

Thermal Evolution of Archaean Basement Rocks from the Eastern Part of the North China Craton and Its Bearing on Tectonic Setting

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Abstract

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The basement rocks in the eastern zone of the North China Craton are composed predominantly of pre-tectonic TTG gneisses and syntectonic granitoids with rafts of supracrustal rocks consisting of ultramafic to felsic volcanic and sedimentary rocks metamorphosed over a range of conditions from greenschist to granulite facies. Most mafic granulites, amphibolites and some pelitic gneisses and schists preserve the prograde, peak and post-peak textures. The prograde metamorphic stage is indicated by mineral inclusions within minerals of the peak stage, represented by the assemblages of hornblende + plagioclase + quartz \pm biotite in mafic granulites, chlorite + actinolite + epidote + plagioclase + quartz in amphibolites and biotite + plagioclase + quartz in pelitic gneisses. The peak stage is shown by the assemblages of orthopyroxene + clinopyroxene + garnet + plagioclase + quartz from the mafic granulites, hornblende + plagioclase + quartz + garnet from garnetiferous amphibolites and garnet + sillimanite + plagioclase + quartz + biotite from pelitic gneisses. The post-peak stage are exhibited by garnet + quartz symplectic coronas in mafic granulites, actinolite + garnet (rim) retrogressive rims around garnet or hornblende grains in amphibolites, and kyanite replacing sillimanite or staurolite replacing sillimanite + garnet in pelitic gneisses. These textural relations and their P–T estimates define anticlockwise P–T paths for the basement rocks in the eastern zone. The anticlockwise P–T–t (time) paths of metamorphic rocks from the eastern zone reflect an origin related to the intrusion and underplating of large amounts of mantle-derived magmas that not only provide heat for the metamorphism but also add a large volume of mostly mafic material to the base of the crust. Crustal growth is therefore dominated by vertical addition of mantle-derived magmas to crust. Combined with the lithological, structural, metamorphic and geochronological considerations, these large volumes of underplated magma are considered to be related to upwelling mantle plumes (hot-spots).