

Stratigraphic Characteristics of the Alibonca Formation in the Southern Arapgir, Malatya, Turkey

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Abstract— The main purpose of this article is to reveal the age and formation environment of the Alibonca Formation. The units that cropped out in the study area are Keban Metamorphites (Permo-Trias), Alibonca Formation (Lower Miocene), Malatya Volcanites (Lower-Upper Miocene), Meteristepe formation (Lower Pleistocene), Yoncalı formation (Upper Pleistocene), talus and alluviums (Holocene-current).

Alibonca Formation is composed of medium-thick bedded limestone that is the product of carbonate platform. The unit also comprises mudstone containing clay-rich limestone, marl and coal strata that deposited on the lagoons connected to the Miocene Sea that the limestone deposited on. The unit unconformably overlying different bases was formed in the Aquitanian- Burdigalian period when the region fell under transgression effect. The Lower-Upper Miocene aged Malatya Volcanites are composed of agglomerate, tuff lapilli and lava flows with dacitic, andesitic and basaltic composition crossing them. There is a transitional and concordant contact between Alibonca Formation and Malatya Volcanites.

Key words— Malatya, Stratigraphy, Alibonca Formation, Malatya Volcanites.

I. INTRODUCTION

The study area is located in the W-SW part of Arapgir that is located approximately 60 km NE of Malatya (Figure 1). It is a tectonic area under the impact of Malatya Fault Zone and Ovacık Fault Zone. There are a considerable amount of studies on petrographic, geochemical, radiometric age and formation of the igneous rocks in the area. However, stratigraphic studies on the Alibonca Formation are very few. Keban Metamorphites was first included in Alanya Assembly that is one of the differentiated assemblies in the Taurus Orogenic Belt and called as Keban Metamorphites by [1]. The unit was called as Permian-Trias by [1], Permo-Carboniferous by [2] and Permian-Lower Trias by [3]. Alibonca Formation was identified by [4] with this name in Alibonca district in NW of Muş. The unit dates back to the Lower-Miocene period according to the fossil content [5]. The name Malatya Volcanites was first used by [6] to describe the volcanites spreading on a vast area in the northern Malatya. Applying radiometric methods, [7] identified the Lower Miocene age in andesites, Middle Miocene age in basalts and Middle-Upper Miocene age in dacites. [8] suggests that the volcanites in the region have transitional and alkali characteristics and are the product of continental crust arc volcanism.

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II. STRATİGRAPHY

Keban Metamorphites (Permo-Trias), Alibonca Formation (Lower Miocene), Malatya Volcanites (Lower-Upper Miocene), Meteristepe formation (Lower Pleistocene), Yoncalı formation (Upper Pleistocene), talus and current alluvium (Holocene-current) crops out in the study area (Figure 1).

In the study area, the base of Keban Metamorphites cannot be examined and is unconformably covered by the limestone of Alibonca Formation. The unit is represented by a lithology composed of chalcocyst and chalcophyllite beneath and marble above.

Alibonca Formation is represented by carbonate rich claystone, clay-rich limestone and marl lithology in the western part of the study area. Here, the unit presents disconnected and narrow-field crops due to heavy tectonism. It is composed of thick bedded and abundantly fossiliferous limestone in the eastern parts. While the base of the unit cannot be observed in the western parts of the region, it crops out in the NE that cover the marbles of Keban Metamorphites with angular unconformity. Alibonca Formation is concordantly and transgressively overlaid by tuff and agglomerates that are the part of Malatya volcanites. The unit was divided into two members as Kınık (Tak) and Süceyin (Tas), and examined accordingly. [9], in their study in the area, defined Alibonca Formation exposures around Çobandere Village as Çobandere member (Taç) and said that this member comprises the base level of Alibonca Formation.

Malatya Volcanites are composed of agglomerate, alternately tuff-lapillistone, dacite, basalt and andesite respectively from bottom to the top in the study area. These sub-lithologies forming Malatya Volcanites were divided into 5 members: Yanıklar agglomerate member (Tmy), Sığircıuşağı tuff-lapillistone member (Tms), Geyiktepe dacite member (Tmg), Sarıkaya basalt member (Tmsk) and Şakşaktepe andesite member (Tmş).

