Goldschmidt 2000
September 3rd–8th, 2000
Oxford, UK.

Journal of Conference Abstracts
Volume 5(2), 157

Constraints on Petrology and Petrogenesis of Tertiary Volcanism in the Eastern Pontide Paleo-Arc System, NE Turkey

Mehmet Arslan (marslan@ktu.edu.tr)[1], **Zafer Aslan** (aslan@ktu.edu.tr)[1], **Cüneyt Sen** (csen@ktu.edu.tr)[1] & **Paul W. O. Hoskin** (papanui@xtra.co.nz)[2]

[1] Department of Geology, Karadeniz Technical University, 61080-Trabzon, Turkey
[2] Department of Geological Sciences, Canterbury University, Christchurch 8020, New Zealand

Introduction and Regional Setting

As an island-arc complex, the Pontides developed mainly with subduction of Neotethyan oceanic crust from the Late Cretaceous to the Late Eocene. The region is an example of arc generation and long-term crustal evolution from pre-subduction rifting, through convergent margin to post-subduction alkaline volcanism. Volcanic rocks lie unconformably on Palaeozoic basement containing metamorphic sequences and cross-cutting granitoids. Three main groups of volcanic rocks are distinguished broadly: Liassic, Upper Cretaceous and Eocene, although the age boundaries are poorly constrained. Recent studies describe differences between three volcanic groups. Investigations (Arslan et al., 1997; Sen et al., 1998) within each volcanic 'cycle' are providing important information on the nature of Eastern Pontide volcanism but there is a lack of direct information on the chemical composition, mineralogy and structure of the Palaeozoic basement and upper mantle. Such data is fundamental to the rigorous interpretation of geochemical data obtained from the overlying igneous rocks.

Volcanic Stratigraphy and Petrography

The post Cretaceous volcanism extending in large areas in both northern and southern zones of the Eastern Pontides is known as Eocene volcanism, although there is rock-type and chemical variation between the northern and the southern regions. In the southern region, volcanics are intercalated with sediments, and mainly andesite, basalt and pyroclastics, containing plagioclase, augite, hornblende, biotite and lesser Fe-Ti oxide and quartz. In the northern region, volcanics are disconformably overlying Upper Cretaceous rocks, and contain dominantly basalt, tephrite and andesite and pyroclastics. Large augite is characteristically dominant and associated with olivine, plagioclase, phlogopite, nepheline, sanidine, cancrinite and Fe-Ti oxides. Although, there is no reliable geological control for the age of the volcanics, present data indicate Eocene-Miocene ages and even existence of younger products of the volcanism. An important constraint on regional tectonic reconstruction is the absolute timing of volcanic events. U-Pb isotope analyses by Hoskin et al. (1998) on titanite and zircon from northern region indicate that the duration of volcanism may extend from Late Palaeocene/Early Eocene to the Pliocene, although it is almost certain to have been episodic.

Hoskin et al. (1998) were able to recognise open-system magma-chamber dynamics in the source-region of these rocks from chemical and fractal statistical analyses of two large, zoned clinopyroxene crystals. Although both crystals derive from the same magmatic system, they are interpreted to have experienced different crystallisation pathways, having crystallised partially under different P-T-x conditions. Changes in the phenocryst texture, chemistry and fractal geometry will be related to T-x conditions of the whole-rock at eruption. Factors other than T and composition, x, such as melt-polymerisation are likely to play an affective role.

Geochemistry

In the southern region, volcanics are mainly calcalkaline and low to medium K in composition. Geochemical variations reflect significant role of plagioclase, hornblende, augite and Fe-Ti oxide fractionation, magma mixing and contamination processes during the evolution of these volcanics (Arslan and Aliyazicioglu, 2000). Data indicate typical arc related calcalkaline character. The rocks may be interpreted Palaeocene-Eocene continuation of Albo-Cenomanian to Campanian volcanism that migrated toward south. In the northern zone, volcanics are alkaline in composition, and modified by contamination and differentiation at low level magma chambers. Data suggest that volcanics were derived from mantle metasomatized by dehydration of subducted slab.

