

Origin of the Permo-Triassic Swat-Chakdarra granites in the higher Himalayan region of Pakistan: I- or S-type granites

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Abstract

The Swat-Chakdarra granites are exposed in the higher Himalayan region of Pakistan. The granites of the area are metamorphosed into augen gneisses comprising of quartz, feldspar, muscovite, biotite $\pm$ garnet. These granites are mainly subalkaline and peraluminous. These are enriched in large ion lithophile and light rare earth elements. Using REE patterns, the granites show prominent depletion in Eu, suggesting fractionation and/or early crystallization of plagioclase. The Chakdarra granites yield Rb-Sr whole-rock isochron age of 213 ± 24 Ma whereas the Saidu-Paroona and Illum-Karakar granites of Swat area illustrate 285 ± 8 and 260 ± 52 Ma ages, respectively. The $\delta^{18}\text{O}$ values in Chakdarra, Illum-Karakar and Saidu-Paroona granites are $+8.8$ to $+9.2\%$, $+8.6$ to $+9.4\%$ and $+9.0$ to $+9.5\%$, respectively. These granites show less than $+10\%$ $\delta^{18}\text{O}$ values, suggesting their I-type origin, however, the mineral assemblage and peraluminous chemistry classify the granites as S-type. Therefore, we conclude that the Permo-Triassic Swat-Chakdarra peraluminous granites with less than 10% $\delta^{18}\text{O}$ values are the W-type (White, A.J.R -type) granites, which were formed by fractional crystallization process from I-type crust rather than partial melting of the continental crust and/or crustal contamination, i.e. C-type (Chappell, B.W -type) granites. Based on the geochronological data the Illum-Karakar, Saidu-Paroona and the Chakdarra granite gneisses may belong to Permo-Triassic magmatic events resulted from rifting of the Gondwanaland.