Upper Cretaceous Stratigraphy and Volcanism in the İğneada Region, Pontides, NW Turkey

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Introduction

The Pontide Upper Cretaceous magmatic arc can be traced for over 1000 km along the southern Black Sea coast from Georgia to Bulgaria. The arc extrusive sequence is well-exposed in the İğneada region in Thrace close to the Bulgarian border. The Upper Cretaceous sequence in İğneada region overlies the schists and phyllites of Strandja Massif with an unconformity. As it is seen in the generalized stratigraphic section (Fig. 1), the sequence consists at the base of Cenomanian shallow marine limestone, which pass up into carbonate-rich sandstone, marl and calcareous siltstone indicating deepening upwards.

Stratigraphy

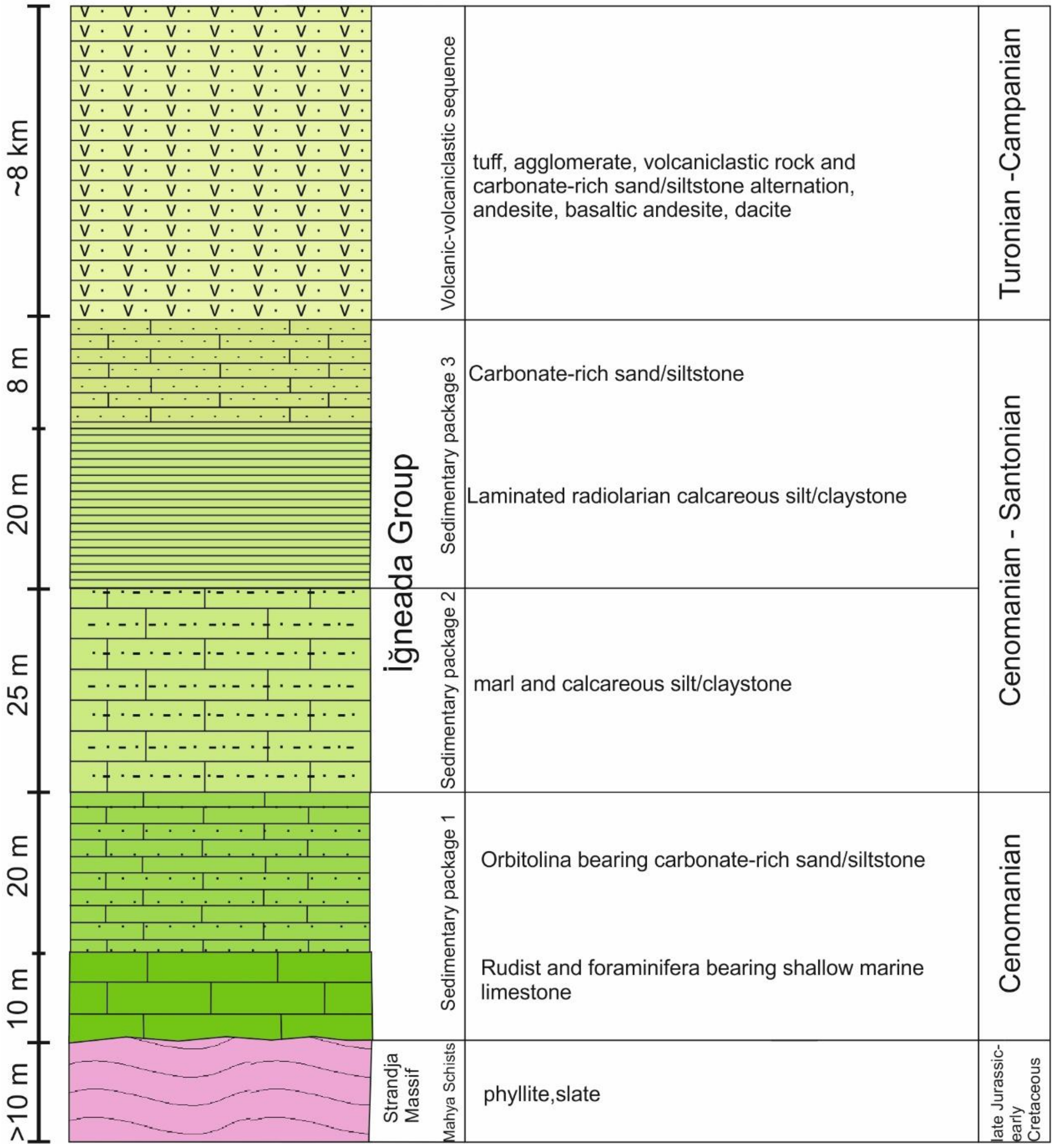

Figure 1. Generalized stratigraphic section of the study area.

