Stratigraphy, geochemistry, and petrology of the Upper Cretaceous volcanic arc sequence north of Istanbul, Pontides, NW Turkey

Cemre Ay[1], Gürsel Sunal[2], Aral I. Okay[1]
[1] Eurasia Institute of Earth Sciences, Istanbul Technical University, Istanbul, Turkey
[2] Department of Geological Engineering, Istanbul Technical University, Istanbul, Turkey (ay19@itu.edu.tr)

1.Introduction

The Upper Cretaceous magmatic arc extends along the southern coasts of the Black Sea from Georgia to the Bulgaria. The Upper Cretaceous arc-related volcanic and volcanoclastic units overlying the Paleozoic sedimentary rocks of the Istanbul Zone are a key unit related to the opening of the Black Sea as a back-arc basin. They formed as a result of north dipping subduction of the Neo-Tethys Ocean beneath Laurasia.

The volcanic and volcaniclastic rocks north of Istanbul are divided into İshaklı and Riva formations (Figure 1). At the base there is a fore-arc turbidite succession,the Ishaklı Formation, which is made up of volcaniclastic sandstone, shale, marl, tuff, debris flow horizons and epiclastic rocks of Campanian age. The Ishaklı Formation is transitionally overlain by the Campanian volcaniclastics, tuffs, andesite, and basalt lavas, and agglomerates- the Riva Formation, which represents the arc/ intra-arc series (Figure 2).
We aim to determine the beginning and end of the magmatism age in the Istanbul Zone, to reveal the stratigraphy of the Upper Cretaceous volcanic rocks and the the environment of magmatism.

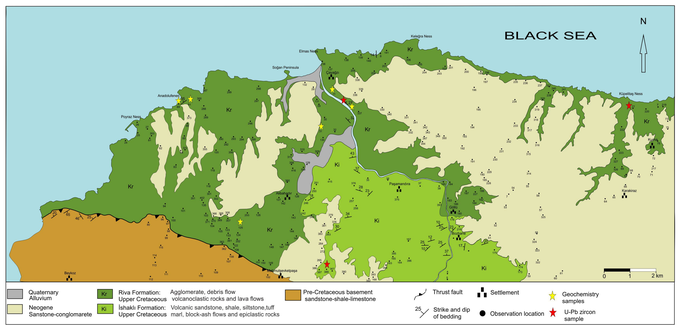


Figure 1: Geological map of northeast of Istanbul.

2. Stratigraphy and Petrography

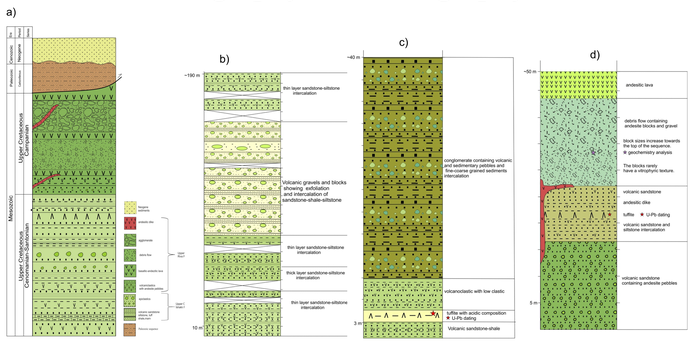


Figure 2: a) Generalized stratigraphic section of the study area. b,c)Detailed stratigraphic section of the Ishaklı Formation. d) Detailed stratigraphic section of the Riva Formation.