Petrogenesis and Discussion

The petrogenesis of the volcanic rocks are closely related to major events recognised within the tectonic framework of the Pontides. Maximum crustal thickening of the volcanic arc at the termination of subduction in the Eocene triggered partial melting of the lower crust/upper mantle producing alkaline volcanic rocks. Detailed field and analytical study of the Eocene volcanics are required in terms of stratigraphy, physical volcanology, and spatial and temporal chemical evolution.

Arslan et al. (1997) and Sen et al. (1998) define two related groups in the northern region. The significance and nature of chemical differences between the groups are not well understood presently, but may represent mantle heterogeneity on a ~20 km scale underneath the Pontide crust. Another alternative is that both groups derived from the same source-region but are products of different degrees of partial melting. The former alternative is favoured by Sen et al. (1998) on the basis of differences between the two groups in compatible element concentrations. Recently obtained analyses from the northern region volcanics support the general conclusions, although (Ba/Y) vs. Ba and (Ba/Zr) vs. Ba plots indicate open-system

Journal of Conference Abstracts
Volume 5(2), 158

dynamics as well as simple batch melting, a result supported by analysis of oscillatory zoning clinopyroxene phenocrysts (Hoskin et al., 1998). These new data indicate smaller degrees of partial melting of the mantle-source based on (Zr/Y) and (Zr/Nb) ratios, and perhaps a significant role for crustal assimilation in some samples as suggested by scatter in some discriminant plots.

The role of the Palaeozoic basement as an assimilant during magma evolution is uncertain, although Arslan et al. (1997) attribute the relative enrichment-trend of the (La/Sm)N ratio of alkaline rocks with respect to (Ba/La)N to 'crustal material'-contamination. It is not clear, however, at this stage what the relative roles of crustal contamination, crystal fractionation and subduction-derived input are. A study of lower- and mid-crustal xenoliths would involve identification of possible contaminants to volcanic rocks. Chemistry of xenoliths may identify the low (Ba/La)-high (La/Sm) 'crustal material'-contaminant. However, xenoliths in the northern volcanics are cognate type and occurred during the stops of uprising magma (Sen, 1998).

Information about the upper-mantle beneath the Pontides derived from the geochemistry of volcanic rocks, indicates the mantle source-region is enriched relative to N-MORB (Arslan et al., 1997). This is supported by Pb isotopic analyses by Hoskin and Wysoczanski (1998). The timing of this enrichment is unknown, but is probably related to metasomatism of the mantle wedge during subduction of Neotethyan oceanic crust during the Cretaceous, although the pre-subduction Liassic volcanics display slight-enrichment also. Certainly by the Eocene, the alkaline volcanics show strong LREE-enrichment (and garnet in the source) as well as enrichment in the LIL elements (Arslan et al., 1997). Sen et al. (1998) suggest that the mantle source-region were heterogeneously enriched by the subduction-related metasomatism, although no data is currently available on the mineralogy and modal proportions of the mantle in this region.

Conclusively, the detailed characterisation of these volcanic rocks by field, major and trace element and geochronological studies is necessary to understand the importance and role of various processes involved in magma generation and differentiation, spatially and temporally.

Arslan M & Aliyazicioglu I, *International Geological Review*, (in press), (2000).

Arslan M, Tüysüz N, Sadettin K & Kurt H, *Chemie der Erde*, **57**, 157-187, (1997).

Hoskin PWO & Wysoczanski RJ, . *Journal of Analytical Atomic Spectrometry*, **13**, 597-601, (1998).

Hoskin PWO, Arslan M & Aslan Z, *Mineralogical Magazine*, **62A**, 653-654, (1998).

Sen C, *MTA 75th Year Earth Sciences & Mining Congress Abstracts*, 10-12, (1998).

Sen C, Arslan, M & Van A, *Turkish J. Earth Sciences*, **7/3**, 231-239, (1998).