

Metamorphic Evolution of Neoproterozoic complexes in the Sinai, Egypt: petrology, mineral chemistry and K-Ar age dating

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The metapelite schists and gneisses in three metamorphic complexes of Sinai have been discussed in terms of the mode of occurrence, metamorphic evolution, mineral chemistry, and age dating. Nine representative samples of metapelitic schists, migmatites and gneisses from the Taba (TMC), Kid (KMC) and Feiran-Solaf (FSC) metamorphic complexes in southern Sinai Peninsula have been analyzed by electron microprobe and K-Ar geochronological methods. Two distinct metamorphic assemblages of metapelitic schists from the TMC and KMC are recognized: 1) quartz-biotite-plagioclase-garnet-staurolite-corderite-ilmenite-chlorite, and 2) quartz-biotite-plagioclase-garnet-muscovite-tourmaline-magnetite, respectively. Garnet from the metapelites and pegmatite are Fe-rich and usually show zoning with variable X (Fe) values.

The estimated P-T metamorphic conditions of the TMC range from 560-578 degree/3-4.5 kbar for the metapelitic schists, to 685 degree/5.3 kbar for the migmatites, while those for the metapelitic schists in the KMC are 590 degree/4-5.9 kbar in the Umm Zariq Formation, and 636 degree/4.7 kbar in the northern part of the Malhaq Formation. The P-T metamorphic conditions of the hornblende-biotite gneisses from the SZ are 634-641 degree/ 4-5 kbar. These P-T conditions and mineral assemblages indicate lower amphibolite facies conditions of the LP/HT-type of metamorphism.

The K-Ar biotite ages range from 594 to 617 Ma for the TMC, from 593 to 609 Ma for the KMC, and from 589 to 602 Ma for the FSC. The average ages the TMC is 604 Ma, the KMC is 602 Ma, and the FSC is 596 Ma. Therefore, it could be suggested that the cooling metamorphic ages of all complexes lie at approximately 600 Ma, and thus points to a uniform and single metamorphic event for the whole complexes in the southern Sinai Peninsula.

The estimated geothermal gradient is in the range of 30-50 degree/km. Such a steep gradient and the LP/HT mineral assemblages suggest that they were formed in an extensional setting and a heat flow might have transferred from nearby late/post-orogenic granite intrusions.