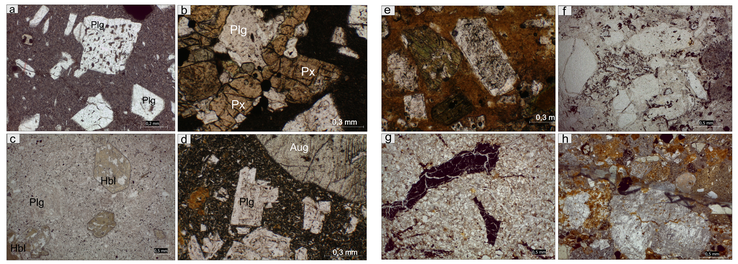


Figure 2.1: Photomicrographs of volcanic and volcaniclastic rocks from the Riva and İshaklı Formation. a) Plagioclase (plg) phenocryst which exhibit sieve texture in a basalt. b) Pyroxene and plagioclase phenocrysts surrounded by the fine-grained groundmass c) Hornblende phenocryst in a fine groundmass in an andesite d) Plagioclase and augite phenocrysts in a fine-grained groundmass. e) Hornblende and plagioclase minerals surrounded by volcanic glass in crystalline tuff f) acidic tuff containing feldspar and quartz g) Volcanogenic sandstone in a turbidite sequence h) Lithic tuff containing plagioclase and amphibole minerals, volcanic rock fragment, and pelagic fossil

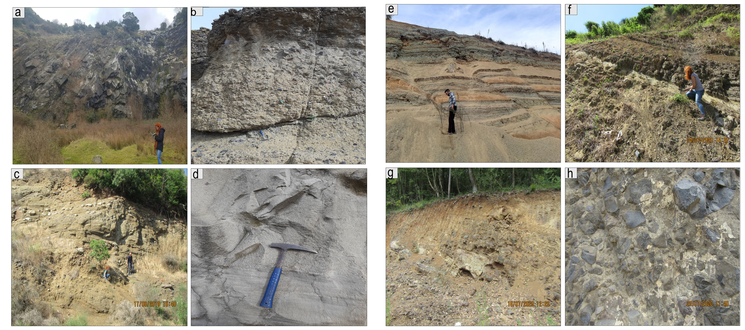


Figure 2.2. Filed photographs. a) Upper Cretaceous andesitic lava. b) Agglomerate. c) Debris flow observed within the Riva Formation. d) Lithic tuff level within the volcaniclastic sequence. e) Turbiditic succession cut by normal faults. f) Lithic tuff level within the volcanic sandstone . g) Debris flow over interbedded sandstone and siltstone. h) Epiclastic rocks composed of volcanic and sedimentary blocs.

3. Geocronology

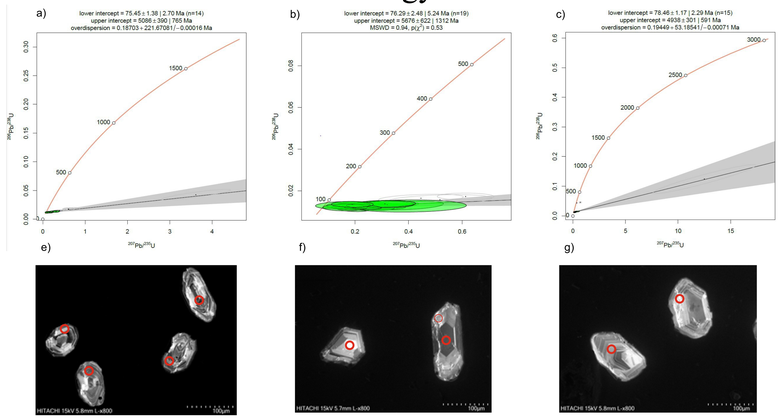


Figure 3: a) Zirkon U-Pb discordia diagram from tuff of İshaklı Formation. b,c) Zirkon U-Pb discordia diagrams from tuff of Riva Formation. e) Cathodoluminescenge images of the zircons from tuff of Ishaklı Formation. f.g) Cathodoluminescenge images of the zircons from tuff of Riva Formation.

4. Geochemistry

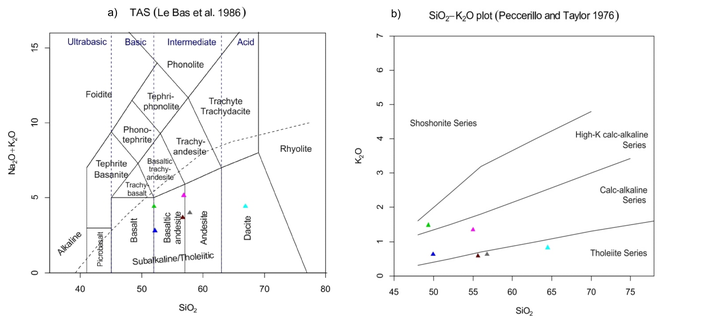


Figure 4: a) TAS (total alkali vs. silica) diagram of Le Bas et al. (1986) from Riva Formation b) SiO2-K2O diagram of Peccerillo and Taylor (1976) from Riva Formation.