Meteristepe formation that unconformably covers the unit is composed of loosely bonded conglomerates. Yoncalı formation is made up of planar cross-bedded (Gilbert type) sandstone, limestone and siltstone, and concordantly overlies Meteristepe formation. On the other hand, talus and alluvium unconformably cover all the units.

In accordance with the purpose of the study, 4 measured stratigraphical sections were obtained from Alibonca Formation and correlated with each other. These sections are Kınık, Dikilitaş, Süceyin and Sekisu measured sections from west to the east (Figure 1). The geological data obtained from these sections are given below.

The base of Kınık member cannot be examined in the study area. The unit is represented by conglomerate, sandstone and mudstone in near NE of Kınık Neighbourhood (Kınık measured stratigraphic section). The lower part of the sequence that is approximately 85 m thick is composed of lenticular geometric conglomerate, middle-thick bedded red mudstone-grey sandstone alternation and conglomerates overlying them with an eroded base. The next part of the sequence exists a lithology of densely chert-banded and nodular carbonate-rich claystone, limestone and marl up to

the level of 613 m. It is overlaid by 52 m thick grey-red mudstones. These mudstones contain chert intercalated fine limestone and marl strata at upper levels. The alternation of tuffite-claystone-sandstone overlying the mudstones is indicator of the beginning of volcanic activity. This 100 m thick section involves lapillistone-agglomerate settlements. It is overlaid by Malatya Volcanites with lapillistone containing basalt blocks with eroded base. The measurable thickness of Kınık sequence is 750 m (Figure 2).

