Abstract

The plutonic complex at Turkel comprises a NE-SW trending, centrally-bulged anorthosite - leuconorite massif (81 sq km) within granulite facies gneisses (metapelite, calc-silicate gneiss, quartzofeldspathic gneiss and mafic granulite) that document three phases of folding. The massif was emplaced presumably during the earliest phase of folding. Gneissose felsic intrusives, broadly quartz monzonite to granite in composition, separate the massif from the metamorphic cover rocks. Ferrodiorites occur as veins at the felsic intrusives - anorthosite massif interface, and as apophyses within the massif.

Textural relations and phase equilibrium considerations prove that the metamorphic cover rocks attained high temperature ($\approx 900^0$C) and pressure (≈ 8 kbar) during peak metamorphic condition. Thereafter, the rocks experienced slow cooling ($T < 600^0$C) that was interrupted by near-isothermal decompression at $T \approx 750^0$C. The anorthosite massif originated at $T \approx 1200^0$C and $P \approx 12$ kbar, but experienced the retrograde cooling event documented by the cover rocks.

In all element variation diagrams, anorthosite, leuconorite and ferrodiorite plot along linear trends, but the felsic intrusives fall off the trends. It has been demonstrated that the ferrodiorites and the quartz monzonites are not related through liquid unmixing. Thus the low-K anorthosite - leuconorite - ferrodiorite suite and the high-K felsic suite do not share a common parentage. It is deemed that the anorthosite suite originated by polybaric plagioclase fractionation of parental magmas resembling high-Al gabbros. The geochemical signatures in the ferrodiorites, e.g., very high $fe^{\#}$ and strong enrichment of plagioclase-incompatible elements like $Zr \approx 4674$ ppm and REE $\approx$ 130X chondrite are typical for residual melts formed by extreme plagioclase fractionation. However, modelling of Sr vs. Zr and La vs. Eu indicate that the residual melts were not entirely segregated from the coexisting solids, a fact supported by the presence of plagioclase phenocrysts in ferrodiorite that are compositionally similar to those in leuconorite.

By contrast, the geochemical characteristics of the granitic rocks, e.g., peraluminous nature, high $fe^{\#} \approx 77$, high $\delta^{18}O \approx 10.5$ ‰, moderately high K_2O / Na_2O

≈ 2.5 and Ba content ≈ 1130 ppm are consistent with with their derivation by vapour-absent incongruent melting of crustal precursors. The metaluminous quartz monzonite gneisses are also proposed to be products of crustal anatexis, albeit from chemically different source rocks.