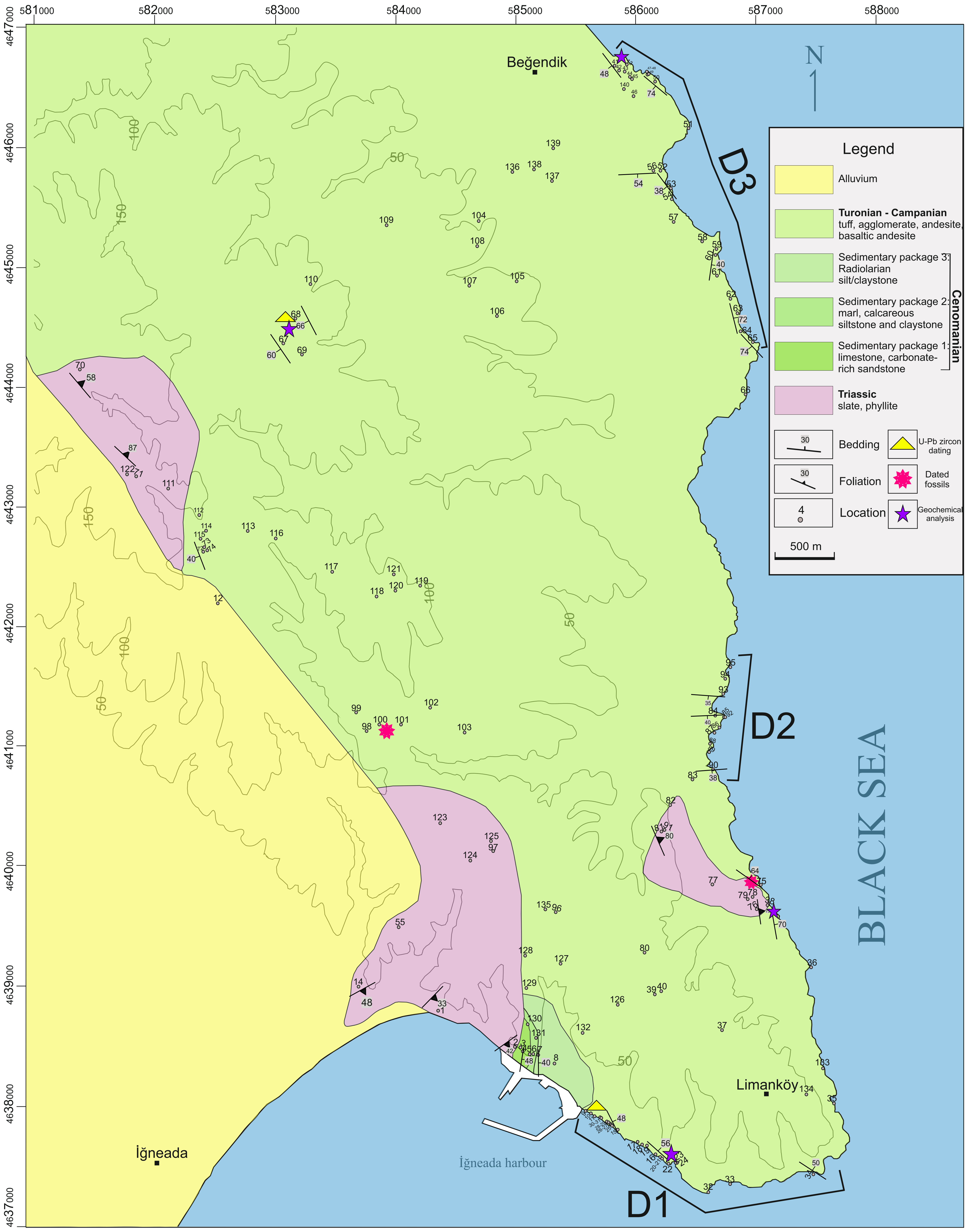

Figure 2. Geological map of the study area

The metamorphic basement is unconformably covered by sedimentary rocks of İğneada Group. The sedimentary rocks pass up into a volcanic-volcaniclastic sequence of andesitic tuff, lapillistone, agglomerate, andesitic and basaltic-andesitic (Fig.4) lava flows. The volcanic-volcaniclastic sequence is divided into three domains for a detailed investigation and they are indicated on the map (Fig. 2) as D1, D2 and D3. The volcaniclastic rocks are intercalated with lava flows (Fig. 3), rare pelagic limestone and shale beds. The sequence starts with andesitic volcaniclastic rocks and lava flows, and changes to basaltic-andesitic and then, to andesitic and dacitic rocks. Although it is disrupted by several faults, the volcanic sequence can be traced from older to younger along the coast of İğneada. The sea floor alteration, which is found in all volcaniclastic and volcanic rock samples, the intercalated pelagic limestones, and turbiditic sedimentary structures (Fig. 5) show that the rocks were deposited in deep submarine conditions in an intra-arc to fore-arc environment.

Figure 3. Field photo from location 94 showing the alternation of the andesitic tuff-sandstone in the SW and the light green massive andesitic rocks in the NE. The red line separates these two units.

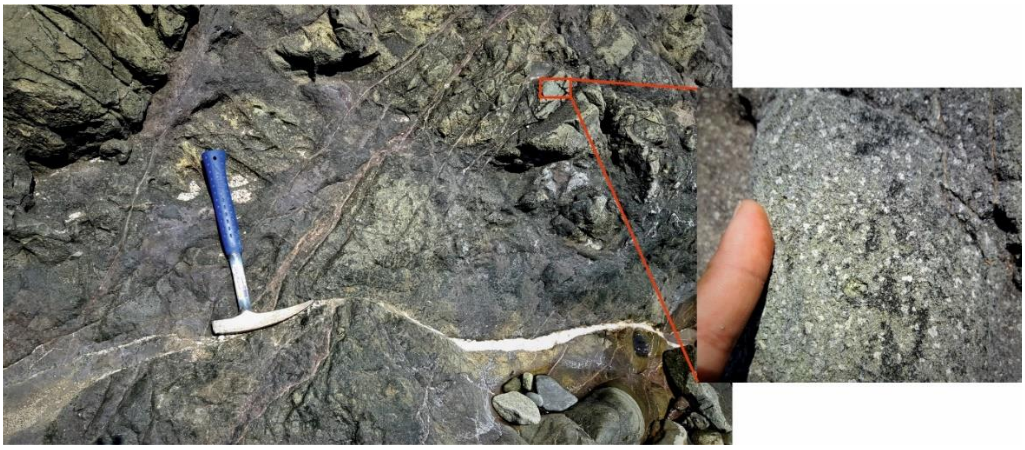