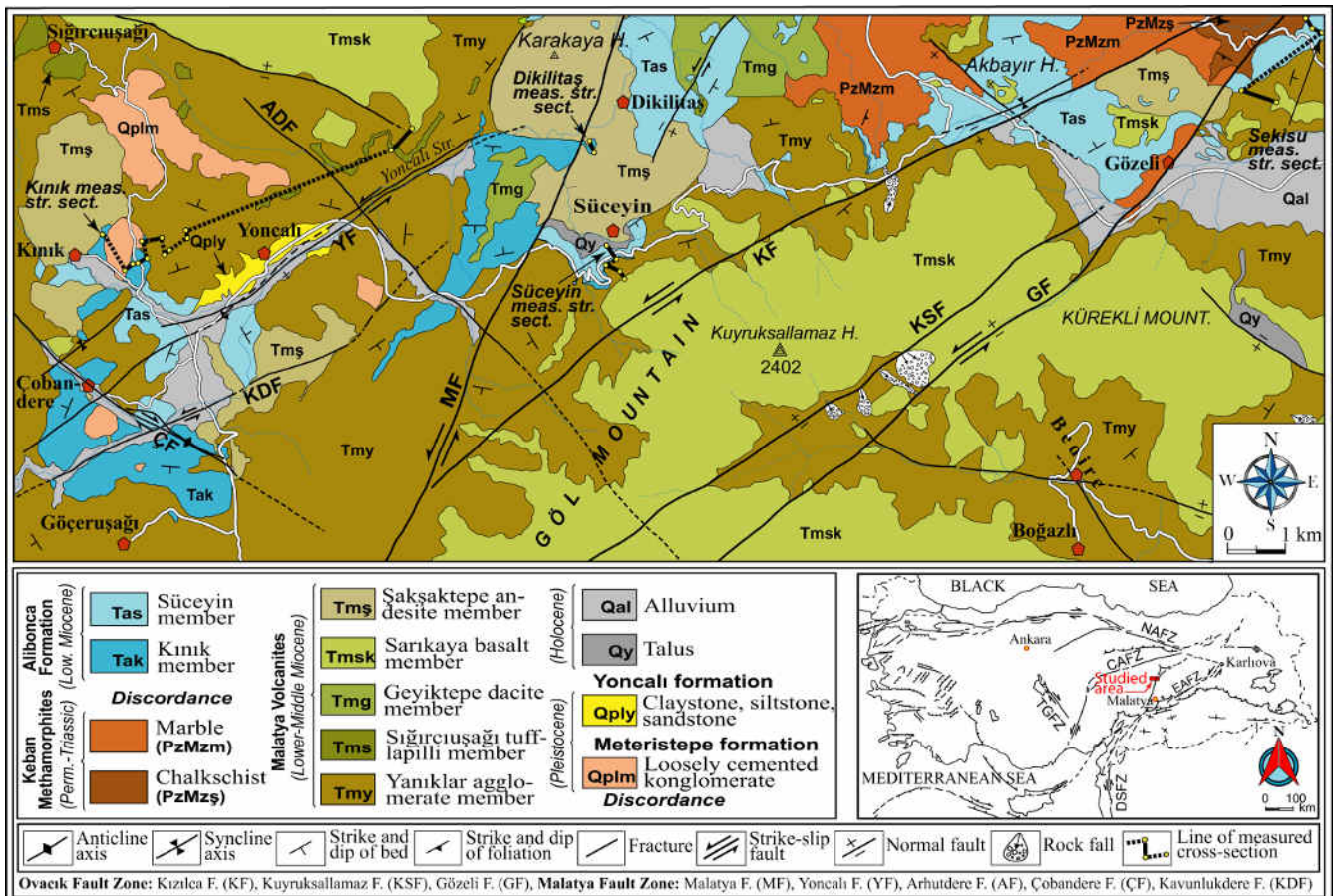


Figure 1. Detailed geological map of studied area [modified after 10].

The base of the sequence cannot be observed in the measured stratigraphical section (Dikilitaş measured stratigraphic section) obtained from the crop located approximately 800 m SW of Dikilitaş Village as well. The measurable thickness of the sequence is approximately 118 m and it is covered by andesitic lava flow created by Malatya Volcanites. The whole sequence is composed of the alternation of proper bedded grey-brown mudstone-claystone whose thickness varies between 1-40 cm, and it contains coal beds with different frequency and thickness (Figure 3).

In the crop (Süceyin measured stratigraphic section) in the southern part of the study area, the base of Süceyin member also cannot be observed. The base level of the unit in the crop is composed of foliated, white, unfossiliferous and thin bedded clayey limestone; macro fossiliferous sandy limestone and lenticular cross bedded carbonate rich claystone-clayey limestone. It is overlaid by white-beige, 2-50 cm thick bedded, amply macro fossiliferous, intraformational conglomerate up to the level of 72 m. The part of the section

transitioning to clayey limestone and marls has the characteristics of amply lamellibranch coquina, ripple mark and bioturbation. The upper levels of the sequence is composed of mostly altered, incompetent, laminated-fine bedded white claystone, clayey limestone and marl. The unit passes to the pyroclastics of Malatya Volcanites with approximately 4 m thick, loosely gravelly, greenish-beige claystone containing 0,5-4 cm clay nodules. Here, the agglomerates of the Volcanites have an eroded base. The measurable thickness of the unit is 102 m in this section (Figure 4).

Süceyin member overlies the marbles of Keban Metamorphites with angular disconformity in the exposure located at the southern Sekisu Neighbourhood (Sekisu measured stratigraphic section). The base section of the sequence is formed of hard, grey-beige limestone, which thickness is diminishing upper layer, with ripple marks, plenty bioturbation at higher levels, and abundant macrofossils. The upper levels of the sequence are composed of bedded, back

graded, carbonated matrix conglomerate strata. The gravels of the conglomerate are made up of mostly limestone and of chert to a lesser degree. The total thickness of the sequence is 178 m and it is concordantly covered by agglomerates (Figure 5).

The clastic sequence of Alibonca Formation consisting of red conglomerates and sandstones (Kınık base) characterize alluvial fan facies. All levels in Kınık and Dikilitaş sequences show similarity to lithofacies composed of clayey carbonate, carbonate-rich claystone and shale, and contain coquinas of

Ostracod and Gastropod macrofauna. These Ostracod and Gastropod shells indicate that the sea Alibonca Formation deposited on was occasionally connected to the lagoon basins as well. Coal levels found at the lower levels of Dikilitaş sequence display the occasional formation of swamp and development of coal beds under these swamp conditions in this environment. As for the chert bands and nodules frequently found in Kınık sequence, they reveal the continuation of volcanic activity during the sedimentation of the unit.

