Bulletin of Scientific Contribution, Volume 13, Nomor 2, Agustus 2015: 108-..

LIMESTONE BEDS DEVELOPMENT OF THE MIDDLE–LATE MIOCENE JATILUHUR FORMATION IN THE BOGOR TROUGH, WEST JAVA

Abdurrokhim and Hendarmawan
Faculty of Geology, Padjadjaran University

ABSTRACT

The sedimentary rock succession of the Jatiluhur Formation comprises of mixed siliciclastic and carbonate sedimentary rocks. Two intervals of limestone beds are observed along the Cipamingkis River, on the lower and upper part of succession. Limestone in the lower part is typified by coarse-grained slump-scar-fill deposits that deposited during middle Miocene. It is largely consisting of skeletal fragments that have been delivered from the shallow marine carbonate reef of the Upper Cibulakan Formation during relative sea level fall. The punctuated mixing of siliciclastic and carbonate detritus took place during the middle Miocene in the Bogor Trough. Limestone beds in the upper part are characterized by thick- to very thick bedded limestone intercalated with thin- to very thin laminated siltstone, claystone, and fine-grained sandstone, which are interpreted to have been deposited in the shelf margin environment during late Miocene. The limestone consists of various characteristic of packstone, grainstone, rudstone and boundstone. Carbonate reef of the Klapanunggal Formation is interpreted to be the source of thick-bedded limestone in the upper part. The facies mixing of siliciclastic and carbonate sediments occurred in the middle part of Jatiluhur Formation during the late Miocene.

Keywords: *Jatiluhur Formation, mixed siliciclastic and carbonate, facies, Cipamingkis River*

.

INTRODUCTION

The mixtures of carbonate and siliciclastic materials are observed in both modern and ancient shallow-marine environments. Their stratigraphic records are characterized by successions that consist of limestones, sandstones, and mudstones, and commonly formed in the middle and low latitude shelves (e.g., Mount, 1984; McNeill et al., 2004; Lubeseder et al., 2009; Gischler et al., 2010). Mount (1984) identified four major processes that are responsible for the mixing of siliciclastic and carbonate sediments: (1) punctuated mixing, (2) facies mixing, (3) in situ mixing, and (4) source mixing.

In the northern part of the Bogor Trough, the mixed siliciclastic and carbonate deposits, which is known as the Jatiluhur Formation, is well exposed (Sudjatmiko, 1972; Effendi, 1974). The formation consists of claystone, siltstone, quartz sandstone, basalt & tuffaceous breccia, and marl & limestone (Sudjatmiko, 1972).

Characteristic and genetic of the limestone beds within the succession of the Jatiluhur Formation is not yet clearly described. The processes that are responsible for developing limestone beds are also not yet clearly identified. This paper intends to discuss the major processes that are corresponding to the carbonate mixing in the siliciclastic sediments in the lower and upper parts of the Jatiluhur Formation that exposed in the Cipamingkis River.

DATA AND METHOD

This study focuses on the limestone beds of the Jatiluhur Formation that exposed in the Cipamingkis River. There are two intervals of limestone in the Jatiluhur Formation: (1) limestone bed in the lower part of the Jatiluhur Formation, which is associated with the slope deposits, and (2) limestone beds in upper part of formation that are associated with sandy siltstone dominated facies of shelf margin deposits. Hand specimen samples were taken from the limestone beds of the Jatiluhur Formation for petrographic examination in order to identifying mineral composition and faunal features by using a polarization microscope.

The age of the Jatiluhur Formation in the Cipamingkis River is interpreted

to have been deposited during the latest middle Miocene–earliest late Miocene (N12–N16) (Nurani, 2010).