Figure 4. Field photo and close up view of the dark greenish grey basaltic andesite from location 38.

Figure 5. Field examples of convolute bedding in volcanogenic sand/siltstone from location 42 and 44.

Geochemistry

According to the K2O-SiO2 (Peccerillo and Taylor, 1976) and Th-Co diagrams (Hastie et al., 2007) (Fig. 6), which are conducted to classify altered volcanic arc lavas, the samples are basaltic andesite, andesite and dacite. They are located in calc-alkaline, high-K calc-alkaline or shoshonite series.

High field strength elements, which are relatively immobile and more resistant to alteration, are important for interpretation of altered samples. According to primitive mantle-normalized trace element spider diagram (Fig.7), distinct Nb-Ta anomaly, which is typical for volcanic arc basalts, is seen for all samples. The reason for the negative anomaly in Ba may be fractionation of a feldspar or mica mineral. Negative anomaly in Ti may be explained with fractionation of rutile or ilmenite. Zr also shows negative anomaly indicating that a mineral including Zr is fractionated. The reason for slight negative anomaly in Eu may be limited plagioclase fractionation. Positive anomaly in Pb may be seen because of hydrothermal alteration.

Consequently, the calc-alkaline characteristic of samples and negative Nb-Ta anomaly indicate the volcanic arc setting.