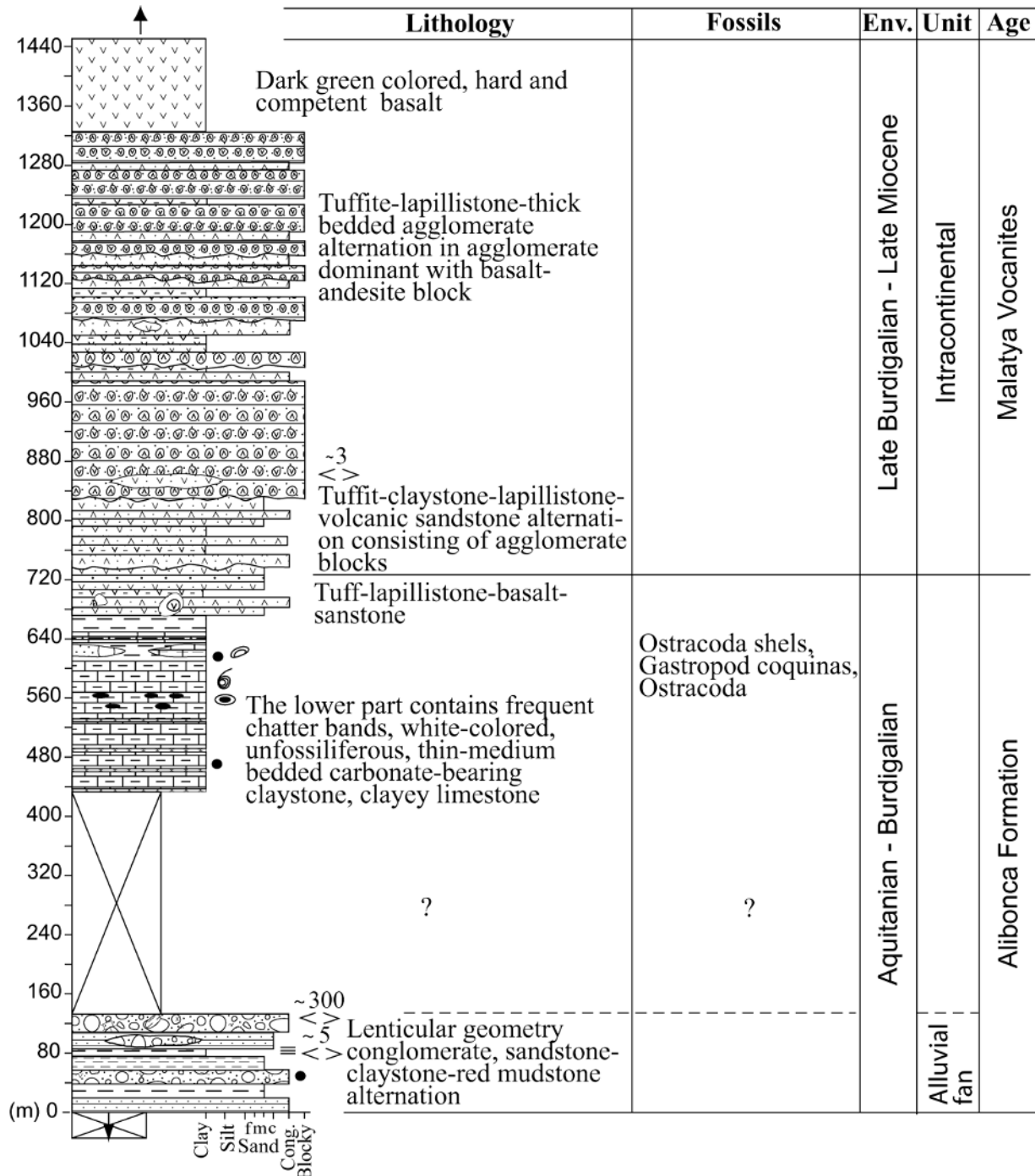


Figure 2: Kınık measured stratigraphic section.