Stratigraphic setting

The Jatiluhur Formation that exposed along the Cipamingkis River consists of mixed siliciclastic and carbonate sedimentary rocks that were deposited in the slope and shelf margin settings (Abdurrokhim and Ito, 2013). The formation was defined as a succession, which consists of inter-bedded quartz sandstone and marl, siltstone, claystone, limestone, basalt and tuffaceous breccia, and well exposed around Purwakarta City area in the east and Bogor City area in the west (Fig. 1) (Sudjatmiko, 1972; Effendi, 1974). The formation was deposited during the middle Miocene (Sudjatmiko, 1972; Sujanto and Sumantri, 1977). To the south, this formation is overlain by volcaniclastic succession of the Cantayan Formation, while towards the north; it is overlain conformably by carbonate reef deposits of the Klapanunggal Formation and marine shales of the Subang Formation (Sudjatmiko, 1972; Effendi, 1974; Sujanto and Sumantri, 1977).

The Klapanunggal Formation in the study area is also well known as the Parigi Formation. This formation developed during the late Miocene (Burbury, 1977; Bukhari et al., 1992) on stable shallow-marine platforms as a build-up reef complex associated with an adjacent paleohigh. The paleohigh is not necessarily correlated with the older structure or basement highs (Burbury, 1977; Yaman et al., 1991). The outcrops of this formation are well observed not only in this study area, but also in the Pangkalan area, Karawang, about 25 km to the east of the study area (Sudjatmiko, 1972).

The Cantayan Formation consists of claystone interbedded with thick- to very thick-bedded polymictic breccia (Martodjojo, 2003). This formation is up to 675 m in maximum thickness as exposed in the Cicantayan River and was deposited during the late Miocene (N16–N18) (Sudjatmiko, 1972; Sujanto and Sumantri, 1977; Martodjojo, 2003).

The Subang Formation is characterized by thick bluish-grey to greenish-grey calcareous-shale, which is overlain conformably by the carbonate of both the Klapanunggal and Jatiluhur Formations. The thickness of the Subang Formation in the Karawang area is 516 m, and the formation was deposited during the late Miocene (Sudjatmiko, 1972; Sujanto and Sumantri, 1977; Martodjojo, 2003). Stratigraphic column of the west Java, included the Bogor Trough and NW Java Basin is presented in Fig. 2.

Limestone beds of the Jatiluhur Formation

There are two intervals of lime-stone bed within the Jatiluhur Formation that exposed in the Cipamingkis River (Fig. 3). A limestone bed in the lower part succession is typified by coarse-grained slump-scar-fill deposits, which represents the constituents are largely consisting of skeletal fragments, intraclasts and clay pellets. This bed is typified by a concave-up lenticular geometry (Fig. 4), and the contact into underlying strata is erosional The graded, gently inclined stratification and cross bedding are observed within the bed (Fig. 5). Under the polarized microscope, this limestone is characterized by grain-supported bioclasts (Fig. 6), and is poorly to moderately sorted. It primarily comprises coarse- to very coarse-grained skeletal fragments of larger benthic foraminifera, coralline algae, and others with lime mud matrix and cement, and represented by grain-supported texture. Small amounts of siliciclastic fragments, less than 5%, are occasionally found in several samples, which contain fine-

grained detritus of quartz and feldspar.

Large skeletal fragments of the limestone bed in the lower part of the Jatiluhur Formation are interpreted to have been delivered from the shallow marine carbonate reef of the Upper Cibulakan Formation (e.g., Arpandi and Patmosukismo, 1975) during relative sea level fall. An accumulation of carbonate detritus in shallow marine area of the NW Java shelf retransported incidentally, possibly by storm currents and/or turbidity currents, into the Bogor Trough to the south. The punctuated mixing of siliciclastic and carbonate detritus took place during the middle Miocene in the Bogor Trough.

