

Geochemical and Sr-Nd isotopic characteristics of the calc-alkaline volcanic rocks from Borçka (Artvin): Implications for genesis of Tertiary magmatism in the Eastern Pontides (NE Turkey)

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Whole-rock geochemistry and Sr-Nd isotopic data are reported for the Tertiary Borçka (Artvin) volcanics in the eastern Pontide orogenic belt (NE Turkey). Borçka (Artvin) volcanics were made of two groups that comprise of basalt-basaltic andesite-basaltic trachyandesite (Group A) and andesite-trachyandesite (Group B). The Group A contains plagioclase (An₃₁₋₉₃), clinopyroxene (Wo₃₈₋₄₈En₃₈₋₄₄Fs₈₋₁₇), hornblende (Mg[#]=0.57-0.72) phenocrysts and titanomagnetite microphenocrysts, whereas the Group B rocks include plagioclase (An₅₂₋₉₃), clinopyroxene, hornblende (Mg[#]=0.64-0.71) phenocrysts and titanomagnetite and apatite microphenocrysts with porphyritic, microlitic porphyritic, hyalo-microlitic porphyritic, fluidal and cumulo-phiritic textures.

Petrochemically, the volcanic rocks show calc-alkaline character with their medium K contents. They are enriched in LREE and LILE, with pronounced depletion of HFSE. The chondrite-normalized REE patterns (La_N/Lu_N=1-7) show low to medium enrichment, indicating similar sources for the rock suite. Textural features and calculated pressures based on the Cpx-barometer in each series indicate that the calc-alkaline magma equilibrated at shallow crustal depths under a pressure of about 2-7 kbar and approximating a crystallization depth of 5-18 km.

The Borçka (Artvin) volcanics are slightly depleted in isotopic composition. ⁸⁷Sr/⁸⁶Sr values vary between 0.70423 and 0.70511 while ¹⁴³Nd/¹⁴⁴Nd values change between 0.51266 and 0.51288. Sr-Nd isotopic ratios imply that the rocks derived from depleted mantle source in their origin. The increasing values of SiO₂ (wt.%), Sr (ppm) and (1/Sr)x10³ ppm⁻¹ versus (⁸⁷Sr/⁸⁶Sr)_i values reveal fractional crystallisation (FC) rather than assimilation (AFC) in their evolution.

Low molybdenum isotope compositions in euxinic Sapropel S1

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Molybdenum isotopes are a powerful proxy for paleoredox conditions in organic-rich sediments. Here, we apply this isotopic system to a Holocene S1 sapropel layer sampled at 2550m depth in the Eastern Mediterranean Sea (ODP core 967D). Our study utilizes the isotopic systems of Mo and Fe, together with geochemical tracers (Ba/Al, Fe_T/Al, Mn/Al, S) to explore the relationship between the sapropel formation conditions and the Mo paleoredox proxy.

Euxinic (sulphidic) bottom water conditions during the sapropel formation are supported by Fe isotopic composition, which shows negative correlations between δ⁵⁷Fe and Fe_T/Al and S wt%. This is consistent with the benthic Fe shuttle model whereby Fe is exported from the oxic shelf to the deep euxinic basin [1]. The Mo paleoredox model for highly sulphidic restricted marine systems envisages organic-rich sediments acquiring Mo isotope signatures of sea water (δ⁹⁸Mo = 2.3‰) due to the quantitative removal of Mo from the sulphidic water column. This scenario is not realized in the 967D profile, which shows a decrease in δ⁹⁸Mo values from ca 0‰ in the pre-sapropel sediment to negative values of -0.8‰ within the sapropel, before gradually rising to values of 0 to 0.4‰ in the overlying post-sapropel sediment. Negative linear correlations between δ⁹⁸Mo values and Fe_T/Al, Ba/Al, Mo/Al and S indicate that maximum euxinic conditions are associated with the lowest Mo isotopic compositions.

The low δ⁹⁸Mo values are potentially compatible with sulphidization of Mo in mildly sulphidic euxinic conditions [2,3]. Nevertheless, increasing euxinia should lead to positive correlations between δ⁹⁸Mo and the geochemical proxies. Thus, additional factors such as open system conditions for Mo uptake may be required to explain the full workings of the Mo paleoredox proxy.

[1] Lyons *et al* (2009), *Annu. Rev. Earth Planet. Sci.* **37**, 507-534. [2] Neubert *et al* (2008), *Geology* **36**, 775-778. [3] Dahl *et al* (2009), *GCA* **74**, 144-163.