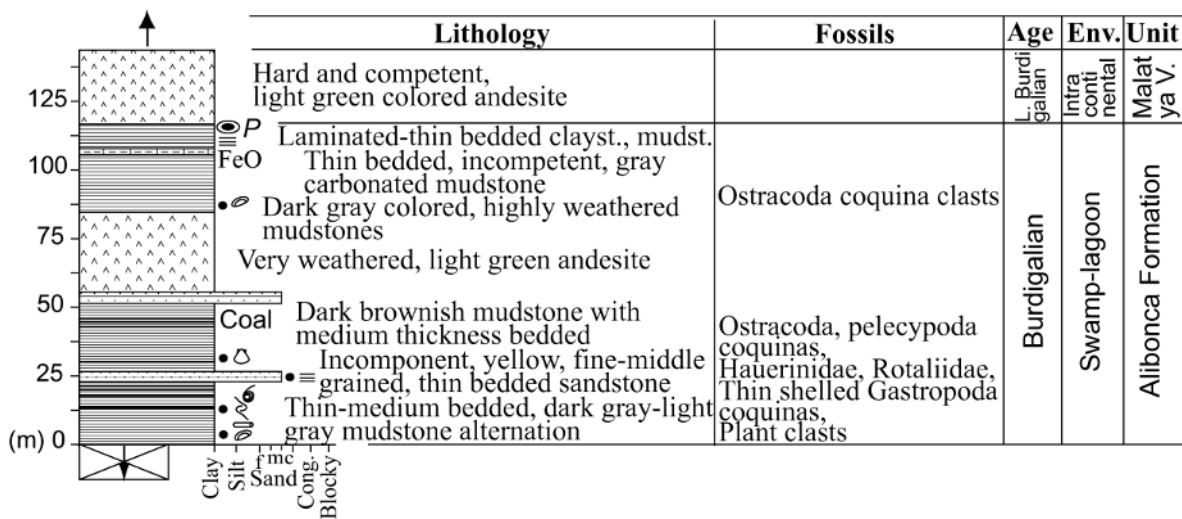


Figure 3. Dikilitaş measured stratigraphic section.

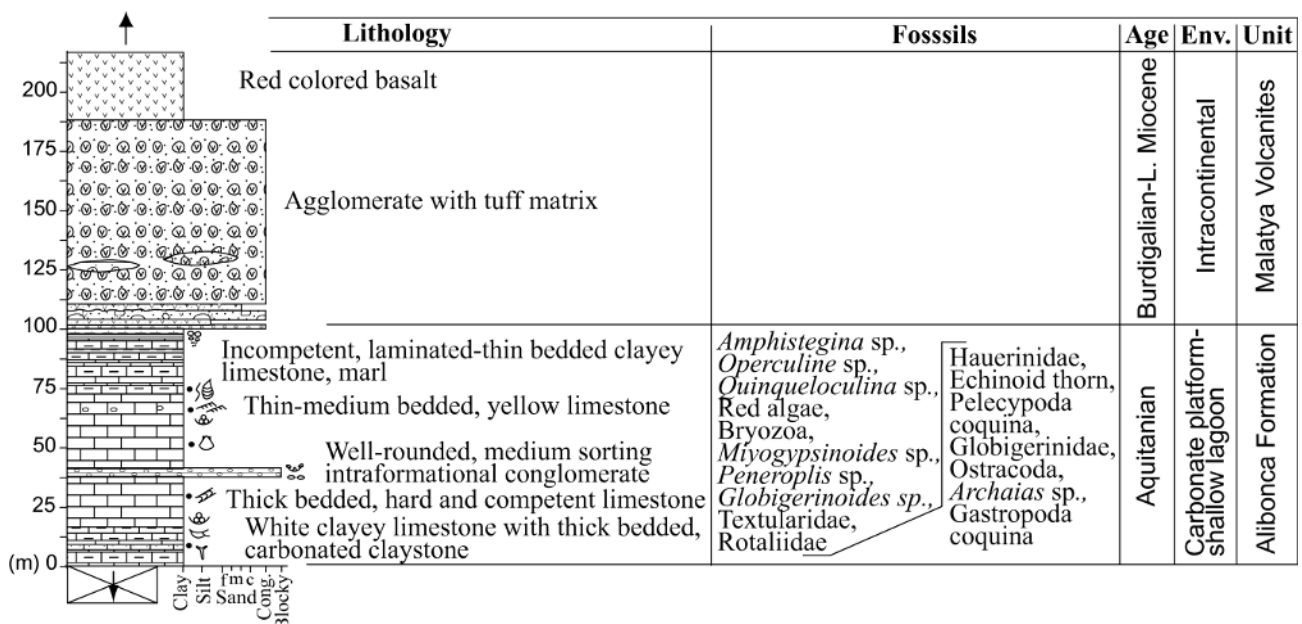


Figure 4. Süceyin measured stratigraphic section.