The limestone beds in the upper part of succession are exposed close to the Dayeuh Kaum area. Those beds are characterized by thick- to very thick bedded limestone intercalated with thin- to very thin laminated siltstone, claystone and fine-grained sandstone. The limestone consists of various characteristic of packstone, grainstone, rudstone and boundstone (Fig. 7 and 8). Limestone is typically characterized by grain-supported bioclasts (Fig. 9), in local association with boundstone, and is poorly to moderately sorted. It primarily comprises coarse- to very coarse-grained skeletal fragments of larger benthic foraminifera, coralline algae, and others with lime mud matrix and cement, and represented by grain-supported texture. Some samples show matrix-supported texture with fine to very coarse-grained skeletal fragments, which are floated and embedded within the lime mud matrix and calcite cement. Neomorphism is commonly found in this petrofacies. Cementing material is blocky and fibrous calcite, and this facies varies from boundstone to wackestone. Small amounts of siliciclastic fragments, less than 5%, are occasionally found in several samples, which contain fine-grained detritus of quartz and feldspar. The mixing composition of siliciclastic & carbonate constituents is also observed in a few samples of the middle part the Jatiluhur Formation. It is largely comprises coarse-grained siliciclastic detritus and very coarse-grained skeletal fragments within carbonate cement (Fig. 10). The framework detritus composition of both siliciclastic and carbonate skeletal fragments is in the range of 30–70%; the amount of carbonate skeletal fragments is commonly higher than that of siliciclastic fragments. Coarse-grained glaucony and mud chips are also commonly found in these samples, and are typically rounded to subrounded, having matrix- supported texture.

The limestone beds in upper part of succession in Cipamingkis River have been developed in the shelf margin during late Miocene (Abdurrokhim and Ito, 2013), and at the same time, the carbonate reefs of the Klapanunggal Formation also developed in the shelf margin. Carbonate reef of the Klapanunggal Formation is interpreted to be the source of thick-bedded limestone in the middle part of Jatiluhur Formation. The facies mixing of siliciclastic and carbonate sediments occurred in succession of the Jatiluhur Formation. The development of both types of deposits took place during the late Miocene in response to an early rise in relative sea level.

CONCLUSIONS

The sedimentary succession of the Jatiluhur Formation that exposed in the Cipamingkis reveals two intervals of limestone beds: (1) a limestone bed in the lower part, which is typified by coarse-grained slump-scar-fill deposits and associated with slope deposits, (2) the limestone beds in the upper part that is characterized by various facies of packstone, grainstone, rudstone and boundstone, which are deposited in the shelf margin.

The limestone bed in the lower part of the Jatiluhur Formation are interpreted to have been delivered from the shallow marine carbonate reef of the Upper Cibulakan Formation during relative sea level fall. The punctuated mixing of siliciclastic and carbonate detritus took place during the middle Miocene in the Bogor Trough.

The limestone beds in the upper part of succession in the Cipamingkis River developed in the shelf margin during late Miocene (Abdurrokhim and Ito, 2014). Carbonate reef of the Klapanunggal Formation is the source of limestone beds that exposed in Dayeuh Kaum area. The facies mixing of siliciclastic and carbonate sediments occurred during the late Miocene in response to an early rise in relative sea level.

ACKNOWLEDGMENT

I would like to thank Faculty of Geology, Padjadjaran University for financial supporting. I thank to Benny, Kevin, and many students of Padjadjaran University for their support during fieldworks in the Bogor Trough. Edy Sunardi on behalf of Puriska and Pak Widi from PPGL, both provide very suitable polarizing microscopes and camera. I thank to Karyono from Tekmira for making thin sections.

REFERENCES

Abdurrokhim, and Ito, M., 2013, The role of slump scars in slope channel initiation: A case study from the Miocene Jatiluhur Formation in the Bogor Trough, West Java: Journal of Asian Earth Sciences, v. 73, p. 68–86, doi: 10.1016/j.jseaes.2013.04.005.

Arpandi, D., and Patmosukismo, S., 1975, The Cibulakan Formation as one of the most prospective stratigraphic units in the Northwest Java Basinal area, *in* Indonesian Petroleum Association, Proceeding 4th Annual Convention, p. 181–210.

Bukhari, T., Kaldi, J.G., Yaman, F., Kakung, H.P., and Williams, D.O., 1992, Parigi carbonate buildups : Northwest Java Sea, *in* Indonesian Petroleum Association, Carbonate Rocks and Reservoirs of Indonesia: A Core Workshop., p. 28 pp.

Burbury, J.E., 1977, Seismic expression of carbonate build-ups Northwest Java Basin, *in* Indonesian Petroleum Association, Proceeding 6th Annual Convention, p. 239–268.

Effendi, A.C., 1974, Peta geologi lembar Bogor, Skala 1 : 100.000: Pusat Penelitian dan Pengembangan Geologi, Bandung.

