

Geochemistry and petrogenesis of the Oligocene Volcaniclastic Rocks from the Chagai Arc, West Pakistan

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The Oligocene volcaniclastic rocks are found in an east-west trending subduction related magmatic belt known as the Chagai arc in the western part of Pakistan. The volcanism in this arc was initiated during the Late Cretaceous, which intermittently continued up to the Quaternary period. The volcanism up to Paleocene is tholeiitic whereas Eocene onwards it is calc-alkaline.

The petrological studies of rock samples collected from these volcaniclastic rocks reveal that there are mainly andesitic tuffs (56.62-60.11 wt% SiO₂). The petrochemical studies show that these rocks belong to high K (2.04-3.56 wt % K₂O) calc-alkaline series. The low Mg # (47-57) and high FeO (total/MgO (1.35 - 2.02) ratios indicate the fractionated nature of the parent magma.

The primordial mantle normalized trace element patterns exhibit negative Nb anomalies with spikes generally on K, Sr and Rb which strongly confirm their island arc signatures. The LREE enriched chondrite-normalized REE patterns with negative Eu anomalies are consistent with high K-calc-alkaline series and suggests plagioclase fractionation during differentiation. Plots in various tectonomagmatic discrimination diagrams depict that these rocks were erupted in a continental margin type (Andean-type) arc environment. The Z versus Zr/Y and Cr versus Y studies suggest that parent magma of these rock suites was generated by the partial melting of about 15-25 % enriched sub-arc mantle source. A comparison of average trace element chemistry of Oligocene volcaniclastic rocks from the Chagai arc with other analogous of the said arc show relatively more enrichment of LILE and LREE in the Oligocene and Miocene volcanics. This suggests that during aforementioned period, which was the time of emplacement of several porphyry copper deposits in the Chagai arc; relatively higher quantity of subduction related fluids were added to the sub-arc mantle source from the subducting slab.

Keywords: Chagai arc, Petrogenesis, Volcaniclastics, Andean-type, high-K calc-alkaline