The clastic sequence of Alibonca Formation consisting of red conglomerates and sandstones (Kınık base) characterize alluvial fan facies. All levels in Kınık and Dikilitaş sequences show similarity to lithofacies composed of clayey carbonate, carbonate-rich claystone and shale, and contain coquinas of Ostracod and Gastropod macrofauna. These Ostracod and Gastropod shells indicate that the sea Alibonca Formation deposited on was occasionally connected to the lagoon basins as well. Coal levels found at the lower levels of Dikilitaş sequence display the occasional formation of swamp and development of coal beds under these swamp conditions in this environment. As for the chert bands and nodules frequently found in Kınık sequence, they reveal the continuation of volcanic activity during the sedimentation of the unit.

It was found that the sequence in Süceyin crop of Alibonca Formation contains a benthic and planktic foraminifera collection like Textulariidae, Rotaliidae, *Quinqueloculina* sp., Hauerinidae, *Peneroplis* sp., *Archaias* sp., *Amphistegina* sp., *Globigerinoides* sp., Globigerinidae, *Miyogypsinoidea* sp

and a macrofauna collection like Ostracoda, Red Algae components, Bryozoa, Gastropoda coquina, Pelecypoda coquina components, Echinoid thorn and Echinoid coquinas (Figure 4). The sequence that was found to be Aquitanian aged according to this fauna collection is lateral-vertical transitional with crops around Sekisu Neighbourhood. The fossils of *Archaias* sp., *Quinqueloculina* sp., *Peneroplis* sp. and Hauerinidae family found in the limestone strata at the lower levels of the sequence reflect the environmental conditions of shallow lagoon. Thick bedded limestone overlying this section and containing intraclast *Miyogypsinoidea* sp. fossils reflect the characteristics of carbonate platform.

In Sekisu crop of the unit (Figure 5), the sequence contains a mixed collection of fossils including *Operculina* sp., *Lepidocyclina* sp., *Miyogypsina* sp., Rotaliidae, Textulariidae, *Lepidocyclina (Eulepidina) (Nephrolepidina)* spp., *Operculina* sp., *Quinqueloculina* sp., *Globigerinoides* sp., *Borelis* sp., *Amphistegina* sp., *Miyogypsinoidea* sp., Globigerinidae, Acervulinidae, Bryozoa, red algae pieces,