Gischler, E., Ginsburg, R.N., Herrle, J.O., and Prasad, S., 2010, Mixed carbonates and siliciclastics in the Quaternary of southern Belize: Pleistocene turning points in reef development controlled by sea-level change: Sedimentology, v. 57, no. 4, p. 1049–1068, doi: 10.1111/j.1365-3091.2009.01133.x.

Lubeseder, S., Redfern, J., and Boutib, L., 2009, Mixed siliciclastic-carbonate shelf sedimentation—Lower Devonian sequences of the SW Anti-Atlas, Morocco: Sedimentary Geology, v. 215, no. 1-4, p. 13–32, doi: 10.1016/j.sedgeo.2008.12.005.

Martodjojo, S., 2003, Evolusi Cekungan Bogor Jawa Barat: ITB Press, Indonesia.

McNeill, D.F., Cunningham, K.J., Guertin, L.A., and Anselmetti, F.S., 2004, Depositional themes of mixed carbonate-siliciclastics in the South Florida Neogene: Application to ancient deposits, *in* Grammer, G.M., Harris, P.M., and Eberli, G.P. eds., Integration of outcrop and modern analogs in reservoir modeling, AAPG Memoir 80, p. 23–43.

Mount, J.F., 1984, Mixing of siliciclastic and carbonate

sediments in shallow shelf environments: Geology, v. 12, p. 432–435.

Nurani, A., 2010, Biofacies dan biostratigrafi berdasarkan analisis foraminifera pada outcrop di Sungai Cipamingkis, Kecamatan Jonggol, Kabupaten Bogor, Provinsi Jawa Barat: Undergraduate Thesis, Univer-sitas Padjadjaran, Bandung, 106 pp.

Sudjatmiko, 1972, Peta geologi lembar Cianjur, skala 1 : 100.000: Pusat Penelitian dan Pengembangan Geologi, Bandung.

Sujanto, F.X., and Sumantri, Y.R., 1977, Preliminary study on the Tertiary depositional patterns of Java, *in* Indonesian Petroleum Association, Proceeding 6th Annual Convention, p. 183–213.

Yaman, F., Ambismar, T., and Bukhari, T., 1991, Gas exploration in Parigi and Pre-Parigi carbonate buildups, NW Java Sea, *in* Indonesian Petroleum Association, Proceeding 20th Annual Convention, p. 319–346.