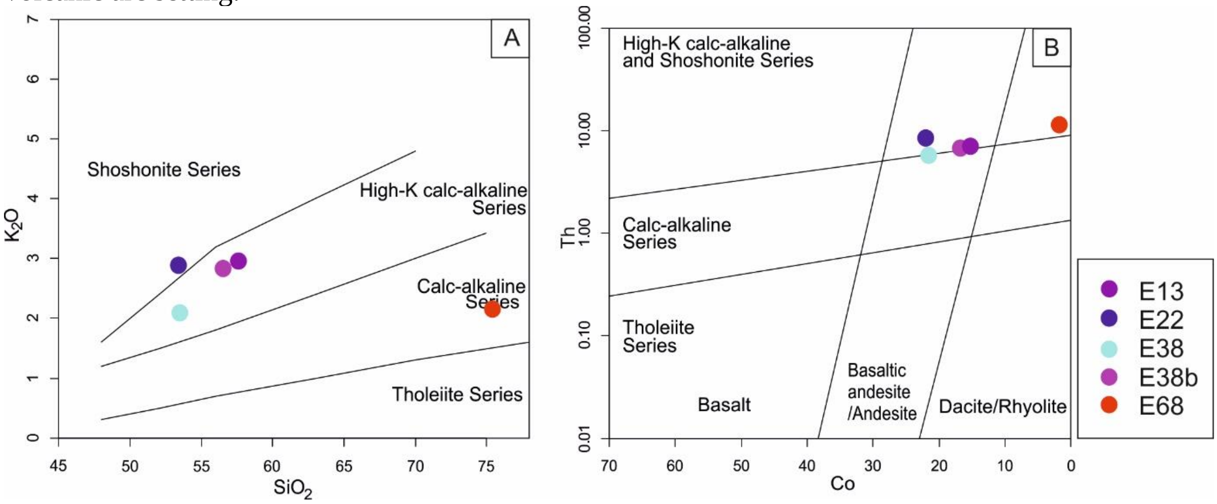

Figure 6. Discrimination diagrams A) K2O-SiO2 diagram after Peccerillo and Taylor (1976) B) Th-Co diagram for rock type and volcanic series after Hastie et al. (2007)

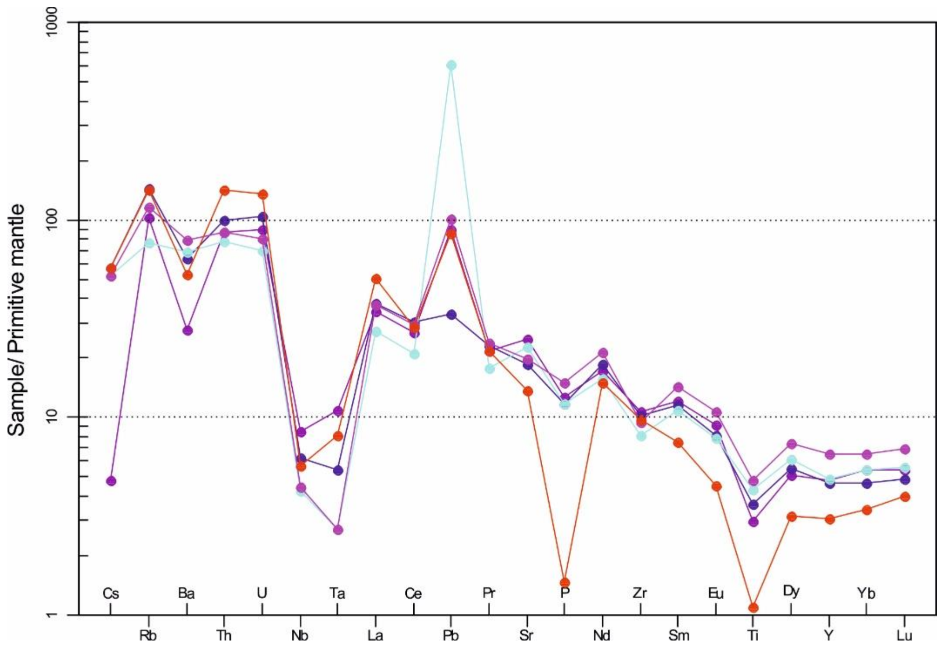

Figure 7. Trace element spider diagrams normalized to primitive mantle after McDonough and Sun (1995)

