoirs may co-exist and could accommodate crystallization and crystal accumulation, recharging, remobilization crystal mush, crustal anatexis, magma mixing and mingling, assimilation and randomly entrainment of various crystal cargoes and crustal xenoliths at various crustal levels. Crust-mantle interaction and crustal differentiation mainly happened in the MASH (melting, assimilation, storage and homogenisation) zones or deep crustal hot zones in the mid-lower curst.