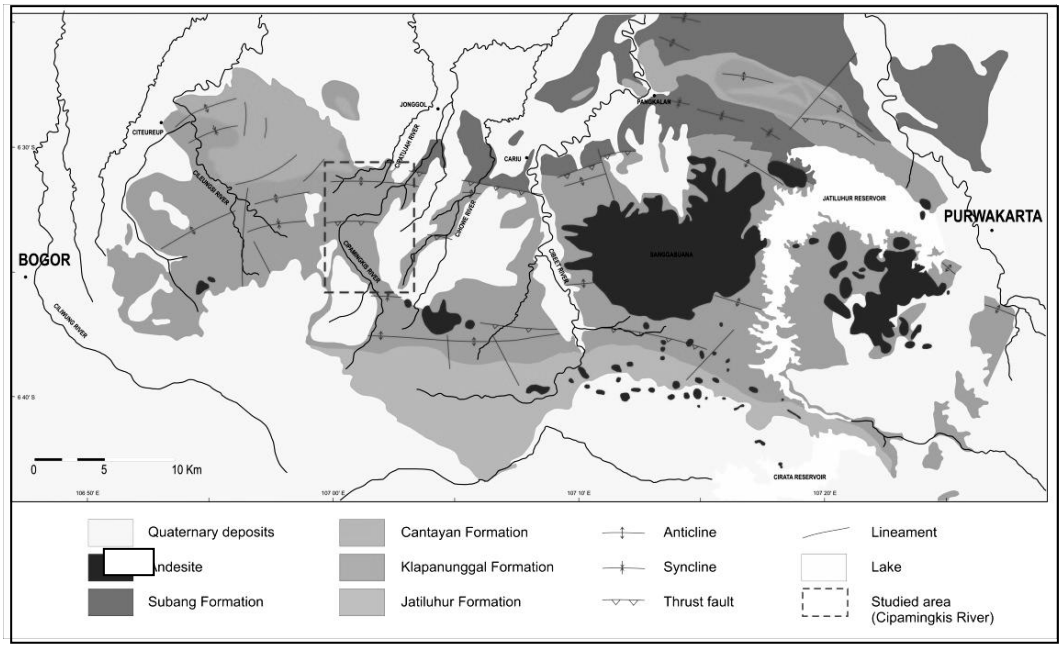

Figure 1.
Geological sketch map of the northern part of the Bogor Trough modified mainly after Sudjatmiko (1972). The Jatiluhur Formation is conformably overlain by the Klapanunggal Formation in the west, and by the Cantayan Formation in the south.

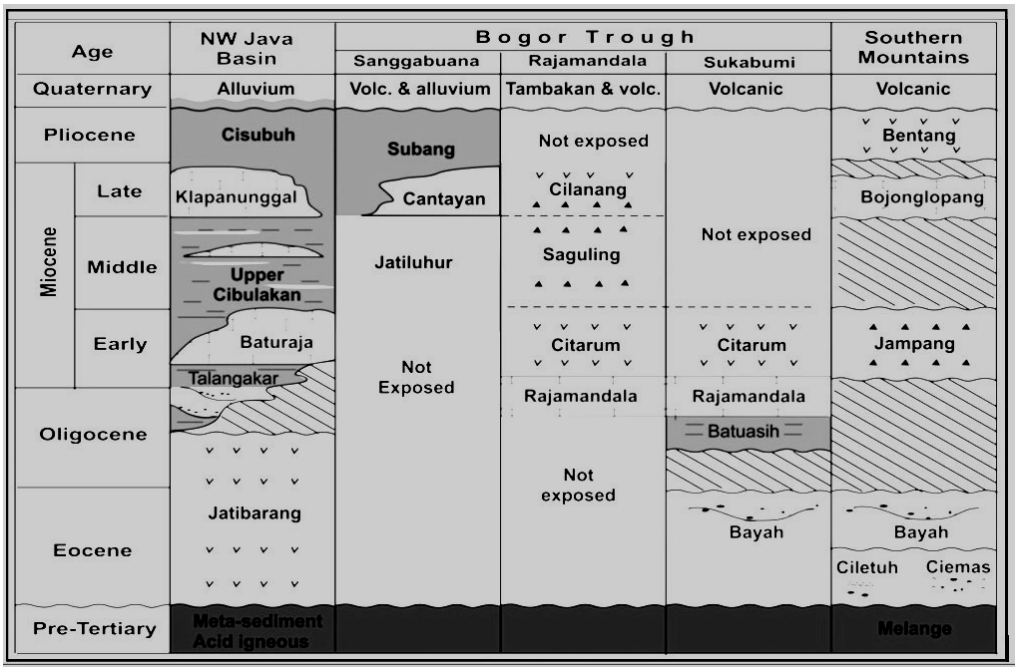

Figure 2.
Stratigraphic classification and ages of the Cenozoic stratigraphic successions in the studied and adjacent areas (after Sujanto and Sumantri, 1977; Martodjojo, 2003; Suyono et al., 2005).

