

Single-grain garnet Sm-Nd isochron dating on Granulite

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Determining metamorphic time of high-grade metamorphic rocks, such as granulite and eclogite, is of vital significance for the study of metamorphic evolution. The commonly used dating technique of whole-rock and mineral Sm-Nd internal isochron does not always successfully yield geologically meaningful ages by reason of the Nd isotopic disequilibrium among different minerals. Single-grain garnet dating can avoid this problem, but extremely low Nd contents in garnet will restrict the application of this analytical technique and degrade the high accuracy of analytical data. So far, the isochron dating of single-grain garnet has been mostly obtained via two-point data of core/rim and whole rock/matrix on the centimeter scale of a grain. Otherwise, several-hundred milligrams of garnet need to be used for analysis. Here in this study, Sm-Nd isochron method is used for single-grain garnet via isotopic dilution and TIMS isotopic measurement in Nd⁺ mode. Using this method, three granulite samples from the North China Craton yield isochron ages of 1575 ±73 Ma (n=4), 1719 ±24 Ma (n=3), 1520 ±26 Ma (n=5), and 1745 ±24 Ma (n=4). These isochrones have good linear relationship (MSWD values of 0.4 - 2.1). High-quality Nd isotopic data were obtained by using small amount of garnet (~2 mg for each analytical point). In combination of zircon U-Pb isotopic ages and chemical composition of garnet, significance of the single-grain garnet ages is summarized as: two isochron ages of ~1.7 Ga are similar to the metamorphic time as recorded in zircon grains, which can represent the time of the granulite-facies metamorphism; ages of ~1.5 Ga might suggest Nd isotopic re-equilibrium or partial resetting of garnet grains during the retrograde metamorphism. The results show that the single-grain garnet dating is feasible for the dating on high-grade metamorphism.