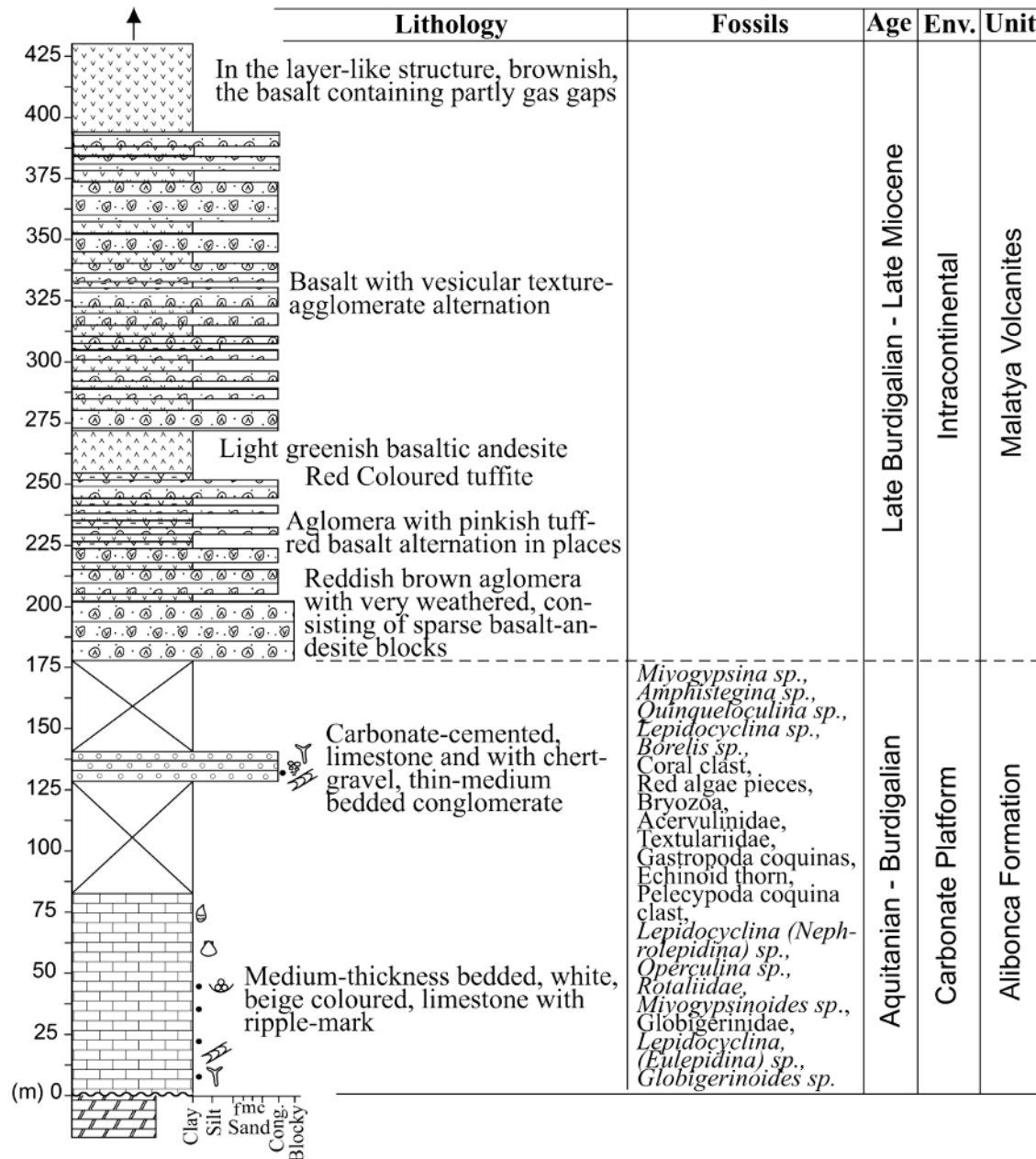


Figure 5. Sekisu measured stratigraphic section.

Pelecypoda coquina clasts, Echinoid thorn, Gastropoda coquinas and Coral clasts. The lower part of the sequence that has abundant *Operculina* and *Lepidocyclina* partly characterizes the open sea conditions of the carbonate platform in approximately 60-80 m water depth. According to this fossil collection, the sequence is Aquitanian aged. In the rock samples obtained from the crops of Alibonca Formation apart from the measured stratigraphical sections, *Ditrupa* sp., *Miyogypsina* spp., *Lenticulina* sp., Soritidae, Peneroplidae, *Victoriella* sp., *Heterostegina* sp., *Globigerina* sp., Charophyta and *Miyogypsinoidea* fossils were found in addition to the abovementioned fossil collection and the age of the unit was found to go back to the Burdigalian time.

III CONCLUSIONS

Alibonca Formation is the product of carbonate platform connected with lagoon basins and containing alluvial fan levels. The age of the formation was found as Aquitanian-

Burdigalian according to the fossil content. The formation depositing on the transgressive Miocene Sea was affected by the intracontinental volcanism leading to the formation of Malatya Volcanites in the last phases of its deposition (Late Burdigalian).

In the study area, the unit is unconformably overlaid by Pleistocene aged Meteristepe formation and Yoncali formation. Based on the stratigraphical data, it will not be a healthy interpretation to say that the volcanism continued in the Pliocene period. Therefore, the Upper Miocene age concluded from the radiometric age analyses conducted in the previous studies was accepted as the upper age limit of Malatya Volcanites in this study as well. Consequently, the age of Malatya Volcanites is Late Burdigalian (Lower Miocene)-Upper Miocene.

ACKNOWLEDGMENT

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