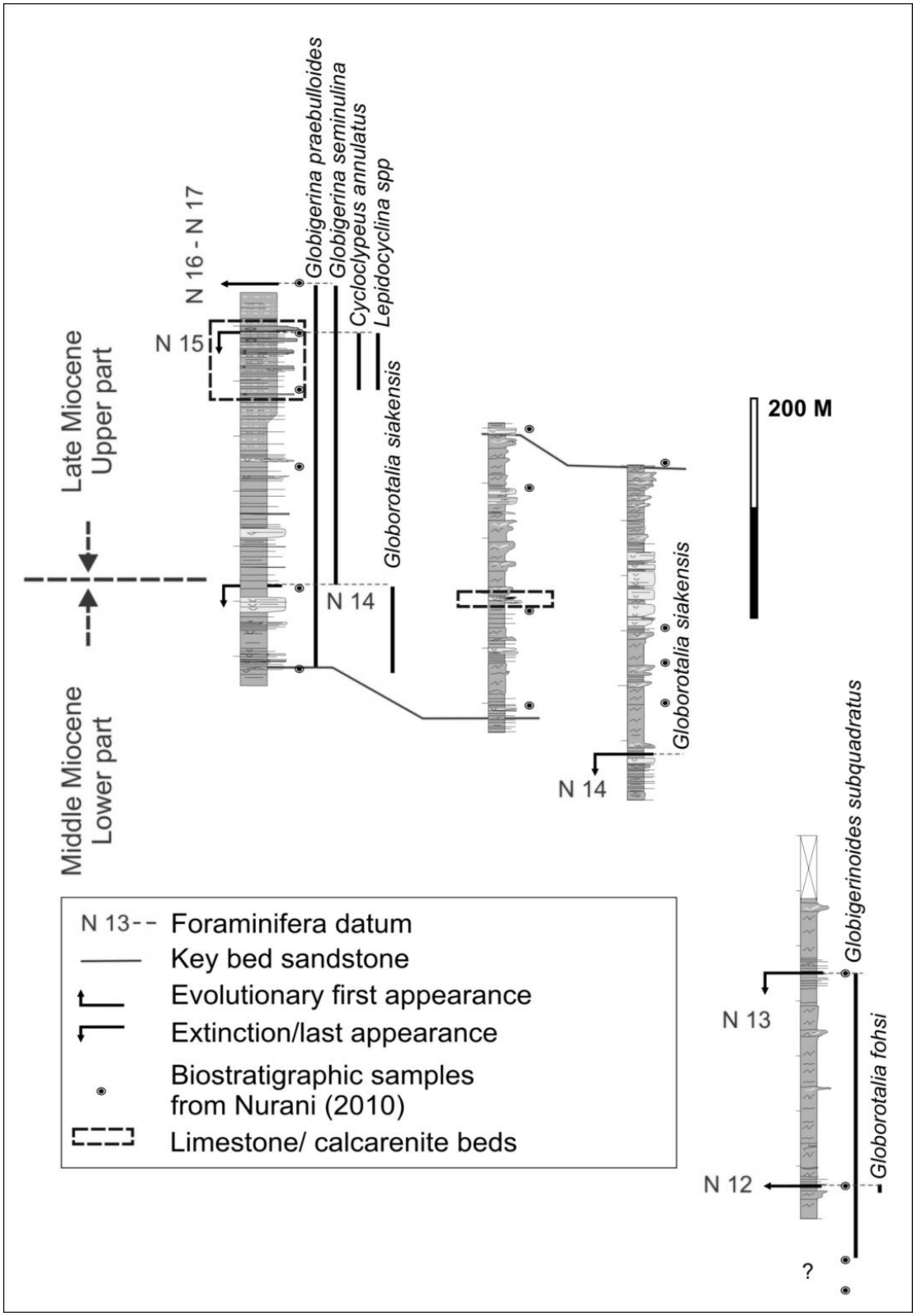

Figure 3.
Biostratigraphic dating along the Cipamingkis River and limestone/calcarenite intervals.

