New geochemical and geochronological constraints for the origin of Orhaneli-Dursunbey volcanic rocks, NW Anatolia (Turkey)

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An extensive volcanism constructed through multiple eruptions of basic to silicic magmas developed during the Late Cenozoic in NW Anatolia (Turkey). New radiometric age and geochemical data are presented from the volcanic activity in the study area which is situated between the towns of Orhaneli (Bursa) and Dursunbey (Balıkesir). The felsic lavas are volumetrically more dominant than mafic lavas.Volcanism in the region began with felsic pyroclastic rocks and rhyolitic-rhyodasitic lavas. K/Ar radiometric age data obtained from rhyolite lavas indicates that their age varies from 19.4 to 19.0 Ma corresponding to the Early Miocene. According to their mode of occurrences, pyroclastic rocks of felsic phase may be divided into two groups; the pryoclastic fall deposits and the pyroclastic flow deposits. The pyroclastic fall deposits are represented by pumice fall, pumice-ash, ash and ash-block fall deposits. The pyroclastic flow deposits may also divided into two subgroups; ash-block deposit and ignimbrites. Our field observations indicate that the volcanic rocks were formed from a number of small vents which set along approximately NNE-SSE trending fault zones by the plinian/sub-plinian eruptions. Felsic volcanism was followed by transitional basalts, basaltic andesite lavas with the age of 18.7 to 17.5 Ma as the last products of volcanism in the Orhaneli-Dursunbey volcanic field.

Geochemically, the volcanic association is high-K calc-alkaline in nature and show similar characteristics to post-collisional volcanic rocks. Both volcanic suites exposed in Orhaneli and Dursunbey area display a gap in silica concentrations. Trace element characteristics and Sr-Nd isotope data indicate that coexisting mafic and felsic magmas derived from lithospheric mantle source yielding depleted but LILE-enriched compositions, with subsequent contamination. Basic parental magmas of mafic and intermediate volcanic rocks were generated from EM1-type mantle previously modified by subduction, whereas felsic volcanic rocks were produced by assimilation of silicic crust and combined fractional crystallization (AFC).

Rates and mechanisms of hydration in crystalline crust

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A free water phase in crystalline rocks of the mid to lower crust fulfils two roles: it enhances deformation while present, but participates in hydration reactions that lead to its consumption. The precise rate of hydration has important implications for crustal rheology as it determines whether the continental crust normally contains free water. We have investigated hydration rates for powdered enstatite-oligoclase-quartz under mid-crustal conditions of 400ºC and 300 MPa and find that c. 2.0E-07 g H_2O is consumed per m^2 enstatite surface per second. This rate is comparable to the rates of hydration of andalusite + K-feldspar from Schramke *et al.* [1].

Such rates are dependent on calculated surface areas, which may change during the run. We therefore carried out a series of experiments using 4mm diameter cores of fine grained (100-200 microns) basaltic hornfels. These hydrated too slowly for accurate weight loss measurements, consistent with only the outer surface of the cylinder being effectively reactive. This result validates the approach in earlier work [2], in which we calculated that water films with a half width of 100 μm can only persist for periods of a few tens of years under these conditions.

Experiments with hollow cores resulted in marked segregation as product minerals grew as well-formed crystals creating vein-like material in the available space.

[1] Schramke *et al.* (1986) *American Jl Sci* **287**, 517-59. [2] Yardley *et al.* (2010) *Geofluids* **10**, 234-40.