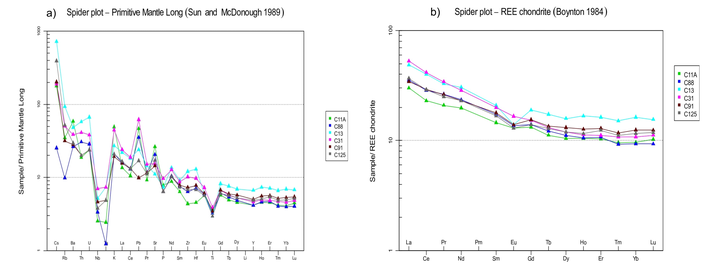


Figure 4.1: a) Primitive Mantle -normalized multi-element patterns of the lav and agglomerates within the Riva Fm. b) Chondrite-normalized REE patterns of the lav and agglomerates within the Riva Fm.

-low K calc-alkaline to medium-high K calc-alkaline
-negative Nb-Ta anomalies
-La/Yb=2,76-4,89
-Mg=32.6% to 51.5%

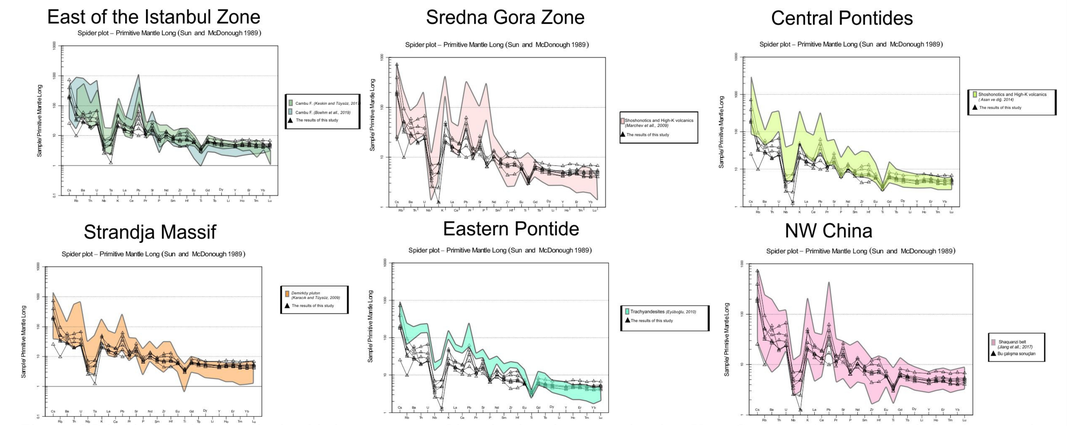


Figure 4.2:Primitive Mantle -normalized multi-element patterns of the volcanic rocks outcropping along Upper Cretaceous Arc magmatism belt and compared with the results of this study. In addition, our results were compared with results of Shaquanzi belt rocks results interpreted as intra-continental back-arc.

5. Conclusion

1- Detailed 1/25 000 scaled geological maps and stratigraphic sections of the region north of Istanbul Zone have been prepared.
2- Basalts and basaltic andesites from the Riva Formation belong low to medium-high-K calc-alkaline series and are characterized by subduction component.
3- LA-ICP-MS U-Pb zircon datings of the tuff levels from the Ishakli and Riva formations yield 75.45 Ma (Campanian) and 78.46 - 76.29 Ma (Campanian) ages, respectively.
4- Regional correlation of the geochemical data in the literature indicates that the geochemical characteristics of the Upper Cretaceous volcanic rocks exposed in the study area are similar to those exposed in the whole Western Pontides. Furthermore, geochemical nature of the volcanic rocks in the Istanbul Zone shows a close similarity with Shaquanzi belt located in NW China , and represents a possible intra-continental back-arc setting.
5- Our new geological and geochemical data suggest that there was a transition from fore-arc turbidite deposition to arc volcanism during the Late Cretaceous opening of the Western Black Sea as a back-arc basin.