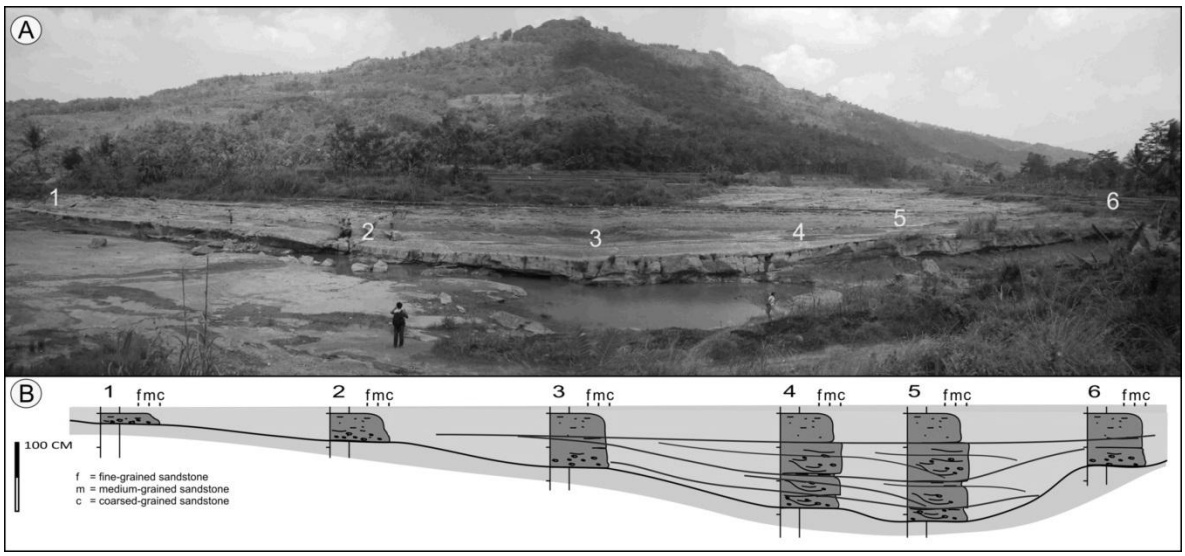

Figure 4.
Lenticular geometr of coarse-grained slump-scar-fill deposits, which consists largely of skeletal fragments.

Figure 5.
Close-up of gently inclined cross stratification of coarse-grained, slump-scar-fill deposits observed in the Cipamingkis River.

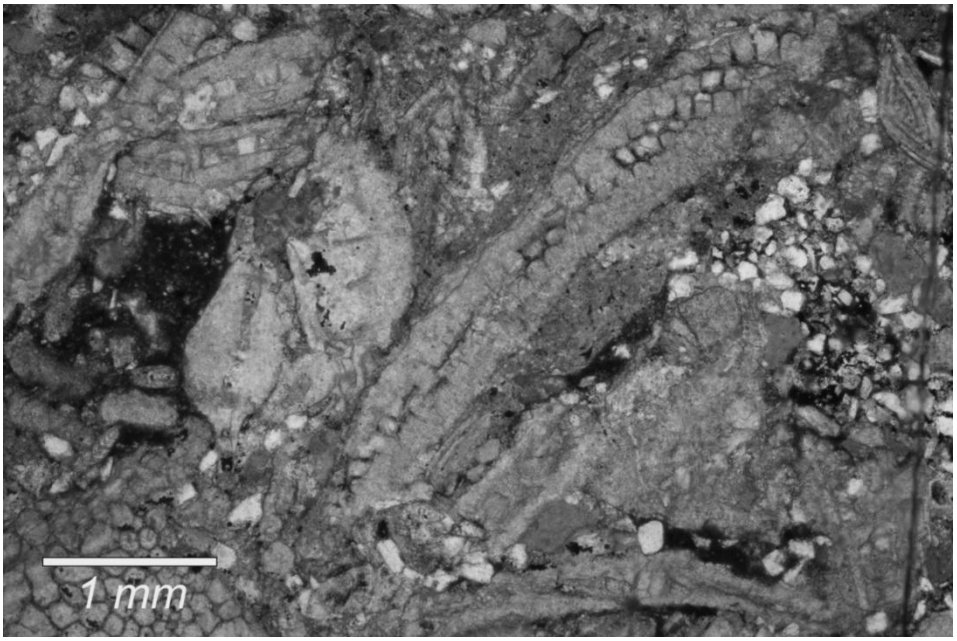

Figure 6.
Bioclastic grainstone contents skeletal fragments of large foram, mud clast and fine-grained siliciclastic.

Figure 7.
A skeletal limestone bed with trough cross-stratification encased within sandy siltstones of facies association 6 observed in the Cipamingkis River. Scale = 10 cm.

