Geochemistry and uranium-lead isotopic ages of volcanic rocks associated with Ladakh batholith, western Himalaya: Implications for petrogenesis and tectonic evolution

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We present zircon U-Pb ages and whole-rock geochemistry along with mineral chemistry of the Khardung volcanic rocks outcropped in the northern margin of the Ladakh batholith in order to constrain their origin and tectono-magmatic history. These volcanic rocks are sandwiched between the Ladakh batholith in the south and the Shyok suture zone in the north and span a continuous compositional range from basalt to rhyolite, although mafic rocks are minor and intermediate to felsic rocks are volumetrically predominant. New zircon U-Pb dating for andesite coupled with two rhyolitic rocks yield 69.71 Ma, 62.49 Ma, and 66.55 Ma, defining the probable span of their magmatism from Late Cretaceous to Palaeogene. Based on their mineralogical and geochemical compositional diversity, the Khardung volcanic rocks are categorized as intermediate volcanic rocks (basaltic andesite-andesite) and felsic volcanic rocks (dacite-rhyolite). The intermediate volcanic rocks are marked by low SiO$_2$ (52.80-61.31 wt.%), enriched LREEs, and negative HFSEs (Nb, Ti, Zr) anomalies whereas, felsic volcanic rocks are characterized by high SiO$_2$ (64.52-79.19 wt.%), pronounced negative Eu anomalies, enriched LREE and concave-downward HREE's and negative HFSE's (Nb, Ti) anomalies. Both the intermediate and felsic volcanic rocks exhibit quartz, sanidine, albite, bytownite, and diopside as their dominant mineral phases. Geochemical signatures indicate that the fractional crystallization and crustal contamination played a significant role in the evolution of the Khardung volcanic rocks and their geochemical diversity probably resulted from the partial melting of the common primary source, which had been metasomatized by variable contributions of fluids released from down going Neo-Tethyan oceanic crust. Thus, the Khardung volcanic rocks could be considered as a product of mature stage of arc magmatism during the subduction of the Neo-Tethyan oceanic crust, which occurred during Early Cretaceous to Palaeogene, prior to the main collision between the Indian and Asian plates.