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Petrochemical and Sr-Nd isotopic evidences of assimilation-fractional crystallization and magma mixing in Eocene aged collisional volcanics in the Ulubey (Ordu) area, NE Turkey

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The Eastern Pontide Tertiary Volcanic Province (EPTVP) in NE Turkey is divided into two sub-provinces as a northern alkaline and a southern calcalkaline one on the basis of lithological and petrochemical differences (Arslan et al., 1997; Arslan & Aliyazı cı oğlu, 2001; Temizel & Arslan, 2008, 2009). Collisional Eocene aged volcanic rocks in the Ulubey (Ordu) area of the eastern Pontide are grouped into three suites; the Trachydacite-Dacite (TD) suite, Trachyandesite-Trachydacite-Rhyolite (TTR) suite and Andesite-Trachyandesite (AT) suite.

Petrochemically, the volcanic rocks show tholeiitic-alkaline to the calc-alkaline affinities, and have medium to high-K contents. Most samples have low Mg#, Cr, and Ni, which indicates that they have undergone significant fractional crystallization from mantle-derived melts. The geochemical variations can be explained by fractionation of common mineral phases such as hornblende + biotite + plagioclase $\pm$ clinopyroxene $\pm$ magnetite $\pm$ apatite $\pm$ sanidine in the TD, TTR and AT suite rocks. Sr and Nd isotopic composition for the intermediate-acidic rocks are relatively homogeneous in isotopic composition, with $(^{87}Sr/^{86}Sr)_i$ ranging from 0.704347 to 0.704909, $(^{143}Nd/^{144}Nd)_i$ from 0.512563 to 0.512748 and εNd_i from (-0.81) to (+2.83). $(^{87}Sr/^{86}Sr)_i$ ratios and εNd_i values of the volcanics reveal a depleted mantle source region enriched by slab components. Petrochemical and Sr-Nd isotopic data suggest that fractional crystallization (FC) $\pm$ magma mixing (MM) $\pm$ assimilation-fractional crystallization (AFC) played a significant role in the evolution of the volcanic rocks.

The parental magma of the volcanics may have been derived from $\sim$20-30% partial melting of garnet-lherzolite mantle source. Fractional crystallization modelling based on trace elements shows 35-60% plagioclase, 15-50% hornblende, 5-10% biotite, 5-10% clinopyroxene, 5% sanidine and 5% magnetite fractionation in TD, 35-75% plagioclase, 10-55% hornblende, 5-10% biotite, 5-45% clinopyroxene, 5% sanidine and 5% magnetite fractionation in TTR and 35-70% plagioclase, 25-60% hornblende, 5-10% biotite, 5-30% clinopyroxene, 5% sanidine and 5% magnetite fractionation in AT. XLFRAC modelling results indicate that fractional crystallization is the most important magmatic processes and, magma mixing and AFC are accompanied to FC in the evolution of the volcanic rocks. Trace element and Sr-Nd isotopic AFC modelling show that assimilation/fractional crystallization ratio (r) is $\leq$0.2, suggesting that the effect of assimilation coupled with fractional crystallization (AFC) processes on the evolution of the rocks would not take part more important role than FC. Furthermore, Sr and Nd isotopic modelling suggests that mantle-crust mixing ratios are between 5 and 25%, revealing that the parental magma of the volcanics has not been affected much by continental crust.

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