Figure 8.
Platy coralline boundstone observed in the Cipamingkis River, closed to Dayeuh Kaum area

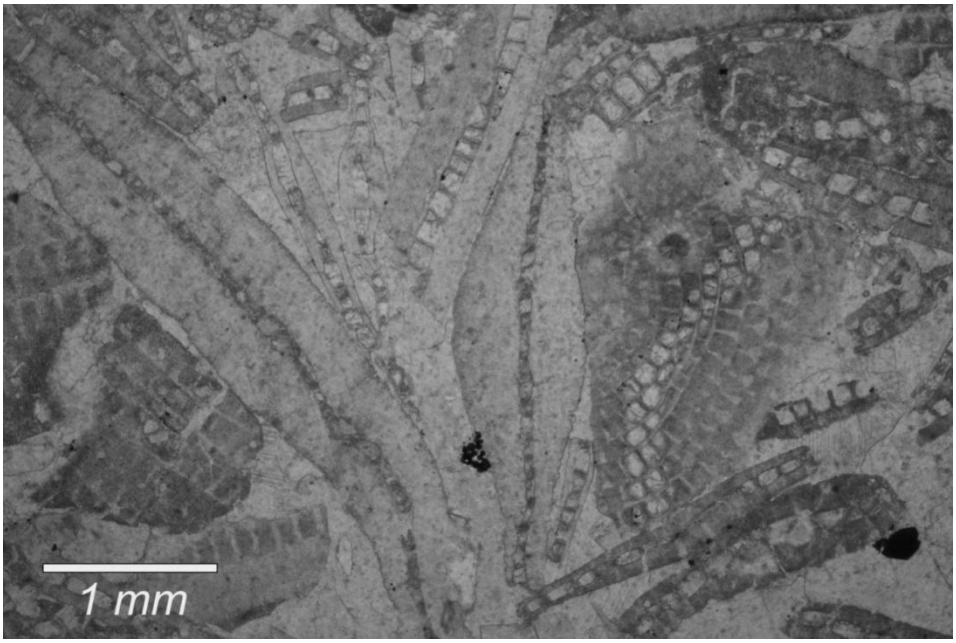

Figure 9.

Bioclastic grainstone facies represents various large foraminiferal

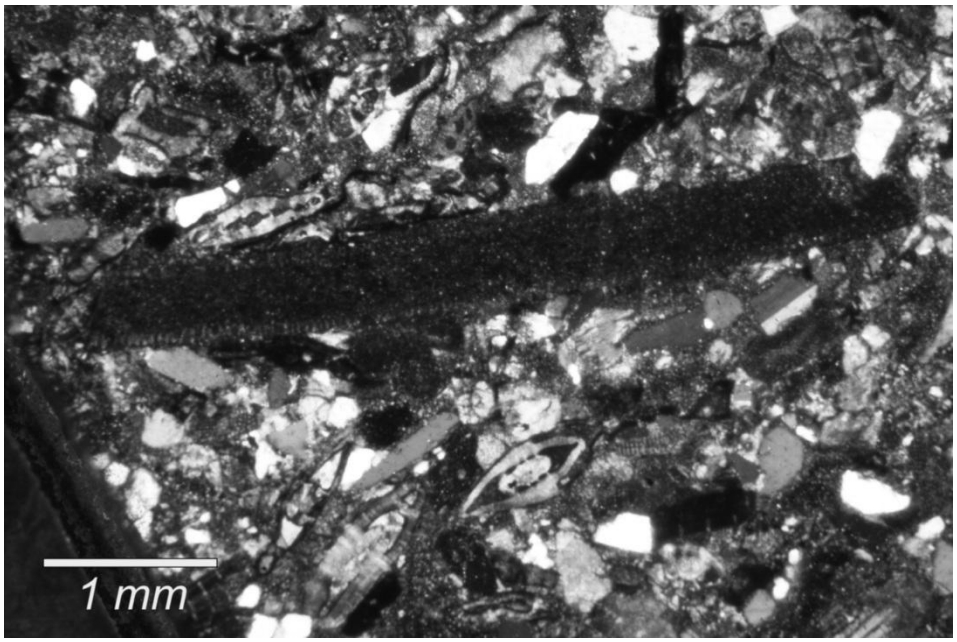

Figure 10.

Grain supported of mixed siliciclastic and intraclasts component