The Age of Volcanism: U-Pb zircon and fossil ages

The beginning of the sedimentation in the İğneada region is suggested as Albian based on rudist ages or Cenomanian based on foraminifera ages from the basal carbonate-rich sandstones (Pamir and Baykal, 1947; Çağlayan and Yurtsever, 1998; Arca, 2012). In this study, the start of the volcaniclastic deposition and hence the beginning of the volcanism is determined as Turonian based on the planktonic foraminifera *Marginotruncana pseudolinneana*, *Marginotruncana marginata*, *Whitenella* sp., *Whitenella praehelvetica*, *Muricohedbergella* sp (Fig. 8). In addition, the U-Pb zircon ages from two different locations reveal Santonian and Campanian ages (Fig. 9) indicating a continued volcanism from Turonian to Campanian.

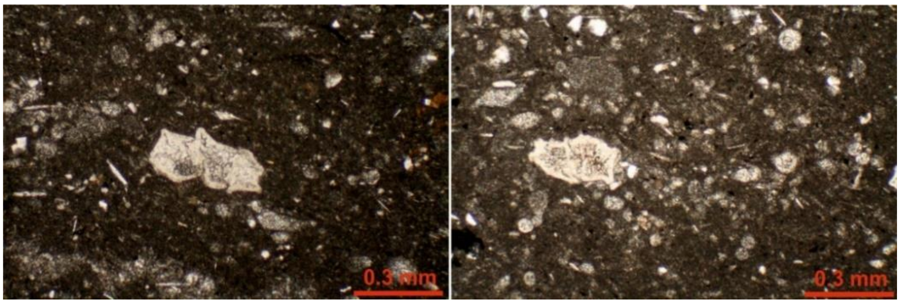

Figure 8. Photomicrographs of sample 75 showing the biomicrite from location 75 including the fragments of Turonian planktonic foraminifera *Marginotruncana pseudolinneana* and *Marginotruncana marginata*.

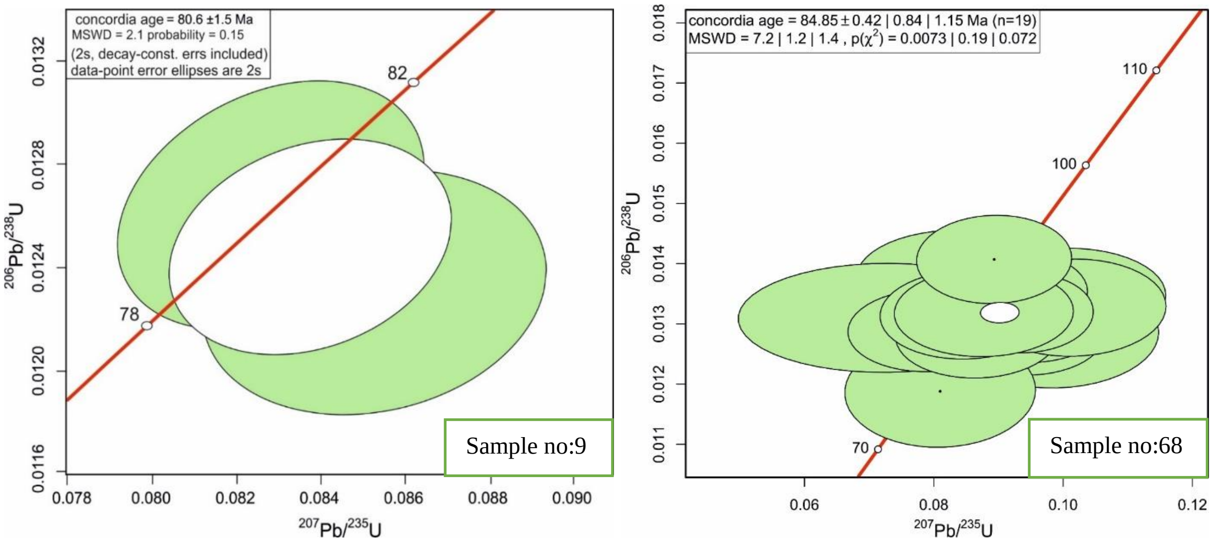

Figure 9. U-Pb concordia diagrams showing LA-ICP-MS zircon data of sample 9 and 68 which are taken from location 9 and 68, respectively.

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