Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.14442

Role of crystal entrainment in producing chemical variation in S-type granite: a case study from Central Indian Tectonic Zone

ARIMITA CHAKRABARTY[1] AND DR. SUBHAM MUKHERJEE, PHD[2]

[1]Jadavpur University
[2]University of Delhi
Presenting Author: arimitachakrabarty@gmail.com

S-type granitoids, a chief component of the continental crust, show wide chemical variation and deviate from the composition of the experimentally derived melts from metasedimentary protolith. Crystal fractionation, magma mixing, wall-rock assimilation, crystal entrainment are proposed to be major reasons behind such chemical variations. In the northern part of the Central Indian Tectonic Zone, the protolith of a suite of felsic granulites, is inferred to be an Mesoproterozoic (ca. 1400 Ma) S-type granite that shows wide compositional range in terms of SiO_2, FeO + MgO, K/Na, Ca and Alumina Saturation Index (ASI). Based on modal mineralogy and geochemistry two types of granitoids, namely Type-1 (Monzogranite) and Type-2 (Granodiorite) are recognized. Type-1 rocks have restricted SiO_2 content (70-75%) and are alkali-calcic to calc-alkalic, highly potassic ($K_2O/Na_2O>1$) and highly peraluminous (ASI>1.1). Type-2 rocks, showing large variation in SiO_2 content (60-76%), are distinctly less potassic ($K_2O/Na_2O=0.15$-0.85), more calcic and metaluminous to marginally peraluminous (ASI<1.1). A negative correlation of molar Si, K, ASI, Rb, Ba and roughly positive pattern for Ti, Ca with respect to maficity (molar Fe+ Mg content) are noted in the studied rocks.

To address the chemical variation, path-dependent, open system melting of commonly occurring sedimentary rocks, have been modeled in the NCKFMASHTO system (with RCRUST). The results shows that (a) the chemical variation in the studied granitoids can be explained by isobaric heating of metagreywacke or biotite gneiss at the crustal depth that correspond to 7-9 kbar pressure at temperature range of 850-900°C; (b) the whole compositional range can be explained by composition of the melts with variable amount (0 to 30 vol%) of entrained phases, dominantly garnet ± orthopyroxene. The proportion and the nature of the entrained minerals in the parental melts exerted a strong control on the observed compositional variation in geochemistry; (c) elevated CaO contents of the S-type granitoids cannot be explained only by the entrainment of garnet and warrants the limited dissolution of residual anorthite.